

Index

Page numbers in **bold** refer to definitions of terms and algorithms.

Page numbers in *italics* refer to items in the bibliography.

Symbols

α (alpha) learning rate, 765
 α (alpha) normalization constant, 400
 \wedge (and), 217
 χ^2 (chi squared), 664
 \vdash (derives), 216
 \models (entailment), 214
 ϵ (epsilon)-ball, **673**
 \exists (there exists), 262
 \forall (for all), 261
 γ (gamma) discount factor, 642
 $_$ (gap) in sentence, 846
 $|$ (given), 389
 \Leftrightarrow (if and only if), 217
 \Rightarrow (implies), 217
 \sim (indifferent), 530
 λ (lambda)-expression, **259**
 ∇ (nabla) gradient, 120
 \neg (not), 217
 \vee (or), 217
 \succ (preferred), 530
 σ (sigma) standard deviation, 1028
 \top (matrix transpose), 1026

A

$A(s)$ (actions in a state), 562
 A^* search, 85–90
Aaronson, S., 984, *1034*
Aarts, E., 206, *1034*
Aarup, M., 384, *1034*
Abbas, A., 559, 560, *1034*
Abbeel, P., 62, 498, 561, 648, 719, 790, 817, 821, 822, 978, 979, 1004, *1034, 1040, 1044, 1046, 1048, 1051, 1052, 1061*
Abbott, L. F., 788, 822, *1041*
ABC computer, 14
Abdennadher, S., 207, *1044*
abd James Andrew Bagnell, B. D. Z., 817, *1050*
Abdolmaleki, A., 822, *1063*
Abelson, R. P., 23, *1060*
Abney, S., 838, *1034*
Aboian, M. S., 30, *1042*
Abramson, B., 176, 597, *1034*
Abreu, D., 647, *1034*
absolute independence, 398, 401
absorbing state, **799**
abstraction, **66**, 172, 622

abstraction hierarchy, **382**
ABSTRIPS (planning system), 382
Abu-Hanna, A., 410, *1053*
AC-3, **187**
accessibility relation, **327**
accountability, **711**
accusative case, 841
Acharya, A., 109, *1039*
Achlioptas, D., 249, *1034*
Ackerman, E., 29, *1034*
Ackerman, N., 526, *1034*
Ackley, D. H., 143, *1034*
acoustic model
 in disambiguation, 849
ACT (cognitive architecture), 292
acting rationally, 3
action, 36, **65**, 105
 egocentric, 67
 high-level, **357**
 irreversible, **136**, 799
 joint, **603**
 monitoring, 372, 373
 primitive, **357**
 rational, 7, 34
action-utility function, **545**, 568
action-utility learning, **790**
action cost function, **65**, 105
Action Description Language (ADL), 380
action exclusion axiom, **245**, 604
action monitoring, 372, 373
action schema, **345**
action sequence, 53, 66
activation function, **752**
active sensing, 881
actor, **601**
actor model, 646
actuator, **36**, 43, **929**
 electric, 929
AD-tree, 747
ADABOOST, **702**
adaline, 21
Adams, A., 1016, *1053*
Adams, J., 325
Adams, M., 313, *1046*
Adams, R. P., 672, *1062*
adaptive control theory, 819
adaptive dynamic programming (ADP), **793**, 818
adaptive perception, 938
ADASYN (data generation system), 707, 995

add-one smoothing, 827
additive decomposition (of value functions), **810**
add list, **345**
Adida, B., 339, *1034*
adjustment formula, **453**
ADL (Action Description Language), 380
admissibility, 86
admissible heuristic, **86**, 353
Adolph, K. E., 801, *1034*
Adorf, H.-M., 384, *1049*
ADP (adaptive dynamic programming), **793**, 818
adversarial example, **770**, 787
adversarial search, **146**
adversarial training, 968
adversary argument, **136**
Advice Taker, 19
AFSM (augmented finite state machine), **969**
Agarwal, P., 967, 979, 990, *1054, 1061*
agent, **3**, 36, 60
 active learning, 797
 architecture of, **47**, 1018
 autonomous, 210
 benevolent, 599
 components, 1012–1018
 decision-theoretic, 388, 528
 function, **36**, 37, 47, 564
 goal-based, 53–54, 60, 61
 greedy, **797**
 hybrid, **241**
 impatient, 642
 intelligent, 34
 knowledge-based, 13, 208–210
 learning, 56–58, 62
 logical, 237–246, 279
 model-based, **52**, 51–53
 online planning, 379
 personal, **1015**
 problem-solving, **63**, 63–66
 program, **37**, **47**, 48, 60
 rational, **4**, 3–4, 36, **39**, 39–40, 55, 60, 61, 557
 reflex, **49**, 49–51, 60, 564, 790
 situated, 982
 software agent, **43**
 taxi-driving, 57, 1019
 utility-based, 54–56, 60
 vacuum, 39
 wumpus, 212, 270, 881

- Agerbeck, C., 205, *1034*
 Aggarwal, A., 787, *1059*
 Aggarwal, G., 637, *1034*
 aggregate querying, **991**
 aggregation, **376**
 Agha, G., 646, *1034*
 AGI (artificial general intelligence), **32**
 Agichtein, E., 855, *1034*
 Agmon, S., 785, *1034*
 Agostinelli, F., 106, *1034*
 Agrawal, P., 979, *1034*
 Agrawal, R., 1009, *1035*
 Agre, P. E., 383, *1034*
 Ai, D., 30, *1053*
 AI2 ARC (science test questions), 850
 AI4People, 1008
 AI FAIRNESS 360, 996
 AI for Humanitarian Action, 986
 AI for Social Good, 986
 AI Habitat (simulated environment), 822
 AI Index, **27**
 Aila, T., 780, *1050*
 AI Now Institute, 995, 1008
 Airborne Collision Avoidance System X (ACAS X), 598
 aircraft carrier scheduling, 383
 airport, driving to, 385
 airport siting, 540, 545
 AI safety, 1010
 AI Safety Gridworlds, 822
 AISB (Society for Artificial Intelligence and Simulation of Behaviour), 35
 Aitken, S., 748, *1041*
 AI winter, 24, 27
 Aizerman, M., 717, *1034*
 Akametalu, A. K., 821, *1034*
 Akgun, B., 979, *1034*
 al-Khwarizmi, M., 9
 Alami, R., 979, *1062*
 Albantakis, L., 1007, *1057*
 Alberti, C., 853, *1034*
 Alberti, L., 920
 Aldous, D., 142, *1034*
 ALE (Arcade Learning Environment), 822
 Alemi, A. A., 312, *1034*
 Alexandria, 15
 AlexNet (neural network system), 782
 Algol-58, 852
 algorithm, **9**
 algorithmic complexity, 716
 Algorithmic Justice League, 995
 Alhazen, 920
 Alibaba, 1017
 Allais, M., 538, 560, *1034*
 Allais paradox, 538, 560
 Allan, J., 850, *1034*
Alldiff constraint, 184
 Allen, B., 383, *1044*
 Allen, C., 560, *1040*
 Allen, J. F., 324, 340, 383, 384, *1034*
 Allen, P., 1010, *1034*
 Allen-Zhu, Z., 786, *1034*
 Alleva, F., 29, *1066*
 alliance (in multiplayer games), **151**
 Almulla, M., 108, *1057*
 Alperin Resnick, L., 332, *1037*
 alpha-beta pruning, **152**
 alpha-beta search, 152–155, 174, 175
 ALPHA-BETA-SEARCH, **154**
 ALPHAGO (Go program), ix, 19, 27, 30, 176, 177, 816
 ALPHASTAR (game-playing program), 172, 179
 ALPHAZERO (game-playing program), 30, 172, 174, 177
 Alshawi, H., 840, *1062*
 Alterman, R., 382, *1034*
 alternating offers bargaining model, **641**
 Altman, A., 179, *1034*
 altruism, 387
 Alvey report, 23
 ALVINN (autonomous vehicle), 967
 Amarel, S., 144, 338, *1034*
 Amazon, 29, 1017
 ambient light, **886**
 ambiguity, 252, **847**
 lexical, **847**
 semantic, **847**
 syntactic, **847**, 853
 ambiguity aversion, **539**, 560
 Amir, E., 249, 527, *1034*, *1041*
 Amit, Y., 718, *1034*
 Amodei, D., 15, 879, 1010, 1018, *1034*, *1059*
 ANALOGY, 20
 analysis of algorithms, **1023**
 Analytical Engine, 15
 Anantharaman, T. S., 176, *1048*
 Anbulagan, 248, *1052*
 anchor box, 900
 anchoring effect, **539**
 And-Elimination, **223**
 AND-OR-SEARCH, **125**
 AND-OR graph, 230
 AND-OR tree, **123**
 Andersen, S. K., 455, 456, *1034*
 Anderson, C. R., 383, *1065*
 Anderson, J. A., 785, *1047*
 Anderson, J. R., 14, 292, 458, *1034*, *1058*
 Anderson, K., 108, 822, *1034*, *1036*
 Andersson, M., 648, *1060*
 AND node, **123**
 Andoni, A., 717, *1034*
 Andor, D., 853, *1034*
 Andre, D., 143, 596, 820, 822, *1034*, *1041*, *1051*
 Andrae, P., 822, *1034*
 Andrew, G., 1009, *1055*
 Andrieu, C., 499, *1034*
 Andrychowicz, M., 959, 979, *1034*
 Aneja, J., 909, *1034*
 Angeli, G., 880, *1037*
 ANGELIC-SEARCH, **364**
 angelic semantics, 379
 animatronics, **973**
 Anisenia, A., 456, *1061*
 answer set programming, 312
 antecedent, 217
 anthropomorphic robot, **926**, 930
 Antonoglou, I., 27, 30, 155, 174, 177, 178, 784, 790, 820, 822, *1055*, *1061*
 anytime algorithm, **1019**
 Aoki, M., 597, *1034*
 aperture, **883**
 apparent motion, 893
 Appel, K., 204, *1034*
 Appelt, D., 854, *1034*
 Apple, 1008
 applicable, **65**, 345
 apprenticeship learning, **813**, 1003, 1016
 approval voting, **640**
 approximate near-neighbors, **689**
 Apps, C., 30, 179, *1064*
 Apt, K. R., 205, 207, *1034*
 Apté, C., 852, *1034*
 Arbuthnot, J., 408, *1034*
 Arcade Learning Environment (ALE), 822
 arc consistency, **186**
 Archibald, C., 179, *1034*
 architecture
 agent, **47**, 1018
 AI, 1018
 cognitive, 34, **292**
 computer, 652
 for speech recognition, 25
 network, 768, 770, 787, 922
 reflective, **1019**
 RNN, 861
 rule-based, 292
 subsumption, 969
 transformer, 868, 880
 Arentoft, M. M., 384, *1034*
 Arfaee, S. J., 109, *1034*, *1052*
 Argall, B. D., 979, *1034*
 argmax, 1026
 argument
 from disability, 982–983
 from informality, 981–982
 Ariely, D., 538, 560, *1034*
 ARISTO (question-answering system), 875, 876, 880
 Aristotle, ix, 3, 6, 7, 11, 60, 61, 247, 278, 338, 339, 341, 715, 920, 976
 arity, **257**, 288

- Arkin, R., 980, 989, *1034*
 Armando, A., 250, *1034*
 Armstrong, S., 1002, *1034*
 Arnauld, A., 7, 10, 557, *1034*
 Arnoud, S., 769, *1046*
 Arora, J. S., 119, *1054*
 Arora, N. S., 512, 526, *1034*
 Arora, S., 107, *1034*
 Arous, G. B., 786, *1039*
 Arpit, D., 716, *1035*
 Arrow's theorem, **640**, 649
 Arrow, K. J., 640, 649, *1035*
 artificial flight, 2
 artificial general intelligence (AGI), **32**
 artificial intelligence, 1–1022
 applications of, 27–30
 conferences, 35
 ethics, 986–1001
 foundations, 5–17, 819
 future of, 31–34, 1012–1022
 goals of, 1020–1021
 history of, 17–27
 journals, 35
 philosophy of, 981–1011
 possibility of, 981–984
 programming language, 19
 provably beneficial, **5**
 real-time, **1019**
 risks, 31–34, 987–996
 safety, 1001–1005
 societies, 35
 strong, **981**, 1005, 1006
 weak, **981**, 1005, 1006
 artificial intelligence (AI), **1**
 artificial life, 143
 artificial superintelligence (ASI), **33**
 Arulampalam, M. S., 499, *1035*
 Arulkumar, K., 820, *1035*
 Arunachalam, R., 649, *1035*
 arXiv.org, 27, 788, 1018
 Asada, M., 976, *1050*
 asbestos removal, 533
 Ashburner, M., 316, *1062*
 Ashby, W. R., 16, *1035*
 Asimov, I., 975, 1007, *1035*
 ASKMSR (question-answering system), 850
 Aspuru-Guzik, A., 920, *1060*
 assertion (logical), **265**
 assertion (probabilistic), 388
 assignment (in a CSP), **181**
 assistance, **561**
 assistance game, *see* game, assistance
 assumption, **337**
 Astrom, K. J., 144, 597, *1035*
 asymmetry, 860
 asymptotic analysis, **1024**, 1023–1024
 Atanasoff, J., 14
 Atari video game, 816
 Athalye, A., 787, *1039*
 Atkeson, C. G., 596, 820, 979, *1035*, *1056*
 Atkin, L. R., 107, *1062*
 Atlas (robot), ix
 atom, **260**
 atomic representation, **59**, 63
 atomic sentence, **217**, **260**, 260, 264
 attention (neural net), 865, **866**, 880
 attentional sequence-to-sequence model, **866**
 attribute, **59**
 AUC (area under ROC curve), **710**
 auction, **634**
 ascending-bid, **634**
 English, **634**
 first-price, 636
 sealed-bid, **636**
 second-price, **636**
 truth-revealing, **635**
 Vickrey, **636**
 Audi, R., 1007, *1035*
 Auer, P., 597, *1035*
 Auer, S., 316, 339, *1037*, *1052*
 augmentation, 851
 augmented finite state machine (AFSM), **969**
 augmented grammar, **841**
 Aumann, R., 647, *1035*
 AURA (theorem prover), 309, 313
 Auray, J. P., 559, *1036*
 Austerweil, J. L., 821, *1048*
 Australia, 181, 182, 193
 author attribution, **826**
 AUTOCLASS (unsupervised learning algorithm), 748
 autoencoder, **778**
 variational, **778**
 automata, 1006
 automated machine learning (AutoML), **719**
 automated reasoning, 2
 automated taxi, 42, 43, 57, 210, 385, 1019
 automatic differentiation, **756**
 reverse mode, **756**
 Automatic Statistician, 719
 AutoML, 719
 automobile insurance, 539
 Auton, L. D., 249, *1040*
 autonomatronics, **973**
 autonomic computing, **61**
 autonomous underwater vehicle (AUV), 927
 autonomy, **42**, 924, 971
 autoregressive model, **779**, 787
 deep, **779**
 AUV (autonomous underwater vehicle), 927
 average pooling, **863**
 average reward, **567**
 Awwal, I., 978, *1061*
 Axelrod, R., 647, *1035*
 axiom, **209**, 267
 action exclusion, **245**, 604
 decomposability, 531
 domain-specific, **316**
 effect axiom, **239**
 frame axiom, **239**
 Kolmogorov's, 393
 of number theory, 268
 of probability, 394
 Peano, **268**, 278, 289
 precondition, 245
 of probability, 393, 1027
 of set theory, 269
 successor-state, **240**, 250
 of utility theory, 531
 wumpus world, 270
 axon, 12
-
- ## B
-
- b^* (branching factor), 98
 B* search, 175
 Ba, J. L., 786, *1035*
 Baader, F., 312, 341, *1035*
 Babbage, C., 15, 175
 Babuschkin, I., 30, 179, *1064*
 Bacchiani, M., 849, *1039*
 Bacchus, F., 204, 207, 410, 456, 524, 559, *1035*
 Bach, F. R., 852, *1048*
 bachelor, 318
 Bachmann, L. M., 30, *1053*
 Bachmann, P. G. H., 1029, *1035*
 back-propagation, 22, 24, 162, 163, **755**, 766, 785
 through time, **774**
 backgammon, 164, 178, 804, 815
 background knowledge, **209**, 302
 backing up (in a search tree), **93**, 149
 backjumping, **195**, 205
 backmarking, 206
 backoff model, **827**
 BACKTRACK, **192**
 backtracking
 chronological, 195
 dependency-directed, **205**
 dynamic, 206
 intelligent, 195–197, 234
 BACKTRACKING-SEARCH, **192**
 backtracking search, 80, 195–197, 199, 203
 Backus, J. W., 852, *1035*
 Backus–Naur form (BNF), **1030**
 backward chaining, **230**, 231–232, 247, 293–298, 311
 backward induction, **614**
 backward message, 469

- backward search for planning, 350–351
 Bacon, D., 992, *1051*
 Bacon, F., 6, 31, *1035*
 Baeza-Yates, R., 850, *1035*
 bag-of-words model, **824**, 826, 832, 851
 Bagdasaryan, E., 1009, *1035*
 bagging, **697**, 718
 Bagnell, D., 979, *1060*
 Bagnell, J. A., 817, 951, 963, 966, 978, 979, *1035*, *1050*, *1059*, *1067*
 Bahdanau, D., 880, *1035*
 Bahubalendruni, M. R., 107, *1035*
 Bai, A., 822, *1035*
 Bai, H., 598, *1035*
 Bai, Y., 707, 978, 995, *1037*, *1047*
 Baidu, 850, 924
 Baird, L. C. I., 596, *1065*
 Bajcsy, A., 967, *1035*
 Baker, B., 959, 979, *1034*
 Baker, C. L., 821, *1035*
 Baker, J., 852, 854, *1035*
 Baker, L., 27, 30, *1061*
 Bakkes, S., 176, *1039*
 Balaskas, K., 30, *1053*
 Balch, T., 178, *1058*
 Baldi, P., 106, 498, *1034*, *1035*
 Baldwin, J. M., 118, 143, *1035*
 Baldwin effect, **118**, 143
 Ball, M., 381, *1065*
 Ballard, B. W., 175, *1035*
 Ballas, N., 716, *1035*
 Baluja, S., 143, 922, *1035*, *1060*
 BANANAS (neural net architecture search), 787
 Bancilhon, F., 311, *1035*
 bandit
 Bernoulli, **584**
 one-armed, **582**
 problem, **581**, 597, 798
 superprocess (BSP), **586**
 Banerjee, A., 979, 990, *1039*, *1063*
 bang-bang control, **816**
 Banger, R., 649, *1065*
 Banko, M., 26, 316, 339, 719, 850, 854, 855, *1035*, *1043*
 Bansal, K., 309, *1035*
 Bapna, A., 850, *1039*
 Bar-Hillel, Y., 853, *1035*
 Bar-Shalom, Y., 61, 497, 526, *1035*
 Barber, D., 749, *1035*
 Bard, N., 30, 178, *1056*
 Barifaijo, E., 372, *1049*
 Barnes, P., 995, *1055*
 Barr, A., 107, *1035*
 Barreiro, J., 29, *1035*
 Barreno, M., 1010, *1035*
 Barrett, S., 179, *1035*
 Barry, M., 455, *1048*
 Barták, R., 205, 207, *1035*
 Barthels, A., 525, *1049*
 Bartholdi, J. J., 649, *1035*
 Bartlett, F., 13
 Bartlett, P., 821, *1035*
 Barto, A. G., 145, 597, 598, 820–822, *1035*, *1063*
 Bartunov, S., 179, 822, *1064*
 Barwise, J., 279, *1035*
 baseline, 879, **902**
 base model, **696**
 Basin, D. A., 176, *1044*
 Basturk, B., 142, *1050*
 Basye, K., 977, *1041*
 batch normalization, **768**, 923
 Bates, E., 854, *1043*
 Bates, M. A., 14, 175, *1064*
 Batra, D., 822, 910, *1046*, *1060*
 Bauer, G., 313, *1046*
 Baum, E., 116, 175, *1035*
 Baum, L. E., 497, 748, *1035*
 Baumert, L., 205, *1046*
 Baxter, J., 821, *1035*
 Bayardo, R. J., 206, 207, 248, 1009, *1035*
 Baydin, A. G., 457, 527, *1052*
 Bayen, A. M., 498, *1048*
 Bayerl, S., 312, *1052*
 Bayes' rule, 8, **399**, 399–400, 408
 Bayes, T., 399, 410, 747, *1035*
 Bayes–Nash equilibrium, **623**
 Bayesian, 409
 Bayesian classifier, 402
 Bayesian learning, 701, **722**, 722–723, 746
 Bayesian network, 25, **412**, 412–460, 748
 continuous-time, 498
 dynamic, **485**
 hybrid, **422**, 454
 inference in, 427–435
 learning hidden variables in, 745–746
 learning in, 734–735
 multi-entity, 526
 semantics, 414
 Bayesian optimization, **672**
 Bayesian reinforcement learning, **800**
 BDD (binary decision diagram), 382
 Beal, J., 32, *1036*
 Beame, P., 456, *1060*
 beam search, **92**, 106, **115**, 159, 831, 836, 868
 local, **115**
 Beardon, A. F., 558, *1036*
 Beattie, C., 30, 179, 820, 822, *1036*, *1049*, *1055*
 Beber, G., 1006, *1043*
 Bechhofer, R., 597, *1036*
 Beck, J. C., 206, *1036*
 Beckert, B., 312, *1036*
 beer factory scheduling, 383
 Beeri, C., 206, *1036*
 beetle, dung, 41, 62, 374, 970
 Beetz, M., 525, *1049*
 behavioral cloning, 821, **966**
 behaviorism, **13**, 16
 BEINGS (multiagent system), 646
 Bekey, G., 980, *1036*
 belief, 326
 degree of, 385, **386**, 394
 desires and, 528–529
 propagation, **458**
 loopy, 458
 revision, **335**
 update, 335
 belief network, *see* Bayesian network
 belief state, **122**, 241, 365, 385, 388
 in game theory, 620
 probabilistic, 461, **465**
 wiggly, 243
 Belkin, M., 716, *1036*
 Bell, C., 359, 383, *1036*
 Bell, D. A., 747, *1039*
 Bell, J. L., 279, *1036*
 Bell, T. C., 851, 852, *1066*
 Bellamy, E., *1036*
 Bellamy, R. K. E., 996, 1009, *1036*
 BELLE (chess program), 176
 Bellemare, M. G., 820–822, *1036*, *1044*, *1055*, *1056*
 Bellman, R. E., 10, 106, 107, 176, 177, 568, 596, 717, *1036*
 Bellman equation, **568**
 Bellman operator, 574
 Bellman update, **573**
 Ben-Tal, A., 143, *1036*
 benchmark, 24, 879, 922, **1023**
 Bendix, P. B., 312, *1050*
 benevolent agent assumption, **599**
 Bengio, E., 716, *1035*
 Bengio, S., 30, 716, 787, 879, *1036*, *1064*, *1067*
 Bengio, Y., 17, 716, 718, 719, 786–788, 849, 878, 880, 1016, *1035*, *1036*, *1041*, *1045*, *1046*, *1052*, *1064*, *1067*
 Benjamin, M., 989, *1036*
 Bennett, B., 342, *1040*
 Bennett, F. H., 143, *1051*
 Bennett, J., 313, *1046*
 Bennett, K., 719, *1046*
 Bentham, J., 8, 558, *1036*
 Benz Müller, C., 313, *1036*
 Beresniak, A., 559, *1036*
 Berg, A. C., 786, *1060*
 Berger, H., 11
 Berger, J. O., 457, 748, *1036*, *1057*
 Berges, V., 822, *1049*
 Bergstra, J., 719, *1036*
 Berk, R., 1009, *1036*
 Berkeley, 678

- Berkeley Parser, 853
 Berkson, J., 455, *1036*
 Berleur, J., 1008, *1036*
 Berlin, K., 717, *1036*
 Berliner, H. J., 175, 178, *1036*
 Bermúdez-Chacón, R., 719, *1036*
 Bernardo, J. M., 731, *1036*
 Berners-Lee, T., 339, *1036*
 Bernoulli, D., 7, 10, 535, 557, *1036*
 Bernoulli, J., 8, 409
 Bernstein, M., 786, *1060*
 Bernstein, P. L., 411, *1036*
 Berrada, L., 716, *1036*
 Berrou, C., 458, *1036*
 Berry, C., 14
 Berry, D. A., 597, *1036*
 BERT (natural language system), 879, 1021
 Bertele, U., 456, *1036*
 Bertoli, P., 382, 383, *1036*
 Bertot, Y., 312, *1036*
 Bertsekas, D., 61, 410, 598, 822, 1029, *1036*
 Bertsimas, D., 70, 716, *1036*
 Berzuini, C., 499, *1045*
 Beschastnikh, I., 1009, *1044*
 Bessen, J., 1000, *1036*
 Bessière, C., 205, *1036*
 Best, N., 525, 747, *1054*
 BEST-FIRST-SEARCH, **73**
 best-first search, **73**, 105
 best-fit function, 654
 best possible prize, 533
 best response, **608**
 beta distribution, 487, **730**
 Betancourt, M., 458, 527, 747, *1039*
 Bethge, M., 983, *1045*
 Betlem, H., 372, *1049*
 Betlem, J., 372, *1049*
 Betteridge, J., 850, *1055*
 betting game, 394
 Beutel, A., 311, 1009, *1036*, *1051*
 bfloat16, 15
 Bhar, R., 498, *1036*
 Bharath, A. A., 820, *1035*
 Bhattacharya, P., 498, *1066*
 bias
 societal, **992**
 bias (statistical), **654**
 bias (unfairness in outcomes), 706, 992–996
 bias–variance tradeoff, **655**
 Bibel, W., 312, 313, *1036*, *1052*
 BiBF-SEARCH, **83**
 Bible, 832
 Bickford, M., 309, *1062*
 biconditional, **217**
 bicycle, 1010
 bid, **633**
 bidder, **634**
 bidirectional RNN, **863**
 bidirectional search, **82**, 96–97, 109
 Bidlack, C., 976, *1040*
 Bien, J., 719, *1036*
 Biere, A., 249, *1036*
 Bies, A., 852, *1036*
 big computation, 922
 big data, **26**, 922, 1015
 BigDog, 29
 Bigelow, J., 16, *1059*
 Bigham, J., 854, *1057*
 billiards, 179
 Billings, D., 647, *1036*
 Billingsley, P., 411, *1036*
 Bilmes, J., 498, *1053*
 Bimbo, J., 920, *1054*
 binary CSP, **184**
 binary decision diagram (BDD), 382
 binary resolution, **300**
 Binder, J., 497, 498, 748, *1036*, *1060*
 binding list, **266**
 Bingham, E., 526, *1036*
 Binmore, K., 647, *1036*
 binocular stereopsis, **902**, 902–903, 921
 binomial nomenclature, 339
 bioinformatics, 852
 biological naturalism, **985**
 Biran, O., 1009, *1037*
 Birattari, M., 142, *1042*
 Birbeck, M., 339, *1034*
 Bischof, J., 1009, *1036*
 Bishop, C. M., 142, 455, 717, 720, 748, 787, *1037*, *1064*
 Bishop, M., 1007, *1058*
 Bishop, R. H., 61, *1042*
 Bisson, T., 985, *1037*
 Bistarelli, S., 204, *1037*
 Biswal, B. B., 107, *1035*
 Bitner, J. R., 205, *1037*
 Bizer, C., 316, 339, *1037*, *1052*
 Bjerager, P., 457, *1050*
 Bjornsson, Y., 177, *1060*
 BKG (backgammon program), 178
 Black, M., 907, *1050*
 BLACKBOX (planning system), 381
 Blake, A., 498, *1049*
 Blankespoor, K., 29, *1059*
 Blau, H. M., 30, *1043*
 Blazewicz, J., 384, *1037*
 Blei, D. M., 526, 852, *1037*, *1048*, *1064*
 Bliss, C. I., 455, *1037*
 Blizzard, 822
 Block, H. D., 21, *1037*
 Block, N., 1007, *1037*
 block sampling, **447**
 blocks world, **20**, 342, 346
 BLOG (probabilistic programming language), 526
 Blondel, M., 720, *1058*
 bluff, **171**
 Blum, A. L., 381, 704, 718, 720, 855, *1037*
 Blum, C., 142, *1042*
 Blumer, A., 717, *1037*
 BNF (Backus–Naur form), **1030**
 BO (bounded optimality), **1020**
 Bobick, A., 498, *1049*
 Bobrow, D. G., 20, *1037*
 Bod, R., 840, *1037*
 Boddington, P., 1008, *1037*
 Boddy, M., 144, 382, 1019, *1041*, *1046*
 Boden, M. A., 1007, *1037*
 body (of Horn clause), **230**
 Bojanowski, P., 852, *1049*
 Bokeh (data analysis software), 709
 Bolognesi, A., 176, *1037*
 Bolton, A., 27, 30, 822, *1036*, *1061*
 Bolton, R. J., 990, *1037*
 Boltzmann machine, **788**
 Boltzmann rationality, **814**
 Bonawitz, K., 526, 992, *1037*, *1046*
 Bond, A. H., 646, *1037*
 Boneh, D., 116, *1035*
 Bonet, B., 144, 380–383, 598, *1037*, *1047*
 Bongard, J., 1006, *1058*
 Boole, G., 8, 247, 409, *1037*
 Boolean classification, 657
 boosting, **699**
 Booth, T. L., 852, *1037*
 bootstrap, 697
 Borda count, **640**
 Bordes, A., 786, *1045*
 Borel, E., 647, *1037*
 Borenstein, J., 977, 978, *1037*
 Borgida, A., 332, *1037*
 Borgström, J., 526, 527, *1040*, *1046*
 Borochowitz, Z. U., 456, *1061*
 Boroditsky, L., 253, *1037*
 Borrajo, D., 381, *1064*
 Boser, B., 718, 922, *1037*, *1052*
 BOSS (autonomous vehicle), 972, 973, 977
 Bosse, M., 977, *1037*
 Boston Dynamics, ix
 Bostrom, N., 33, 1010, *1037*
 Botea, A., 381, *1047*
 Bottou, L., 26, 717, 786, 922, *1037*, *1052*
 Boué, L., 716, *1037*
 bounded-cost search, **92**
 bounded optimality (BO), **1020**
 bounded suboptimal search, **92**
 bounding box, **899**
 bounds-consistent, **189**
 bounds propagation, **189**
 Bousmalis, K., 978, *1037*
 Bousquet, O., 717, 786, *1037*

- Boutilier, C., 455, 559, 561, 597, 646, 1037
- Bouzy, B., 177, 1037
- Bowden, B. V., 14, 175, 1064
- Bower, G. H., 819, 1047
- Bowling, M., 30, 178, 647, 648, 822, 1036, 1037, 1056, 1065, 1067
- Bowman, D., 985
- Bowman, S., 877, 879, 880, 1037, 1046, 1065
- Bowman, S. R., 880, 1065
- Bowyer, K. W., 707, 995, 1039
- Box, G. E. P., 143, 497, 747, 787, 1037
- BOXES (reinforcement learning algorithm), 816
- Boyan, J. A., 142, 1037
- Boyce, M., 29, 1035
- Boyd, D., 1009, 1039
- Boyd, S., 143, 1037
- Boyden, E., 11, 1047
- Boyen, X., 499, 1037
- Boyer–Koller algorithm, 499
- Boyer, R. S., 309, 312, 313, 1037
- Boyer–Moore theorem prover, 312, 313
- Boyko, A. S., 30, 1053
- Boyle, J., 313, 1066
- Boys, D., 179
- Brachman, R. J., 332, 341, 343, 1037, 1052
- Bradlow, H., 978, 1061
- Bradt, R. N., 581, 597, 1037
- Bradtke, S. J., 145, 597, 820, 1035
- Brady, J. M., 498, 1056
- Brafman, O., 560, 1037
- Brafman, R., 560, 1037
- Brafman, R. I., 382, 383, 559, 646, 820, 1037, 1048
- Brahmagupta, 204
- brain, 17, 750
 - computational power, 13
 - electronic super, 9
 - human, 11
 - imaging, 2
- brain–machine interface, 11, 971
- Braitenberg, V., 979, 1037
- Brakel, P., 849, 1067
- branch-and-bound, 108, 377, 597
- branching factor, 76
 - effective, 98, 107, 155
- Brandenburger, A., 647, 1035
- Brandt, F., 649, 1037
- Brants, T., 852, 880, 1037, 1044
- Bratko, I., 109, 312, 1037
- Bratman, M. E., 61, 1038
- Braverman, E., 717, 1034
- BREADTH-FIRST-SEARCH, 77
- breadth-first search, 76, 76–77, 105, 358
- Breck, E., 713, 719, 1038
- Breese, J. S., 62, 455, 525, 527, 559, 1019, 1038, 1048, 1065
- Breiman, L., 698, 716, 718, 1038
- Brelaz, D., 205, 1038
- Brendel, W., 787, 1039
- Brent, R. P., 142, 1038
- Bresnan, J., 853, 1038
- Breuel, T., 879, 1053
- Brevdo, E., 526, 1064
- Brewka, G., 342, 1038
- Brickley, D., 339, 1038
- bridge (card game), 178
- BRIDGE BARON, 178
- Briggs, R., 338, 1038
- brightness, 886
- Brill, E., 26, 719, 850, 852, 854, 1035, 1038
- Brin, D., 855, 1038
- Brin, S., 854, 1038
- Bringsjord, S., 1006, 1038
- Brioschi, F., 456, 1036
- Britain, 22, 23
- Broadbent, D. E., 14, 1038
- Broadhead, M., 850, 855, 1035
- Broca, P., 11
- Brock, B., 312, 1048
- Brockman, G., 822, 1038
- Brokowski, M., 144, 1065
- Brooks, M. J., 923, 1048
- Brooks, R. A., 27, 61, 249, 383, 969, 977, 979, 1006, 1010, 1038, 1058, 1063
- Brooks, S., 458, 1038
- Brouwer, P. S., 820, 1035
- Brown, C., 207, 1038
- Brown, E., 30, 1043
- Brown, J. S., 342, 1041
- Brown, K. C., 559, 1038
- Brown, M., 498, 1051
- Brown, N., 30, 178, 648, 790, 1038
- Brown, P. F., 878, 880, 1038
- Browne, C., 176, 1038
- Browning, B., 979, 1034
- Brownston, L., 311, 1038
- Brubaker, M., 458, 527, 747, 1039
- Bruce, V., 924, 1038
- Brügmann, B., 177, 597, 1038
- Bruna, J., 787, 1063
- Brundage, M., 820, 1035
- Brunelleschi, F., 920
- Brunnstein, K., 1008, 1036
- Brunot, A., 26, 786, 922, 1052
- Brunskill, E., 598, 821, 1059, 1063
- Bruynseels, A., 30, 1053
- Bryce, D., 144, 381, 383, 1038
- Brynjolfsson, E., 27, 998, 1005, 1011, 1038, 1063
- Bryson, A. E., 22, 785, 1038
- Bryson, J. J., 997, 1007, 1038
- BSP (bandit superprocess), 586
- Buchanan, B. G., 22, 23, 62, 338, 459, 1038, 1043, 1053
- Buck, C., 852, 1038
- Budden, D., 822, 1063
- Buehler, M., 977, 1038
- Buffet, O., 598, 1061
- Buffon, G., 457, 1038
- BUGS (probabilistic reasoning system), 458, 525
- Bui, P., 30, 1053
- BUILD (planning system), 342
- Bulatov, Y., 769, 1046
- Bulfin, R., 649, 1059
- Bulitko, V., 145, 1063
- bunch, 319
- Bunt, H. C., 340, 1038
- Buolamwini, J., 995, 1038
- Burch, N., 30, 177, 178, 647, 1036, 1037, 1056, 1060
- Burgard, W., 61, 526, 977, 978, 980, 1038, 1039, 1044, 1061, 1064
- Burget, L., 878, 879, 1055
- burglar alarm, 413–414
- Burkov, A., 720, 1038
- Burns, C., 455, 1056
- Burns, E., 108, 1038
- Buro, M., 159, 178, 1038
- Burstein, J., 338, 1038
- Burton, R., 560, 1038
- Busbee, T. A., 1013, 1051
- business process automation, 999
- Buss, D. M., 560, 1038
- Butler, S., 33, 1010, 1038
- Bylander, T., 384, 1038
- Byrd, R. H., 717, 1038

C

- c* (action cost), 65
- C-space, 939
- C-space obstacle, 940
- C4 (Colossal Clean Crawled Corpus), 877, 879
- C4.5 (decision tree learning algorithm), 715
- Cabeza, R., 11, 1038
- Cabral, J., 339, 1054
- caching, 108, 241, 507
- Cafarella, M. J., 850, 855, 1035, 1038, 1043
- CAFFE (machine learning software), 1021
- Cai, S., 598, 713, 719, 1035, 1038
- Cain, A., 822, 1036
- Cajal, S., 11
- Cakmak, M., 967, 979, 1034, 1061, 1063
- calculus, 120, 678, 754
- calculus of variations, 142
- Calo, R., 27, 1063

- Calvanese, D., 341, 1035, 1038
 Camacho, R., 821, 1038
 Cambefort, Y., 62, 1047
 Cambridge, 13
 camera
 for robots, 927
 stereo, 927
 surveillance, **990**
 time-of-flight, **928**
 Campbell, D. E., 649, 1038
 Campbell, M. S., 176, 1038, 1048
 Campbell, W., 559, 1039
 Candeal, J. C., 558, 1036
 Cannings, C., 456, 1038
 Canny, J., 921, 978, 979, 1038
 Canny edge detection, 921
 canonical distribution, **420**
 Cant, M., 822, 1036
 Cantor, C. R., 456, 1067
 Cantu-Paz, E., 143, 1058
 Cao, Y., 29, 783, 850, 865, 1066
 Čapek, K., 975, 1001
 Capen, E., 559, 1039
 Carbone, R., 250, 1034
 Carbonell, J. G., 382, 879, 1039, 1066
 Carbonnel, C., 207, 1039
 Cardano, G., 8, 178, 408, 1039
 card games, 171
 Carlin, J. B., 748, 1045
 Carlini, N., 787, 1039
 Carlson, A., 253, 850, 1055
 CARMEL (mobile robot), 976
 Carnap, R., 7, 394, 409, 410, 1039
 Carnegie Mellon University, 18
 Carpenter, B., 458, 527, 747, 1039
 Carpenter, M., 384, 1041
 Carroll, S., 143, 1039
 Carson, D., 312, 1066
 CART, **665**, 716
 cart–pole problem, **816**
 Casas, D. d. L., 822, 1063
 Casati, R., 340, 1039
 case
 accusative, 841
 dative, 841
 nominative, 841
 objective, 841
 subjective, 841
 Cash, S. S., 253, 1060
 Cassandra, A. R., 596, 597, 1039, 1049, 1053
 Cassandras, C. G., 61, 1039
 Castaneda, A. G., 30, 179, 1049
 Casteran, P., 312, 1036
 Castro, R., 455, 1039
 catastrophic forgetting, **805**
 categorical distribution, **391**
 category, **317**, 317–322, 329
 Cauchy, A., 717, 1039
 causal network, 412, 449–453, 748
 causal probability, **399**
 causal rule, 418
 causation, 219, 401
 Cawley, G. C., 719, 1046
 Cazenave, T., 177, 1037
 Ceder, G., 872, 1064
 cell decomposition, **945**
 cell layout, 70
 center (in mechanism design), **632**
 Center for Human-Compatible AI, 1008
 Center for Humane Technology, 1008, 1015
 central limit theorem, **1028**
 Centre for the Study of Existential Risk, 1008
 cerebral cortex, 12
 Cerf, V., 1011, 1057
 Černocký, J., 878, 879, 1055
 certainty effect, **538**
 certainty equivalent, **535**
 certainty factor, 23, 459
 certification, **996**
 Cesa-Bianchi, N., 597, 718, 1035, 1039
 CGP (Conformant Graphplan), 382
 CHAFF (logical reasoning system), 248
 chain rule
 for differentiation, **678**, 685, 754
 for probabilities, **416**
 Chajewska, U., 561, 1039
 Chakrabarti, P. P., 109, 145, 1039, 1041
 Chalkiadakis, G., 648, 1039
 Chalmers, D. J., 1007, 1039
 Chambers, R. A., 816, 1055
 chance node (decision network), **545**
 chance node (game tree), **165**
 chance of winning, 156
 Chandola, V., 990, 1039
 Chandra, A. K., 311, 1039
 Chang, C.-L., 313, 1039
 Chang, H. S., 597, 1039
 Chang, K.-M., 253, 1055
 Chang, K. C., 457, 1044
 Chang, M.-W., 879, 1042
 channel (in neural networks), **764**
 channel routing, 70
 Chao, W.-L., 877, 1039
 Chapman, D., 380, 383, 1034, 1039
 Chapman, N., 106
 character-level model, **826**, 860
 characteristic function, **626**
 Charniak, E., 23, 311, 455, 497, 525, 788, 852, 853, 1039
 chart parser, **835**, 851
 Chaslot, G., 176, 1039
 chatbot, 984
 Chater, N., 560, 1039
 Chatfield, C., 497, 1039
 Chatila, R., 977, 1056
 Chauvin, Y., 498, 1035
 Chavira, M., 456, 1039
 Chawla, N. V., 707, 995, 1039
 checkers, 19, 62, 177, 819, 820
 checkmate, 169
 Cheeseman, P., 206, 454, 455, 748, 977, 1039, 1062
 Chekaluk, R., 977, 1041
 chemistry, 22, 338, 983
 Chen, D., 15, 853, 876, 879, 1018, 1039, 1053, 1066
 Chen, J., 96, 108, 526, 1009, 1036, 1039, 1043
 Chen, K., 858, 878, 1055
 Chen, M. X., 850, 1039
 Chen, R., 498, 1053
 Chen, S. F., 852, 1039
 Chen, T., 718, 1039
 Chen, W., 853, 1067
 Chen, X., 381, 822, 1044, 1064
 Chen, Y., 27, 30, 1061
 Chen, Z., 29, 783, 849, 850, 865, 1039, 1066
 Cheng, J., 457, 747, 1039
 Cheng, J.-F., 458, 1055
 Cheng, Y., 15, 1018, 1066
 Chernova, S., 979, 1034
 Chervonenkis, A. Y., 717, 1064
 chess, 5, 14, 21, 30, 46, 107, 147, 155–158, 176
 Chess, D. M., 61, 1050
 CHESS 4.5, 107
 Cheung, V., 822, 1038
 Chi, E. H., 311, 1009, 1036, 1051
 χ^2 pruning, **664**
 Chickering, D. M., 175, 747, 1047, 1051
 Chien, S., 383, 1044
 Child, R., 879, 1059
 child node, **72**
 Chin, C.-S., 717, 1036
 Chinese room, **985**, 1007
 CHINOOK (checkers program), 177
 Chintala, S., 777, 1018, 1059, 1064
 Chiu, C., 849, 1039
 Chklovski, T., 316, 1039
 Cho, K., 786, 880, 1035, 1041
 Chocieł, M., 959, 979, 1034
 Choi, D. H., 30, 179, 1064
 Chollet, F., 312, 720, 1007, 1034, 1039
 Chomsky, C., 853, 1046
 Chomsky, N., 14, 16, 851, 852, 854, 855, 1039
 Chomsky Normal Form, **836**, 851
 Choromanska, A., 786, 1039
 Chorowski, J., 849, 1039
 Choset, H., 61, 978, 980, 1039
 Chouldechova, A., 1009, 1039
 Christian, B., 1006, 1039
 Christiano, P., 1010, 1034

- Christin, A., 1009, *1039*
 chronicle, 340
 chronological backtracking, 195
 Chrupa, L., 381, *1064*
 Chu-Carroll, J., 30, *1043*
 cHUGIN, 455
 Chung, J., 30, 179, *1064*
 Chung, K. L., 1029, *1039*
 Chung, S., 249, *1065*
 Church, A., 9, 279, 282, 310, *1039*
 Church, K., 851–853, 855, *1039*
 Church–Turing thesis, 9
 Churchland, P. M., 1007, *1039*
 Ciancarini, P., 61, 176, *1037, 1040*
 Ciccolini, J., 1009, *1043*
 Cimatti, A., 381–383, *1036, 1040*
 circuit, 70, 143, 271
 Boolean, 49, 52, 751
 domain, 273–277
 integrated, 110
 verification, 248, **276**
 circumscription, **333**, 338, 341
 prioritized, **334**
 CiteSeer, 511, 512
 city-block distance, 98
 Claessen, K., 313, *1063*
 clairvoyance, 171
 Clamp, S. E., 410, *1041*
 Clapp, R., 559, *1039*
 Clapp, T., 499, *1035*
 Claret, G., 527, *1040*
 Clark, A., 982, 1006, *1040*
 Clark, C., 879, *1058*
 Clark, K. L., 342, *1040*
 Clark, P., 850, 876, 880, *1040*
 Clark, S., 853, 977, *1040, 1042*
 Clark completion, 342
 Clarke, A. C., 454, *1040*
 Clarke, E., 381, *1040*
 CLASSIC (description logic), 332
 classical planning, **344**
 classification (in description logic), 331
 classification (in learning), **652**
 clause, **226**
 Clearwater, S. H., 649, *1040*
 Clerc, M., 142, *1042*
 Cleven, R., 526, *1055*
 Clocksin, W. F., 312, *1040*
 closed-loop, **64**, 951
 closed-world assumption, **264**, 297, 338,
 367, 502
 closed class, **835**
 closed list, 72
 CLP (constraint logic programming), **205**,
 298
 CLP(R) (constraint logic programming
 system), 312
 clustering (in Bayesian networks), **434**,
 434–435, 456
 clustering (unsupervised learning), 653,
 738
 clutter (in data association), **516**
 CNF (conjunctive normal form), **226**,
 226–227, 247, 299–300
 CNLP (conditional nonlinear planning),
 383
 CNN (convolutional neural network),
 760, 896
 co-NP, **1025**
 co-NP-complete, 222, **1025**
 coalition, **626**
 coalition structure, **626**
 coalition structure graph, **631**
 coarse-to-fine search, **108**
 Coase, R. H., 649, *1040*
 coastal navigation, **957**
 Coates, A., 817, 821, 1004, *1040*
 Coates, M., 455, *1039*
 Cobham, A., 9, *1040*
 Cocke, A., 835
 Cocke, J., 880, *1038*
 COCO (image data set), 25, 781, 909
 codes of ethics, 1008
 coercion, 366
 cognitive architecture, 34, **292**
 cognitive modeling, 2–3
 cognitive psychology, **13**, 823
 cognitive science, **3**, 526
 Cohen, B., 249, *1061*
 Cohen, C., 976, *1040*
 Cohen, P. R., 24, 646, *1040*
 Cohen, W., 850, *1055*
 Cohn, A. G., 342, *1040*
 COLBERT (robot control language), 980
 collaboration, 961, 964
 Collin, Z., 207, *1040*
 Collins, M., 718, 845, 853, 854, *1034*,
 1040, 1067
 collision checker, **946**
 collusion, **634**
 Colmerauer, A., 278, 311, *1040*
 Colombano, S. P., 143, *1053*
 color, 888
 Colossal Clean Crawled Corpus (C4),
 877, 879
 Colossus, 14
 Colton, S., 176, *1038*
 column player, **606**
 combinatorial auction, 638
 combinatorial explosion, 21
 commitment
 epistemological, **255**, 277, 386
 ontological, **254**, 277, 386
 Common Crawl, 852, 871
 common goal, **600**
 common sense, 408
 common value, 634
 communication, 605, 823
 commutativity (in search problems), **191**
 Compagna, L., 250, *1034*
 COMPAS (expert system), 993, 1009
 competitive environment, 146
 competitive ratio, **135**
 complementary literals, **226**
 complete-state formulation, **111**
 complete assignment, **181**
 complete data, **724**
 completeness
 of a proof procedure, **216**, 222, 246
 of resolution, 226, 303–306
 of a search algorithm, **75**, 105
 completing the square, **481**
 completion (of a data base), **297**
 complexity, 1023–1025
 analysis, **1024**
 sample, **674**
 space, **75**, 105
 time, **75**, 105
 complex sentence, **217**, 260
 component (of mixture distribution), **739**
 composite decision process, 108
 composite object, **318**
 compositionality, **251**
 compositional semantics, **843**
 computability, **9**
 computational learning theory, 672, **673**
 computational linguistics, **16**, 853
 computation graph, **754**
 computed torque control, **954**
 computer engineering, 14–15
 computer vision, **2**, 12, 20, 204, 882–919
 concession, **644**
 conclusion (of an implication), **217**
 concurrency, **601**
 concurrent action constraint, **604**
 condensation, 498
 condition–action rule, 559
 conditional distribution, 391
 conditional distributions, 420–424
 conditional effect, **368**
 conditional Gaussian, **423**
 conditional independence, **401**, 406, 408,
 415, 418–427, 454, 469
 conditional plan, 110, **122**, 123, 590
 conditional probability, **389**, 396, 399,
 407, 416
 conditional probability table (CPT), **413**
 conditioning, **396**
 conditioning case, **414**
 Condon, J. H., 176, *1040*
 Condorcet’s Paradox, **639**
 configuration space, **939**
 confirmation theory, **7**, 409
 conflict-directed backjumping, **196**, 203
 conflict clause learning, 234
 conflict deal, **641**
 conflict set, **195**

- conformant planning, 365, 367–370, 379, **382**
- confusion matrix, **710**
- Congdon, C. B., 976, *1040*
- Conitzer, V., 649, *1037*
- conjugate prior, **731**
- conjunct, 217
- conjunction (logic), **217**
- conjunctive normal form (CNF), **226**, 226–227, 247, 299–300
- conjunct ordering, **290**
- Conlisk, J., 560, *1040*
- Conneau, A., 879, *1052*
- connected component, **199**
- connectionism, **24**, 785
- connective, logical, 17, 217, 246, 260
- Connell, J., 980, *1040*
- consciousness, 11, **985**, 1007
- consequent, 217
- consequentialism, 8, **39**
- conservative approximation, **243**, 369
- consistency, **331**
- arc, **186**
 - condition, 107
 - of a CSP assignment, **181**
 - of a heuristic, **88**
 - path, **188**, 204
- consistent estimation, **437**
- consistent hypothesis, **653**
- conspiracy number, 175
- constant symbol, **257**, 259
- constrained optimization problem, 121, **185**
- constraint
- binary, 184
 - global, **184**, 188
 - nonlinear, **183**
 - preference constraint, **185**
 - propagation, **185**, 185–191, 194–195
 - resource constraint, **189**
 - symmetry-breaking, **203**
 - unary, 184
- constraint graph, **181**, 200
- constraint hypergraph, **184**
- constraint learning, **196**, 203, **206**
- constraint logic programming, 298, 312
- constraint logic programming (CLP), **205**, **298**
- constraint satisfaction problem (CSP), 20, **180**, 180–185, 352
- finite-domain, **183**, 298
- constraint weighting, **198**
- consumable resource, **375**
- context, 860
- context (in computer vision), **899**
- context-free grammar, 833, 851, 852, **1030**
- context-specific independence, 504
- Conti, E., 822, *1045*
- Conti-Cook, C., 1009, *1043*
- contingency planning, 365, 370–371, 379
- continuity (of preferences), **530**
- continuous domains, **183**
- continuous values, 422
- contour (of a state space), **89**
- contraction mapping, **574**
- contract net protocol, **632**
- contradiction, **223**
- control, **931**
- bang-bang, **816**
 - lateral, 917
 - longitudinal, 917
- control law, **952**
- controller, 4, 61, 782, 817, 952
- control theory, **16**, 15–16, 61, 142, 380, 785, 816, **950**
- adaptive, 819
 - robust, **801**
- control uncertainty, 957
- convention, **605**
- conversion to normal form, 299–300
- convexity, 122
- convex optimization, **122**, 141
- CONVINCE (Bayesian expert system), 454
- convolution, **890**
- convolution (in neural networks), **760**
- convolutional neural network (CNN), **760**, 896
- Conway, D., 720, *1040*
- Cook, P. J., 1000, *1044*
- Cook, S. A., 9, 248, 249, 1029, *1040*
- Cooper, G., 457, 747, *1040*
- Cooper, M. C., 207, *1039*
- cooperation, 604–605
- cooperative distributed problem solving, **646**
- cooperative game, **601**, 645
- coordination problem, **600**, 608, 961
- Copeland, J., 340, 1007, *1040*
- Copeland, T. P., 30, *1042*
- COQ (theorem prover), 204, 312
- Coram, M., 30, *1046*
- Corbett-Davies, S., 1009, *1040*
- core, **627**, 645, 648
- Corkill, D. D., 646, *1052*
- Cormen, T. H., 107, 1029, *1040*
- Cornell, C. A., 457, *1050*
- corpus, **825**
- Corrado, G., 30, 858, 878, *1053*, *1055*
- correspondence problem, **968**
- Cortes, C., 26, 718, 786, 922, *1040*, *1052*
- cost function, **16**
- cost optimality, 105
- cost to go, 955
- cotraining, 855
- Cotton, C., 1009, *1037*
- counterparts, **600**
- count noun, **322**
- Cournot, A., 647, *1040*
- Cournot competition, **622**
- Courville, A., 716, 787, 788, 849, *1035*, *1046*, *1067*
- covariance, **1029**
- covariance matrix, 1028, **1029**
- Cover, T., 720, *1040*
- Cowan, J. D., 20, 785, *1040*, *1066*
- Cowell, R., 559, 747, *1040*, *1062*
- Cowhey, I., 850, *1040*
- Cowling, P. I., 176, *1038*
- Cox, I., 526, 976, *1040*
- Cox, R. T., 394, 409, 410, *1040*
- Coz, D., 30, *1053*
- Cozmo (entertainment robot), 973
- CPCS (medical diagnosis system), 421, 455
- CPLAN (planning system), 381
- CPT (conditional probability table), **413**
- Craig, J., 978, *1040*
- Craik, K., 13, *1040*
- Crammer, K., 718, *1042*
- Cramton, P., 649, *1040*
- Crato, N., 206, *1046*
- Craven, M., 854, *1040*
- Crawford, J. M., 249, *1040*
- Crawford, K., 995, *1045*, *1065*
- creativity, 16
- credible threat, **619**
- credit assignment, **807**
- Cremers, A. B., 526, 977, *1038*, *1061*
- Cresswell, M. J., 340, *1048*
- Crick, F., 11, 118, 1007, *1040*, *1065*
- Crisan, D., 499, *1040*
- Cristianini, N., 718, *1040*
- critic (in learning), **57**
- critical path, **376**
- Crockett, L., 249, *1040*
- Croft, W. B., 850, 854, 855, *1040*, *1058*
- Cross, S. E., 29, *1040*
- cross-entropy, **758**
- CROSS-VALIDATION, **667**
- cross-validation, **666**, 716
- crossover, 141
- crossover point, **116**
- crossword puzzle, 46
- crowdsourcing, 705
- Cruise, 924
- Cruse, A., 853, *1040*
- cryptarithmic, **184**
- CSI, *see* independence, context-specific
- Csorba, M., 977, *1042*
- CSP (constraint satisfaction problem), 20, **180**, 180–185, 352
- CTRL (language model), 833
- Cuadros, J., 30, *1046*
- Cuellar, J., 250, *1034*
- Culberson, J., 109, *1040*

- culling, 116
 cult of computationalism, 982
 Cummins, D., 560, 1040
 Cummins, F., 787, 1045
 cumulative distribution, 541, 1027
 Curie, M., 1
 curiosity, 799
 Curran, J. R., 853, 1040
 curriculum learning, **840**
 Currie, K. W., 384, 1044
 curse
 of dimensionality, **688**, 717, 945
 optimizer's, **537**, 559
 winner's, **559**
 Curtis, F. E., 717, 1037
 Cushing, W., 384, 1040
 Cushman, F., 821, 1048
 Cusumano-Towner, M. F., 526, 527, 1040
 Cutler, A., 698
 cutoff test, **156**
 cutset conditioning, **201**, 204, 456
 Cybenko, G., 785, 1040
 CYBERLOVER (chatbot), 984
 cybernetics, **16**, 15–16
 cybersecurity, 32, **990**
 CYC (knowledge base), 316, 340
 cycle, **74**
 cycle constraint, 914
 cycle cutset, **201**
 cycle of net negative cost, 65
 cyclic solution, **125**
 Cyert, R., 561, 1040
 Cyganiak, R., 316, 339, 1037
 CYK-PARSE, **837**
 CYK algorithm, **835**, 851
 Czarnecki, W. M., 30, 179, 787, 1049, 1064
-
- D**
- D'Ambrosio, B., 456, 1061
 d-separation, **419**
 Dafoe, A., 28, 1046
 DAG (directed acyclic graph), 412, 454
 Dagan, I., 880, 1040
 Daganzo, C., 455, 1040
 Dagdelen, J., 872, 1064
 DAGGER (imitation learning system), 967, 979
 Dagum, P., 457, 1041
 Dahiya, R., 920, 1054
 Dahl, G., 30, 849, 854, 1048, 1053
 Dahy, S. A., 682, 684, 1050
 Dai, A. M., 879, 1041
 Dai, Z., 879, 1066
 Dalal, N., 922, 1041
 Dalibard, V., 787, 1049
 Dalmao, S., 456, 1035
 Dalvi, B., 850, 1055
 Dalvi, N. N., 524, 1041
 Daly, R., 748, 1041
 Damasio, A. R., 1007, 1041
 Damerau, F., 852, 1034
 Danaher, J., 1006, 1041
 Dang, T. D., 313, 1046
 Danish, 826
 Dantzig, G. B., 143, 1041
 DARPA, 29, 1010
 DARPA Grand Challenge, 28, 972, 977, 1020
 DARPA Urban Challenge, 972
 Darrell, T., 790, 923, 979, 1045, 1052
 Dartmouth workshop, 18
 Darwiche, A., 456, 457, 460, 1039, 1041, 1057
 Darwin, C., 118, 1041
 Dasgupta, P., 145, 649, 1041
 data-driven, **231**
 data-oriented parsing, 840
 data association, **514**, 935
 data augmentation, **707**
 database, 59, 264
 probabilistic, **524**
 database semantics, **265**, 297, 345, 502
 data complexity, **290**
 dataflow graph, **754**
 Datalog, **287**, 310, 311
 data matrix, **680**
 data provenance, **706**
 data science, 698, 699, 702, 720, 1015
 data set augmentation, **898**
 data sheet, **995**
 dative case, 841
 Daun, B., 384, 1041
 Dauphin, Y., 786, 1041
 Davidson, A., 647, 1036
 Davidson, D., 340, 824, 1041
 Davidson, M., 106, 1059
 Davis, A., 718, 1021, 1061
 Davis, E., 340–343, 1041
 Davis, G., 384, 1041
 Davis, M., 233, 248, 303, 310, 527, 1041
 Davis, T., 30, 178, 1056
 Davis–Putnam algorithm, **233**
 Dawid, A. P., 456, 559, 747, 1040, 1052, 1062
 Dayan, P., 177, 788, 820–822, 1041, 1061
 da Silva, B. C., 821, 1063
 da Vinci, L., 6, 920
 DBN (dynamic Bayesian network), 461, 485–498
 DBPEDIA (knowledge base), 316, 339
 DDN (dynamic decision network), 570, 595
 de-identification, **991**
 Deacon, T. W., 24, 1041
 dead end, **135**
 Deale, M., 384, 1041
 Dean, J., 311, 652, 718, 787, 852, 858, 878, 880, 1018, 1021, 1037, 1041, 1051, 1055, 1058, 1061
 Dean, M. E., 250, 1057
 Dean, S., 1009, 1053
 Dean, T., 383, 455, 498, 596, 597, 977, 978, 1019, 1041
 Dearden, R., 597, 820, 1037, 1041
 Deb, S., 142, 1066
 Debevec, P., 923, 1041
 de Borda, J-C., 640
 Debreu, G., 543, 1041
 debugging, 273
 DEC (Digital Equipment Corporation), 23, 292
 Dechter, A., 205, 1041
 Dechter, R., 107, 204–207, 456, 457, 460, 1040, 1041, 1049, 1054, 1058, 1061
 decision
 rational, 385, 528
 robust, **553**
 sequential, 547, **562**
 DECISION-LIST-LEARNING, **675**
 decision analysis, **558**
 decision boundary, **682**
 decision list, **674**
 decision maker, **558**
 decision network, 454, 528, **544**, 544–547, 557
 dynamic, **570**, 595
 evaluation of, 546
 decision node, **545**
 decision stump, **700**
 decision theory, 10, 25, **387**, 557
 decision tree, **657**, 715
 expressiveness, 657
 pruning, **663**
 declarative, 251
 declarativism, **210**, 247
 decoder (in autoencoders), 778
 decoding, 867
 decoding (in MT), **867**
 greedy, 867
 decomposability (of lotteries), **531**
 DECOMPOSE, **364**
 decomposition, **356**
 DeCoste, D., 718, 1041
 Dedekind, R., 278, 1041
 deduction theorem, **222**
 deductive database, **292**, 310, 311
 Deep Blue, 176
 Deep Blue (chess program), viii, 30, 176
 deepfake, **915**
 DEEPHOL (theorem prover), 309
 deep learning, **26**, 698, 750–788
 for NLP, 856–880
 for robotics, 958–968
 for vision, 894–918

- DEEPMATH (theorem prover), 312
 DeepMind, 31, 179, 779, 784, 816, 822, 1008
 deep Q-network (DQN), 784, **816**, 822
 deep reinforcement learning, 806, 979
 Deep Space One, 355, 384
 DeepStack (poker program), 178, 622
 DEEP THOUGHT (chess program), 176
 Deerwester, S. C., 852, 878, *1042*
 default logic, **334**, 338, 341
 default reasoning, 333–335, 459
 default value, **331**
 definite clause, **229**, 286–287
 definition (logical), **267**
 degree heuristic, **193**, 205, 234
 degree of belief, 385, **386**, 393, 394
 degree of truth, **255**
 degree of usefulness, 387
 degrees of freedom (DOF), **940**
 DeGroot, M. H., 410, 748, *1042*
 Dehaene, S., 1007, *1042*
 Deisenroth, M. P., 820, *1035*
 Delarue, A., 70, *1036*
 delete list, **345**
 Delgrande, J., 341, *1042*
 deliberative, **968**
 Dellaert, F., 179, 977, *1044*, *1064*
 Della Pietra, S. A., 880, *1038*
 Della Pietra, V. J., 880, *1038*
 Delling, D., 108, *1042*
 delta rule, **804**
 Del Favero, B. A., 456, *1061*
 Del Moral, P., 499, *1042*
 demodulation, **307**, 312
 demographic parity, **993**
 Dempster, A. P., 459, 497, 748, *1042*
 Dempster–Shafer theory, 459
 Denardo, E. V., 596, *1042*
 DENDRAL (expert system), 22, 23, 338
 dendrite, 12
 DeNero, J., 717, *1056*
 Deng, J., 26, 786, *1042*, *1060*
 Deng, L., 788, 849, 854, *1042*, *1048*, *1066*
 Deng, X., 144, 648, *1042*
 Denker, J., 26, 786, 787, 922, *1052*
 Denney, E., 312, *1042*
 Denniston, A. K., 30, *1053*
 density estimation, **724**
 nonparametric, **736**
 DeOliveira, J., 339, *1054*
 deontological ethics, **8**
 dependency grammar, **838**
 D'Épenoux, F., 596, *1042*
 depth-first search, **78**, 78–80, 105, 358
 DEPTH-LIMITED-SEARCH, **81**
 depth limit, 158
 depth of field, **885**
 derivation, 216
 Dervovic, D., 1018, *1042*
 Descartes, R., 6, 920, 1006, *1042*
 descendant (in Bayesian networks), **418**
 Descotte, Y., 383, *1042*
 description logic, **329**, **331**, 331–333, 337, 341
 descriptive theory, **538**
 Deshpande, A., 909, *1034*
 Deshpande, I., 916, *1042*
 Deslippe, J., 30, *1052*
 Desouza, P. V., 878, *1038*
 detailed balance, **444**
 detection failure (in data association), **516**
 deterministic environment, **45**
 deterministic node, **420**
 deterministic parser, **838**
 Dethridge, J., 106, *1059*
 detour index, **91**
 Deutscher, G., 278, *1042*
 development set, 666
 Deville, Y., 205, *1064*
 DEVISER (planning system), 383
 Devlin, J., 879, *1042*
 Devlin, K., 1006, *1042*
 Devol, G., 976
 Devroye, L., 748, *1042*
 Dewey Decimal system, 317
 Dey, A. K., 817, 963, 979, *1067*
 Dey, K., 996, 1009, *1036*
 de Condorcet, M., 718, *1041*
 de Dombal, F. T., 410, *1041*
 de Fariás, D. P., 596, *1041*
 de Finetti's theorem, 394
 de Finetti, B., 394, 409, *1041*
 de Freitas, J. F. G., 498, 499, *1041*, *1042*
 de Ghellinck, G., 596, *1041*
 de Groot, M., 561, *1040*
 De Kleer, J., 339, *1044*
 de Kleer, J., 206, 311, 342, *1041*, *1044*, *1065*
 de Marcken, C., 854, *1041*
 De Marneffe, M.-C., 839, *1057*
 De Morgan, A., 204, 278, *1041*
 De Morgan rules, 263
 de Oliveira Marinho, G., 30, *1053*
 De Raedt, L., 854, *1056*
 de Salvo Braz, R., 527, *1041*
 de Sarkar, S. C., 109, 145, *1039*, *1041*
 De Wever, A., 559, *1036*
 diabetic retinopathy, 698
 Diaconis, P., 538
 diagnosis, 386, 399, 400
 dental, 386
 medical, 23, 410, 418, 547
 diagnostic rule, 418
 dialysis, 534
 diameter (of a graph), **80**
 Dias, M. B., 142, *1042*
 Dickerson, S., 979, *1063*
 Dickinson, M. H., 1013, *1044*
 Dickmanns, E. D., 28, 923, 977, *1042*
 dictionary, **828**
 Dieleman, S., 29, 779, 787, 849, 920, *1043*, *1064*
 Dietterich, T., 822, *1042*
 Difference Engine, 15
 differentiable programming, **1016**
 differential equation, stochastic, 462
 differential GPS, **929**
 differential heuristic, **103**
 differential privacy, **991**, 1009
 Digital Equipment Corporation (DEC), 23, 292
 Dijkstra's algorithm, 77, 107
 Dijkstra, E. W., 107, 984, *1042*
 Dill, D. L., 250, *1057*
 Ding, Y., 30, *1042*
 Dinh, H., 107, *1042*
 Dionne, A., 109, *1063*
 Diophantine equations, **204**
 Diophantus, 204
 DiPasquo, D., 854, *1040*
 Diplomacy, 151
 direct collocation, 955
 directed acyclic graph (DAG), 412, 454
 directional arc consistency, **199**
 direct utility estimation, 818
 Dirichlet distribution, **731**
 Dirichlet process, **748**
 disambiguation, 846–849
 discontinuity (depth), 889
 discount factor, **565**, 596, 642, 792
 discretization, **120**, **422**
 discriminative model, **728**, 832
 discriminator (in GANs), **780**
 disjoint sets, **318**
 disjunct, 217
 disjunction, **217**, 393
 disjunctive constraint, **183**
 disparity, **902**
 Dissanayake, G., 977, *1042*
 distribute \vee over \wedge , 227, 300
 distributed constraint satisfaction, 207
 distributed representation, **60**
 distribution
 beta, 487, **730**
 categorical, 391
 conditional, nonparametric, **422**
 cumulative, 541, 1027
 heavy-tailed, **142**
 mixture, **739**
 Dittmer, S., 560, *1042*
 dividing a pie, 641
 Dix, J., 342, *1038*
 DLV (logic programming system), 342
 DNA, 116
 Do, M., 29, 381, *1035*, *1042*
 Do, M. B., 383, *1042*

- do-calculus, **452**
 Doctorow, C., 12, 340, *1042*
 Dodd, L., 840, *1042*
 domain
 continuous, **183**
 element of, **256**
 infinite, **183**
 in first-order logic, **256**
 in knowledge representation, **265**
 domain closure, **264**, 502
 domain randomization, **960**
 dominance
 stochastic, **541**, 557
 strict, **540**
 dominant strategy, **607**, 635
 dominant strategy equilibrium, **607**
 dominated plan (in POMDP), **592**
 domination (of heuristics), **99**
 Domingos, P., 35, 410, 456, 525, 708, 718, 720, 747, *1042*, *1045*, *1059*
 Domshlak, C., 381, 559, 646, *1037*, *1048*
 Donahue, J., 787, 923, *1045*, *1049*
 Dong, W., 26, *1042*
 Dong, X., 316, *1042*
 Donti, P. L., 30, *1059*
 Doorenbos, R., 311, *1042*
 Doran, J., 107, 108, *1042*
 Dorf, R. C., 61, *1042*
 Dorigo, M., 142, *1042*
 Doron, Y., 822, *1063*
 Doshi, T., 1009, *1036*
 Doshi-Velez, F., 719, *1042*
 Dota 2, 28, 30
 do the right thing, 1, **4**, 8, 39, 529
 Doucet, A., 498, 499, *1034*, *1040*, *1042*, *1057*
 Downey, D., 855, *1043*
 Downs, L., 978, *1037*
 downsampling, **762**
 downward refinement property, **360**
 Dowty, D., 853, *1042*
 Doyle, J., 61, 206, 341, 342, 559, 560, *1042*, *1055*, *1065*, *1067*
 DPLL, **234**, 248, 397
 DPLL-SATISFIABLE?, **234**
 DQN (deep Q-network), 784, **816**, 822
 Drabble, B., 384, *1042*
 Dragan, A. D., 62, 561, 648, 821, 964, 967, 979, *1035*, *1042*, *1046*, *1054*, *1060*
 DRAGON (speech recognition system), 854
 Drake, J. P., 717, *1036*
 Draper, D., 383, *1043*
 Drebbel, C., 16
 Drechsler, R., 108, *1043*
 Dredze, M., 718, *1042*
 Dressel, J., 993, 1009, *1042*
 Dreyfus, H. L., 249, 981, 982, *1042*
 Dreyfus, S. E., 107, 596, 785, 982, *1036*, *1042*
 Driessens, K., 820, *1063*
 drilling rights, 547
 driver assist, **973**
 dropout (in neural networks), **772**, 787
 Droppo, J., 29, *1066*
 Drucker, H., 26, 786, 922, *1052*
 Druzdzal, M. J., 457, *1039*
 DT-AGENT, **388**
 Du, J., 876, 879, *1053*
 Du, S. S., 786, *1042*
 dual graph, **184**
 dualism, **6**
 dual use, **990**
 Dubois, D., 460, *1042*
 Dubois, O., 249, *1062*
 Dubourg, V., 720, *1058*
 Ducharme, R., 878, *1036*
 duck, mechanical, 976
 Duda, R. O., 410, 720, 747, 749, *1042*, *1043*
 Dudek, G., 980, *1043*
 Dudzik, A., 30, 179, *1064*
 Duffy, D., 313, *1043*
 Duffy, K., 718, *1040*
 Duffy, N., 119, 143, *1055*
 Dumais, S. T., 850, 852, 854, 878, *1035*, *1042*
 dummy player, **629**
 dung beetle, 41, 62, 374, 970
 Dunham, B., 21, *1044*
 Dunham, C., 311, *1063*
 Dunn, A., 872, *1064*
 Dunn, H. L., 525, *1043*
 Dunn, J., 716, *1036*
 Dunn, R. C., 30, *1053*
 Dunning, I., 30, 179, 787, *1049*
 DuPont, 23
 Dupont, D., 559, *1036*
 Durand, F., 1016, *1053*
 duration, **375**
 Dürer, A., 920
 Durfee, E. H., 649, *1043*
 Durme, B. V., 855, *1043*
 Durrant-Whyte, H., 977, *1042*, *1052*
 Duru, G., 559, *1036*
 Dwork, C., 995, 1009, *1043*, *1066*
 DYNA (reinforcement learning agent), 820
 dynamical system, 497
 quadratic, 143
 dynamic backtracking, 206
 dynamic Bayesian network (DBN), 461, **485**, 485–498
 approximate inference in, 491
 exact inference in, 489
 dynamic decision network (DDN), **570**, 595
 dynamic environment, **45**
 dynamic programming, 61, 101, 107, **297**, 470, **563**, 596, 835
 adaptive (ADP), **793**, 793
 nonserial, **456**
 dynamics model, **951**
 dynamic state, **951**
 Dyson, F., 716, *1043*
 Dyson, G., 1010, *1043*
 dystopia, 1011, 1022
-
- ## E
-
- E (theorem prover), 312, 313
 \mathcal{E}_0 (English fragment), 833
 Earley, J., 853, *1043*
 early payout termination, **164**
 early stopping, **664**
 earthquake, 413
 Ebendt, R., 108, *1043*
 EBL (explanation-based learning), 382
 Eck, D., 920, *1043*
 Ecker, A. S., 983, *1045*
 Ecker, K., 384, *1037*
 Eckerle, J., 96, 108, *1043*
 Eckert, J., 14
 Eckhouse, L., 1009, *1043*
 economics, 9–10, 61, 534
 economy, **146**
 Edelkamp, S., 109, 381, *1043*
 edge (in a scene), **889**
 edge detection, 889–892
 Edinburgh, 976
 Edmonds, D., 17
 Edmonds, J., 9, *1043*
 Edward (probabilistic programming language), 526
 Edwards, D. J., 175, *1047*
 Edwards, P., 1007, *1043*
 Edwards, W., 558, *1065*
 EEG, 11
 Een, N., 312, *1034*
 effect, **345**
 missing, **372**
 effective depth, **98**
 effector, **925**
 efficient auction, **634**
 Efros, A., 26, 879, 908, 913–915, 923, *1044*, *1047–1050*, *1067*
 egalitarian social welfare, **610**
 egocentric action, 67
 Ehrenfeucht, A., 717, *1037*
 8-puzzle, **68**, 97, 100, 106
 8-queens problem, 110, 112, 116, 197
 Einstein, A., 1
 Eisner, J., 853, *1062*
 Eitelman, S., 311, *1063*
 Eiter, T., 342, *1043*
 Ekart, A., 143, *1059*

- EKF (extended Kalman filter), **483**, 935
 ELBO (evidence lower bound), **778**
 Elder, J. F., 718, *1061*
 Elementary Perceiver And Memorizer (EPAM), 715
 Elfes, A., 977, *1056*
 ELIMINATION-ASK, **432**
 Elio, R., 560, *1043*
 Eliot, T.S., 824
 Elisseeff, A., 719, *1046*
 elitism, **116**
 ELIZA (chatbot), 984
 Elkan, C., 747, 1009, *1043*, *1049*
 Elkind, E., 648, *1039*
 Ellington, C., 1013, *1044*
 Elliott, G. L., 205, *1047*
 Elliott, P., 249, *1065*
 Ellsberg, D., 560, *1043*
 Ellsberg paradox, 538, 560
 Elman, J. L., 786, 854, *1043*
 ELMO (natural language system), 879
 Elo, A. E., 526, *1043*
 Elskén, T., 787, *1043*
 EM algorithm, 466, 737–746
 structural, **746**
 embodied cognition, **982**
 empirical gradient, **120**, 811
 empirical loss, **670**
 empiricism, **6**, 855
 Empson, W., 853, *1043*
 EMV (expected monetary value), **534**
 ENAS (Efficient Neural Architecture Search), 787
 encoder (in autoencoders), 778
 end-to-end learning, 960
 Enderton, H. B., 279, 310, *1043*
 Endriss, U., 649, *1037*
 Eng, C., 30, *1053*
 Engel, J., 920, *1043*
 Engelbart, D., 14
 Engelberger, J., 976
 ENIAC, 14
 ensemble learning, **696**, 696–702
 ensemble model, **696**
 entailment, **214**, 246
 entropy (H), **661**, 662
 ENUMERATE-ALL, **429**
 ENUMERATION-ASK, **429**
 environment, **36**, 42–47
 class, **47**
 competitive, **45**
 continuous, **46**
 cooperative, **45**
 deterministic, **45**
 discrete, **46**
 dynamic, **45**
 episodic, 45
 history, 563
 known, **46**
 multiagent, **44**, 599
 nondeterministic, **45**, 110
 observable, **43**
 one-shot, **45**
 partially observable, **43**
 properties, 43
 semidynamic, **46**
 sequential, **45**
 single-agent, **44**
 static, **45**
 stochastic, **45**, 562
 taxi, 42, 43
 unknown, **46**
 unobservable, **44**
 virtual, 43
 EPAM (Elementary Perceiver And Memorizer), 715
 Ephrati, E., 649, *1051*
 epistemological commitment, **255**, 277, 386
 epoch, **679**
 Epstein, R., 1006, *1043*
 EQP (theorem prover), 313
 equality (in logic), 264, 306
 equality symbol, **264**
 equality test, 665
 equilibrium, 171
 Bayes–Nash, **623**
 dominant strategy, **607**
 maximin, **613**
 Nash, **608**, 645
 subgame perfect, **619**
 equivalence (logical), **222**
 Erdmann, M. A., 144, *1043*
 Erez, T., 822, 979, *1047*, *1053*, *1063*
 ergodic, **444**
 Erhan, D., 30, 787, 879, *1063*, *1064*
 ERNIE (NLP system), 879
 Ernst, G., 107, *1056*
 Ernst, H. A., 976, *1043*
 Ernst, M., 381, *1043*
 Erol, K., 382, *1043*
 Erol, Y., 499, *1043*
 error (of a hypothesis), **666**, 673
 error function, 1028
 error rate, **666**
 Escalante, H. J., 719, *1046*
 Escalera, S., 719, *1046*
 Essig, A., 410, *1046*
 Esteva, A., 30, *1043*
 Estrin, D., 1009, *1035*
 Etchemendy, J., 279, *1035*
 ethics, 986–1005
 Etzioni, A., 1008, 1009, *1043*
 Etzioni, O., 27, 316, 339, 383, 850, 854, 855, 876, 880, 1008, 1020, *1035*, *1040*, *1043*, *1052*, *1063*, *1065*
 Euclid, 9, 920
 Eugene Goostman, 984
 Euler-Lagrange equation, **949**
 EUROPA (planning system), 29
 Europe, 23
 European Space Agency, 384
 evaluation function, **73**, 105, 146, 156–158, 803
 linear, 104
 Evans, O., 28, 821, *1046*, *1060*
 Evans, T. G., 20, *1043*
 event, 322–325
 exogenous, **372**
 in probability, **389**, **427**
 event calculus, **323**, 322–324, 340, 846
 Everett, B., 977, *1037*
 Everitt, T., 822, 1003, *1052*
 evidence, **389**, 721
 reversal, **498**
 evidence lower bound (ELBO), **778**
 evidence variable, 427
 evolution, 118
 machine, **21**
 of machines, **21**
 evolutionary algorithm, **115**, 141
 evolutionary psychology, **539**
 evolution strategies, **116**, 143
 Ewalds, T., 30, 179, 822, *1064*
 exception, 315, 331
 exclusive or, 219
 execution monitoring, **372**, 371–374, 383
 exhaustive decomposition, **318**
 existence uncertainty, **507**
 existential graph, **329**
 Existential Instantiation, **281**
 existential quantifier, **262**
 expansion (of nodes), **71**
 expectation, **1028**
 expectation maximization, 746
 expected monetary value (EMV), **534**
 expected utility, **55**, 62, 387, 528, **529**, 534
 expected value (in a game tree), **156**, 165
 expectiminimax, 166, 174, 175
 complexity of, 167
 value, **165**
 experience replay, **806**
 expert system, **23**, 338, 558
 commercial, 23, 292
 medical, 459
 Prolog-based, 294
 expit model, **424**
 explainability, **711**
 explainable AI (XAI), 719, **997**
 explanation, **336**
 most probable, **457**
 explanation-based learning (EBL), 382
 exploitation, **161**, 581, 798
 exploration, 40, 41, 134–141, **161**, 581, 791, 797, 798
 bonus, **585**

function, **799**, 802
 safe, **136**
 exploratory data analysis, **653**, 708
 expressiveness, **59**
 extended Kalman filter (EKF), **483**, 935
 extension (of default theory), **335**
 extensive form, **617**
 externalities, **637**, 1002
 extremely randomized trees (ExtraTrees),
698
 extrinsic property, **322**
 eyes, 881, 884, 885, 920

F

Facebook, 29, 822, 1008
 fact, **230**
 factor (in variable elimination), **430**
 factored frontier, **499**
 factored representation, **59**, 63, 180, 344,
 390, 570, 652
 factoring, **226**, 301
 Faes, L., 30, *1053*
 Fagin, R., 206, 341, *1036*, *1043*
 Fahlman, S. E., 20, 342, *1043*
 failure model, 488
 failure modes and effect analysis
 (FMEA), **1001**
 fair division, 628
 fairness, 706, 711, 992–996, 1009
 fall in love, 982
 false alarm (in data association), **516**
 false positive, **710**
 Fan, J., 30, *1043*
 Farhadi, A., 880, *1061*
 Farid, H., 993, 1009, *1042*
 FARMVILLE (video game), 999
 Farrell, R., 311, *1038*
 FASTDOWNWARD (planning system),
 380
 Fast Downward Stone Soup, 381
 Faster RCNN (computer vision system),
 900
 FASTFORWARD (planning system), 356
 FASTTEXT (word embedding), 857
 Fatica, M., 30, *1052*
 Faugeras, O., 923, *1043*
 fault tree analysis (FTA), **1001**
 Favini, G. P., 176, *1040*
 Fawcett, T., 990, *1043*
 FDSS (planning system), 381
 Fearing, R. S., 978, *1043*
 Featherstone, R., 978, *1043*
 feature (of a state), **104**, 156
 feature expectation, **814**
 feature extraction, 881
 feature map, **764**
 feature matching, **814**
 feature selection, **671**, 825

federated learning, 706, **992**, 1009
 feedback, 15, 651, **653**
 feedforward network, **751**
 Fei-Fei, L., 26, 786, 879, *1042*, *1050*,
1060
 Feigenbaum, E. A., 17, 22, 23, 107, 338,
 715, *1035*, *1038*, *1043*, *1053*
 Feiten, W., 977, *1037*
 Feldman, J., 62, 558, *1043*
 Feldman, M., 13, *1043*
 Fellbaum, C., 852, *1043*
 Fellegi, I., 525, *1043*
 Feller, A., 1009, *1040*
 Felner, A., 88, 108, 109, 381, *1043*, *1048*,
1051, *1060*
 Felzenszwalb, P., 144, *1043*
 Feng, L., 977, *1037*
 Feng, S., 879, *1063*
 Feng, T. K., 206, *1036*
 Fenton, N., 558, *1043*
 Fergus, R., 690, 787, *1063*, *1064*
 Ferguson, T., 176, 597, 748, *1043*
 Fermat, P., 8, 408
 Fern, A., 561, *1043*
 Fernández, F., 821, *1045*
 Fernandez, J. M. F., 30, 179, *1043*
 Fernando, C., 787, *1049*, *1053*
 FERPA, 990
 Ferraris, P., 382, *1043*
 Ferriss, T., 1000, *1043*
 Ferrucci, D., 30, *1043*
 FF (planning system), 356, 380
 Fidjeland, A., 820, 822, *1055*
 FIFO queue, **74**
 15-puzzle, **68**, 106
 Fifth Generation project, 23
 figure of speech, 847, 848
 Fikes, R. E., 61, 144, 278, 380, 382, 383,
 976, *1044*
 filtering, **132**, 335, 466–467, 496, 588,
 744, 931
 assumed-density, **499**
 Fine, S., 498, *1044*
 finite state machine, 614
 Fink, D., 119, 143, *1055*
 Finkelstein, L., 207, *1038*
 Finn, C., 719, 790, 979, *1044*, *1052*
 Finney, D. J., 455, *1044*
 Firat, O., 850, *1039*
 Firby, R. J., 383, *1041*
 FIRE (theorem prover), 339
 Firoiu, V., 179, *1044*
 first-order logic, **251**, 251–279
 first mover, 642
 Firth, J., 856, *1044*
 Fisac, J. F., 648, 821, *1034*, *1054*
 Fischer, A., 716, *1035*
 Fischer, B., 312, *1042*
 Fischer, P., 597, *1035*

Fischer, R., 168
 Fisher, M. L., 561, *1056*
 Fisher, R. A., 9, 409, *1044*
 fitness landscape, 143
 Fix, E., 717, *1044*
 fixation, **903**
 FIXED-LAG-SMOOTHING, **475**
 fixed-lag smoothing, **471**
 Flannery, B. P., 142, *1058*
 Floreano, D., 1013, *1044*
 Floyd, R. W., 107, *1044*
 fluent, **238**, 247, 325
 missing, **372**
 fly eyes, 905, 917
 FMEA (failure modes and effect
 analysis), **1001**
 focal length, **883**
 focal plane, **885**
 focal point (in game theory), **608**
 focus of expansion, **904**
 Fogel, D. B., 144, *1044*
 Fogel, L. J., 143, *1044*
 fog of war, 168
 FOL-BC-AND, **293**
 FOL-BC-ASK, **293**
 FOL-BC-OR, **293**
 FOL-FC-ASK, **288**
 folk psychology, 343
 Fong, R., 979, *1034*
 FOPC, *see* logic, first-order
 Forbes, J., 598, *1044*
 FORBIN (planning system), 383, 384
 Forbus, K. D., 311, 339, 342, *1044*
 force sensor, **929**
 Ford, K. M., 1006, *1044*
 Ford, L. R., 107, *1044*
 Ford, M., 28, 35, 1011, *1044*
 foreshortening, 882
 Forestier, J.-P., 822, *1044*
 forget gate (in LSTM), **775**
 Forgy, C., 311, *1044*
 formal logic, **8**
 Forrest, S., 143, *1055*
 Forster, E. M., 1011, *1044*
 Forsyth, D., 914, 916, 924, *1042*, *1044*,
1050
 Fortmann, T. E., 497, 526, *1035*
 Fortran, 756
 forward-backward, **470**, 744
 FORWARD-BACKWARD, **470**
 forward chaining, **230**, 230–231, 247,
 286–293, 311
 forward checking, **194**, 194
 forward kinematics, **940**
 forward message, 469
 forward pruning, **159**
 forward search for planning, 348–350
 Foster, G., 850, *1039*
 Fouhey, D., 908, *1044*

- four-color map problem, 204, 983
 Fourier, J., 204, *1044*
 Fowlkes, C., 921, *1054*
 Fox, C., 560, *1044*
 Fox, D., 526, 977, 980, *1038, 1044, 1061, 1064*
 Fox, M. S., 383, *1044*
 FPGA, 27
 frame, **23**, 341
 FrameNet (lexical database), 339
 frame problem, **239**, 249, 250
 representational, **239**
 framing effect, **539**
 Francis, J., 559, *1050*
 Franco, J., 248, *1044*
 Francois-Lavet, V., 820, *1044*
 Francon, O., 119, 143, *1055*
 Frank, E., 720, *1066*
 Frank, I., 176, *1044*
 Frank, J., 29, *1035*
 Frank, R. H., 1000, *1044*
 Frankenstein, 1001
 Frans, K., 822, *1044*
 Franz, A., 852, *1044*
 Frasconi, P., 786, *1036*
 FREDDY (robot), 107, 144, 976
 Fredkin Prize, 176
 Freeman, W., 458, *1065, 1066*
 Freer, C., 526, *1034*
 free space, **940**
 free will, 6
 Frege, G., 8, 248, 278, 310, *1044*
 Freitag, D., 854, 855, *1040, 1044*
 frequentism, **408**
 Freuder, E. C., 205, 206, *1044, 1054, 1060*
 Freund, Y., 700, 718, *1044*
 Frey, B. J., 787, *1044*
 Frey, C. B., 999, *1044*
 Friedberg, R. M., 21, 143, *1044*
 Friedman, G. J., 143, *1044*
 Friedman, J., 716, 718, 720, 749, *1038, 1044, 1047*
 Friedman, N., 455, 456, 460, 498, 499, 596, 747, 748, 820, *1034, 1037, 1041, 1044, 1051*
 Friendly AI, 1010
 frisbee, 30, 982
 Fristedt, B., 597, *1036*
 front-to-end, **96**
 front-to-front, **96**
 frontier, **72**
 Frost, D., 205, 207, *1041*
 Fruhwirth, T., 207, *1044*
 FTA (fault tree analysis), **1001**
 Fu, D. J., 30, *1053*
 Fu, J., 341, 1014, *1053*
 Fu, M. C., 597, *1039*
 Fuchs, J. J., 384, *1044*
 Fudenberg, D., 648, *1044*
 Fukunaga, A. S., 383, *1044*
 Fukushima, K., 786, 922, *1044*
 Fuller, S. B., 1013, *1044*
 full joint distribution, 395, 397
 fully connected (neural network), **754**
 fully observable, 588
 function, **254**
 total, **257**
 functional, 949
 functional magnetic resonance imaging (fMRI), 11, 253
 function approximation, **803**
 function symbol, **257**, 259
 Fung, C., 1009, *1044*
 Fung, C. C., 984, *1049*
 Fung, R., 457, *1044*
 Furcy, D., 145, *1051*
 Furnas, G. W., 852, 878, *1042*
 Furst, M., 381, *1037*
 futility pruning, **176**
 Future of Humanity Institute, 1008
 Future of Life Institute, 1008
 future of work, 998–1000, 1011
 fuzzy control, 459
 fuzzy logic, 214, 255, 459
 fuzzy set, 459
-
- G**
-
- g* (path cost), 73
 Gödel number, 305
 Gabriele, S., 30, *1053*
 Gabrilovich, E., 316, *1042*
 Gaddum, J. H., 455, *1044*
 Gadepalli, K. K., 30, *1053*
 Gaffney, S., 822, *1036*
 Gaifman, H., 524, 525, *1044*
 gain factor, **952**
 gait, 29, **969**, 990
 Gale, W. A., 851, *1039*
 Galfrin, E., 456, *1061*
 Galileo, G., 1, 57
 Gallagher, G., 963, 979, *1067*
 Gallaire, H., 311, *1044*
 Gallegos, J., 30, *1053*
 Gallier, J. H., 279, *1044*
 Galperin, G. R., 176, *1063*
 Galstyan, A., 1009, *1055*
 Galton, F., *1044*
 Gamba, A., 785, *1045*
 Gamba perceptrons, 785
 Gamberini, L., 785, *1045*
 gambling, 8, 531
 game, 10
 assistance, **34**, 623, 815
 backgammon, 164, 178, 804, 815
 billiards, 179
 of chance, 164–168
 checkers, 19, 62, 177, 819, 820
 chess, 5, 14, 21, 30, 46, 107, 147, 155–158, 176
 cooperative, 626
 dice, 171
 Diplomacy, 151
 Go, 161
 of imperfect information, **146**
 incomplete information, 561
 inspection game, **606**
 Kriegspiel, **168**
 multiplayer, 151–152
 normal form, **605**
 optimal decisions in, 148–152
 Othello, 178
 partially observable, 168–172
 of perfect information, **147**
 physical, 179
 poker, 178, 648
 principal–agent, **648**
 repeated, 608, **614**
 Reversi, 178
 Scrabble, 179
 Settlers of Catan, 151
 stochastic, **164**
 Tetris, 572, 581
 Yahtzee, 168
 zero-sum, **147, 610**
 game playing, 146–175
 game show, 534
 game theory, 10, **600**, 645
 cooperative, 626
 non-cooperative, 605–625
 Gammage, C., 30, *1062*
 GAN (generative adversarial network), **780**, 787, 915
 Ganchev, K., 853, *1034*
 Gandomi, A., 719, *1045*
 Ganguli, S., 786, 787, *1041, 1058*
 Gannon, I., 456, *1061*
 Gao, J., 652, *1045*
 Gao, Q., 29, 783, 850, 865, *1066*
 Gao, Y., 822, *1049*
 Garcia, E. A., 707, 995, *1047*
 García, J., 821, *1045*
 Gardner, M., 248, 850, 879, *1045, 1055, 1058*
 Garey, M. R., 1025, 1029, *1045*
 Garg, A., 498, *1057*
 GARI (planning system), 383
 Garrett, C., 116, *1035*
 Gaschnig, J., 107, 205, 206, *1045*
 Gašić, M., 598, *1066*
 Gasquet, A., 384, *1044*
 Gasser, L., 646, *1037*
 Gasser, R., 109, *1045*
 Gat, E., 979, *1045*
 gate (logic), 274
 Gates, B., 33

- gating unit (in LSTM), **775**
 Gatys, L. A., 983, *1045*
 Gauci, J., 822, *1045*
 Gauss, C. F., 204, 497, 717, *1045*
 Gaussian distribution, **1027**
 multivariate, 479, 1028
 Gaussian error model, **487**
 Gaussian filter, **890**
 Gaussian noise, 479
 Gaussian process, 672, **748**
 Gazzaniga, M., 1007, *1045*
 GBM (gradient boosting machine), 701
 GBRT (gradient boosted regression tree), 701
 GDPR, 990, 997
 GDPR (General Data Protection Regulation), 712
 Gearhart, C., 597, *1046*
 Gebru, T., 995, *1038, 1045, 1055*
 Gee, A. H., 498, *1041*
 Geffner, H., 144, 380, 382, 383, *1037, 1047, 1057*
 Geiger, D., 455, 456, 747, *1045, 1047, 1061*
 Gelatt, C. D., 142, 206, *1050*
 Gelb, A., 497, *1045*
 Gelder, A. V., 313, *1063*
 Gelernter, H., 19, 312, *1045*
 Gelfond, M., 312, 342, *1045*
 Gelman, A., 458, 527, 719, 747, 748, *1038, 1039, 1045*
 Geman, D., 457, 718, 921, *1034, 1045*
 Geman, S., 457, 921, *1045*
 Gemp, I., 820, *1053*
 generalization, **966**
 generalization loss, **670**
 generalizing fields, 991
 General Problem Solver, 2, 7, 19, 380
 GENERATE-IMAGE, **519**
 GENERATE-LETTERS, **519**
 GENERATE-MARKOV-LETTERS, **521**
 generation (of nodes), **72**
 generative adversarial network (GAN), **780**, 787, 915
 generative model, **727**, 831
 generator, **1031**
 generator network (in GANs), **780**
 Genesereth, M. R., 61, 144, 179, 278, 279, 298, 303, 311, 312, *1045, 1053, 1062*
 GENETIC-ALGORITHM, **119**
 genetic algorithm, **116**, 115–119, 143–144
 genetic programming, 21, **116**, 143
 Gene Ontology Consortium, The., 340, *1045*
 Gent, I., 207, *1045*
 Geometry Theorem Prover, 19
 Georgeson, M., 924, *1038*
 Georgiev, P., 30, 179, 822, *1064*
 Gerbault, F., 748, *1045*
 Gerkin, R. C., 920, *1060*
 Géron, A., 720, *1045*
 Gers, F. A., 787, *1045*
 Gesmundo, A., 719, *1066*
 Gestalt school, 921
 Getoor, L., 527, *1045*
 Ghaheri, A., 143, *1045*
 Ghahramani, Z., 455, 498, 719, 748, 787, *1045, 1049, 1060, 1062*
 Ghallab, M., 344, 380, 383, 384, *1045*
 Gharbi, M., 1016, *1053*
 Ghavamzadeh, M., 820, *1053*
 Ghose, D., 142, *1051*
 Ghose, S., 109, *1039*
 GIB (bridge program), 178
 Gibbard–Satterthwaite Theorem, **641**
 Gibbs, R. W., 853, *1045*
 GIBBS-ASK, **443**
 Gibbs sampling, **442**, 445, 457
 Gibson, J. J., 921, 923, *1045*
 Gil, Y., 316, *1039*
 Gilks, W. R., 457, 458, 499, 525, 747, *1045*
 Gillies, D. B., 648, *1045*
 Gillula, J. H., 821, *1034*
 Gilmore, P. C., 310, *1045*
 Gilpin, A., 647, *1045*
 Gini coefficient, **610**
 Ginsberg, M. L., 178, 206, 311, 460, *1041, 1045, 1062*
 Ginter, F., 839, *1057*
 Gionis, A., 717, *1045*
 Girshick, R., 923, *1045*
 Gittins, J. C., 597, *1045*
 Gittins index, **583**
 Giunchiglia, E., 382, *1043*
 Givan, R., 820, *1063*
 Gladman, A. S., 1013, *1051*
 Glanc, A., 975, *1045*
 Glass, J., 498, *1053*
 Glavieux, A., 458, *1036*
 Glickman, M. E., 526, *1045*
 Glickman, O., 880, *1040*
 GLIE (greedy in the limit of infinite exploration), **798**
 global constraint, **184**, 188
 Global Positioning System, **928**
 GLONASS (Russian GPS), 929
 Glorot, X., 786, *1045*
 GloVe (word embedding software), 857, 858, 872, 875
 Glover, F., 142, *1045*
 Glover, K., 560, *1067*
 GLUE (General Language Understanding Evaluation), 879
 Gluss, B., 560, *1045*
 Glymour, C., 278, 747, *1046, 1062*
 Go (game), 19, 27, 30, 161, 177, 784, 816
 goal, **53**, 63, 345
 clause, **230**
 common, 600
 formulation of, **63**
 inferential, 266
 monitoring, 372
 state, **65**, 105
 goal-based action selection, 53
 goal-based agent, 53–54, 60, 61
 goal-directed reasoning, **232**
 goal test
 early, **76**
 late, **76**
 God, existence of, 409
 Godefroid, P., 381, *1045, 1062*
 Gödel, K., 9, 310, 983, *1045*
 Goebel, J., 748, *1045*
 Goel, A., 637, *1034*
 Goel, S., 1009, *1040*
 Goertzel, B., 33, *1045*
 GOFAI (Good Old-Fashioned AI), **982**
 Gogate, V., 456, *1045*
 gold, 210
 Gold, E. M., 716, 854, *1045*
 Goldberg, A. V., 108, *1045*
 Goldberg, D. E., 143, *1058*
 Goldberg, K., 144, *1065*
 Goldberg, Y., 839, 849, 853, 878, *1045, 1052, 1057*
 Goldman, R., 144, 382, 525, *1039, 1046, 1065*
 Goldstein, T., 1009, *1046*
 Goldszmidt, M., 455, 460, 597, 747, *1037, 1044, 1046*
 Golgi, C., 11
 Golomb, S., 205, *1046*
 Golub, G., 716, *1046*
 Gomes, C., 142, 206, 248, 381, *1046*
 Gomez, A. N., 850, 868, 880, *1064*
 Gondek, D., 30, *1043*
 Gonina, K., 849, *1039*
 Gonnet, G. H., 719, *1036*
 Gonthier, G., 204, *1046*
 Good, I. J., 177, 409, 454, 455, 1004, *1046*
 Good–Turing smoothing, 851
 good and evil, 557
 Gooday, J. M., 342, *1040*
 Goodfellow, I., 769, 786–788, *1039, 1046, 1063*
 Goodman, J., 852, *1039, 1046*
 Goodman, N., 340, *1046, 1052*
 Goodman, N. D., 526, 527, *1036, 1046, 1054, 1066*
 Good Old-Fashioned AI (GOFAI), **982**
 Goodrich, B., 458, 527, 747, *1039*
 Google, 29, 31, 652, 763, 850, 852, 853, 924, 986, 1008, 1017

- Google Duplex, 29
 Google Knowledge Graph, 316
 Google Scholar, 511
 Gopnik, A., 278, 1046
 Gordon, A. D., 526, 527, 1040, 1046
 Gordon, A. S., 341, 1046
 Gordon, G., 498, 598, 979, 1058, 1060, 1064
 Gordon, M. J., 278, 1046
 Gordon, N., 498, 499, 1035, 1042, 1046
 Gordon, S. A., 179, 1046
 gorilla problem, **33**
 Gorry, G. A., 410, 1046
 Gottlob, G., 207, 1046
 Gotts, N., 342, 1040
 Goyal, N., 876, 879, 1053
 Goyal, Y., 910, 1046
 GP-CSP (planning system), 381
 GPT-2 (language model), 832, 833, 876, 879, 1021
 GPU (graphics processing unit), 15, 27
 Grace, K., 28, 1046
 graceful degradation, 594
 gradient, **120**, 701
 empirical, **120**, 811
 exploding, **774**
 vanishing, **756**, 774
 gradient boosted regression tree (GBRT), 701
 gradient boosting, 698, **701**
 gradient boosting machine (GBM), 701
 gradient descent, 114, **677**
 batch, **679**
 stochastic, **679**, 765
 Graepel, T., 27, 30, 155, 174, 177, 178, 526, 820, 1046, 1047, 1061
 Graham, S. L., 853, 1046
 Gramfort, A., 720, 1058
 grammar, 823, 832, 833, 1030
 augmented, **841**
 categorical, 853
 context-free, 833, 851, 852, **1030**
 lexicalized, **841**
 probabilistic, **833**, 833–835, 852
 dependency, 853
 induction of, 854
 lexical-functional (LFG), 853
 phrase structure, 851
 grand coalition, **626**
 graph, **65**
 coloring, 204
 Eulerian, **144**
 graphical model, 412, 460
 graphics processing unit (GPU), 15, 27
 Graphplan (planning system), 352, 381
 graph search, **74**
 grasping, 978
 Grassmann, H., 278, 1046
 Graunt, J., 8
 Gravano, L., 855, 1034
 Grave, E., 852, 1049
 Graves, A., 779, 784, 787, 790, 820, 822, 849, 1055, 1064
 Grayson, C. J., 535, 1046
 Greaves, M., 1010, 1034
 Greece, 247, 340
 Green, B., 853, 1046
 Green, C., 20, 278, 309, 311, 1046
 Green, P., 924, 1038
 Green, S., 822, 1036
 Green, T., 787, 1049
 Greenbaum, S., 853, 1059
 Greenspan, M., 179, 1052
 Greiner, R., 747, 1039
 Grenager, T., 648, 1061
 Gribkoff, E., 527, 1046
 grid search, **671**
 Griffiths, T. L., 118, 143, 278, 560, 598, 1046, 1056, 1059, 1063
 Grinstead, C., 410, 1046
 Grisel, O., 720, 1058
 GRL (robot control language), 980
 Grosz, B. J., 27, 637, 649, 1046, 1048
 grounding, **216**, **506**
 ground resolution theorem, **228**, 303
 ground term, **261**, 280
 ground truth, **653**
 Grove, A., 410, 559, 1035
 Grove, W., 338, 1046
 Gruber, T., 316, 340, 1046
 Grumberg, O., 381, 1040
 GSAT (satisfiability algorithm), 249
 Gu, J., 206, 248, 1046, 1062
 Guan, M. Y., 787, 1058
 Guard, J., 313, 1046
 Guestrin, C., 561, 597, 647, 718, 719, 822, 1039, 1046, 1051, 1054, 1059
 Guez, A., 19, 27, 30, 155, 174, 176–178, 820, 1061
 Gugger, S., 720, 1048
 Guha, R. V., 316, 339, 1038, 1052
 Guibas, L. J., 457, 978, 1046, 1064
 guided missile, 987
 Guiver, J., 526, 1046
 Guizzo, E., 29, 1034
 Gulcehre, C., 786, 1041
 Gulshan, V., 30, 1046
 Gunkel, D. J., 1011, 1046
 Gunning, D., 1010, 1046
 Guo, C., 1009, 1046
 Guo, J., 458, 527, 747, 1039
 Gupta, A., 561, 979, 1051, 1058
 Gupta, R., 877, 1059
 Gupta, V., 30, 1053
 Gururangan, S., 877, 1046
 Gustafsson, F., 498, 1047
 Guterres, A., 988
 Guthrie, F., 204
 Guugu Yimithirr, 253
 Guyon, I., 26, 718, 719, 786, 922, 1037, 1046, 1052
-
- ## H
-
- \mathcal{H} (hypothesis space), 653
 H (entropy), **661**, 662
 h (heuristic function), 84
 h_{MAP} (MAP hypothesis), 723
 HACKER (planning system), 380
 Hacking, I., 411, 1046
 Hadfield-Menell, D., 62, 561, 597, 648, 821, 1046, 1054
 Hager, G., 27, 1063
 Hahn, M., 718, 1040
 Hahnel, D., 977, 1038
 Haider, M., 719, 1045
 Hailperin, T., 524, 1046
 Haimes, M., 527, 1055
 Hajic, J., 839, 1057
 Hajishirzi, H., 880, 1061
 Haken, W., 204, 1034
 HAL 9000 computer, 454, 985, 1007
 Hald, A., 411, 1046
 Hales, T., 313, 1046
 Halevy, A., 26, 311, 340, 719, 850, 855, 1038, 1046
 Halgren, E., 253, 1060
 Hall, L. O., 707, 995, 1039
 Halpern, J. Y., 278, 341, 410, 524, 1035, 1043, 1046
 halting problem, 282
 Hamilton, A., 850
 Hamiltonian Monte Carlo, 527
 Hamm, F., 340, 1064
 Hammersley, J. M., 821, 1047
 Hamming distance, **688**
 Hamori, S., 498, 1036
 ham sandwich, 848
 Han, J., 720, 1047
 Han, X., 11, 1047
 Hanan, S., 381, 1043
 Hand, D. J., 990, 1037
 hand-tuning, **671**
 Handschin, J. E., 498, 1047
 Handscomb, D. C., 821, 1047
 Hanks, S., 383, 1043
 Hannun, A., 1009, 1046
 Hans, A., 821, 1047
 Hansen, E., 109, 144, 371, 383, 597, 1047, 1067
 Hansen, M. O., 205, 1034
 Hansen, P., 248, 1047
 Hanski, I., 62, 1047
 Hansson, O., 109, 1047
 happy graph, 661
 haptics, **978**

- Harabagi, S. M., 854, 1057
 Harada, D., 596, 1056
 Haralick, R. M., 205, 1047
 Hardin, G., 649, 1002, 1047
 Hardt, M., 716, 1009, 1043, 1047, 1053, 1067
 Harel, D., 311, 1039
 Harman, D., 850, 1034
 Harnish, R., 30, 1042
 HARP (speech recognition system), 142
 Harris, T., 1015, 1047
 Harris, Z., 851, 1047
 Harrison, J., 313, 559, 1046, 1047
 Harrison, M. A., 853, 1046
 Harrow, A. W., 1018, 1047
 Harsanyi, J., 561, 647, 1047
 Harshman, R. A., 852, 878, 1042
 Hart, P. E., 107, 144, 382, 383, 410, 720, 747, 749, 1042–1044, 1047
 Hart, T. P., 175, 1047
 Hartley, H., 748, 1047
 Hartley, R., 923, 924, 1047
 Harutyunyan, A., 821, 1056
 Harvard, 539
 Harvey Mudd University, 994
 Hashimoto, K., 1021, 1047
 Haslum, P., 380, 381, 383, 1047
 Hassabis, D., 19, 27, 30, 31, 176–179, 820, 822, 1036, 1055, 1061, 1064
 Hassidim, A., 1018, 1047
 Hastie, T., 717, 718, 720, 749, 1044, 1047, 1049
 Hastings, W. K., 457, 1047
 Hatem, M., 108, 1038, 1047
 Haugeland, J., 1007, 1047
 Haussler, D., 498, 717, 1037, 1051
 Havelund, K., 309, 1047
 Havenstein, H., 26, 1047
 Hawking, S., 33
 Hawkins, J., 785, 1047
 Hay, N., 597, 1019, 1047
 Hayes, P. J., 249, 340–342, 1006, 1044, 1047, 1054
 Hays, J., 26, 1047
 He, H., 707, 995, 1047
 He, K., 786, 1047, 1066
 He, Y., 822, 1045
 head (in NLP), **841**
 head (of Horn clause), **230**
 Heafield, K., 852, 1038
 Hearst, M. A., 852, 1060
 Heath, M., 716, 1046
 Heath Robinson, 14
 heavy-tailed distribution, **142**
 Heawood, P. J., 983, 1047
 Hebb, D. O., 17, 21, 819, 1047
 Hebbian learning, **17**
 Hebert, M., 817, 923, 963, 979, 1048, 1050, 1067
 Heckerman, D., 455, 459, 498, 747, 1038, 1047, 1048, 1062
 Hedau, V., 914, 1050
 hedonic calculus, **558**
 Heess, N., 979, 1047, 1053
 Heidari, H., 1009, 1036
 Heidegger, M., 1006, 1047
 Heinlein, R. A., 1020, 1047
 Heitz, G., 316, 1042
 Held, M., 109, 1047
 Hellmann, S., 339, 1052
 Helmert, M., 107, 380, 381, 1047, 1059, 1061
 Helmholtz, H., 12, 920
 Hempel, C., 7
 Henaff, M., 786, 1039
 Hendebay, G., 498, 1047
 Henderson, P., 820, 1044
 Henderson, T. C., 205, 1055
 Hendler, J., 339, 382, 384, 1034, 1036, 1043, 1062
 Henrion, M., 62, 421, 455, 457, 559, 1047, 1048, 1058
 Henry, H., 822, 1049
 Henzinger, M., 854, 1062
 Henzinger, T. A., 61, 1047
 Hephaistos, 975
 Herbrand's theorem, **304**, 310
 Herbrand, J., 282, 304, 310, 1047
 Herbrand base, **304**
 Herbrand universe, **303**, 310
 Herbrich, R., 526, 1047
 Herbster, M., 1018, 1042
 Herden, G., 558, 1036
 Hernandez, D., 15, 1018, 1034
 Hernández-Orallo, J., 1007, 1047
 Herring, R., 498, 1048
 Herskovits, E., 747, 1040
 Hertz, J. A., 787, 1051
 Hess, C., 1010, 1047
 Hessian, **121**
 Hestness, J., 855, 1039
 Heule, M., 249, 1036
 heuristic, 105
 admissible, **86**, 353
 composite, 100
 degree, **193**, 205, 234
 for planning, 353–356
 function, **84**, 97–104
 inadmissible, 89
 least-constraining-value, **193**
 Manhattan, **98**
 min-conflicts, **197**
 minimum remaining values, **193**, 205, 290, 378
 null move, **176**
 search, 107
 straight-line, 85
 heuristic function, **84**
 Heuristic Programming Project (HPP), 23
 Hewitt, C., 311, 646, 1047
 hexapod robot, 968
 Hezaveh, Y. D., 652, 1047
 hidden Markov model (HMM), 25, 461, **473**, 473–478, 485, 497, 744, 830
 hidden variable, **425**, 737
 HIERARCHICAL-SEARCH, **359**
 hierarchical decomposition, **357**
 hierarchical look-ahead, **365**
 hierarchical reinforcement learning, **807**, 1014
 hierarchical structure, 1014
 hierarchical task network (HTN), **357**, 379, 807
 Hierholzer, C., 144, 1047
 high-level action, **357**
 higher-order logic, **255**
 Hilbert, M., 719, 1047
 Hilgard, E. R., 819, 1047
 Hill, F., 879, 880, 1065
 HILL-CLIMBING, **111**
 hill climbing, **111**, 141
 first-choice, **113**
 random-restart, **113**
 stochastic, **113**
 Hind, M., 995, 996, 1009, 1010, 1036, 1047
 Hingorani, S. L., 526, 1040
 Hinrichs, T., 179, 1053
 Hinrichs, T. R., 339, 1044
 Hintikka, J., 340, 1047
 Hinton, G. E., 17, 26, 118, 143, 718, 785–788, 821, 849, 854, 922, 1021, 1035, 1041, 1047, 1048, 1051, 1052, 1056, 1060–1062
 HIPAA, 990
 Hipp, J. D., 30, 1053, 1062
 Hirschberg, J., 27, 1063
 Hirth, M., 1017, 1048
 Hitachi, 359
 HMM (hidden Markov model), 25, 461, **473**, 473–478, 485, 497, 744, 830
 Ho, J., 822, 978, 1044, 1061
 Ho, M. K., 821, 1048
 Ho, T. K., 718, 719, 1046, 1048
 Ho, Y.-C., 785, 1038
 Hoane, A. J., 176, 1038
 Hobbes, T., 6
 Hobbs, J. R., 341, 343, 853, 1046, 1048
 Hochreiter, S., 787, 1048
 Hodges, J. L., 717, 1044
 Hoff, M. E., 21, 819, 1065
 Hoffman, G., 979, 1063
 Hoffman, M., 458, 526, 527, 747, 852, 1039, 1048, 1064
 Hoffman, S. C., 996, 1009, 1036
 Hoffmann, J., 354, 356, 380–383, 1048
 Hofleitner, A., 498, 1048

- Hofmann-Wellenhof, R., 30, *1053*
Hogan, N., 978, *1048*
Hoiem, D., 914, 923, *1048, 1050*
Holenstein, R., 499, *1034*
Holland, J. H., 143, *1048, 1055*
Hollerbach, J. M., 978, *1043*
Holte, R. C., 88, 96, 108, 109, 647, *1034, 1036, 1039, 1043, 1048, 1052*
Holzmann, G. J., 309, *1048*
Homan, K. A., 1013, *1051*
homeostatic, **16**
Homo sapiens, 1, 823
Hood, A., 11, *1048*
Hooker, J., 207, *1048*
Hoos, H. H., 142, 206, 559, 719, *1037, 1048, 1064*
Hopcroft, J., 720, 977, *1037, 1061*
Hopfield, J. J., 788, *1048*
Hopfield network, **788**
Hopkins Beast, 976
HORIZON (reinforcement learning platform), 822
horizon, 883
 infinite, 596
horizon (in MDPs), **565**
horizon effect, **158**
Horn, A., 248, *1048*
Horn, B. K. P., 923, *1048*
Horn, K. V., 410, *1048*
Horn, W., 316, *1042*
Horn clause, **229**
Horn form, 247, 248
Horning, J. J., *1048*
Horowitz, M., 250, *1057*
Horrocks, J. C., 410, *1041*
Horsfall, P., 526, *1036*
Horswill, I., 980, *1048*
Horvitz, E. J., 62, 455, 498, 559, 1019, *1048, 1057*
Hoseini, S. S., 143, *1045*
Hoßfeld, T., 1017, *1048*
Hotelling, H., 787, *1048*
Houde, S., 996, 1009, *1036*
HOUDINI (chess program), 176
Houlsby, N., 719, *1066*
Houston, M., 30, *1052*
Hovel, D., 455, *1048*
Howard, J., 716, 720, 879, *1048, 1054*
Howard, R. A., 544, 558–560, 596, *1048, 1055*
Howe, A., 344, 380, *1045*
Howe, D., 313, *1048*
Howe, P., 719, 1009, *1055*
Howson, C., 524, *1048*
HPP (Heuristic Programming Project), 23
Hruschka, E., 850, *1055*
HSCP (planning system), 382
Hsiao, K., 598, *1048*
Hsieh, H.-P., 718, *1066*
HSP (Heuristic Search Planner), 380
Hsu, D., 598, 716, *1035, 1036*
Hsu, F.-H., 176, *1038, 1048*
Hsueh, C.-H., 176, *1065*
HTML, 840
HTN (hierarchical task network), **357**, 379, 807
Hu, H., 877, *1039*
Hu, J., 597, 648, *1039, 1048*
Hu, Y.-T., 916, *1042*
Hua, Y., 1009, *1035*
Huang, A., 19, 27, 30, 176, 177, *1061*
Huang, L., 845, 853, 854, *1045, 1067*
Huang, S., 30, *1053*
Huang, T., 498, 525, 598, *1044, 1048*
Huang, X., 29, *1066*
Huang, Y., 787, *1059*
Huang, Z., 786, *1060*
Hubble Space Telescope, 183, 197, 384
Hubel, D. H., 786, 922, 924, *1048*
Huber, M., 976, *1040*
Hubert, T., 27, 30, 155, 174, 177, 178, 820, *1061*
Huddleston, R. D., 853, *1048*
Huet, G., 312, *1036*
Huffman, D. A., 20, *1048*
Huffman, S., 976, *1040*
Hughes, B. D., 138, *1048*
Hughes, G. E., 340, *1048*
Hughes, M., 850, *1039*
HUGIN (Bayes net system), 456, 498
Huhns, M. N., 62, *1048*
Hui, F., 27, 30, *1061*
human–computer interaction, 14
human–robot interaction, 964, 979
human-level AI, **32**
human actions, 979
human judgment, 538
human performance, 1
Hume, D., 6, *1048*
Humphrys, M., 984, *1048*
Hungarian algorithm, **517**
Hunkapiller, T., 498, *1035*
Hunsberger, L., 637, 649, *1048*
Hunt, J. J., 979, *1053*
Hunt, W., 312, *1048*
Hunter, L., 748, *1048*
Huq, A., 1009, *1040*
Hur, C.-K., 527, *1048*
Hurst, M., 855, *1048*
Hurst, S., 820, *1060*
Hurwicz, L., 649, *1048*
Hussein, A. I., 682, 684, *1050*
Hut, P., 30
Hutchinson, B., 995, *1055*
Hutchinson, S., 61, 978, 980, *1039*
Huth, M., 279, *1048*
Huttenlocher, D., 922, *1048*
Hutter, F., 381, 719, 787, *1043, 1048, 1061, 1064*
Huygens, C., 408, 647, *1049*
Huyn, N., 107, *1049*
Huynh, V. A., 598, *1049*
Hwa, R., 853, *1049*
Hwang, C. H., 339, *1049*
Hyafil, L., 716, *1049*
HYBRID-WUMPUS-AGENT, **242**
hybrid A*, **946**
hyperbolic reward, **598**
hyperparameter, **666, 730**
hypertext, 14
hypertree width, 207
hypothesis, 651, 653
 approximately correct, 673
 null, **663**
 prior, **722**
 space, **653**
Hyun, S., 977, *1041*
-
- I**
- i.i.d. (independent and identically distributed), **665, 722**
Iagnemma, K., 977, *1038*
Iatauro, M., 29, *1035*
IBAL (probabilistic programming language), 526
Ibarz, J., 769, 978, 979, *1037, 1046, 1052*
IBM, 19, 1008, 1017
identifiability, **743**
identification in the limit, 716
identity matrix (**I**), **1026**
identity uncertainty, **507**
idiot Bayes, 402
IEEE P7001, 997
Ieong, S., 648, *1049*
ignorance, **386**
ignore-delete-lists heuristic, **354**
ignore-preconditions heuristic, **353**
Iida, H., 176, *1060*
III, H. D., 995, *1045*
IJCAI (International Joint Conference on AI), 35, 109
ILOG (constraint logic programming system), 312
ILQR (iterative LQR), **955, 975, 978**
image, **882**
 formation, 882–888
 segmentation, 894–895
image captioning, 30
ImageNet, **705**
ImageNet (image data set), 25, 26, 28, 896, 1020
image transformation, **913**
IMDB, 991
imitation learning, **813, 966**
imperfect information, 174, 618, **619**

- implementation (of a high-level action),
357
- implementation level, 210
- implication, 217
- implicative normal form, 299
- implicit model, 780
- importance sampling, 439
adaptive, 457
sequential, 491
- imputation, 627
- inadmissible heuristic, 89, 90
- incentive, 601
- incentive compatible, 635
- inclusion–exclusion principle, 393
- Inclusive Images Competition, 995
- income inequality, 987, 1000
- incomplete information game, 961
- incompleteness, 296
theorem, 9, 305, 983
- incremental search, 141
- independence, 398, 397–399, 401, 407
absolute, 398, 401
conditional, 401, 406, 408, 415,
418–427, 454, 469
context-specific, 420
marginal, 398
- independent subproblems, 199
- indexical, 846
- indexing, 284, 284–286
- India, 16, 204, 338
- indicator variable, 740
- indifference, principle of, 409
- individually rational offer, 643
- individual rationality, 627
- individuation, 321
- induced width, 206
- induction, 6, 652
mathematical, 9
- inductive learning, 653–656, 715
- inductive logic, 410
- Induráin, E., 558, 1036
- Indyk, P., 717, 1034, 1045
- inference, 209
probabilistic, 395, 395–397, 412
- inference by enumeration, 427
- inference procedure, 273
- inference rule, 223, 247
- inferential frame problem, 239, 250
- infinite branching factor, 119
- infinite horizon, 596
- influence diagram, 454, 528, 544, 544,
544–547, 557
- INFORMATION-GATHERING-AGENT,
551
- information extraction, 850
- information gain, 662, 663, 957
- information gain ratio, 665
- information gathering, 41, 956
- information retrieval (IR), 850, 854
- information set, 620
- information theory, 661–662, 715
- information value, 547, 560
- informed search, 63, 84, 84–105
- Ingerman, P. Z., 852, 1049
- Ingham, M., 249, 1065
- inheritance, 317, 329
multiple, 330
- initial state, 65, 68, 105, 147, 345
- initial state model, 464
- input gate (in LSTM), 775
- input resolution, 308
- inside–outside algorithm, 840
- instance (of a schema), 117
- instance-based learning, 686, 686–688
- instant runoff voting, 640
- insurance premium, 535
- integrated information theory, 1007
- intelligence, 1, 36
- intelligence augmentation, 14
- intelligent backtracking, 195–197, 234
- interior-point method, 143
- interleaved execution, 602
- interleaving, 134, 194, 380
- internal state, 51
- International Joint Conference on AI
(IJCAI), 35, 109
- interpolation (of data), 668
- interpolation smoothing, 851
- interpretability, 711, 719
- interpretation, 258, 277
extended, 261, 277
intended, 258
- interval, 324–325
- Intille, S., 498, 1049
- intractability, 21
- intrinsic property, 322
- introspection, 2, 13
- invariance, temporal, 760
- inverse (of a matrix), 1026
- inverse dynamics, 951
- inverse kinematics, 940
- inverse reinforcement learning, 813,
1003, 1014
- inverted pendulum, 816
- Ioffe, S., 786, 1049
- IPL (programming language), 18
- IQ test, 20
- IR (information retrieval), 850, 854
- Irpan, A., 784, 820, 978, 1037, 1049
- irrationality, 1, 531, 560
- irreversible action, 136, 799
- Irving, G., 312, 1034, 1053
- IS-A links, 341
- Isard, M., 498, 1049
- Isbell, C., 341, 1014, 1053
- ISBN, 507
- Isele, R., 339, 1052
- ISIS (planning system), 383
- Islam, R., 820, 1044
- Isola, P., 879, 914, 915, 1049, 1067
- iterated best response, 610
- iterated game, 614
- ITERATIVE-DEEPENING-SEARCH, 81
- iterative deepening search, 80, 80–82,
105, 107, 155, 158, 358
- iterative expansion, 108
- iterative LQR (ILQR), 955, 975, 978
- Ivanov, V., 992, 1037
- Iwasawa, S., 1006, 1058
- iWeb (language corpus), 825
- IxTeT (planning system), 383
- Iyyer, M., 879, 1058

J

- Jaakkola, T., 458, 787, 1049, 1060
- Jabbari, S., 1009, 1036
- JACK (bridge program), 178
- Jackel, L., 26, 786, 922, 1052
- Jackson, C., 525, 747, 1054
- Jacobi, C. G., 526
- Jacobs, D., 907, 1050
- Jacobson, D. H., 978, 1049
- Jacquard, J., 15
- Jacquard loom, 15
- Jaderberg, M., 30, 179, 787, 1049
- Jaffar, J., 312, 1049
- Jaggi, M., 787, 1066
- Jaguar, 383
- Jain, A., 30, 854, 872, 1053, 1057, 1064
- Jain, B., 822, 1060
- Jain, D., 525, 1049
- Jaitly, N., 849, 854, 1039, 1048
- Jakob, M., 339, 1052
- James, G., 720, 1049
- James, W., 13
- janitorial science, 39
- Jankowiak, M., 526, 1036
- Janz, D., 719, 1062
- Janzing, D., 458, 1058
- Japan, 23, 976
- Jarrett, K., 786, 1049
- Jasra, A., 499, 1042
- Jastrzebski, S., 716, 1035
- Jaumard, B., 248, 1047
- Jauvin, C., 878, 1036
- Jaynes, E. T., 394, 409–411, 1049
- Jeffrey, R. C., 409, 558, 1049
- Jeffreys, H., 851, 1049
- Jelinek, F., 851, 855, 880, 1038, 1049
- Jenkin, M., 980, 1043
- Jenkins, G., 497, 787, 1037
- Jenkins, N. W., 30, 1042
- Jennings, H. S., 13, 1049
- Jennings, N. R., 648, 1059
- Jenniskens, P., 372, 1049

- Jensen, F., 455, 456, 560, *1034*, *1042*, *1056*
 Jensen, F. V., 455, 456, 460, *1034*, *1049*
 Jentzsch, A., 339, *1052*
 Jeopardy, 26, 30
 Jevons, W. S., 248
 Ji, Z., 1009, *1049*
 Jiang, H., 994, *1049*
 Jiang, K., 979, *1034*
 Jiao, J., 787, *1067*
 Jie, K., 30
 Jimenez, P., 144, 383, *1049*
 Joachims, T., 718, 852, *1049*
 job, **375**, 1000
 Job, J., 1018, *1056*
 job-shop scheduling problem, **375**
 Johansen, A. M., 499, *1042*
 Johanson, M., 30, 178, 647, *1037*, *1056*, *1067*
 Johnson, C. R., 62, *1038*
 Johnson, D. S., 1025, 1029, *1045*
 Johnson, I., 719, *1065*
 Johnson, J., 1018, *1064*
 Johnson, M., 850, 853, 854, 1006, *1039*, *1043*, *1049*, *1052*
 Johnson, S. M., 581, 597, *1037*
 Johnson, W. W., 106, *1049*
 Johnston, M. D., 142, 206, 384, *1049*, *1055*
 joint action, **603**
 joint agent, **964**
 joint probability distribution, **392**
 full, **393**, 407, 412, 414–418
 join tree, **434**
 Jonathan, P. J. Y., 984, *1049*
 Jones, D. M., 597, *1045*
 Jones, G., 458, *1038*
 Jones, L., 850, 868, 880, *1039*, *1064*
 Jones, M., 560, 922, *1049*, *1064*
 Jones, R., 855, *1049*
 Jones, R. M., 311, *1049*, *1066*
 Jones, T., 61, *1049*
 Jonsson, A., 29, 383, *1049*
 Jordan, M., 821, *1061*
 Jordan, M. I., 458, 498, 499, 598, 728, 748, 786, 787, 812, 817, 821, 845, 852, 979, *1037*, *1049*, *1053*, *1056*, *1060–1062*, *1065*
 Joseph, A. D., 1010, *1035*
 Joshi, M., 876, 879, *1053*
 Jouannaud, J.-P., 312, *1049*
 Joulin, A., 852, *1049*
 Jouppi, N. P., 1018, *1049*
 Joy, B., 1010, *1049*
 Jozefowicz, R., 787, 878, 959, 979, *1034*, *1049*
 Juang, B.-H., 497, *1059*
 Judah, K., 561, *1043*
 Juels, A., 143, 1009, *1049*, *1064*
 Julesz, B., 921, *1049*
 Julian, K. D., 598, *1049*
 Juliani, A., 822, *1049*
 Jung, M. W., 822, *1052*
 Junker, U., 312, *1049*
 Jurafsky, D., 840, 849, 852, 855, *1049*, *1062*
 Just, M. A., 253, *1055*
 justification (in a JTMS), **336**
-
- K**
-
- k-anonymity, **991**
 k-consistency, **188**
 k-DL (decision list), 675
 k-DT (decision tree), 675
 k-d tree, **688**
 k-fold cross-validation, **666**
 Kaack, L. H., 30, *1059*
 Kadane, J. B., 561, 647, *1049*
 Kaden, Z., 822, *1045*
 Kadian, A., 822, *1060*
 Kaelbling, L. P., 249, 498, 527, 596–598, 977, *1039*, *1041*, *1048*, *1049*, *1053*, *1055*, *1061*, *1063*
 Kager, R., 851, *1049*
 Kaggle, 698
 Kahn, H., 457, 821, *1049*
 Kahneman, D., 418, 538, 560, *1049*, *1064*
 Kaindl, H., 109, *1049*
 Kaiser, L., 850, 868, 877, 879, 880, *1050*, *1064*
 Kalakrishnan, M., 978, *1037*
 Kalchbrenner, N., 779, 787, 849, *1064*
 Kale, A. U., 30, *1053*
 Kaliszzyk, C., 312, 313, *1046*, *1053*
 Kalman, R., 479, 497, *1050*
 Kalman filter, 461, **479**, 479–485, 497, 935
 extended (EKF), **483**, 935
 switching, **484**
 Kalman gain matrix, **483**
 Kalra, N., 142, *1042*
 Kalyanakrishnan, S., 27, *1063*
 Kalyanpur, A. A., 30, *1043*
 Kamar, E., 27, *1063*
 Kamber, M., 720, *1047*
 Kambhampati, S., 144, 381–384, *1038*, *1040*, *1042*, *1050*
 Kameya, Y., 525, *1060*
 Kaminka, G., 649, *1063*
 Kan, A., 107, 377, 384, *1052*
 Kanada, K., 30, *1053*
 Kanade, T., 28, 922, 923, *1050*, *1060*, *1064*
 Kanal, E., 990, *1050*
 Kanal, L. N., 108, *1051*
 Kanazawa, A., 907, 913, *1050*
 Kanazawa, K., 498, 596, 598, 748, *1036*, *1041*, *1044*, *1050*, *1060*
 Kanefsky, B., 206, *1039*
 Kang, S. M., 1013, *1050*
 Kannan, A., 849, *1039*
 Kannan, K., 996, 1009, *1036*
 Kannan, R., 720, *1037*
 Kanodia, N., 597, *1046*
 Kanoui, H., 278, 311, *1040*
 Kanoulas, E., 850, *1034*
 Kant, E., 311, *1038*
 Kant, I., 8
 Kanter, J. M., 719, *1050*
 Kantor, G., 61, 978, 980, *1039*
 Kantorovich, L. V., 143, *1050*
 Kanwal, M. S., 716, *1035*
 Kaplan, D., 341, *1050*
 Kaplan, H., 108, *1045*
 Kaplow, R., 598, *1061*
 Karaboga, D., 142, *1050*
 Karafiát, M., 878, 879, *1055*
 Karaletsos, T., 526, *1036*
 Karamchandani, A., 457, *1050*
 Karlin, S., 581, 597, *1037*
 Karlsson, R., 498, *1047*
 Karmarkar, N., 143, *1050*
 Karmiloff-Smith, A., 854, *1043*
 Karp, R. M., 9, 107, 109, 1029, *1047*, *1050*
 Karpas, E., 381, *1047*
 Karpathy, A., 786, 862, 879, *1050*, *1060*
 Karpatne, A., 720, *1063*
 Karras, T., 780, *1050*
 Karsch, K., 914, *1050*
 Kartam, N. A., 383, *1050*
 Kasami, T., 835, 853, *1050*
 Kasif, S., 456, *1067*
 Kasparov, G., viii, 30, 176
 Kassirer, J. P., 410, *1046*
 Kataoka, T., 786, *1055*
 Katehakis, M. N., 597, *1050*
 Katriel, I., 205, *1064*
 Katz, B., 850, *1050*
 Katz, S., 207, *1040*
 Kaufmann, M., 313, *1050*
 Kautz, D., 384, *1041*
 Kautz, H., 142, 206, 248, 249, 381, 456, *1046*, *1050*, *1060*, *1061*
 Kautz, J., 879, *1053*
 Kavradi, L., 61, 978, 980, *1039*, *1050*
 Kavukcuoglu, K., 779, 784, 786, 787, 790, 820, 822, 849, *1049*, *1053*, *1055*, *1064*
 Kawczynski, M. G., 30, *1042*
 Kay, A. R., 11, *1057*
 Kaynama, S., 821, *1034*
 Kazemi, S. M., 527, *1050*
 KB (knowledge base), **209**, 246
 KB-AGENT, **209**
 Keane, M. A., 143, *1051*

- Keane, P. A., 30, *1053*
 Kearns, M., 597, 598, 717, 718, 720, 820, 1009, *1036*, *1050*
 Kebeasy, R. M., 682, 684, *1050*
 Kedzier, D., 820, *1060*
 Keeney, R. L., 539, 544, 559, 560, *1050*
 keepaway, **808**
 Kegelmeyer, W. P., 707, 995, *1039*
 Keil, F. C., 3, 1007, *1065*
 Kelcey, M., 978, *1037*
 Kelley, H. J., 22, 785, *1050*
 Kelly, J., 649, 747, 748, *1038*, *1039*
 Kelly, K., 1005
 Kembhavi, A., 880, *1061*
 Kemp, C., 560, *1046*
 Kemp, M., 920, *1050*
 Kempe, A. B., 983, *1050*
 Kenley, C. R., 455, *1061*
 Kephart, J. O., 61, *1050*
 Kepler, J., 920
 Keras (machine learning software), 720, 1021
 Kern, C., 30, *1053*
 kernel (in neural networks), **760**
 kernel (in regression), 691
 kernel function, **694**, 736
 kernelization, **696**
 kernel machine, 692–696, 717
 kernel trick, 692, **695**, 717
 Kernighan, B. W., 107, *1053*
 Kersting, K., 525, 527, *1050*, *1055*
 Keskar, N. S., 880, *1050*
 keyframe, **968**
 Keynes, J. M., 409, 998, *1050*
 key vector (in transformers), **869**
 Khairy, K., 716, *1054*
 Khanna, R., 719, *1050*
 Khare, R., 339, *1050*
 Khatib, O., 978, 980, *1050*, *1059*, *1061*
 Khorsand, A., 109, *1049*
 Khosla, A., 786, *1060*
 Khot, T., 850, 876, 880, 910, *1040*, *1046*
 Khudanpur, S., 878, 879, *1055*
 Kichkaylo, T., 29, *1035*
 killer move, **155**
 Kim, B., 719, *1042*, *1050*
 Kim, H. J., 817, 821, 979, *1056*
 Kim, J.-H., 982, *1050*
 Kim, J. H., 454, *1050*
 Kim, T. W., 1009, *1050*
 Kimmig, A., 527, *1050*
 Kinect, 928
 kinematic state, **951**
 kinesthetic teaching, **968**
 King, H., 820, 822, *1036*, *1055*
 Kingma, D. P., 787, *1050*
 King Midas problem, **33**, 1003
 Kingsbury, B., 849, 854, *1048*
 Kinsey, E., 106
 kinship domain, 266–268
 Kirchlechner, B., 525, *1049*
 Kirchner, C., 312, *1049*
 Kirk, D. E., 61, *1050*
 Kirk, J. T., 1007
 Kirkpatrick, S., 142, 206, *1050*
 Kirman, J., 597, *1041*
 Kiros, J. R., 786, *1035*
 Kirubarajan, T., 61, *1035*
 Kishimoto, A., 177, *1060*
 Kisiel, B., 850, *1055*
 Kisynski, J., 527, *1050*
 Kitaev, N., 853, 877, 879, *1050*
 Kitani, K. M., 817, *1050*
 Kitano, H., 976, *1050*
 Kitchin, D. E., 381, *1064*
 Kjaerulff, U., 498, *1050*
 Klarman, H. E., 559, *1050*
 Klein, D., 845, 852, 853, 877, *1050*, *1053*, *1057*
 Kleinberg, J. M., 994, 1009, *1050*
 Klemperer, P., 649, *1050*
 Klempner, G., 455, *1056*
 Kneser, R., 852, *1050*
 Knight, B., 21, *1037*
 Knoblock, C. A., 108, 344, 380, 382, *1039*, *1045*, *1050*
 KNOWITALL (information extraction system), 855
 knowledge
 acquisition, 23, **272**
 and action, 7, 326–328
 background, **209**, 302
 base (KB), **209**, 246
 commonsense, 19
 diagnostic, 400
 engineering, **271**, 271–277, 415
 level, **210**, 247
 model-based, 400
 prior, 40, 41, **652**
 knowledge-based agents, **208**
 knowledge-based system, 22–24, 819
 knowledge representation, **2**, 17, 19, 23, **208**, 251–256, 314–343
 for everything, 314
 language, **209**, 246, 251
 uncertain, 412–414
 knowledge state, 387
 Knuth, D. E., 68, 175, 249, 312, 978, *1046*, *1050*
 Ko, J., 30, *1043*
 Kober, J., 979, *1050*
 Kobilarov, G., 316, 339, *1037*
 Koch, C., 1007, *1040*, *1050*
 Kochenderfer, M. J., 598, 822, *1049*, *1051*
 Kociemba, H., 106, *1059*
 Kocsis, L., 176, 597, *1051*
 Koditschek, D., 979, *1051*
 Koehn, P., 880, *1051*
 Koelsch, S., 920, *1051*
 Koenderink, J. J., 923, *1051*
 Koenig, S., 145, 381, 383, 596, 977, *1047*, *1051*, *1062*
 Kohlberger, T., 30, *1053*
 Kohli, P., 527, *1051*
 Kolesky, D. B., 1013, *1051*, *1056*
 Kollar, T., 979, *1063*
 Koller, D., 176, 410, 455, 460, 498, 499, 525–527, 561, 597, 621, 647, 747, 748, 852, 977, *1035–1037*, *1039*, *1044*, *1046*, *1048*, *1050*, *1051*, *1055*, *1057*, *1058*, *1060*, *1063*
 Kolmogorov's axioms, **393**
 Kolmogorov, A. N., 409, 410, 497, 716, *1051*
 Kolmogorov complexity, **716**
 Kolobov, A., 526, 598, *1054*, *1055*
 Kolter, J. Z., 817, *1051*
 Koltun, V., 822, *1060*
 KOMODO (chess program), 176
 Kondrak, G., 205–207, *1051*
 Konečný, J., 992, *1051*
 Konolige, K., 206, 342, 646, 977, 978, 980, *1037*, *1038*, *1051*
 Kononova, O., 872, *1064*
 Kontokostas, D., 339, *1052*
 Koopmans, T. C., 596, *1051*
 Korb, K. B., 460, *1051*
 Koren, S., 717, *1036*
 Koren, Y., 978, *1037*
 Korf, R. E., 98, 106–109, 145, 175, 381, *1043*, *1051*, *1058*
 Kortenkamp, D., 976, *1040*
 Koss, F., 976, *1040*
 Kotthoff, L., 719, *1048*
 Koutsoupias, E., 142, 248, *1051*
 Kovacs, D. L., 380, *1051*
 Kowalski, R., 278, 294, 299, 311, 340, *1051*, *1060*
 Kowalski form, 299
 Koyama, M., 786, *1055*
 Koyejo, O. O., 719, *1050*
 Koyejo, S., 916, *1042*
 Koza, J. R., 143, *1051*
 Krakovna, V., 822, 1003, *1051*, *1052*
 Kramer, S., 525, *1050*
 Kraska, T., 311, *1051*
 Kraus, S., 27, 649, 650, *1051*, *1063*
 Kraus, W. F., 143, *1053*
 Krause, A., 561, *1051*
 Krause, J., 786, *1060*
 Krauss, P., 524, *1061*
 Krawiec, K., 143, *1062*
 Kreitmann, P., 1009, *1036*
 Kretch, K. S., 801, *1034*
 Kreuter, B., 992, *1037*
 Kriegspiel, **168**
 Krikun, M., 29, 783, 850, 865, *1066*

- Kripke, S. A., 340, *1051*
 Krishna, V., 649, *1051*
 Krishnamurthy, V., 598, *1051*
 Krishnan, A., 498, *1053*
 Krishnan, T., 748, *1055*
 Krishnanand, K., 142, *1051*
 Krizhevsky, A., 26, 786, 787, 922, 979, *1051, 1052, 1062*
 Krogh, A., 498, 787, *1051*
 Krueger, D., 716, *1035*
 Kruppa, E., 921, *1051*
 Ktesibios of Alexandria, 15
 Kübler, S., 853, *1051*
 Kuffner, J. J., 978, *1051*
 Kuhlmann, G., 822, *1063*
 Kuhn, H. W., 517, 526, 647, *1051*
 Kuipers, B. J., 342, 977, *1051*
 Kulkarni, T., 527, *1051*
 Kullback–Leibler divergence, **758**
 Kumar, M. P., 716, *1036*
 Kumar, P. R., 61, *1051*
 Kumar, S., 15, 850, 1018, *1051, 1066*
 Kumar, V., 108, 720, 990, *1039, 1051, 1063*
 Kumaran, D., 27, 30, 155, 174, 177, 820, 822, *1055, 1061*
 Kuniyoshi, Y., 976, *1050*
 Kuo, W.-C., 908, *1044*
 Kuppaswamy, N., 982, *1050*
 Kuprel, B., 30, *1043*
 Kurakin, A., 787, *1039*
 Kurien, J., 144, *1051*
 Kurth, T., 30, *1052*
 Kurzweil, R., 12, 1004, 1005, 1010, *1052*
 Küttler, H., 822, *1036*
 Kwok, C., 854, *1052*
-
- L**
-
- L-BFGS (optimization algorithm), 717
 label (in machine learning), **653**
 label (in plans), **125**
 Laborie, P., 384, *1052*
 Lacoste-Julien, S., 716, *1035*
 Ladkin, P., 340, *1052*
 Lafferty, J., 855, *1052*
 Lagoudakis, M. G., 647, *1046*
 Laguna, M., 142, *1045*
 Lahiri, S., 787, *1058*
 Lai, J. C., 878, *1038*
 Lai, M., 27, 30, 155, 174, 177, 820, *1061*
 Lai, T. L., 585, 597, *1052*
 Laine, S., 780, *1050*
 Laird, J., 292, 311, 382, *1049, 1052, 1066*
 Laird, N., 497, 748, *1042*
 Laird, P., 142, 206, *1055*
 Lake, B., 526, *1052*
 Lake, R., 177, *1060*
 Lakemeyer, G., 977, *1038*
 Lakoff, G., 339, 853, 1006, *1052*
 Lally, A., 30, *1043*
 Lam, J., 179, *1052*
 Lamarck, J. B., 118, *1052*
 Lample, G., 879, *1052*
 Lamure, M., 559, *1036*
 Lanctot, M., 27, 30, 155, 174, 177, 820, *1061*
 Landauer, T. K., 852, 878, *1042*
 Landhuis, E., 538, *1052*
 landmark (recognizable feature), **933**
 landmark point, **102**
 land mine, 987
 Landolin, J. M., 717, *1036*
 landscape (in state space), **110**
 Lang, J., 649, *1037*
 Langdon, W., 144, *1052, 1058*
 Lange, D., 822, *1049*
 Langton, C., 143, *1052*
 language, 833
 formal, 823
 model, **824**, 860
 in disambiguation, 848
 masked, **874**
 natural, 4, 252, 823
 processing, 17, 823–880
 source, **864**
 target, **864**
 understanding, 20, 23
 language identification, **826**
 Lao, N., 316, *1042*
 LaPaugh, A. S., 107, *1052*
 Laplace, P., 8, 408, 409, 827, 851, *1052*
 Laplace smoothing, 827
 Larkey, P. D., 647, *1049*
 Laroche, H., 672, 787, *1052, 1062*
 Larsen, B., 456, *1052*
 Larson, K., 648, *1060*
 Larson, S. C., 716, *1052*
 Laruelle, H., 383, *1045*
 Laskey, K. B., 526, 560, *1052*
 Lassez, J.-L., 312, *1049*
 Lassila, O., 339, *1036*
 late move reduction, **160**
 latent Dirichlet allocation, 852
 latent semantic indexing, 852
 latent variable, **737**
 Latham, D., 822, *1054*
 Latombe, J.-C., 383, 977–979, *1042, 1050, 1052, 1067*
 lattice theory, 313
 Laugherty, K., 853, *1046*
 Laurent, C., 849, *1067*
 Lauritzen, S., 455, 456, 558, 559, 747, 748, *1040, 1052, 1057, 1062*
 LaValle, S., 384, 978, 980, *1051, 1052*
 Lave, R. E., 598, *1060*
 Lavie, A., 853, *1060*
 Lawler, E. L., 107, 108, 377, 384, *1052*
 laws of robotics, 1007
 laws of thought, 3–4
 layer (in neural networks), **750**
 hidden, **754**
 input, 756
 mixture density, **759**
 output, **754**
 Lazanas, A., 979, *1052*
 laziness, **386**
 La Mettrie, J. O., 1001, 1006, *1052*
 La Mura, P., 559, *1052*
 LCF (Logic for Computable Functions), 278
 Le, Q. V., 29, 718, 783, 787, 849, 850, 865, 879, 880, 1021, *1041, 1058, 1059, 1061, 1063, 1066, 1067*
 Le, T. A., 457, 527, *1052*
 Leacock, C., 338, *1038*
 leak node, **421**
 Leaper, D. J., 410, *1041*
 LEARN-DECISION-TREE, **660**
 learned index structures, 311
 learning, **41**, 46, 60, 210, 217, 651, 823
 apprenticeship, 1003
 assessing performance of, 665–666
 Bayesian, 701, **722**, 722–723, 746
 Bayesian network, 734–735
 in the blocks world, 20
 in checkers, 19
 computational theory of, 672
 decision list, 674–676
 decision tree, 657–661
 deep, **26**, 698, 750–788
 element, **56**
 ensemble, **696**, 696–702
 in game playing, 815–816
 grammar, 854
 heuristics, 104
 in hidden Markov models, 744
 hidden variables, 741–743
 inductive, 653–656, 715
 instance-based, **686**, 686–688
 large-scale, **670**
 MAP, 723–724
 maximum likelihood, 725–729
 metalevel, **104**
 mixtures of Gaussians, 738–740
 naive Bayes, 727
 neural network, 17
 noise in, 663–664
 nonparametric, 686
 online, **703**, 804
 PAC, 673, 717
 parameter, **724**, 730–732
 Q, **790**, 802, 810, 925
 rate of, **678**, 795
 reinforcement, 10, 164, 595, **653**, **789**, 789–822, 979
 relational, **820**

- in the restaurant problem, 656
 in search, 103–104
 statistical, 721–724
 to search, 103
 unsupervised, **653**, 738–740
 weak, **700**
- learning curve, **661**
 Learning to Learn, 719
 least-constraining-value heuristic, **193**
 leave-one-out cross-validation (LOOCV),
666
 Lebedev, M. A., 11, *1052*
 Lecoutre, C., 207, *1052*
 LeCun, Y., 17, 26, 718, 786–788, 852,
 922, 1016, 1018, *1036*, *1039*,
1049, *1052*, *1064*, *1067*
 Lederberg, J., 22, 23, 338, *1043*, *1053*
 Ledsam, J. R., 30, *1053*
 Lee, A. X., 978, *1061*
 Lee, B. K., 920, *1060*
 Lee, C.-H., 982, *1050*
 Lee, D., 458, 527, 747, 822, *1039*, *1052*
 Lee, G. A., 11, *1067*
 Lee, J. D., 786, *1042*
 Lee, K., 30, 879, *1042*, *1053*, *1058*, *1059*
 Lee, K.-F., 1, 35, *1052*
 Lee, K.-H., 982, *1050*
 Lee, K. C., 979, *1042*
 Lee, M. S., 747, *1056*
 Lee, R. C.-T., 313, *1039*
 Lee, S.-I., 719, *1053*
 Lee, S.-W., 498, *1063*
 Lee, T.-M., 11, *1057*
 Lee, W. S., 598, *1035*
 Leech, G., 852, 853, *1052*, *1059*
 LEELAZERO (game-playing program),
 172
 Lefrancq, A., 822, 1003, *1036*, *1052*,
1063
 Legendre, A. M., 717, *1052*
 Legg, S., 820, 822, 1003, *1036*, *1052*,
1055
 Lehmann, D., 649, *1051*
 Lehmann, J., 316, 339, *1037*, *1052*
 Lehrer, J., 560, *1052*
 Lehtinen, J., 780, *1050*
 Leibniz, G. W., 6, 120, 247, 409, 647
 Leibo, J. Z., 822, *1036*
 Leighton, M. J., 108, *1038*
 Leike, J., 822, 1003, *1052*
 Leimer, H., 456, *1052*
 Leipzig, 12
 Leiserson, C. E., 107, 1029, *1040*
 Lelis, L., 109, *1052*
 Lenat, D. B., 316, 339, 646, *1052*
 lens, **884**
 Lenstra, J. K., 107, 206, 377, 384, *1034*,
1052
 Lenzerini, M., 341, *1038*
 Leonard, H. S., 340, *1052*
 Leonard, J., 977, *1037*, *1052*
 Leone, N., 207, 342, *1043*, *1046*
 Lepage, G. P., 457, *1052*
 Lerman, K., 1009, *1055*
 Lerner, U., 455, *1052*
 Lesh, N., 383, *1043*
 Leśniewski, S., 340, *1052*
 Lesser, V. R., 646, 649, *1043*, *1052*
 Letz, R., 312, *1052*
 Levasseur, L. P., 652, *1047*
 level of abstraction, **66**
 Lever, G., 30, 179, *1049*
 Levesque, H. J., 142, 249, 341, 343, 646,
1037, *1040*, *1052*, *1061*
 Leviathan, 6
 Levin, D. A., 497, *1052*
 Levine, S., 719, 790, 821, 978, 979, *1034*,
1037, *1044*, *1052*, *1060*, *1061*
 Levinstein, B., 1002, *1034*
 Levitt, R. E., 383, *1050*
 Levitt, T. S., 977, *1051*
 Levskaya, A., 877, 879, *1050*
 Levy, D., 178, 982, 1006, *1052*
 Levy, O., 876–880, *1046*, *1052*, *1053*,
1065
 Lew, A. K., 526, 527, *1040*
 Lewis, A., 142, *1055*
 Lewis, J. A., 1013, *1051*, *1056*
 Lewis, M., 876, 879, *1053*
 lexical-functional grammar (LFG), 853
 lexical category, 829
 lexicalized PCFG, **841**, 853
 lexicon, **835**, 853
 Leyton-Brown, K., 648, 650, 719, *1052*,
1061, *1064*
 Le Truong, H., 313, *1046*
 LFG (lexical-functional grammar), 853
 Li, B., 849, *1039*
 Li, C. M., 248, *1052*
 Li, D., 850, *1034*
 Li, H., 176, 786, *1042*, *1065*
 Li, K., 26, 787, *1042*, *1052*
 Li, L., 499, 527, *1043*, *1066*
 Li, L.-J., 26, *1042*
 Li, M., 717, *1053*
 Li, P., 458, 498, 527, 747, *1039*, *1053*
 Li, S., 707, 995, *1047*
 Li, T.-M., 1016, *1053*
 Li, W., 879, 978, *1053*, *1059*
 Li, X., 142, *1053*
 Li, X.-R., 61, *1035*
 Li, Y., 786, 822, 879, *1034*, *1063*
 Li, Z., 498, *1053*
 Liang, G., 455, *1039*
 Liang, J., 119, 143, *1055*
 Liang, P., 845, 880, *1053*, *1059*
 Liang, Y., 822, *1045*
 LIBBI (probabilistic programming
 language), 527
 Liberatore, P., 249, *1053*
 Libratus (poker program), 172, 178, 622
 lidar, 917
 Lidar, D., 1018, *1056*
 Liebana, D. P., 176, *1038*
 Lifchits, A., 854, *1057*
 life, value of statistical, **533**
 life insurance, 539
 Lifschitz, V., 342, 343, *1045*, *1053*, *1064*
 lifting, **283**, 282–286, 527
 in probabilistic inference, 507
 lifting lemma, 303, **306**
 light, 886–888
 ambient, **886**
 Lighthill, J., 21, *1053*
 Lighthill report, 21, 23
 likelihood, **722**
 LIKELIHOOD-WEIGHTING, **440**
 likelihood weighting, **439**, 454, 491
 Likhachev, M., 145, *1051*
 Lillicrap, T., 27, 30, 178, 979, *1047*,
1053, *1061*
 Lim, G., 316, *1062*
 LIME (explainable machine learning
 system), 712, 719
 limited rationality, **4**, 328
 limit of means, **615**
 Lin, D., 854, *1057*
 Lin, J., 850, 854, *1035*
 Lin, S., 107, 649, *1053*, *1065*
 Lin, T., 316, *1062*
 Lin, Y., 498, *1066*
 Linares López, C., 381, *1064*
 Lindley, D. V., 560, *1053*
 Lindsay, R. K., 338, *1053*
 Lindsten, F., 499, *1053*
 linear–Gaussian, **422**, 455, 479, 515, 728
 linear algebra, 1025–1026
 linear constraint, **183**
 linear function, **676**
 linearization, **935**
 linear programming, **121**, 141, 143, 183,
 572, 613
 linear quadratic regulator (LQR), **955**,
 975
 linear regression, *see* regression (in
 machine learning)
 linear resolution, **308**
 linear separability, **682**
 linear separator, 694
 linear temporal logic, **328**
 line search, **121**
 linguistics, 16–17, 823
 Linnaeus, 339
 Lipton, Z. C., 1009, *1049*
 liquid (naive physics of), 342
 Lisp, **19**, 259, 344

- lists (logical axioms for), **269**
- Lisý, V., 30, 178, *1056*
- literal (sentence), **217**
- literal, watched, 248
- Littman, M. L., 143, 341, 383, 596, 597, 648, 821, 822, 1014, *1034*, *1039*, *1048*, *1049*, *1053*, *1054*
- Lituiev, D., 30, *1042*
- Liu, B., 820, *1053*
- Liu, H., 787, 920, *1053*, *1054*
- Liu, J., 498, 499, 820, 822, *1053*, *1060*
- Liu, L. T., 1009, *1053*
- Liu, M.-Y., 879, *1053*
- Liu, P. J., 879, *1059*
- Liu, W., 747, *1039*
- Liu, X., 30, *1053*
- Liu, Y., 30, 876, 879, *1053*, *1062*
- Livescu, K., 498, *1053*
- Ljung, G. M., 497, 787, *1037*
- Lloyd, J., 719, *1062*
- Lloyd, S., 1018, 1020, *1047*, *1053*
- Lloyd, W. F., 649, *1053*
- Llull, R., 6, *1053*
- Lo, H.-Y., 718, *1066*
- LoBue, V., 801, *1034*
- local-sensing vacuum world, 130
- local beam search, **115**
- local consistency, **186**
- localist representation, **59**
- locality, **239**
- locality-sensitive hash (LSH), **689**
- localization, **133**, 476, **932**
- Markov, **977**
- locally structured system, **417**
- locally weighted regression, **691**
- local search, 110–119, 142, 206, 235–236, 247, 248
- location sensor, **928**
- Locke, J., 6
- Lockhart, E., 178, *1061*
- Loebner Prize, 1006
- Loftus, E., 253, *1053*
- log-normal distribution
- discrete, **509**
- Logemann, G., 233, 248, *1041*
- logic, 3, 214–217
- atoms, 260
- default, **334**, 338, 341
- equality in, 264
- first-order, **251**, 251–279
- inference, 280–282
- semantics, 256
- syntax, 256
- first-order (FOL), 251
- fuzzy, 214, 255, 459
- higher-order, **255**
- inductive, 410
- interpretations in, 257–259
- model preference, **334**
- models, 256–257
- nonmonotonic, 225, **333**, 333–335, 341
- notation, 3
- propositional, 208, 217–222, 246, 251
- inference, 220–236
- semantics, 218–220
- syntax, 217–218
- quantifier, 260–264
- resolution, 225–229
- sampling, 457
- temporal, **255**
- terms, 259–260
- logical agent, 386
- logical connective, 17, 217, 246, 260
- logical inference, 215, 280–313
- logically exhaustive, 386
- logical minimization, **319**
- logical omniscience, **328**
- logical piano, 248
- logical positivism, **7**
- logical reasoning, 222–237
- logicism, **3**
- logic programming, 230, 278, 294–298
- constraint, 298, 312
- probabilistic, 524
- tabled, **297**
- Logic Theorist (LT), 18, 248
- LOGISTELLO (Othello program), 160
- logistic function, **424**, 717
- logistic regression, **685**, 717, 830
- logit model, inverse, **424**
- log likelihood, **725**
- Lohia, P., 996, 1009, *1036*
- Lohn, J. D., 143, *1053*
- long-distance dependency, 846
- long-term memory, 292
- long short-term memory (LSTM), **775**, 863
- long tail, **712**
- Longuet-Higgins, H. C., 923, *1053*
- LOOCV (leave-one-out cross-validation), **666**
- Look ma, no hands, 18
- loopy belief propagation, *see* belief propagation, loopy
- Loos, S., 309, 312, *1035*, *1053*
- loosely coupled system, **603**
- Lopez, A. M., 822, *1059*
- Lopez, P., 719, *1047*
- Lopez de Segura, R., 5, *1053*
- Lopyrev, K., 880, *1059*
- Lorentz, R., 176, *1053*
- Losey, D. P., 967, *1035*
- loss function, **669**
- Lotem, A., 381, *1065*
- lottery, **530**
- standard, **533**
- Lou, J.-K., 718, *1066*
- love, 982
- Love, B. C., 560, *1049*
- Love, N., 179, *1053*
- Lovejoy, W. S., 597, 598, *1053*
- Lovelace, A., ix, 15, *1053*
- Loveland, D., 233, 248, 312, *1041*, *1053*
- low-dimensional embedding, **937**
- Lowe, D., 922, *1053*
- Löwenheim, L., 278, *1053*
- Lowerre, B. T., 142, *1053*
- lowest path cost, 65
- low impact, **1002**
- Lowrance, J. D., 459, *1060*
- Lowry, M., 309, 312, *1047*, *1053*
- Loyd, S., 106, *1053*
- Lozano-Perez, T., 598, 977–979, *1038*, *1048*, *1053*, *1065*
- LQR (linear quadratic regulator), **955**, 975
- LRTA*-AGENT, **140**
- LRTA*-COST, **140**
- LRTA*, 139, 145, 365, 580
- LSH (locality-sensitive hash), **689**
- LSTM (long short-term memory), **775**, 863
- LSVRC, 28
- LT (Logic Theorist), 18, 248
- Lu, C., 821, *1066*
- Lu, F., 977, *1053*
- Lu, P., 177, 717, *1038*, *1060*
- Lu, Y., 719, *1066*
- Luan, D., 879, *1059*
- Lubbets, A., 177, *1053*
- Luby, M., 114, 457, *1041*, *1053*
- Lucas, J. R., 983, *1053*
- Lucas, P., 410, *1053*
- Lucas, S. M., 176, *1038*
- Luce, D. R., 10, 647, *1053*
- Luddite, 998
- Luehr, N., 30, *1052*
- Lugosi, G., 718, *1039*
- Lukasiewicz, T., 524, *1053*
- Lum, K., 1009, *1043*
- LUNAR (question-answering system), 854
- Lundberg, S. M., 719, *1053*
- Lunn, D., 525, 747, *1054*
- Luo, S., 920, *1054*
- Luong, Q.-T., 923, *1043*
- Lusk, E., 313, *1066*
- Luu, C., 1009, *1036*
- Lygeros, J., 61, *1039*
- Lyman, P., 719, *1054*
- LYNA (medical diagnosis system), 30
- Lynch, K., 61, 978, 980, *1039*, *1054*

M

- MA* search, **95**, 95, 109
- Ma, S., 716, 786, *1036*, *1060*
- Maas, A. L., 817, *1067*

- MacDonald, R., 30, *1062*
 MacGlashan, J., 341, 821, 1014, *1048*,
1053
 Macherey, K., 29, 783, 850, 865, *1066*
 Macherey, W., 29, 783, 850, 865, *1039*,
1066
 Machina, M., 560, *1054*
 machine evolution, **21**
 machine learning, **2**, 4, 35, 174, **651**,
 651–980
 machine translation (MT), 849, **864**, 880
 unsupervised, **780**
 Machover, M., 279, *1036*
 Macià, N., 719, *1046*
 MacKay, D. J. C., 458, 720, *1054*, *1055*
 MacKenzie, D., 313, *1054*
 Mackworth, A. K., 61, 187, 204–206,
1054, *1058*
 Macready, W. G., 715, *1066*
 macrop (macro operator), **382**
 madaline, 785
 Madams, T., 30, *1046*
 Maddison, C. J., 19, 27, 176, 177, *1061*
 Madhavan, R., 979, *1054*
 Madigan, C. F., 206, 248, *1056*
 Madry, A., 787, *1039*
 magic set, **292**, 311
 Magnini, B., 880, *1040*
 Magron, V., 313, *1046*
 Mahadevan, S., 820, *1053*
 Mahalanobis distance, **688**
 Maharaj, T., 716, *1035*
 Mahaviracarya, 408
 Mahendiran, T., 30, *1053*
 Mahesh, A., 30, *1052*
 Maheswaran, R., 207, *1057*
 Mahlmann, T., 30, 179, *1043*
 Maier, D., 206, 311, *1035*, *1036*
 Mailath, G., 647, *1054*
 Majercik, S. M., 383, *1054*
 makespan, **375**
 Makov, U. E., 748, *1064*
 Maksymets, O., 822, *1060*
 Malave, V. L., 253, *1055*
 Malhotra, P., 990, *1054*
 Malik, D., 648, *1054*
 Malik, J., 498, 787, 822, 894, 907, 908,
 913, 921, 923, 979, *1034*, *1041*,
1044, *1045*, *1048*, *1050*, *1052*,
1054, *1060*, *1061*
 Malik, S., 206, 248, *1056*
 Malone, T. W., 1011, *1054*
 MAML (Model-Agnostic
 Meta-Learning), 719
 manager (of tasks), 633
 Manchak, D., 340, *1064*
 Mandal, S., 716, *1036*
 Mané, D., 1010, *1034*
 Maneva, E., 249, *1054*
 Manhattan distance, 100
 Manhattan heuristic, **98**
 manipulator, **926**
 Manna, Z., 278, 279, *1054*
 Manne, A. S., 596, *1054*
 Manning, C., 839, 850, 852–854, 872,
 878, 880, *1037*, *1039*, *1050*, *1054*,
1057, *1058*
 Mannion, M., 278, *1054*
 Manolios, P., 313, *1050*
 Mansinghka, V. K., 526, 527, *1040*, *1046*,
1051, *1054*, *1060*
 Mansour, Y., 597, 598, 821, 822, *1050*,
1063
 map, 708
 MAP (maximum a posteriori), **723**, 746,
 771
 mapping problem, **135**
 Marais, H., 854, *1062*
 Marbach, P., 821, *1054*
 Marcedone, A., 992, *1037*
 March, J. G., 559, *1047*
 Marcinkiewicz, M. A., 829, 852, *1054*
 Marcot, B., 456, *1058*
 Marcus, G., 560, *1054*
 Marcus, M. P., 829, 852, *1054*
 Marcus, S. I., 597, *1039*
 margin, **693**
 marginal contribution, **628**
 marginal contribution net, **630**
 marginalization, **396**
 Marin-Urias, L. F., 979, *1062*
 Marinescu, R., 457, *1054*
 Mari Aparici, C., 30, *1042*
 Markov, A., 463, 497, 851, *1054*
 Markov assumption, **463**, 497, 773
 Markov blanket, **419**, 442, 443
 Markov chain, **442**, 463, 826
 Markov chain Monte Carlo (MCMC),
441, 441–448, 454, 457, 491, 527,
 732
 decayed, **499**
 Markov decision process (MDP), 10, **563**,
 595, 597, 789
 factored, **597**
 partially observable (POMDP), **588**,
 588–595, 597
 relational, **597**
 structural estimation of, 821
 Markov game, 648
 Markov network, 456
 Markov process, **463**
 second-order, 463
 time-homogeneous, 463–465, 496
 Markov property, 471, 496, 563
 Markov reward process, **581**
 Marler, R. T., 119, *1054*
 Maron, M. E., 410, *1054*
 Márquez, L., 852, *1054*
 Marr, D., 786, 924, *1054*
 Marriott, K., 205, *1054*
 Marris, L., 30, 179, *1049*
 Mars Exploration Rover, ix
 Marshall, A. W., 821, *1049*
 Marshall, P. J., 652, *1047*
 Marsland, S., 720, *1054*
 Martelli, A., 107, 144, *1054*
 Marthi, B., 382, 499, 512, 525, 526, 822,
1054, *1055*, *1057*
 Martic, M., 822, 1003, *1052*
 Martin, D., 921, *1054*
 Martin, F. G., 1000, *1054*
 Martin, J. H., 849, 852, 853, 855, *1049*,
1054
 Martin, N., 311, *1038*
 Martin, S., 70, *1036*
 Martino, J., 996, 1009, *1036*
 Marx, G., 847
 masked language model (MLM), **874**
 Maskell, S., 499, *1035*
 Maskin, E., 649, *1041*
 Mason, M., 144, 382, 978–980, *1043*,
1053, *1054*
 Mason, R. A., 253, *1055*
 mass noun, **322**
 mass spectrometer, 22
 Mataric, M. J., 980, *1054*
 matching pennies, **609**
 Mateescu, R., 207, 456, *1041*
 Mateis, C., 342, *1043*
 Matena, M., 879, *1059*
 materialism, 6
 material science, 872
 material value, **157**
 Materzynska, J., 822, *1059*
 Mates, B., 247, *1054*
 mathematical induction schema, 305
 mathematics, history of, 8–9
 Matheson, J. E., 544, 558, 560, *1048*,
1055
 Matheson, M., 30, *1052*
 Mathieu, M., 30, 179, 786, 1018, *1039*,
1064
 matrix, **1026**
 matrix form, 474
 Matsubara, H., 176, *1044*
 Mattar, M., 822, *1049*
 Matuszek, C., 339, *1054*
 Mauchly, J., 14
 Mausam., 384, 598, *1040*, *1054*
 MAVEN (Scrabble program), 179
 MAX-VALUE, **150**, **154**
 maximin, **611**
 maximin equilibrium, **613**
 maximum
 global, **111**
 local, **112**

- maximum a posteriori (MAP), **723**, 746, 771
 maximum expected utility (MEU), **387**, 529, 575
 maximum likelihood, **724**, 725–729, 746
 maximum margin separator, 692, **693**
 maximum mean discrepancy, 719
 max norm, **574**
 Maxwell, J., 16, 408, 920, *1054*
 Mayer, A., 109, *1047*
 Mayer, J., 716, *1054*
 Mayne, D. Q., 498, 978, *1047*, *1049*
 Mayor, A., 1006, *1054*
 Maziarz, K., 718, 1021, *1061*
 MBP (planning system), 383
 McAfee, A., 1011, *1038*
 McAleer, S., 106, *1034*
 McAllester, D. A., 25, 144, 175, 206, 342, 380, 381, 526, 821, 822, 838, *1034*, *1043*, *1050*, *1051*, *1054*, *1063*
 McArthur, N., 1006, *1041*
 MCC (Microelectronics and Computer Technology Corporation), 23
 McCallum, A., 527, 854, 855, *1040*, *1044*, *1049*, *1052*, *1054*, *1058*, *1063*
 McCann, B., 880, *1050*
 McCarthy, J., 17, 18, 32, 60, 247, 249, 278, 317, 341, 381, *1054*
 McCawley, J. D., 853, *1054*
 McClelland, J. L., 24, 785, *1060*
 McClure, M., 498, *1035*
 McCorduck, P., 1007, *1054*
 McCulloch, W. S., 16, 17, 20, 249, 750, 785, *1054*
 McCune, W., 308, 313, *1054*
 McDermott, D., 144, 311, 329, 340, 341, 344, 380, 383, *1039*, *1045*, *1054*, *1055*
 McDermott, J., 23, 292, 311, *1055*
 McDonald, R., 254, 839, 853, *1051*, *1057*
 McElicce, R. J., 458, *1055*
 McGregor, J. J., 205, *1055*
 McGrew, B., 959, 979, *1034*
 McGuinness, D., 332, 339, 341, *1035*, *1037*, *1062*
 McIlraith, S., 278, *1055*
 McKenzie, D., 458, *1057*
 McKinney, W., 720, *1055*
 McLachlan, G. J., 748, *1055*
 McLaughlin, S., 313, *1046*
 McMahan, B., 561, *1051*
 McMahan, H. B., 992, 1009, *1037*, *1051*, *1055*
 MCMC (Markov chain Monte Carlo), **441**, 441–448, 454, 457, 491, 527, 732
 McMillan, K. L., 381, *1055*
 McPhee, N., 144, *1058*
 MCTS (Monte Carlo tree search), **161**
 McWhorter, J. H., 278, *1055*
 MDL (minimum description length), **671**, 716, 724
 MDP (Markov decision process), 10, **563**, 595, 597, 789
 mean-field approximation, **458**
 measure, **319**
 measurement, 319–321
 mechanism
 strategy-proof, **635**
 mechanism design, **600**, 632
 Medea, 975
 medical diagnosis, 23, 410, 418, 547
 Medina-Lara, A., 559, *1036*
 Meehan, J., 311, *1039*
 Meehl, P., 338, *1046*, *1055*
 Meek, C., 456, *1065*
 Meet (interval relation), 324
 meganode, **435**
 Megarian school, 247
 megavariable, 473
 Meggido, N., 621, 647, *1051*
 Mehri, N., 1009, *1055*
 Mehta, G. B., 558, *1036*
 Mehta, S., 995, 996, 1009, 1010, *1036*, *1047*
 Mellish, C. S., 312, *1040*
 Melo, F. S., 179, *1061*
 memoization, 310
 memorization (of data), 668
 memory (in neural networks), **773**
 memory cell (in LSTMs), **775**
 memory requirements, 77, 80
 MEMS (micro-electromechanical system), 1013
 MENACE (learning algorithm), 177
 Mendel, G., 118, *1055*
 Mendes, P. N., 339, *1052*
 Meng, X.-L., 458, *1038*
 Mengüç, Y., 1013, *1056*
 meningitis, 399
 mental model, in disambiguation, 848
 mental object, 326–328
 Mercer's theorem, **695**
 Mercer, J., 695, *1055*
 Mercer, R. L., 851, 878, 880, *1038*, *1049*
 Merel, J., 822, *1063*
 mereology, **340**
 Merkhofer, M. M., 558, *1055*
 Merleau-Ponty, M., 1006, *1055*
 Mertz, C., 963, 979, *1067*
 Meshulam, R., 109, *1043*
 metalearning, 719, 960, 979
 metalevel reasoning system (MRS), 298
 metalevel state space, **103**
 metaphor, **848**, 853
 metareasoning, **173**
 decision-theoretic, **1019**
 metarule, **298**
 meteorite, 372, 385
 metonymy, **847**
 Metropolis, N., 142, 176, 457, *1055*
 Metropolis–Hastings, **442**
 Metropolis algorithm, 142, 457
 Metz, L., 777, *1059*
 Metzger, J. H., 787, *1043*
 Metzler, D., 850, 854, *1040*
et al., 30, 179, *1042*, *1049*
 MEU (maximum expected utility), **387**, 529, 575
 Meyerson, E., 119, 143, *1055*
 Mézard, M., 142, *1055*
 MGONZ (chatbot), 984
 MGSS*, 175
 MGU (most general unifier), **284**, 286, 306
 MHT (multiple hypothesis tracker), 526
 Mian, I. S., 498, *1051*, *1056*
 Michael, J., 879, 880, *1065*
 Michalak, T. P., 648, *1059*
 Michaylov, S., 312, *1049*
 Michel, V., 720, *1058*
 Michie, D., 107, 108, 144, 175, 177, 816, 820, 821, 976, *1038*, *1042*, *1055*, *1060*
 micro-electromechanical system (MEMS), 1013
 microarray gene expression, 698
 Microelectronics and Computer Technology Corporation (MCC), 23
 micromort, **533**, 559
 Microsoft, 455, 986, 1008, 1017
 microworld, **20**, 21
 Middleton, B., 421, 455, *1058*
 Miesenböck, G., 11, *1067*
 Miikkulainen, R., 119, 143, 177, *1053*, *1055*
 Mikolov, T., 852, 858, 878, 879, *1049*, *1055*
 Milch, B., 512, 525–527, *1054*, *1055*, *1057*, *1058*
 milestone, **946**
 Milgrom, P., 649, *1055*
 Milios, E., 977, *1053*
 Mill, J. S., 8, *1055*
 Miller, A. C., 558, *1055*
 Miller, D., 383, *1041*
 Miller, T., 719, 1009, *1055*
 million-queens problem, 197
 MILLIONAIRE (mechanical calculator), 9
 Millstein, T., 381, *1043*
 Milner, A. J., 278, *1046*
 MIN-CONFLICTS, **198**
 min-conflicts heuristic, 197, 206
 MIN-VALUE, **150**, **154**

- Minami, R., 1013, *1066*
- mind
 dualistic view, 1006
 as physical system, 6
 theory of, 2
- minibatch, **679**
- minimal model, **334**
- MINIMAX-SEARCH, **150**
- minimax algorithm, 149–150, 174, 175, 611
- minimax decision, **149**
- minimax search, **148**, 148–152
- minimax value, **148**
- minimum
 global, **111**
 local, **112**
- minimum-remaining-values, **193**, 290
- minimum description length (MDL), **671**, 716, 724
- minimum slack, **378**
- minimum spanning tree (MST), 109
- Minka, T., 526, 747, *1047*, *1055*
- Minker, J., 311, 343, *1044*, *1055*
- Minkowski distance, **687**
- Minsky, M. L., 17, 19, 22, 23, 32, 341, 454, 646, 785, 1005, 1007, 1010, *1055*
- Minton, S., 142, 206, 382, *1039*, *1055*
- Miranker, D. P., 206, *1035*
- Mirhoseini, A., 718, 1021, *1061*
- Mirjalili, S. M., 142, *1055*
- Mirza, M., 787, *1046*
- Misak, C., 278, *1055*
- Mishra, B. D., 876, 880, *1040*
- missing attribute values, **664**
- missing fluent, **372**
- missionaries and cannibals, 338
- MIT, 14, 18, 19, 23, 921, 976
- Mitchell, D., 142, 249, *1040*, *1061*
- Mitchell, M., 35, 143, 144, 995, *1055*
- Mitchell, T. M., 62, 253, 850, 854, 855, *1037*, *1038*, *1040*, *1055*
- MITSUKU (chatbot), 1007
- Mittelstadt, B., 987, *1055*
- Mitten, L. G., 560, *1055*
- mixed strategy, **606**
- mixing number, 116
- mixing rate, **446**
- mixing time, **468**
- mixture distribution, **739**
- mixture of Gaussians, **739**, 741, 742
- Miyake, S., 786, *1044*
- Miyato, T., 786, *1055*
- Mnih, V., 784, 790, 820, 822, *1055*
- MNIST, 25, 668, 897
- mobile robot, **927**
- Mobileye, 918, 924
- modal logic, 327
- modal operators, **327**
- model
 causal, 418
 class, **653**
 counting, 434
 weighted, **434**
 selection, **666**, 746
 sensor, 474, 481, 496
 transition, **52**, **65**, 105, 122, **147**, 238, 461, 464, 492, 496, 563, 595, 932
- model (abstract description of reality), 66
 small-scale, 13
- model (in logic), **214**, 246, 254, 277, 327
- model (in machine learning), 651, 653
- model (in probability theory), **389**
- model-based
 reflex agents, 60
 reinforcement learning, **790**, 959
 vision, 881
- MODEL-BASED-REFLEX-AGENT, **53**
- model-free
 agent, **56**
- Model-free reinforcement learning, **790**
- MODEL-SELECTION, **667**
- model checking, **215**, 247
- model predictive control (MPC), **956**, 964
- model theory (in logic), 278
- Modus Ponens, **223**, 247, 308, 310
 Generalized, **282**, 282–283
- Moffat, A., 852, *1066*
- Mohamed, A. R., 849, 854, *1048*
- Mohamed, S., 787, *1059*
- Mohr, R., 205, 922, *1055*, *1061*
- Mohtashamian, A., 30, *1053*
- Moir, T. J., 920, *1061*
- Mojsilovic, A., 995, 996, 1009, 1010, *1036*, *1047*
- momentum (in optimization), **766**
- monitoring (in machine learning), **712**
- monitoring (state estimation), **132**
- monotone condition, 107
- monotonic concession protocol, **644**
- monotonicity
 of a logical system, **225**, 333
 of path costs, **89**
 of preferences, **530**
- Monro, S., 717, *1059*
- Montague, P. R., 822, *1061*
- Montague, R., 340, 341, 853, *1050*, *1055*
- Montanari, U., 144, 204, *1037*, *1054*, *1055*
- MONTE-CARLO-LOCALIZATION, **934**
- MONTE-CARLO-TREE-SEARCH, **163**
- Monte Carlo algorithm, **435**
 sequential, **499**
- Monte Carlo localization, **934**
- Monte Carlo search, **pure**, **161**
- Monte Carlo tree search (MCTS), **161**
- Montemerlo, M., 977, *1055*
- Montezuma's Revenge, 816
- Mooney, R., 854, *1055*, *1066*
- Moore's law, **14**
- Moore, A. M., 747, *1056*
- Moore, A. W., 142, 596, 747, 820, 979, *1035*, *1037*, *1056*
- Moore, E. F., 107, *1056*
- Moore, J. D., 1009, *1056*
- Moore, J. S., 309, 312, 313, *1037*, *1050*
- Moore, R. C., 341, 343, 717, *1048*, *1056*
- Moore machine, 647
- Moraes, G., 30, *1053*
- Moravčík, M., 30, 178, *1056*
- Moravec, H. P., 976, 977, 1010, *1056*
- Morcos, A. S., 30, 179, *1049*
- More, T., 18
- Morgan, C. L., 143, *1056*
- Morgan, J., 646, *1040*
- Morgan, T. J. H., 118, 143, *1056*
- Morgenstern, J., 995, *1045*
- Morgenstern, L., 341, 343, *1041*
- Morgenstern, O., 10, 531, 558, 648, *1065*
- Moricz, M., 854, *1062*
- Moritz, P., 821, 979, *1061*
- Morjaria, M. A., 455, *1056*
- Morrill, D., 30, 178, *1056*
- Morris, P., 29, 383, *1035*, *1049*
- Morrison, E., 175, *1056*
- Morrison, P., 175, *1056*
- Morsey, M., 339, *1052*
- Morstatter, F., 1009, *1055*
- Moses, Y., 341, *1043*
- Moskewicz, M. W., 206, 248, *1056*
- Mossel, E., 249, *1054*
- most general unifier (MGU), **284**, 286, 306
- most likely explanation, 496
- most likely state, **956**
- motion, 904–905
- motion model, **932**
- motion parallax, 920
- motion planning, 931, 938, **942**, 977
- motion primitive, **960**
- Mott, A., 1018, *1056*
- Mott, J., 852, *1036*
- Motwani, R., 637, 717, *1034*, *1045*
- Motzkin, T. S., 785, *1056*
- Mountney, P., 1018, *1042*
- Moutarlier, P., 977, *1056*
- move, **147**
- movies
 2001: A Space Odyssey, 454, 985
 AI, 982, 1000
 Centennial Man, 1000
 Her, 982
 The Matrix, 1001
 Rogue One, 915
 The Terminator, 926, 1001
 Wall-E, 982
- MPC (model predictive control), **956**, 964

- MPE, *see* explanation, most probable
 MPI (mutual preferential independence), **543**
 MRS (metalevel reasoning system), 298
 MST (minimum spanning tree), 109
 MT (machine translation), 849, **864**, 880
 MUC (Message Understanding Conference), 854
 Mudd, H. F., 1007
 Mudigonda, M., 30, *1052*
 Mueller, E. T., 316, 340, *1056*, *1062*
 Muggleton, S. H., 854, *1056*
 MUI (mutual utility independence), **544**
 Muldal, A., 822, *1063*
 Mullainathan, S., 994, 1009, *1050*
 Müller, M., 177, *1056*, *1060*
 Muller, U., 26, 786, 922, *1052*
 multi-query planning, **947**
 multiagent environment, 55, 599–605
 multiagent planning problem, **599**
 multiagent system, 61, **599**
 multiattribute utility theory, **540**, 559
 multibody planning, **599**, 601–604
 multiheaded attention, **869**
 multiple hypothesis tracker (MHT), 526
 multiplexer, **505**
 multiply connected network, **433**
 multitask learning, **782**
 multivariable linear regression, **679**
 Mumford, D., 921, *1056*
 Mundy, J., 923, *1056*
 MUNIN (medical diagnosis system), 455
 Munos, R., 821, *1056*
 Murdock, J. W., 30, *1043*
 Murphy, K., 316, 497–499, 526, 720, 749, 787, 977, *1036*, *1042*, *1044*, *1056*, *1063*, *1064*
 Murphy, R., 980, *1056*
 Murray, I., 787, *1052*
 Murray, L. M., 527, *1056*
 Murray, R. M., 978, 1013, *1044*, *1056*
 Murray-Rust, P., 340, *1056*
 Murthy, C., 313, *1056*
 Musat, C., 787, *1066*
 Muscettola, N., 29, 383, 384, *1049*, *1056*
 Musk, E., 33
 Muslea, I., 854, *1056*
 mutation, 21, 141
 mutation rate, **116**
 Muth, J. T., 1013, *1056*
 mutual preferential independence (MPI), **543**
 mutual utility independence (MUI), **544**
 MUZERO (game-playing program), 178
 MYCIN (expert system), 23, 459
 Myers, R. H., 411, *1065*
 Myers, S. L., 411, *1065*
 Myerson, R., 648, 649, *1056*
 myopic best response, **610**
 myopic policy, **550**
-
- N**
-
- n*-armed bandit, **581**
n-gram model, 779, 826, 832, 851, 852, 856
 Nachum, O., 994, *1049*
 Naddaf, Y., 822, *1036*
 Naderan, M., 143, *1045*
 Nagar, S., 996, 1009, *1036*
 Naïm, P., 456, *1058*
 Nair, A. V., 979, *1034*
 Nair, R., 995, 1010, *1047*
 Nair, V., 786, *1056*
 naive Bayes, **402**, 408, 410, 727, 741, 742, 746, 824
 naked triples, 191
 Nalwa, V. S., 12, *1056*
 Nangia, N., 880, *1065*
 Narang, S., 879, *1059*
 Narayanan, A., 991, 1009, *1056*
 Narayanan, V., 822, *1045*
 Narayanaswamy, A., 30, *1046*
 Nardi, D., 341, *1035*, *1038*
 NAS (neural architecture search), **770**, 787
 NASA, 29, 342, 355, 384, 455
 Nash's theorem, 609
 Nash, J., 608, 647, *1056*
 Nash, P., 597, *1056*
 Nash equilibrium, **608**, 645
 Nash folk theorems, **617**
 NATACHATA (chatbot), 984
 Natarajan, S., 561, *1043*
 Natarajan, V., 30, *1053*
 naturalism, 6
 natural kind, **320**
 natural language inference, 880
 natural language processing (NLP), **2**, **823**, 823–880
 natural numbers, **268**
 natural stupidity, 329
 Nau, D. S., 176, 178, 381, 382, 384, *1043*, *1045*, *1057*, *1062*, *1065*
 Navruzian, A., 119, 143, *1055*
 Nayak, P., 144, 342, 384, *1051*, *1056*
 NBS (search algorithm), 108
 nearest-neighbor filter, **517**
 nearest-neighbors, **687**, 717, 736
 nearest-neighbors regression, **691**
 neat *vs.* scruffy, 24
 Nebel, B., 380, *1048*
 Neches, R., 1009, *1056*
 needle in a haystack, 216
 negation, **217**
 negative example, **657**
 negative literal, 217
 negative side effects, **987**
 negotiation set, **641**
 Neil, M., 558, *1043*
 Neiswanger, W., 787, *1065*
 NELL (Never-Ending Language Learning), 850
 Nelson, B., 1010, *1035*
 Nelson, G., 29, *1059*
 Nelson, P. Q., 30, *1053*
 Nemhauser, G. L., 561, *1056*
 Nemirovski, A., 143, *1036*, *1056*
 Nesterov, Y., 143, *1056*
 Netflix Prize, **991**
 network tomography, 455
 Neumann, M., 879, *1058*
 neural architecture search (NAS), **770**, 787
 neural network, 17, 20, 24, **750**, 750–788
 convolutional, 26
 expressiveness, 17
 feedforward, **751**
 hardware, 17
 learning, 17
 multilayer, 22
 recurrent, **751**, 772–775, 860–864
 NeurIPS, 27, 35, 460, 527, 720, 749, 788, 822, 924, 995
 neurobiology, 924
 NEUROGAMMON (backgammon program), 815
 neuron, **11**, 17, 750
 neuroscience, **11**, 11
 Newborn, M., 108, *1057*
 Newcomb, S., 981
 Newell, A., 2, 18, 19, 61, 106, 107, 247, 248, 292, 311, 380, 382, *1052*, *1056*, *1062*
 Newman, P., 977, *1037*, *1042*
 Newton, I., 1, 49, 120, 142, 465, 717, *1056*
 Newton–Raphson method, **121**
 NEXTKB (knowledge base), 339
 Ney, H., 497, 852, 880, *1050*, *1057*
 Ng, A. Y., 596–598, 717, 718, 728, 812, 817, 821, 852, 979, 1004, *1034*, *1037*, *1040*, *1050*, *1051*, *1056*
 Ng, M., 11, *1067*
 Nguyen, P., 849, 854, *1039*, *1048*
 Nguyen, T. T., 313, *1046*
 Nicholson, A., 460, 498, 597, *1041*, *1051*, *1056*
 Nicoletti, M. A., 11, *1052*
 Nielsen, E., 713, 719, *1038*
 Nielsen, M. A., 720, *1056*
 Nielsen, P. E., 311, *1049*
 Nielsen, T., 560, *1056*
 Niemelä, I., 342, *1056*
 Nigam, K., 854, 855, *1040*, *1049*
 Nikolaidis, S., 979, *1056*
 Niles, I., 339, *1056*, *1058*

- Nilsson, D., 558, *1057*
 Nilsson, N. J., 32, 35, 61, 106, 107, 144, 278, 279, 303, 312, 380, 382, 383, 524, 525, 785, 976, *1044*, *1045*, *1047*, *1057*
 Niranjana, M., 498, 820, *1041*, *1060*
 Nisan, N., 648, 649, *1057*
 Niv, Y., 822, *1041*, *1057*
 Nivre, J., 839, 853, *1051*, *1057*
 Nixon, R., 334, 848
 Nixon diamond, 334
 Niyogi, S., 278, *1063*
 NLP (natural language processing), **2**, **823**, 823–880
 no-good, **196**
 no-regret learning, **704**
 NOAH (planning system), 380, 382
 Nobel Prize, 10, 11, 22
 Nocedal, J., 717, *1037*, *1038*
 Noda, I., 976, *1050*
 node (in search trees), **71**, 73
 node consistency, **186**
 Nodelman, U., 498, *1057*
 Noe, A., 1006, *1057*
 noise, **670**
 noise (in images), **889**
 noise (in training data), **659**, 663–664, 721
 noisy-OR, **420**
 nominative case, 841
 non-cooperative game, **601**, 645
 nondeterminism
 angelic, **361**
 demonic, **361**
 nondeterministic environment, **45**, 110
 NONLIN (planning system), 380
 NONLIN+ (planning system), 383
 nonlinear constraints, **183**
 nonlinear dynamical system, **483**
 nonmonotonicity, **333**
 nonmonotonic logic, 225, **333**, 333–335, 341
 Nono, 287
 nonstationary environment, 648, 712
 nonstationary policy, **565**
 nonterminal symbol, 1030
 Nordfors, D., 1011, *1057*
 Nori, A. V., 527, *1040*, *1048*
 Normal–Wishart, 731
 normal distribution, 1027
 standard, **1028**
 normal equation, **680**
 normal form game, **605**
 normalization (of a probability distribution), 396, 400
 normalization (of attribute ranges), **688**
 normative theory, **538**
 Norouzi, M., 29, 30, 783, 850, 865, 920, *1043*, *1053*, *1066*
 North, O., 287
 North, T., 21, *1044*
 Norvig, P., 26, 311, 321, 340, 497, 719, 851, 853, *1046*, *1057*, *1060*
 notation
 infix, **268**
 logical, 3
 prefix, **268**
 noughts and crosses, 147, 175
 Nourbakhsh, I., 144, *1045*
 Novoa, R. A., 30, *1043*
 Nowak, R., 455, *1039*
 Nowatzyk, A., 176, *1048*
 Nowick, S. M., 250, *1057*
 Nowlan, S. J., 118, 143, *1047*
 NP (hard problems), 1024–1025
 NP-complete, 9, 106, 223, 248, 341, 434, 716, **1024**, 1025
 NP-hard, **1025**
 NQTHM (theorem prover), 312
 number statement, **508**
 number variable, **509**
 NumPy, 720
 NUPRL (theorem prover), 313
 Nuro, 924
 Nvidia, 924
 Nyberg, E., 30, *1043*
 Nyberg, L., 11, *1038*
-
- O**
- $O()$ notation, 1024
 O'Malley, K., 649, *1065*
 O'Malley, M. K., 967, *1035*
 O'Neil, C., 718, 1009, *1057*
 O'Reilly, T., 1015
 O'Reilly, U.-M., 143, *1057*
 O-PLAN (planning system), 359, 383, 384
 Oaksford, M., 560, *1039*
 Obermeyer, F., 526, *1036*
 object, 254, 259
 composite, **318**
 object-level state space, **103**
 object-oriented programming, 15, 330
 objective case, 841
 objective function, **110**
 objectivism, **408**
 object model, 881
 observable environment, 43
 observation model, 463
 observation sentence, 7
 occupancy grid, **977**
 occur check, **284**, 295
 Och, F. J., 497, 852, 880, *1037*, *1057*, *1067*
 Ockham's razor, 655, 715, 716, 724
 Ockham, W., 655, 715
 odometry, **929**
 off-switch problem, 623
 Office Assistant, 455
 offline search, **134**
 Ogasawara, G., 498, *1048*
 Ogawa, S., 11, *1057*
 Oglesby, F., 313, *1046*
 Oh, M.-S., 457, *1057*
 Oh, S., 526, *1057*
 Ohashi, T., 179, *1064*
 Oizumi, M., 1007, *1057*
 Olah, C., 1010, *1034*
 Olalainty, B., 384, *1044*
 Olesen, K. G., 455, 456, *1034*, *1057*
 Oliver, N., 498, *1057*
 Oliver, R. M., 558, *1057*
 Olshen, R. A., 716, *1038*
 Olson, N., 30, *1053*
 Olteanu, A., 995, 1010, *1047*
 Olum, P., 921, *1045*
 omniscience, **40**
 Omohundro, S., 33, 1010, *1057*
 one-hot encoding, **707**, 757, 856
 One Hundred Year Study on AI, 27
 Ong, D., 526, *1055*
 Ong, J., 29, *1035*
 ONLINE-DFS-AGENT, **137**
 online gradient descent, **679**
 online learning, **703**, 804
 online planning, 365
 online replanning, **956**
 online search, **134**, 134–141, 144–145
 ontological commitment, **254**, 277, 386
 ontological engineering, **314**, 314–316
 ontology, **272**, 275
 general, 317–328
 upper, 337
 open-loop, **64**, 951
 open-world assumption, 367
 OpenAI, 1008
 OpenAI Gym (simulated environment), 822
 open class, **835**
 OPENCYC (knowledge base), 339
 open list, *see* frontier
 OPENMIND (knowledge base), 316
 open universe probability model (OUPM), **508**
 operations research, **10**, 61, 107, 108
 Oppacher, F., 143, *1057*
 OPS-5 (logical reasoning system), 292, 311
 optical flow, **893**, 921
 optimal brain damage, 787
 optimal control theory, 142
 optimality (of a search algorithm), **75**
 optimality theory (in linguistics), 851
 optimally efficient algorithm, **90**
 optimal solution, **65**
 optimism under uncertainty, **139**

- optimistic description (of an action), **362**
 optimistic prior, 798
 optimization, **666**
 convex, **122**, 141
 optimizer's curse, **537**, 559
 OPTIMUM-AIV (planning and scheduling system), 384
 optogenetics, **11**
 order-of-magnitude distribution, **509**
 orderability, **530**
 order statistic, **536**
 ordinal utility, **532**
 Organon (Aristotle), 247, 339
 origin function, **508**
 OR node, **123**
 Orseau, L., 822, 1003, *1052*
 Ortega, P. A., 822, 1003, *1052*
 Osawa, E., 976, *1050*
 Osborne, M. A., 999, *1044*
 Osborne, M. J., 648, *1057*
 Osherson, D. N., 716, *1057*
 Osindero, S., 786, 787, *1048*, *1049*
 Osman, I., 108, *1059*
 Ostland, M., 525, 526, *1057*
 Ostrom, E., 649, 1010, *1047*, *1057*
 Ostrovski, G., 820, 822, *1055*
 Othello, 178
 Ott, M., 876, 879, *1053*
 Otten, L., 456, *1061*
 OTTER (theorem prover), 313
 out-of-bag error, **698**
 out-of-vocabulary word, **827**
 outcome, **387**, 606, 626
 outlier, **707**
 output gate (in LSTM), **775**
 over-sample, **707**
 Overbeek, R., 313, *1066*
 overfitting, **655**, 663–664, 680, 721, 723
 overgeneration, **835**
 Overmars, M., 978, *1050*
 overriding, **331**
 Owen, M. P., 598, *1049*
 Owens, A. J., 143, *1044*
 OWL (description logic), 339
 Ozair, S., 787, *1046*
-
- P**
- P** (probability vector), 391, 392
 $P(s' | s, a)$ (transition model), 563, 791
 PAC (probably approximately correct), **673**, 675, 717
 pace of change, **999**
 Pachocki, J., 959, 979, *1034*
 Padgham, L., 61, *1057*
 Page, L., 854, *1038*
 Paige, B., 498, 527, *1057*
 Palacios, H., 382, *1057*
 Palaniappan, M., 648, *1054*
 Paleo, B. W., 313, *1036*
 Palmer, J., 253, *1053*
 Palmer, S., 924, *1057*
 Palmieri, G., 785, *1045*
 Pan, X., 821, *1066*
 Pandas, 720
 Pandas (data analysis software), 709
 Panini, 16, 852
 Papadimitriou, C. H., 142, 144, 248, 596, 598, 648, 1029, *1042*, *1051*, *1057*
 Papadopoulou, T., 923, *1043*
 Papavassiliou, V., 820, *1057*
 paperclip game, **624**
 Papernot, N., 787, *1039*
 Papert, S., 22, 785, *1055*
 paradox, 341, 539
 Allais, 538, 560
 Condorcet, 639
 Ellsberg, 538, 560
 Girard, 313
 St. Petersburg, 557
 Zeno, 65
 parallel distributed processing (PDP), 785
 parallel jaw gripper, **929**
 parallel lines, 883
 parameter, **412**, 725
 parameter independence, **732**
 parametric model, **686**
 paramodulation, **307**, 312
 parent node, **72**
 Pareto optimality, **609**
 Parikh, D., 822, 910, *1046*, *1060*
 Parisi, D., 854, *1043*
 Parisi, G., 142, 458, *1055*, *1057*
 Parisi, M. M. G., 249, *1057*
 Park, F. C., 980, *1054*
 Park, J. D., 457, *1057*
 Park, S., 309, *1047*
 Park, T., 879, 915, *1067*
 Parker, A., 176, *1057*
 Parker, D. B., 785, *1057*
 Parker, L. E., 980, *1057*
 Parmar, N., 850, 868, 880, *1039*, *1064*
 Parr, R., 561, 596, 597, 647, 822, *1034*, *1039*, *1046*, *1051*, *1057*
 Parrod, Y., 384, *1034*
 Parsey McParseface, 853
 parsing, **835**, 835–840
 part-of-speech tagging, **830**
 Partee, B. H., 853, *1058*
 partial-order planning, **352**
 partial assignment, **181**
 partial bracketing, **840**
 partial observability, 110, 168, 588
 partial program, **808**
 partial solution, **181**
 PARTICLE-FILTERING, **492**
 particle filtering, **492**, 497
 Rao-Blackwellized, **496**, 498, 977
 particle MCMC, **499**
 partition, **318**, 626
 Partnership on AI, 35, 1008
 part of speech (POS), **829**
 Parzen, E., 748, *1057*
 Parzen window, 748
 Pasca, M., 854, 855, *1043*, *1057*
 Pascal's wager, 409
 Pascal, B., 6, 8, 408
 PASCAL Challenge, 880
 PASCAL VOC (image data set), 922
 Pascanu, R., 786, *1041*
 Pasero, R., 278, 311, *1040*
 Paskin, M., 525, *1057*
 PASSIVE-ADP-LEARNER, **794**
 PASSIVE-TD-LEARNER, **795**
 passive learning agent, **791**
 passive sensing, 881
 Pastor, P., 978, 979, *1037*, *1052*
 Pasula, H., 499, 512, 525, 526, *1054*, *1057*
 Patel, S., 992, *1037*
 Patel-Schneider, P., 339, 341, *1035*, *1057*
 path, **65**, 105, 376, **938**, 942
 loopy, **74**
 redundant, **74**, 74–75
 path consistency, **188**, 204
 PATHFINDER (medical diagnosis system), 455
 path integral, **949**
 Patil, N., 1018, *1049*
 Patil, R., 853, *1039*
 Patrick, B. G., 108, *1057*
 pattern database, **101**, 109, 356
 disjoint, **101**
 pattern matching, **290**
 Patterson, D. A., 652, 1018, *1041*, *1049*
 Paul, R. P., 978, *1057*
 Paulin-Mohring, C., 312, *1036*
 Paull, M., 248, *1044*
 Pauls, A., 853, *1057*
 Pavlovic, V., 456, *1067*
 payoff function, 147, **605**
 payoff matrix, **605**
 payoff vector, **626**
 Paz, A., 455, *1064*
 Pazzani, M., 410, 747, *1042*
 PBT (population-based training), **672**
 PCA (principal components analysis), 777
 PCFG, **833**, 833–835, 852
 lexicalized, **841**, 853
 P controller, **952**
 PD controller, **953**
 PDDL (Planing Domain Definition Language), 344
 PDP (parallel distributed processing), 785
 Peano, G., 278, *1057*
 Peano axioms, **268**, 278, 289

- Pearce, J., 207, 1057
 Pearl, J., 17, 25, 62, 90, 107, 109, 142, 175, 176, 206, 413, 454–460, 747, 748, 1041, 1045, 1046, 1049, 1050, 1057, 1064
 Pearlmuter, B. A., 1016, 1062
 Pearson, K., 747, 787, 1057
 PEAS description, **42**, 44
 Pease, A., 339, 1056, 1058
 Pecheur, C., 309, 1047
 pedigree analysis, **455**
 Pednault, E. P. D., 380, 646, 1058
 Pedregosa, F., 720, 1058
 Peek, M. Y., 1013, 1044
 PEGASUS (reinforcement learning algorithm), 817
 Pei, J., 720, 1047
 Peirce, C. S., 204, 278, 329, 341, 1058
 Peleg, B., 648, 1058
 Pelikan, M., 143, 1058
 Pell, B., 384, 1056
 Pemberton, J. C., 145, 1058
 penalty, **57**
 Penberthy, J. S., 380, 1058
 Peng, J., 820, 1058
 Peng, L., 30, 1046, 1053, 1062
 Penix, J., 309, 1047
 Pennachin, C., 33, 1045
 Pennington, J., 872, 878, 1058
 Pennsylvania, Univ. of, 14
 Penn Treebank, **829**, 839, 877
 Penrose, R., 983, 1058
 Pentagon Papers, 560
 people prediction, **931**
 Peot, M., 383, 457, 1058, 1061
 percept, **36**
 possible, 130
 perception, 36, 270, 881–919
 perceptron, 21, 785
 convergence theorem, 21
 learning rule, **683**
 representational power, 22
 percept schema, **366**
 percept sequence, **36**, 40, 41
 Pereira, F., 26, 294, 340, 718, 719, 838, 840, 855, 877, 1034, 1042, 1046, 1052, 1058, 1059
 Peres, Y., 497, 499, 1052, 1054
 perfect information, **147**, **618**
 perfect recall, 619
 performance element, **56**
 performance measure, **39**, 40, 42, 60, 385, 529
 Perkins, T., 316, 1062
 Perov, Y., 527, 1054
 perplexity, **879**
 Perrault, C. R., 646, 1040
 persistence arc, **489**
 persistent failure model, **488**
 persistent variable, 1031
 personal agent, **1015**
 perspective, 920
 perspective projection, **883**
 Persson, K. A., 872, 1064
 Pesch, E., 384, 1037
 Peshkin, M., 144, 1065
 pessimistic description (of an action), **362**
 Peters, J., 458, 979, 1050, 1058
 Peters, M. E., 879, 1058, 1060
 Peters, S., 853, 1042
 Petersen, S., 820, 822, 1036, 1055
 Peterson, C., 458, 1058
 Peterson, K., 963, 979, 1067
 Petosa, N., 178, 1058
 Petrie, K., 207, 1045
 Petrie, T., 497, 748, 1035
 Petrik, M., 820, 1053
 Petron, A., 959, 979, 1034
 Petrov, S., 839, 853, 989, 1034, 1057
 Pettersson, L., 822, 1038
 Pezeshki, M., 849, 1067
 Pfeffer, A., 176, 502, 525–527, 647, 1051, 1058
 Pfeifer, G., 342, 1043
 Pfeifer, R., 1006, 1058
 Pham, H., 787, 1058
 phase transition, 249
 Phillips, A. B., 142, 206, 1055
 Phillippy, A. M., 717, 1036
 Phillips, E. H., 30, 1052
 Philo of Megara, 247
 philosophy, 6–8, 61, 981–1011
 moral, 39
 photogrammetry, 921
 photometry, 886–888
 photosensitive spot, 917
 phrase structure, **833**
 physical game, 179
 physicalism, 6
 physical symbol system, **19**
 piano mover's problem, **942**
 Piantino, S., 1018, 1064
 Piccione, C., 647, 1067
 PICTURE (probabilistic programming language), 527
 PID controller, **953**
 Pieper, G., 313, 1066
 Pierson, E., 1009, 1040
 Pietra, V. J. D., 878, 1038
 pigeons, 13
 Pineau, J., 598, 820, 979, 1044, 1058, 1061
 Pinedo, M., 384, 1058
 ping-pong, 179
 pinhole camera, **883**, 882–884
 Pinkas, G., 206, 1058
 Pinker, S., 252, 253, 278, 854, 1058, 1060
 Pinto, D., 855, 1058
 Pinto, L., 979, 1058
 Pisa, tower of, 57
 pit, bottomless, 210
 Pitassi, T., 456, 995, 1009, 1035, 1043, 1066
 Pitts, W., 16, 17, 20, 249, 750, 785, 1054
 pixel, **882**
 PL-FC-ENTAILS?, **231**
 PL-RESOLUTION, **228**
 PLAN-ERS1 (planning and scheduling system), 384
 PLAN-ROUTE, **242**
 PLANEX (planning agent), 383
 Plankalkül, 14
 plan monitoring, 372
 PLANNER (logic programming language), 23, 311, 646
 planning, 174, 344–384
 and acting, 365–367
 as refinement, 352
 as satisfiability, 351
 blocks world, 20
 case-based, **382**
 classical, **344**
 conformant, 365, 367–370, 379, **382**
 contingency, 365, 370–371, 379
 decentralized, **599**
 hierarchical, 356–365, 379
 hierarchical task network, 357
 history of, 380
 linear, **380**
 Monte Carlo, **572**
 multibody, **599**, 601–604
 multieffector, **599**
 online, 365
 reactive, **383**, 968
 regression, 350–351
 route, 19
 search space, 348–356
 sensorless, 365, 367–370
 planning graph, **352**
 plan recognition, **605**
 PlanSAT, 384
 bounded, 384
 Plappert, M., 959, 979, 1034
 plateau (in local search), **113**
 Plato, 247, 340
 Platt, J., 718, 1058
 player (in a game), **605**
 payout, **161**
 payout policy, **161**
 Playter, R., 29, 1059
 Plotkin, G., 312, 1058
 Plummer, M., 747, 1058
 Plunkett, K., 854, 1043
 plurality voting, **640**
 Pluribus (poker program), 178, 622
 ply, **148**
 Pnueli, A., 341, 1058

- poetry, 1
Poggio, T., 786, 1054
Pohl, I., 107, 108, 1058
pointwise product, **430**
Poisson distribution, **509**
poker, 178, 648
Poland, 340
Poli, R., 144, 1052, 1058
policy, 160, **564**, 595
 dominating, **587**
 evaluation, **576**, 791
 gradient, **811**
 improvement, **576**
 iteration, 572, **576**, 576–578, 596
 asynchronous, **578**
 modified, **578**
 loss, **575**
 optimal, **564**
 proper, **566**
 search, **790**, **810**, 810–812
 stochastic, **811**
 value, **811**
POLICY-ITERATION, **577**
polite convention, **985**
Pollack, M. E., 646, 1040
Polosukhin, I., 850, 868, 880, 1064
polysemy, 873
polytree, **433**, 434, 454, 470
Polyzotis, N., 311, 1051
POMCP, **594**
POMDP (partially observable MDP), **588**,
 588–595
POMDP-VALUE-ITERATION, **593**
Pomerleau, D. A., 923, 977, 1058
Ponce, J., 924, 1044
Ponte, J., 880, 1067
Poole, B., 787, 1058
Poole, D., 61, 456, 525, 527, 559, 1037,
 1050, 1058, 1067
pooling (in neural networks), **762**
Popat, A. C., 852, 880, 1037
Popescu, A.-M., 855, 1043
Poppe, R., 1013, 1058
Popper, K. R., 409, 716, 1058
population-based training (PBT), **672**
Porphyry, 341
Port-Royal Logic, 557
Porter, B., 343, 1064
portfolio, **379**
Portner, P., 853, 1058
POS (part of speech), **829**
pose, **905**, 939
Posegga, J., 312, 1036
position, **147**
positive example, **657**
positive literal, 217
positivism, logical, 7
possibility theory, **460**
possible percept, 130
possible world, **214**, 246, 277, **327**, 388,
 501
Post, E. L., 248, 1058
post-decision disappointment, **559**
POS tagging, 852
posterior probability, *see* probability,
 conditional
potential (in MDPs), 570
Potts, C., 845, 880, 1037, 1053
Pouget-Abadie, J., 787, 1046
Poulton, C., 1013, 1058
Poundstone, W., 647, 1058
Pourret, O., 456, 1058
Poverty of the Stimulus, 854
Powell, G., 959, 979, 1034
Powell, R., 30, 179, 1064
Powers, R., 648, 1061
Powley, E. J., 176, 1038
PPCA (probabilistic principal
 components analysis), **776**
Prabhat., 30, 1052
Prabhavalkar, R., 849, 1039
Prade, H., 460, 1042
Pradhan, M., 421, 455, 1058
Pradhan, N., 526, 1036
Praet, J.-C., 559, 1036
Prager, J., 30, 1043
pragmatics, 846
Pratt, L., 719, 1064
Prawitz, D., 310, 1058
precedence constraint, **182**
precomputation, **102**
precondition, **345**
 missing, **372**
precondition axiom, 245
predicate indexing, **284**
predicate symbol, **257**, 843
prediction, 130, 467–468, 496
predictive learning, **1017**
preference, **387**, 530
 monotonic, **534**
 unknown, 553–556
preference elicitation, **533**
preference independence, **543**
preference learning, **931**
preferred action, **355**
premise, **217**
president, 325
Presley, E., 325
Press, W. H., 142, 1058
Presta, A., 853, 1034
Preston, J., 1007, 1058
pretraining, 857, **871**
Prettenhofer, P., 720, 1058
Price, B., 597, 1037
Price, E., 1009, 1047
Price Waterhouse, 383
Prieditis, A. E., 100, 109, 1058
Prince, A., 851, 1062
principal components analysis (PCA),
 777
Principia Mathematica, 18
principle of insufficient reason, **409**
PRIOR-SAMPLE, **436**
prioritized sweeping, 596, **796**, 820
priority queue, **74**
prior knowledge, 40, 41, **652**
prior probability, **389**, 407
prismatic joint, **929**
prisoner's dilemma, **606**
Pritzel, A., 979, 1053
privacy, 711, 1009
private value, 634
probabilistic agent, 386
probabilistically complete, **947**
probabilistic context-free grammar
 (PCFG), 851
probabilistic principal components
 analysis (PPCA), **776**
probabilistic roadmap (PRM), **946**
probability, 3, **8**, 25, 385–460, 1027–1028
 axioms of, 393
 conditional, **389**, 396, 399, 407, 416
 conjunctive, 416
 density function, **391**, 1027
 distribution, **391**, 427
 history of, 411
 judgments, 418
 marginal, **395**
 model, **389**, 1027
 open-universe (OUPM), **508**
 prior, **389**, 407
 uninformative, **733**
 theory, 256, **386**, 557
probability logic, **524**
probability notation, 391
probably approximately correct (PAC),
 673, 675, 717
PROBCUT (game-tree search algorithm),
 159
probit, **424**, 455
problem, **65**, 105
 assembly sequencing, 70, 107
 bandit, **581**, 597, 798
 conformant, **126**
 constrained optimization, 121, **185**
 8-puzzle, 97, 100
 formulation, **64**, 66
 generator, **57**
 halting, 282
 inherently hard, 1024–1025
 million-queens, 197, 206
 n-queens, 236
 optimization, **110**
 piano movers, 977
 real-world, **66**
 relaxed, **99**, 100, 353
 robot navigation, 70

sensorless, **126**
 solving, 22
 standardized, **66**
 touring, **70**
 traveling salesperson, 107, 109
 underconstrained, **236**
 VLSI layout, 70, 115
 Procaccia, A. D., 649, *1037*
 procedural approach, **210**, 251
 procedural attachment, **331**
 PROCEED, **83**
 PRODIGY (planning system), 382
 production system, 50, **292**, 310, 311
 product rule, **390**, 399
 programming language, 251
 progression (in planning), 349, 379
 Prolog, 23, **294**, 311, 380
 Prolog Technology Theorem Prover
 (PTTP), 312
 proof, **223**
 proper policy, **566**
 property (unary relation), **254**
 proposal distribution, **447**
 adaptive, **523**
 proposition
 probabilistic, 388–395
 symbol, **217**
 propositional attitude, **326**
 propositionalization, **281**, 309
 propositional logic, 208, 217–222, 246,
 251
 proprioceptive sensor, **929**
 Prosser, P., 205, *1058*
 protein design, **70**
 provably beneficial, 623
 Provan, G. M., 421, 455, *1058*
 PROVER9, 313
 Provost, F., 990, *1043*
 Pruksachatkun, Y., 880, *1065*
 pruning, **90**, **146**, 152, 663, 698
 forward, **159**
 futility, **176**
 in contingency problems, 167
 pseudocode, **1031**
 pseudoexperience, **796**
 pseudoinverse, **680**
 pseudoreward, **807**
 PSPACE, 384, 1025
 psychological experiment, **2**
 psychological reasoning, **343**
 psychology, 12–14
 experimental, 12
 psychophysics, 924
 PTTP (Prolog Technology Theorem
 Prover), 312
 public key encryption, 309
 Puget, J.-F., 207, *1045*
 Pullum, G. K., 278, 853, 854, *1048*, *1058*
 Puma (robot arm), 976

Purdom, P., 207, *1038*
 pure strategy, **606**
 pure symbol, **233**
 Puterman, M. L., 61, 596, 598, *1058*
 Putnam, H., 233, 248, 303, 310, 410, 527,
 1041, *1058*
 Pyro (probabilistic programming
 language), 526
 Pyrros, A., 916, *1042*
 PySC2 (machine learning software), 822
 Python, 259
 PyTorch (machine learning software),
 526, 720, 1021

Q

$Q(s, a)$ (value of action in state), 802
 Q-function, 545, **568**, **790**
 Q-learning, **790**, 802, 810, 925
 Q-LEARNING-AGENT, **803**
 Q-VALUE, **569**
 QA3 (logical reasoning system), 278
 QALY (quality-adjusted life year), **534**,
 559
 Qian, H., 1009, *1036*
 QUACKLE (Scrabble program), 179
 quadratic programming, **693**
 Quake III, 28, 30
 Quale, **985**
 qualification problem, **241**, 385, 982
 qualitative physics, 321, **342**
 qualitative probabilistic network, 460, **542**
 quality-adjusted life year (QALY), **534**,
 559
 quantification, 845
 quantifier, **260**, 278
 existential, 262
 in logic, 260–264
 nested, 263
 universal, 260–262, 280
 quantum computing, **15**
 quasi-logical form, **846**
 query (logical), 266
 query (probabilistic), **395**
 query variable, 427
 query vector (in transformers), **869**
 question answering, **850**, 880
 visual (VQA), 28, **910**
 queue, **74**
 FIFO, **74**
 LIFO, **74**
 priority, **74**
 Quevedo, T., 175
 quiescence, **158**
 Quigley, A., 1013, *1066*
 Quillen, D., 979, *1052*
 Quillian, M. R., 341, *1058*
 Quine, W. V., 279, 320, 339, 340, *1058*
 Quinlan, J. R., 715, 716, *1058*

Quinlan, S., 978, *1059*
 Quirk, R., 853, *1059*
 QXTRACT (information extraction
 system), 855

R

R (statistical software), 720
 R1 (expert system), 23, 292, 311
 Rabani, Y., 143, *1059*
 Rabe, M. N., 309, *1035*
 Rabideau, G., 383, *1044*
 Rabiner, L. R., 497, *1059*
 Rabinovich, Y., 143, *1059*
 Rabinowitz, N. C., 30, 179, *1049*
 radar, 10, **928**
 Radford, A., 777, 879, *1059*
 Raedt, L. D., 525, *1050*
 Raffel, C., 879, *1059*
 Rafferty, A. N., 598, *1059*
 Ragan-Kelley, J., 1016, *1053*
 Raghavan, M., 994, 1009, *1050*
 Raghavan, P., 850, 854, *1054*
 Raghu, M., 787, *1058*
 Rahwan, T., 648, *1059*
 Raibert, M., 29, *1059*
 Raiffa, H., 10, 539, 559, 560, 647, *1050*,
 1053
 Rajamani, S. K., 527, *1040*, *1048*
 Rajan, K., 29, 383, *1049*
 Raji, I. D., 995, *1055*
 Rajpurkar, P., 880, *1059*
 Raju, B., 119, 143, *1055*
 Ramage, D., 992, *1037*
 Ramamurthy, K. N., 995, 996, 1009,
 1010, *1036*, *1047*
 Ramsey, F. P., 10, 409, 558, *1059*
 Ramsundar, B., 499, 720, *1043*, *1059*
 RAND Corporation, 560, 596
 random-restart hill climbing, **113**
 random forest, **697**, 718
 randomForest (machine learning
 software), 698
 randomization, 37, **51**
 randomized controlled trial, **453**
 randomized weighted majority algorithm,
 703
 random restart, 234
 random search, **672**
 random variable, 390, 417
 basic, **503**
 continuous, 391, 422, 455
 indexed, **525**
 random walk, **138**, 480
 range (of a random variable), **390**
 range finder, **927**
 laser, 928
 range sensor array, 933
 Ranzato, M., 786, *1049*

- Rao, A., 62, *1066*
 Rao, B., 498, *1048*
 Rao, D. A. S., 998, *1059*
 Rao, K., 849, *1039*
 Rao-Blackwellization, **496**
 Raphael, B., 107, 311, *1046*, *1047*, *1059*
 Raphson, J., 142, 717, *1059*
 rapidly exploring random trees (RRT), 947
 rapid prototyping, 294
 Raschka, S., 720, *1059*
 Raschke, U., 976, *1040*
 Rashevsky, N., 17, 785, *1059*
 Rasmussen, C. E., 748, *1059*
 Rassenti, S., 649, *1059*
 rating, **505**
 Ratinov, L., 878, *1064*
 Ratio Club, 16
 rational agent, **4**, 3–4, 36, **39**, 39–40, 55, 60, 61, 557
 rational decision, 387
 rationalism, 855
 rationality, **1**, 39–40
 Boltzmann, **814**
 individual, 627
 limited, **4**, 328
 perfect, 4
 rational thought, 3
 Ratliff, N., 951, 963, 966, 978, 979, *1059*, *1067*
 Ratnaparkhi, A., 852, *1059*
 Ratner, D., 106, *1059*
 rats, 13
 Rauber, J., 787, *1039*
 Rauch, H. E., 497, *1059*
 Rawal, A., 119, 143, *1055*
 Ray, A., 959, 979, *1034*
 Ray, B., 719, *1046*
 Rayson, P., 852, *1052*
 Rayward-Smith, V., 108, *1059*
 Razavi, A., 787, *1049*
 RBFS (recursive best-first search), 93–95, 105
 RDF (Resource Description Framework), 339
 Ré, C., 524, *1041*
 reachable set, **361**
 reached (states in search), **72**
 reactive planning, **383**, 968
 Real, E., 787, *1059*
 real-world problem, **66**
 realizability, **670**
 reasoning, 3, 19, **208**
 default, 333–335, 459
 logical, 222–237
 probabilistic, 395–397, 427–435
 approximate, 435–449
 receiver operating characteristic (ROC) curve, **710**
 receptive field, **762**
 Rechenberg, I., 143, *1059*
 Recht, B., 716, *1067*
 recombination, **115**
 recommendation, 502
 recurrent neural network (RNN), *see* neural network, recurrent
 RECURSIVE-BEST-FIRST-SEARCH, **93**
 recursive best-first search (RBFS), 93–95, 105
 recursive estimation, 466
 Reddy, R., 17
 reduction, **433**, 1029
 Rees, M., 33
 Reeves, C., 108, *1059*
 Reeves, D., 649, *1065*
 reference class, **409**
 reference count, **92**
 referential transparency, **327**
 refinement (in hierarchical planning), **357**
 reflectance, 905
 reflection, **886**
 REFLEX-VACUUM-AGENT, **49**
 reflex agent, **49**, 49–51, 60, 564, 790
 Reformer (natural language software), 877, 879
 refutation, **223**
 refutation completeness, 303
 Regan, N., 177, *1060*
 Regin, J., 205, *1059*
 region, **944**
 regional proposal network (RPN), **900**
 region of interest, 900
 regression (in machine learning), **652**
 linear, **677**, 717, 729
 Bayesian, 732–734
 tree, **665**
 regression (in planning), **350**, 349–351, 379
 regression search, **350**
 regret, **704**
 regularization, **671**, 680, 702, 771, 1002
 regularization function, **671**
 Reid, D. B., 526, *1059*
 Reid, M., 98, 107, *1051*
 Reif, J., 977, 979, *1038*, *1059*
 reification, **317**
 REINFORCE (reinforcement learning algorithm), 812
 reinforcement, 789
 reinforcement learning, 10, 164, 595, **653**, **789**, 789–822, 979
 active, **791**, 797–803
 Bayesian, **800**
 deep, **784**, **806**
 distributed, 646
 generalization in, 803–810
 hierarchical, **807**, 1014
 inverse, **34**
 cooperative, 648
 model-based, **790**
 model-free, **790**
 multiagent, 646
 off-policy, **802**
 on-policy, **802**
 passive, **791**, 791–797
 relational, 820
 Reingold, E. M., 205, *1037*
 Reingold, O., 1009, *1043*
 Reinsel, G., 497, 787, *1037*
 Reiter, M. K., 1009, *1064*
 Reiter, R., 250, 341, 381, 597, *1037*, *1059*
 REJECTION-SAMPLING, **438**
 rejection sampling, **437**
 adaptive, 457
 relation (in CSPs), **180**
 relation (in logic), **254**
 relational probability model (RPM), **502**
 relaxed problem, **99**, 100, 353
 relevance, 219
 relevant action, **350**
 ReLU, **752**
 Remolina, E., 29, *1035*
 Remote Agent, 309, 355, 384
 Remote Agent (planning agent), 29
 Ren, S., 786, *1047*
 renaming, **287**
 RENDER-NOISY-IMAGE, **519**
 rendering model, 881
 Renner, G., 143, *1059*
 Rényi, A., 410, *1059*
 repeated game, 608, **614**
 replanning, 365, 371–374, 383
 representation, *see* knowledge representation
 atomic, **59**
 contextual, **873**
 factored, **59**
 structured, **59**
 representation theorem, **543**
 REPRODUCE, **119**
 resampling, 492
 reserve bid, 634
 residual (in neural networks), **764**
 residual network, **764**
 ResNet-50 model, 781
 Resnick, C., 920, *1043*
 Resnick, P., 29, *1059*
 resolution, 19, 21, **226**, 225–229, 247, 298–310
 closure, **228**, 304
 completeness proof for, 303
 input, **308**
 linear, **308**
 strategies, 308–309
 resolvent, **225**, 300
 resource constraint, **374**
 resources, 374–379

- response, 13
restaurant hygiene inspector, 170
result, 345
Rete algorithm, **292**
retiming, **951**
retrograde, **161**
reusable resource, **375**
revelation principle, **635**
revenue equivalence theorem, **636**
Reversi, 178
revolute joint, **929**
reward, **57**, **563**, 595, 789
 additive, **566**
 discounted, **565**
 function, 1014
 hyperbolic, **598**
 shaping, **807**
 sparse, 790
reward-to-go, **792**
rewrite rule, 1030
Rezende, D. J., 787, 1059
RGB (red, green, blue), **888**
Riazanov, A., 312, 313, 1059
Ribeiro, F., 179, 1064
Ribeiro, M. T., 719, 1059
Ribeiro-Neto, B., 850, 1035
Riccati equation, **955**
Rice, T. R., 558, 1055
Richards, J. T., 996, 1009, 1036
Richardson, K., 876, 880, 1040
Richardson, M., 525, 1059
Richardson, S., 457, 1045
Richtárik, P., 992, 1051
Richter, S., 381, 1059
Riddell, A., 458, 527, 747, 1039
ridge (in local search), **112**, 113
Ridley, M., 143, 1059
Riedmiller, M. A., 784, 790, 820, 822, 1055
Riesbeck, C., 23, 311, 1039, 1060
Riley, J., 649, 1059
Riley, P., 719, 1059
Riloff, E., 855, 1049, 1059
Ringgaard, M., 877, 1059
Rink, F. J., 455, 1056
Rintanen, J., 381–384, 1059
Ripley, B. D., 720, 1059
Rish, I., 456, 1041
risk aversion, **535**
risk neutrality, **536**
risk score, 993
risk seeking, **535**
Rissanen, J., 716, 1059
Ristenpart, T., 1009, 1064
Ritov, Y., 525, 526, 1057
Rivest, R., 107, 716, 717, 1029, 1040, 1049, 1059
Rivest, Shamir, and Adelman (RSA), 309
RMS (root mean square), 1029
RNN (recurrent neural network), *see*
 neural network, recurrent
Robbins, H., 585, 597, 717, 1052, 1059
Robbins algebra, **313**
ROBERTA (natural language system),
 781, 875–877, 879
Roberts, A., 879, 920, 1043, 1059
Roberts, G., 1006, 1043
Roberts, L. G., 921, 1059
Robertson, N., 206, 1059
Robertson, S. E., 410, 1059
Robins, J., 458, 1059
Robinson, A., 279, 310, 313, 1059
Robinson, G., 312, 1066
Robinson, J. A., 19, 248, 278, 303, 311, 1059
Robinson, S., 107, 1059
RoboCup, 976
robopocalypse, **1001**
robot, **925**, 925–927, 975
 hexapod, 968
 mobile, 927
 navigation, 70
 rights, 1010
 soccer, 146, 650
robotics, **2**, 487, 925–980
robotic soccer, 179
robust control theory, **801**
Roche, E., 854, 1059
Rochester, N., 18, 19
Rock, D., 998, 1038
Rock, I., 924, 1059
Rodríguez, H., 852, 1054
Rodríguez, K., 1013, 1066
Röger, G., 107, 381, 1047, 1061
Rogue One, 915
Rohlfshagen, P., 176, 1038
ROI pooling, 900
Rokicki, T., 106, 1059
Rolf, D., 248, 1059
Rolf, E., 1009, 1053
Rolland, N., 526, 1046
rollout, **161**
Rolnick, D., 30, 787, 1059
Romania, 63, 181
Romanovskii, I., 647, 1059
Romero, J., 30, 1052
Rong, Z., 872, 1064
Roosin, P., 880, 1038
root mean square (RMS), 1029
Ros, G., 822, 1059
Rosen, C., 976
Rosenblat, A., 1009, 1039
Rosenblatt, F., 21, 717, 785, 921, 1037, 1045, 1059
Rosenblatt, M., 748, 1059
Rosenblitt, D., 380, 1054
Rosenbloom, P. S., 292, 311, 382, 1052
Rosenblueth, A., 16, 1059
Rosenbluth, A., 142, 457, 1055
Rosenbluth, M., 142, 457, 1055
Rosenschein, J. S., 649, 650, 1060, 1063
Rosenschein, S. J., 61, 249, 250, 1049, 1060
Rosenthal, G. D., 559, 1050
Ross, G., 9, 1060
Ross, S., 410, 979, 1029, 1060
Rosse, C., 316, 1062
Rossi, F., 204, 205, 207, 1035, 1037, 1060
Roth, A., 1009, 1036, 1039, 1043
Roth, D., 457, 527, 1041, 1060
Roughgarden, T., 648, 1057
Roussel, P., 278, 311, 1040, 1060
route finding, 69
rover, **927**
Roveri, M., 381–383, 1036, 1040
Rowat, P. F., 977, 1060
Roweis, S. T., 455, 498, 1060
Rowley, H., 922, 1060
row player, **606**
Roy, B. V., 596, 1041
Roy, D., 526, 1034, 1046
Roy, N., 598, 979, 1049, 1060, 1063
Rozonoer, L., 717, 1034
RPM (relational probability model), **502**
RRT (rapidly exploring random trees),
 947, 978
RRT*, **948**
RSA (Rivest, Shamir, and Adelman), 309
Ruan, P., 597, 1062
Rubik's Cube, 98, 100, 106
Rubin, D., 458, 497, 498, 748, 1042, 1045, 1060
Rubin, J., 1009, 1064
Rubinstein, A., 598, 647, 648, 650, 1034, 1057, 1060
Rubinstein, B. I., 1009, 1056
Ruder, S., 875, 879, 1048, 1060
Ruderman, A., 30, 179, 1049
rule, **217**
 causal, 418
 condition–action, **50**
 default, **334**
 diagnostic, 418
 if–then, 50, 217
 implication, 217
 situation–action, 50
rule-based system, 459
Rumelhart, D. E., 24, 785, 1060
Ruml, W., 108, 109, 1038, 1047, 1063, 1066
Rummery, G. A., 820, 1060
Rush Hour (puzzle), 68
Ruspini, E. H., 459, 1060
Russakovsky, O., 786, 1060
Russell, A., 107, 1042
Russell, B., 7, 17, 18, 310, 1065
Russell, J. G. B., 559, 1060

- Russell, J. R., 313, *1056*
 Russell, S. J., 62, 108, 109, 144, 175, 176, 249, 298, 321, 382, 497–499, 512, 525–527, 561, 596–598, 647, 648, 748, 820–822, 977, 1019, 1020, *1034–1036*, *1041–1044*, *1046–1048*, *1050*, *1054–1057*, *1060*, *1062*, *1063*, *1066*, *1067*
 Russo, C., 526, *1046*
 Rustagi, J. S., 458, *1060*
 Rusu, A. A., 820, 822, *1055*
 Ruzzo, W. L., 853, *1046*
 Ryan, M., 279, *1048*
 Rzepa, H. S., 340, *1056*
-
- S**
- Saad, F., 526, 527, *1040*, *1060*
 Sabharwal, A., 248, 381, 850, *1040*, *1046*, *1048*
 Sabin, D., 205, *1060*
 Sabri, K. E., 313, *1060*
 Sacerdoti, E. D., 380, 382, *1060*
 Sackinger, E., 26, 786, 922, *1052*
 Sadeghi, F., 979, *1060*
 Sadeh, N. M., 649, *1035*
 Sadigh, D., 964, 979, *1060*
 Sadik, A., 820, 822, *1036*, *1055*
 Sadler, M., 177, *1060*
 Sadri, F., 340, *1060*
 Saeed, M., 719, *1046*
 safe exploration, 960
 safety engineering, **1001**
 Sagae, K., 853, *1060*
 Sagiv, Y., 311, *1035*
 Saha, D., 996, 1009, *1036*
 Sahami, M., 852, *1051*, *1060*
 Sahin, N. T., 253, *1060*
 Sainath, T., 849, 854, *1039*, *1048*
 SAINT (mathematical problem solver), 20, 144
 St. Petersburg paradox, 557
 Sakuta, M., 176, *1060*
 Salakhutdinov, R., 526, 787, 879, *1052*, *1062*, *1066*
 Salesforce, 1017
 Salib, M., 713, 719, *1038*
 Salido, M. A., 205, 207, *1035*
 Salisbury, J., 978, *1054*
 Salmond, D. J., 498, *1046*
 Salomaa, A., 852, *1060*
 Salvatier, J., 28, *1046*
 Salzmann, M., 787, *1066*
 SAM (theorem prover), 313
 Samadi, M., 109, *1060*
 Samet, H., 717, *1060*
 Sammut, C., 820, *1060*
 Samothrakis, S., 176, *1038*
 sample complexity, **674**
 sample size disparity, **995**
 sample space, **388**
 sampling, 435–441, **1029**
 adaptive, 457
 correlated, **812**, 821
 direct, 436
 rejection, 437
 Samsung, 924
 Samuel, A., 17–19, 33, 62, 177, 715, 819, 820, *1060*
 Samuel, S., 527, *1048*
 Samuelson, L., 647, *1054*
 Samuelson, W., 649, *1059*
 Sanchez-Lengeling, B., 920, *1060*
 Sanders, P., 108, *1042*
 Sandholm, T., 30, 178, 647–649, 790, *1038*, *1045*, *1060*
 Sang, T., 456, *1060*
 Sanna, R., 785, *1045*
 Sanskrit, 338, 852
 Santorini, B., 829, 852, *1054*
 SAPA (planning system), 383
 Sapir, E., 824, *1060*
 Sapir–Whorf hypothesis, 252
 Saraswat, V., 205, *1064*
 Sarawagi, S., 855, *1060*
 Sargent, T. J., 821, *1060*
 SARSA
 (state-action-reward-state-action), **802**
 Sartre, J.-P., 646, *1060*
 Sastry, G., 821, *1060*
 Sastry, S., 61, 526, 817, 821, 964, 979, *1047*, *1056*, *1057*, *1060*
 SAT, **223**
 Satheesh, S., 786, *1060*
 Satia, J. K., 598, *1060*
 satisfaction (in logic), **214**
 satisfiability, **222**, 248
 satisfiability threshold conjecture, **236**
 satisficing, **10**, 90
 SATMC (logical reasoning system), 250
 Sato, T., 311, 525, *1060*, *1063*
 SATPLAN, **244**
 Sattigeri, P., 996, 1009, *1036*
 saturation, **304**
 SATZ (logical reasoning system), 248
 Saul, L. K., 458, 787, *1049*, *1060*
 Saund, E., 852, *1060*
 Saunders, W., 821, *1060*
 Saurous, R. A., 526, *1064*
 Savage, L. J., 394, 409, 558, *1060*
 Savani, Y., 787, *1065*
 Savva, M., 822, *1060*
 Saxe, A. M., 786, *1046*
 Saxe, R., 821, *1035*
 Saxena, N., 1009, *1055*
 Sayre, K., 982, *1060*
 scaled orthographic projection, **885**
 scanning lidar, **928**
 Scarcello, F., 207, 342, *1043*, *1046*
 scene, **882**
 Scha, R., 840, *1037*
 Schaal, S., 979, *1035*, *1058*
 Schabes, Y., 840, 854, *1058*, *1059*
 Schaeffer, J., 88, 108, 109, 177, 647, *1034*, *1036*, *1040*, *1043*, *1060*
 Schäfer, A. M., 821, *1047*
 Schank, R. C., 23, *1060*
 Schapire, R. E., 700, 718, 852, *1044*, *1060*, *1061*
 Scharir, M., 977, *1061*
 Scharre, P., 1008, *1061*
 Schaub, T., 341, *1042*
 Schauenberg, T., 647, *1036*
 scheduling, **374**, **376**, 374–378
 Scheines, R., 747, *1062*
 schema (in a genetic algorithm), **117**
 Schervish, M. J., 410, *1042*
 Schickard, W., 6
 Schlaefer, N., 30, *1043*
 Schlenoff, C. I., 979, *1054*
 Schmid, C., 922, *1061*
 Schmid, M., 30, 178, *1053*, *1056*
 Schmidhuber, J., 787, 788, *1045*, *1048*, *1061*
 Schmidt, G., 384, *1037*
 Schmitt, S., 178, *1061*
 Schneegaß, D., 821, *1047*
 Schneider, J., 817, 822, 979, *1034*, *1035*, *1038*
 Schnitzius, D., 384, *1041*
 Schnizlein, D., 648, *1065*
 Schoenberg, I. J., 785, *1056*
 Schoenick, C., 850, *1040*
 Schofield, M., 176, *1061*
 Schölkopf, B., 458, 718, *1040*, *1041*, *1058*, *1061*
 Schomer, D., 253, *1060*
 Schön, T. B., 499, *1053*
 Schöning, T., 248, *1061*
 Schoppers, M. J., 383, *1061*
 Schrag, R. C., 207, 248, *1035*
 Schraudolph, N. N., 177, *1061*
 Schrauwen, B., 29, *1064*
 Schrittwieser, J., 27, 30, 155, 174, 177, 178, 820, 822, *1036*, *1061*
 Schröder, E., 248, *1061*
 Schrödl, S., 109, *1043*
 Schubert, L. K., 339, *1049*
 Schulman, J., 821, 822, 978, 979, 1010, *1034*, *1038*, *1044*, *1061*
 Schultes, D., 108, *1042*
 Schultz, K., 527, *1054*
 Schultz, W., 822, *1061*
 Schulz, D., 526, 977, *1038*, *1061*
 Schulz, S., 312, 313, *1061*, *1063*
 Schumann, J., 312, *1042*, *1052*

- Schuster, M., 29, 783, 850, 865, 878, 1039, 1049, 1066
- Schutt, R., 718, 1057
- Schütze, H., 850, 852, 854, 1054, 1061
- Schwartz, J. T., 977, 1061
- Schwartz, R., 877, 1046
- Schwartz, S. P., 339, 1061
- Schwartz, W. B., 410, 1046
- Schwing, A., 909, 916, 1034, 1042
- scientific discovery, 716
- Scikit-Learn (machine learning software), 720, 1021
- SciPY (scientific software), 1021
- Sciuto, C., 787, 1066
- Scott, D., 524, 1061
- Scrabble, 179
- scruffy vs. neat, 24
- Sculley, D., 713, 719, 1038
- search, 22, 53
 - A*, 85–90
 - algorithm, **71**
 - alpha-beta, 152–155, 174, 175
 - B*, 175
 - backtracking, 80, 195–197, 199, 203
 - beam, **92**, 106, **115**, 159, 831, 836, 868
 - local, **115**
 - stochastic, **115**
 - best-first, **73**, 105
 - bidirectional, **82**, 96–97, 109
 - breadth-first, **76**, 76–77, 105, 358
 - conformant, 126–130
 - continuous space, 119–122, 142
 - cutting off, 158–160
 - depth-first, **78**, 78–80, 105, 358
 - depth-limited, **80**, 80
 - greedy best-first, **85**, 85
 - heuristic, 107
 - hill-climbing, 111–114, 138
 - in a CSP, 191–199
 - incremental belief-state, **129**
 - informed, 63, **84**, 84–105
 - iterative deepening, **80**, 80–82, 105, 107, 155, 158, 358
 - iterative deepening A*, 108
 - learning to, 103
 - local, 110–119, 142, 206, 235–236, 247, 248
 - greedy, **112**
 - local, for CSPs, 197–199
 - local beam, 115
 - memory-bounded, 92–95, 108
 - memory-bounded A*, **95**, 95, 109
 - minimax, **148**, 148–152
 - nondeterministic, 122–125
 - online, **134**, 134–141, 144–145
 - partially observable, 126–134
 - policy, **790**, **810**, 810–812
 - problem, 942
 - quiescence, **158**
 - real-time, 145, 156–160
 - recursive best-first, 93–95
 - recursive best-first (RBFS), 108
 - simulated annealing, 114–115
 - stochastic beam, **115**
 - systematic, **75**
 - tabu, **142**, 198
 - tree, 71, **147**
 - uniform-cost, **77**, 77–78, 105
 - uninformed, 63, 76–84, 105, 107
 - weighted A*, 91
- search tree, 71, **147**
- Searle, J. R., 11, 985, 1007, 1061
- secure aggregation, **992**
- Sedgewick, R., 1029, 1061
- Sedol, L., ix, 813
- Sefidgar, Y. S., 967, 979, 1061
- Segal, A., 992, 1037
- Segaran, T., 649, 720, 1061
- segmentation (of an image), **894**
- Seipp, J., 381, 1061
- Sejnowski, T., 177, 788, 1047, 1061
- selection (in evolutionary algorithms), **116**
- selection policy (in game tree search), **161**
- selection problem, **586**
- Self, M., 748, 1039
- self-attention, **868**
- self-occlusion, 896
- Selfridge, O. G., 18
- Sellart, L., 822, 1059
- Selman, B., 142, 206, 248, 249, 341, 381, 1046, 1050, 1061
- Selsam, D., 527, 1054
- semantic interpretation, 843–844, 853
- semantic network, **329**, 329–331, 337, 341
- semantics, **214**, 833, 841
 - database, **265**, 297, 345, 502
 - logical, 246
- Semantic Web, 339
- semi-Markov decision process, 809
- semidecidable, 282, 310
- semidynamic environment, **46**
- semisupervised learning, **705**
- semisupervised parsing, **840**
- Senges, M., 1011, 1057
- Seni, G., 718, 1061
- Senior, A., 779, 787, 849, 854, 1048, 1064
- sensitivity analysis, **552**
- sensor, 36, 43, **882**
 - active, **927**
 - lidar, 43, 917, 928
 - passive, **927**
 - sonar, 927
 - tactile, **928**
 - ultrasound, 43
- sensor array, **933**
- sensor failure, 487
- sensorless planning, 365, 367–370
- sensor model, **52**, 461, 464, 474, 481, 496, 588, 932
- Sensory Graphplan (SGP), 383
- sentence
 - atomic, **217**, **260**, 260, 264
 - complex, **217**, 260
 - in a KB, **209**, 246
 - natural language, 823, 834
 - as physical configuration, 216
- sentiment analysis, **826**, 863
- Seo, H., 822, 1052
- Seo, M., 880, 1061
- separator (in Bayes net), 402
- Seppi, K. D., 596, 1066
- sequence-to-sequence model, **865**
- sequence form, **621**
- sequential decision problem, 562–572, 596
- sequential environment, **45**
- sequential importance sampling with resampling (SIR), 498
- serendipity, 374
- Sergot, M., 340, 1051
- serializable subgoals, **355**
- Servant of Philon, 976
- Seshia, S. A., 964, 979, 1060
- set (in first-order logic), **269**
- set-cover problem, **353**
- Seth, K., 992, 1037
- SETHEO (theorem prover), 312
- set of support, **308**
- set partitioning problem, **631**
- Settle, L., 313, 1046
- Settlers of Catan, 151
- Seung, H. S., 979, 1063
- Severini, S., 1018, 1042
- Severyn, A., 853, 1034
- SEXTANT (deep space navigation system), 29
- Seymour, P. D., 206, 1059
- SGD (stochastic gradient descent), **679**, 765
- SGP (Sensory Graphplan), 383
- Sha, F., 877, 1039
- Shachter, R. D., 455–457, 533, 558, 596, 1061, 1063
- Shadow Dexterous Hand, 930
- Shafer, G., 459, 1061
- shaft decoder, **929**
- Shafto, P., 598, 1059
- Shah, J., 921, 979, 1056
- Shahzad, H., 119, 143, 1055
- Shaked, T., 855, 1043
- Shaker, G., 1013, 1066
- Shakey, 20, 61, 144, 380, 383, 976, 979
- Shalata, A., 456, 1061
- Shalla, L., 312, 1066

- Shamdas, M., 30, 1053
 Shanahan, M., 323, 340, 1010, 1061
 Shani, G., 598, 1061
 Shankar, N., 313, 1061
 Shannon, C. E., 18, 155, 175, 661, 715, 720, 851, 1061
 SHAP (explainable machine learning system), 719
 shape from shading, 923
 shaping theorem, **569**
 Shapley, L. S., 648, 1061
 Shapley, S., 596, 648, 1061
 Shapley value, **628**, 629, 645
 Sharan, R. V., 920, 1061
 shared model, **1017**
 Sharir, M., 978, 1046
 Sharon, G., 108, 1048
 Sharp, D. H., 785, 1040
 Shatkay, H., 977, 1061
 Shaw, J. C., 106, 248, 1056
 Shawe-Taylor, J., 718, 1040
 Shazeer, N., 718, 850, 868, 878–880, 1021, 1049, 1059, 1061, 1064
 Shehory, O., 648, 1060
 Shelley, M., 1001, 1061
 Shelton, C., 498, 1057
 Shen, Q., 748, 1041
 Shepard, D., 559, 1066
 Sheppard, B., 179, 1061
 Shet, V., 769, 1046
 Shi, E., 1009, 1056
 Shi, J., 894, 921, 1061
 Shieber, S., 1006, 1061
 shift-reduce parsing, **838**
 Shimelevich, L. I., 498, 1066
 Shimony, S. E., 457, 597, 1019, 1047, 1061
 Shin, M. C., 596, 1058
 Shinkareva, S. V., 253, 1055
 Shmakov, A., 106, 1034
 Shmatikov, V., 991, 1009, 1035, 1056
 Shmoys, D. B., 107, 377, 384, 1052
 Shoar, S., 143, 1045
 Shoham, Y., 61, 179, 312, 559, 648–650, 1034, 1040, 1049, 1052, 1061
 short-term memory, 292
 shortcut, **103**
 Shortliffe, E. H., 459, 1038, 1061
 shoulder (in state space), **113**
 Shpitser, I., 512, 525, 1057
 SHRDLU (natural language system), 20, 23, 346, 854
 Shreve, S. E., 61, 1036
 Shroff, G., 990, 1054
 Shtark, O., 456, 1061
 Siciliano, B., 980, 1061
 Siddiqui, N., 916, 1042
 sideways move (in state space), **113**
 Siebel, W. A., 920, 1051
 Sievers, S., 381, 1061
 Sifre, L., 27, 30, 155, 174, 177, 178, 820, 1061
 SIGAI, 35
 SIGART, 35
 Sigaud, O., 598, 1061
 sigmoid, **685**, **752**
 Sigmund, K., 7, 1061
 signed distance field, **949**
 significance test, **663**
 Silberstein, M., 456, 1061
 Silva, R., 179, 1061
 Silver, D., 19, 27, 30, 155, 174, 176–179, 598, 784, 790, 820, 822, 979, 1047, 1053, 1055, 1061, 1064
 Silverman, B. W., 787, 1061
 Silverstein, C., 854, 1062
 sim-to-real, 926, **959**, 978, 979
 Sima'an, K., 840, 1037
 Simard, P., 26, 786, 922, 1036, 1052
 Simchowitz, M., 1009, 1053
 Simeon, T., 979, 1062
 Simmons, R., 498, 977, 1062, 1064
 Simon's predictions, 21
 Simon, D., 61, 1062
 Simon, H. A., 2, 10, 18, 19, 22, 61, 106, 107, 248, 309, 380, 561, 1049, 1056, 1062
 Simon, J. C., 249, 1062
 Simonis, H., 205, 1062
 Simons, P., 342, 1056
 Simonyan, K., 27, 30, 178, 779, 787, 849, 920, 1043, 1049, 1053, 1061, 1064
 SIMPLE-REFLEX-AGENT, **51**
 simple majority vote, **640**
 simplex algorithm, 143
 SIMULATED-ANNEALING, **115**
 simulated annealing, 114–115, 141, 142, 377, 442
 simulation, **161**
 simultaneous localization and mapping (SLAM), 494, **935**
 Sin, B.-K., 498, 1063
 Sinclair, A., 114, 143, 1053, 1059
 Singer, P. W., 1008, 1062
 Singer, Y., 498, 852, 1044, 1060
 Singh, A., 879, 880, 1065
 Singh, M., 62, 996, 1009, 1036, 1048
 Singh, N., 30, 1053
 Singh, P., 32, 316, 1055, 1062
 Singh, R., 526, 1036
 Singh, S., 145, 527, 597, 719, 820–822, 977, 1035, 1038, 1050, 1054, 1059, 1063
 singly connected network, **433**
 singular extension, **159**
 singularity, 1010
 singularity, **12**, 1004
 singular matrix, **1026**
 sins, seven deadly, 112
 SIPE (planning system), 383
 SIR (sequential importance sampling with resampling), 498
 SIS, *see* importance sampling, sequential
 Sisbot, E. A., 979, 1062
 Siskind, J. M., 1016, 1062
 Sistla, A. P., 381, 1062
 Sittler, R. W., 525, 526, 1062
 situated agent, 982
 situation calculus, **352**
 Sjolander, K., 498, 1051
 Skinner, B. F., 16
 skip-gram, **826**, 872
 Skolem, T., 278, 310, 1062
 Skolem constant, **281**, 310
 Skolem function, **300**, 310
 skolemization, **299**
 Skolnick, M. H., 456, 1038
 Skype, 29
 slack (in scheduling), **376**
 Slagle, J. R., 20, 1062
 SLAM (simultaneous localization and mapping), 494, **935**
 Slate, D. J., 107, 1062
 Slater, E., 175, 1062
 Slattery, S., 854, 1040
 sliding-tile puzzle, **68**, 102, 353
 sliding window, **899**
 SLING (natural language system), 877
 Slocum, J., 106, 1062
 Sloman, A., 32, 1055
 Slovic, P., 560, 1049
 small-scale learning, **670**
 Smallwood, R. D., 597, 1062
 SMA*, 105
 Smith, A., 10, 731, 1036
 Smith, A. F. M., 498, 748, 1046, 1064
 Smith, B., 29, 316, 340, 383, 1049, 1062
 Smith, D. A., 853, 1062
 Smith, D. E., 144, 298, 311, 382, 383, 1038, 1045, 1051, 1058, 1062, 1065
 Smith, E., 719, 1062
 Smith, G., 108, 1059
 Smith, J. E., 537, 559, 1062
 Smith, J. L., 30, 1053
 Smith, J. M., 143, 648, 1062
 Smith, J. Q., 558, 1057, 1062
 Smith, K., 719, 1036
 Smith, M. K., 339, 1062
 Smith, N. A., 877, 1046
 Smith, R. C., 977, 1062
 Smith, R. G., 62, 649, 1038, 1062
 Smith, S. J. J., 178, 1062
 Smith, T., 29, 1035
 Smith, V., 649, 1059
 Smith, W. D., 175, 455, 1035, 1056

- Smith, W. E., 561, *1062*
SMODELS (logic programming system), 342
Smola, A. J., 718, *1061*
Smolensky, P., 851, 1017, *1062*
smoothing, 468–471, 496, 744, **827**, 891
complexity, 470
linear interpolation, **827**
online, 475
SMOTE (data generation system), 707, 995
Smullyan, R. M., 279, *1062*
Smyth, P., 498, *1062*
SNARC (neural network hardware), 17
Snell, J., 410, *1046*
Snoek, J., 672, *1062*
Snyder, W., 312, *1035*
SOAR (cognitive architecture), 292, 311, 382
soccer, 179
robotic, 146, 650
Socher, R., 26, 872, 878, 880, 1021, *1042*, *1047*, *1050*, *1058*
social choice function, **639**
social choice theory, **638**
social law, **605**
social outcome, **639**
social preference order, 639
social welfare, **609**
social welfare function, **639**
societal bias, **992**
Society for Artificial Intelligence and Simulation of Behaviour (AISB), 35
society of mind, 646
Socrates, 3
Soderland, S., 339, 850, 855, *1035*, *1043*
softbot, **43**
soft margin, **696**
softmax, **758**, 811
softplus, **752**
soft threshold, 423
software agent, **43**
software engineering, 1002
Sohl-Dickstein, J., 787, *1058*
Sohn, J. H., 30, *1042*
Soika, M., 977, *1037*
sokoban puzzle, **67**
solipsism, 985
Solla, S., 787, *1052*
Solomonoff, R. J., 18, 716, *1062*
solution, **64**, 65, 105, **181**
optimal, **65**
solution concept, **606**
soma, 12
sonar, **927**
Sondik, E. J., 597, *1062*
Sonenberg, L., 719, 1009, *1055*
Song, Z., 786, *1034*
Sonneveld, D., 106, *1062*
Sontag, D., 526, *1055*
Sophia (robot), 1000
Sorensen, T., 647, *1045*
Sosic, R., 206, *1062*
soundness (of inference), **216**, 222, 230, 246, 288
Sowa, J., 343, *1062*
Spaan, M. T. J., 598, *1062*
space complexity, **75**, 105
spacecraft assembly, 384
SPACY (parser), 853
spam detection, **826**
Sparck Jones, K., 410, *1059*
Sparrow, R., 1000, *1062*
sparse model (in machine learning), **681**
sparse reward (in reinforcement learning), **790**
sparse system, **417**
sparse transition model, 570
SPASS (theorem prover), 312
spatial reasoning, **342**
species, 24, 316, 317, 339, 738, 1010
speech act, **846**
speech recognition, 2, 25, **849**, 854
speech synthesis, 29
speedy search, **92**
sphex wasp, 41, 374
SPI (Symbolic Probabilistic Inference), 456
Spiegelhalter, D. J., 456–458, 525, 559, 747, *1040*, *1045*, *1052*, *1054*, *1062*
SPIKE (planning system), 384
SPIN (logical reasoning system), 309
Spiropulu, M., 1018, *1056*
Spirtes, P., 747, *1062*
Spitkovsky, V. I., 840, *1062*
Spitzer, E., 995, *1055*
split point, **664**
Spronck, P., 176, *1039*
Sproull, R. F., 62, 558, *1043*
SQUAD (Stanford Question Answering Dataset), 25, 28, 880
square root, 49
Srebro, N., 1009, *1047*
SRI, 20, 278, 380, 558, 976
Srinivasa, S., 951, 963, 978, 979, *1042*, *1059*, *1067*
Srinivasan, M. V., 1013, *1044*
Srivastava, M., 309, *1062*
Srivastava, N., 787, *1062*
Srivastava, S., 597, *1062*
SSS* algorithm, 175
Staab, S., 339, *1062*
stability
of a controller, **953**
strict, **953**
stack (data structure), **74**
stacked generalization, **699**
Stader, J., 384, *1034*
STAGE (local search algorithm), 142
stage game, **614**
Stallman, R. M., 205, *1062*
STAN (probabilistic programming language), 458, 527
standard deviation, 173, **1028**
standardized problem, **66**
standardizing apart, **284**, 350
standard model, **4**
Stanfill, C., 717, *1062*
Stanford Parser, 853
Stanford University, 19, 22, 23, 27, 278, 649
Stanhope Demonstrator, 248
Staniland, J. R., 410, *1041*
Stanislawska, K., 143, *1062*
Stanley (autonomous vehicle), 972, 973, 977
StarCraft II, 28, 30, 147, 172, 179, 822
START (question-answering system), 850
Star Trek, 1007
start symbol, **1030**
state, **344**
repeated, **74**
world, 66
state-action-reward-state-action (SARSA), **802**
state abstraction, **355**, 821
state description, 68
state estimation, **132**, 169, 242, 247, **465**, 931
recursive, **132**, 466
States, D. J., 748, *1048*
state space, **65**
graph, 105, **147**
joint, **809**
metalevel, 103
static environment, **45**
stationarity, **665**
stationarity (for preferences), **566**
stationary distribution, **444**, 468
statistics, **8**, 1028
Statnikov, A. R., 719, *1046*
steepest ascent, **111**
Stefik, M., 343, 459, *1062*
Stein, C., 107, 1029, *1040*
Stein, J., 455, *1056*
Steinbach, M., 720, *1063*
Steinberg, R., 649, *1040*
Steiner, D. F., 30, *1062*
Steiner, W., 977, *1038*
Steinhardt, J., 1010, *1034*
Steinruecken, C., 719, *1062*
Stensrud, B., 311, *1063*
Stentz, A., 142, *1042*
Stepleton, T., 821, *1056*
step size, **121**

- stereogram, random dot, 921
 stereo vision, **927**
 Stergiou, K., 205, *1062*
 Stern, H. S., 748, *1045*
 Stickel, M. E., 248, 312, *1062*, *1067*
 stiction, **952**
 stiff neck, 399
 Stilller, L., 176, *1062*
 stimulus, 13, 881
 Stob, M., 716, *1057*
 stochastic beam search, **115**
 stochastic dominance, **541**, 557
 stochastic environment, **45**, 562
 stochastic gradient descent, **679**, 765
 stochastic gradient descent (SGD), **679**, 765
 stochastic local search, 141
 STOCKFISH (chess program), 160, 176, 177
 Stockman, G., 175, *1062*
 Stoffel, K., 339, *1062*
 Stoic school, 247
 Stokes, I., 384, *1034*
 Stolcke, A., 29, *1066*
 Stone, C. J., 716, *1038*
 Stone, M., 716, *1062*
 Stone, P., 27, 179, 649, 650, 822, 977, *1035*, *1046*, *1062*, *1063*
 stopping time, **583**
 Stork, D. G., 720, 749, *1043*
 Storvik, G., 499, *1063*
 Story, W. E., 106, *1049*
 Stoyanov, V., 876, 879, *1053*
 Strachey, C., 14, 17, 175, 177, *1063*, *1064*
 straight-line distance, **85**
 Strat, T. M., 459, *1060*
 strategic decision making, **600**
 strategy, 169, 606
 strategy-proof, **635**
 strategy profile, **606**
 Stratonovich, R. L., 497, 560, *1063*
 Straub, J., 822, *1060*
 Straw, A. D., 1013, *1044*
 strawberries, enjoy, 982
 strictly stable, **953**
 stride, **761**, 900
 Striebel, C. T., 497, *1059*
 string (in logic), **341**
 STRIPS (planning system), 380, 382, 383
 Strohm, G., 383, *1044*
 Strohman, T., 850, 854, *1040*
 Strohmman, T., 316, *1042*
 strong AI, **981**, 1005, 1006
 strong domination, **607**
 Stross, C., 12, *1042*
 structural equation, **450**
 structural estimation of MDPs, 821
 structured light, **928**
 structured representation, **59**, 63, 390
 Stuckey, P. J., 205, 312, *1049*, *1054*
 STUDENT (natural language system), 20
 stuff, **321**
 Stuhlmüller, A., 527, 821, *1060*, *1066*
 Stumpe, M. C., 30, *1046*, *1053*, *1062*
 stupid backoff, 828
 stupid pet tricks, 41
 Sturtevant, N. R., 88, 96, 108, 145, *1034*, *1039*, *1043*, *1048*, *1063*
 Stutz, J., 748, *1039*
 Stütze, T., 142, 206, *1042*, *1048*
 style transfer, **915**
 Su, H., 786, *1060*
 Su, Y., 107, *1042*
 subcategory, **317**, **841**
 subgame, **619**
 subgame perfect Nash equilibrium, **619**
 subgoal independence, **356**
 subjective case, 841
 subjectivism, **409**
 subproblem, **100**
 Subrahmanian, V. S., 176, *1057*
 Subramanian, D., 342, 1020, *1060*, *1063*
 substance, 321–322
 substitutability (of lotteries), **530**
 substitution (in first-order logic), **266**, 280
 subsumption
 in description logic, 331
 in resolution, **308**
 subsumption architecture, **969**
 subsumption lattice, 285
 successor-state axiom, **240**, 250
 successor node, **72**
 Suciú, D., 524, 527, *1041*, *1046*
 Sudderth, E., 512, 526, *1034*
 Sudholter, P., 648, *1058*
 Sudoku, **189**
 Suk, H.-I., 498, *1063*
 Sulawesi, 199
 SUMMATION, **1023**
 Summers-Stay, D., 910, *1046*
 summing out, 396, 431
 sum of squared differences (SSD), **893**
 Sun, A., 29, *1067*
 Sun, J., 786, *1047*
 Sun, R., 916, *1042*
 Sun, S., 316, *1042*
 Sun, Y., 879, *1063*
 SUNFISH (chess program), 176
 Sunstein, C., 560, *1063*
 Sunter, A., 525, *1043*
 superadditivity, **627**
 SUPERGLUE (natural language benchmark), 880
 Superman, 252
 supervised learning, **653**, 789, 804
 support vector machine (SVM), **692**, 692–696
 surely expanded nodes, **90**
 Suresh, A. T., 992, *1051*
 sure thing, 535
 survey propagation, **249**
 survival of the fittest, 498
 Sussman, G. J., 205, 380, *1062*, *1063*
 Sussman anomaly, 380
 Sutcliffe, G., 312, 313, *1063*
 Sutherland, G. L., 22, *1038*
 Sutherland, I., 204, *1063*
 Sutphen, S., 177, *1060*
 Sutskever, I., 26, 786, 787, 849, 858, 879, 880, 922, *1049*, *1051*, *1055*, *1059*, *1062*, *1063*
 Suttner, C., 313, *1063*
 Sutton, C., 855, *1063*
 Sutton, R. S., 62, 596, 598, 820–822, *1035*, *1063*
 Svartvik, J., 853, *1059*
 Svestka, P., 978, *1050*
 Svetnik, V. B., 498, *1066*
 SVM (support vector machine), **692**, 692–696
 Swade, D., 15, *1063*
 Swartout, W. R., 1009, *1056*
 Swartz, R., 338, *1038*
 Swayamdipta, S., 877, 879, *1046*, *1060*
 Sweeney, L., 991, 1009, *1063*
 Swerling, P., 497, *1063*
 Swersky, K., 995, *1066*
 Swetter, S. M., 30, *1043*
 Swift, T., 311, *1063*
 switching Kalman filter, **484**
 sybil attack, **507**
 syllogism, 3, 6, **247**
 SYMBA* (planning system), 381
 Symbolic Probabilistic Inference (SPI), 456
 symmetric players, **629**
 symmetry breaking (in CSPs), **203**
 symmetry reduction, **354**
 synapse, **12**
 synchronization (in multiagent systems), **602**
 syntactic ambiguity, **847**, 853
 syntactic category, **833**
 syntactic sugar, **268**
 syntactic theory (of knowledge), 341
 syntax, 23, **214**, 217
 of logic, 246
 of natural language, 833
 of probability, 392
 synthesis (by theorem provers), **309**
 of algorithms, 309
 SYNTHIA (simulated environment), 822
 Syrjänen, T., 342, *1056*
 systematic search, **75**
 SYSTRAN (machine translation software), 880
 Syverson, C., 998, *1038*

- Szafron, D., 647, 648, *1036, 1037, 1065*
 Szathmáry, E., 143, *1062*
 Szegedy, C., 309, 312, 786, 787, *1034, 1035, 1049, 1053, 1063*
 Szeliski, R., 924, *1063*
 Szepesvari, C., 176, 597, 822, *1051, 1063*
 Szerlip, P., 526, *1036*
 Szita, I., 176, *1039*
-
- T**
-
- T* (fluent holds), 323
 t-distributed stochastic neighbor embedding (t-SNE), **709**, 719
 T-SCHED (planning system), 384
 t-SNE (t-distributed stochastic neighbor embedding), **709**, 719
 T4 (planning system), 383
 T5 (natural language system), 877, 880
 TABLE-DRIVEN-AGENT, **48**
 Tableau (data analysis software), 709
 table lookup, **687**
 tabu search, **142**, 198
 tactile sensor, **928**
 Tadepalli, P., 561, 820, *1043, 1063*
 Taffjord, O., 850, *1040*
 tag (part of speech), 829
 tagging system (for images), **909**
 Tait, P. G., 106, *1063*
 Takusagawa, K. T., 527, *1058*
 Talos, 975, 1006
 Talukdar, P., 850, *1055*
 Tamaki, H., 311, *1063*
 Tambe, M., 207, *1057*
 Tammelin, O., 30, 178, *1037*
 Tan, P., 720, *1063*
 Tang, E., 1018, *1063*
 Tang, J., 822, *1038*
 tanh, **753**
 Tank, D. W., 11, *1057*
 Tardos, E., 648, *1057*
 Tarricone, R., 559, *1036*
 Tarski, A., 278, 279, 853, *1063*
 Tash, J. K., 597, *1063*
 task-oriented domain (in multiagent systems), **643**
 task announcement, **633**
 Taskar, B., 527, *1045*
 task environment, **42**, 60
 task planning (in robotics), **931**
 Tasmania, 199
 Tassa, Y., 822, 979, *1047, 1053, 1063*
 Tate, A., 359, 380, 382–384, *1034, 1036, 1063*
 Tatman, J. A., 596, *1063*
 Tattersall, C., 160, *1063*
 Tavener, S., 176, *1038*
 taxi, 42, 43, 385
 automated, 57, 210, 385, 1019
 taxonomic hierarchy, 23, **317**, 339
 Taylor, A. D., 648, *1063*
 Taylor, C., 923, *1041*
 Taylor, G., 311, *1063*
 Taylor, M., 339, *1062*
 Taylor, P., 849, *1063*
 Taylor, R., 979, *1053*
 Taylor, W., 206, *1039*
 Taylor expansion, **935**
 TD-GAMMON (backgammon program), 19, 178, 816
 technological unemployment, 976, **998**
 teddy bear, 982
 Tedrake, R., 979, *1063*
 Tegmark, M., 787, *1059*
 Teh, Y. W., 498, 786, *1048, 1057*
 telephone, 863
 telepresence robots, **971**
 Teller, A., 142, 457, *1055*
 Teller, E., 142, 457, *1055*
 Teller, S., 977, 979, *1037, 1063*
 Tellex, S., 979, *1063*
 Templeton Foundation, 986
 temporal-difference learning, 793–797, 818
 temporal inference, 465–473
 temporal invariance, 760
 temporal logic, **255**
 temporal projection, 249
 temporal reasoning, 126–134, 237–246, 322–325, 461–499
 Tenenbaum, J. B., 179, 278, 526, 527, 560, 821, *1035, 1044, 1046, 1051, 1052, 1063*
 Tennenholtz, M., 820, *1037*
 tennis, 603
 tense, **846**
 tensor, **763**
 TensorFlow, 720
 TensorFlow (machine learning software), 1009, 1021
 tensor processing unit (TPU), 15, 27, 763
 Teplyashin, D., 822, *1036*
 term (in logic), **259**, 259–260
 ter Meulen, A., 279, *1064*
 terminal state, **147**
 terminal symbol, 1030
 terminal test, **147**
 termination condition, 957
 term rewriting, 312
 Tesauro, G., 19, 176, 178, 804, 815, 816, 820, *1063*
 Tesla, 924, 973
 test set, **654**, 666
 Tetlock, P. E., 28, 338, *1063*
 TETRAD (machine learning software), 747
 Tetris, 572, 581
 Teukolsky, S. A., 142, *1058*
 text-to-speech, **849**
 text classification, **403**, 862
 TEXTRUNNER (information extraction system), 316, 850, 855
 texture, **892**
 texture gradient, 921
 Teyssier, M., 747, *1063*
 Thaler, R., 559, 560, *1063*
 Thayer, J. T., 109, *1063*
 thee and thou, 835
 Theocharous, G., 498, *1063*
 theorem, **267**
 incompleteness, 9, 305, 983
 theorem proving, 21, **222**, 298–309, 380
 thermostat, 16
 Theseus, 715
 Thiele, T., 497, *1063*
 Thielscher, M., 176, 250, 340, *1061, 1063*
 thingification, 317
 thinking humanly, 2
 thinking rationally, 3
 thinkism, **1005**
 Thirion, B., 720, *1058*
 Thitimajshima, P., 458, *1036*
 Thng, F., 30, *1062*
 Thomas, A., 458, 525, 747, *1045, 1054*
 Thomas, J., 720, *1040*
 Thomas, P. S., 821, *1063*
 Thomaz, A., 979, *1034, 1063*
 Thompson, B., 598, *1066*
 Thompson, E., 456, *1038, 1061*
 Thompson, K., 176, *1040, 1063*
 Thompson, W. R., 586, 597, *1063*
 Thompson sampling, **586**
 Thorndike, E., 819, *1063*
 Thornton, C., 719, *1064*
 Thorpe, C., 28, *1050*
 thought, 3, 19, **208**
 laws of, 3–4
 thrashing, **95**
 3-SAT, 248, 249, 290, 433
 threshold function, **683**
 Throop, T. A., 178, *1062*
 Thrun, S., 28, 30, 61, 498, 598, 719, 977–980, *1038, 1039, 1043, 1044, 1055, 1058, 1060, 1064*
 Thurstone, L. L., 526, *1064*
 Tian, H., 879, *1063*
 Tian, J., 455, *1064*
 Tiao, G. C., 747, *1037*
 Tibshirani, R., 717–720, 749, *1036, 1044, 1047, 1049*
 tic-tac-toe, 147, 175
 Tikhonov, A. N., 716, *1064*
 time, 461–499
 time (discrete), **462**
 time (in grammar), **846**
 time-of-flight camera, **928**
 time complexity, **75**, 105

- time interval, 340
time slice (in DBNs), **462**
time well spent, **1015**
Timofeev, A., 30, *1053*
Tinsley, M., 177
Tipping, M. E., 787, *1064*
Tirole, J., 648, *1044*
Tishby, N., 498, *1044*
Tit-for-Tat, **614**
Titterington, D. M., 748, *1064*
TMS (truth maintenance system), 206, **335**, 335–337, 342
Tobarra, L., 250, *1034*
Tobin, J., 979, *1034*
Todorov, E., 978, *1053*
Tohmé, F., 648, *1060*
tokenization, **825**
Tolpin, D., 597, 1019, *1047*
Toma, P., 880, *1064*
Tomasi, C., 923, *1064*
Tomlin, C. J., 821, *1034*
Tononi, G., 1007, *1057*
toothache, 386
Topcu, U., 341, 1014, *1053*
Topol, E., 30, *1053*, *1064*
topological ordering, **416**
topological sort, **199**, 200
Torbica, A., 559, *1036*
torque sensor, **929**
Torrallba, A., 381, 690, *1064*
Torras, C., 144, 383, *1049*
Toshev, A., 30, 879, *1064*
total cost, 104
touring problem, **70**
Toutanova, K., 879, *1042*
Tovey, C. A., 649, *1035*
TPTP (Thousands of Problems for Theorem Provers), 313
TPU (tensor processing unit), 15, 27, 763
tractability of inference, **9**, 332
tragedy of the commons, **637**, 1002
training, 666
training curve, **683**
training set, **653**, 666
 weighted, **699**
trajectory, **939**
trajectory tracking control, **939**, 978
Tramèr, F., 1009, *1064*
Tran, D., 526, *1064*
Tran-Gia, P., 1017, *1048*
transfer learning, 652, **781**, 871, 960, 1016
transformer decoder, **871**
transformer encoder, **871**
transformer model, 833, **868**
transhumanism, **1005**, 1010
transient failure, **487**
transient failure model, **488**
transition kernel, **444**
transition model, **52**, **65**, 105, 122, **147**, 238, 461, 464, 492, 496, 563, 595, 932
 sparse, 570
transitivity (of preferences), **530**
translation, *see* machine translation
transparency, **997**
transpose, **1026**
transposition (in a game), **155**
transposition table, **155**
Trappenberg, T., 788, *1064*
traveling salesperson problem (TSP), 70, 107, 109
Traverso, P., 381, 383, 384, *1036*, *1040*, *1045*
treasure hunt, **551**
TREC (Text REtrieval Conference), 850
tree, 199
TREE-CSP-SOLVER, **200**
tree-like search, **74**
treebank, 839, 851
 Penn, **829**, 839, 877
tree decomposition, **201**, 204
tree width, **202**, 204, 206, 434
Treichler, S., 30, *1052*
trial (in reinforcement learning), **792**
triangle inequality, **88**
trichromacy, **888**
Trick, M. A., 649, *1035*
Triggs, B., 922, *1041*
Trivedi, H., 30, *1042*
Troyanskii, P., 880
Truby, R. L., 1013, *1051*, *1056*
true concurrency, **602**
true majority rule voting, **640**
trust, 710, **996**, 1009
trust region policy optimization, 821
Truszkowski, P., 30, *1062*
truth, **214**, 260
truth-preserving inference, **216**
truth-revealing, **635**
truth maintenance system (TMS), 206, **335**, 335–337, 342
 assumption-based, **336**
 justification-based, **336**
truth table, **219**, 248
truth value, **218**
Tsang, E., 206, 207, *1048*, *1064*
Tse, D., 787, *1067*
Tshitoyan, V., 872, *1064*
Tsipras, D., 787, *1039*
Tsitsiklis, J. N., 410, 596, 598, 805, 820–822, 1029, *1036*, *1054*, *1057*, *1064*
TSP (traveling salesperson problem), 70, 107, 109
Tsuruoka, Y., 1021, *1047*
TT-CHECK-ALL, **221**
TT-ENTAILS?, **221**
Tuberg, D., 456, *1061*
Tukey, J. W., 708, 719, *1064*
Tulsiani, M., 913, *1050*
Tumer, K., 649, *1064*
Tung, F., 497, *1059*
tuple, **256**
turbo decoding, **458**
Turian, J., 878, *1064*
Turing, A., ix, 2, 9, 14, 17, 19, 33, 56, 175, 282, 310, 454, 715, 785, 819, 981–984, 986, 1006, 1010, 1020, 1022, *1064*
Turing Award, 341, 652, 788, 1029
Turing machine, 9, 716
Turing test, **2**, 2, 4, 823, 984, 1006
 total, **2**
turtle, 976
Tversky, A., 418, 538, 560, *1044*, *1049*, *1064*
two-finger Morra, 605
2001: A Space Odyssey, 454
Tygar, J. D., 1010, *1035*, *1064*
Type A strategy, **155**
Type B strategy, **155**
type signature, **503**
typical instance, 320
Tzemach, A., 456, *1061*
-
- U**
- U* (utility), 529
 u_{\top} (best prize), 533
 u_{\perp} (worst catastrophe), 533
UAV (unmanned aerial vehicle), 927
Uber, 924
UCB1 (upper confidence bound), **163**
UCPOP (planning system), 380
UCT (game-tree search algorithm), **163**
Udluft, S., 821, *1047*
UI (Universal Instantiation), **280**
Ulam, S., 176, *1055*
Ullman, J. D., 311, *1035*, *1064*
Ullman, S., 922, 923, *1048*, *1064*
ULMFIT (natural language software), 879
ultimatum game, **642**
ultraintelligent machine, **1004**
unbalanced classes, **707**
unbiased (estimator), **536**
unbounded-cost search, **92**
uncertain reasoning, 386
uncertainty, 23, 315, 385–411
 existence, **507**
 identity, **507**
 relational, **505**
 rule-based approach to, 459
 summarizing, 386
 and time, 461–465
unconditional probability, *see* probability, prior

- underfitting, **655**
 undergeneration, **835**
 undersampling, **707**
 unification, **283**, 283–284, 309, 310
 and equality, 306
 equational, **307**
 unifier, **283**
 most general (MGU), 284, 286, 306
 UNIFORM-COST-SEARCH, **77**
 uniform-cost search, **77**, 77–78, 105
 uniform convergence theory, 717
 uniform distribution, 391, **1029**
 uniform prior, 724
 UNIFY, **285**
 UNIFY-VAR, **285**
 UNIMATE (robot arm), 976
 uninformative prior, **733**
 uninformed search, 63, 76–84, 105, 107
 unintended side effect, **1002**
 unique names assumption, 264, 502
 unit (in neural networks), **751**
 unit clause, **226**, 233, 308
 United Nations, 31
 United States, 13, 14, 533, 999
 unit preference (in resolution), **308**
 unit propagation, **233**
 unit resolution, **225**, 308
 units function, **319**
 universal approximation, 752
 Universal Dependencies (natural language data set), 839
 universal grammar, **854**
 Universal Instantiation (UI), **280**
 universal plan, 383
 universal quantifier, **261**
 unknown word, 827
 unmanned aerial vehicle (UAV), 927
 unobservability, 51
 UNPOP (planning system), 380
 unrolling, 490, **506**
 unsatisfiability, 246
 unsupervised learning, **653**, 738–740
 unsupervised parsing, **840**
 UOSAT-II (satellite), 384
 update (in temporal reasoning), 130, 132, 133, 466–468
 upper confidence bound (UCB), **585**
 upper ontology, 337
 Urban, J., 312, *1034*
 Urban Challenge, 977
 Urmson, C., 977, *1064*
 urn-and-ball model, 722
 Usher, J. M., 339, *1044*
 Usher, N., 1018, *1042*
 Uszkoreit, J., 850, 868, 880, *1064*
 utilitarianism, **8**
 utilitarian social welfare, 609
 utility, **7**, 54, 387
 adaptive, **561**
 axioms of, 531
 estimation, **792**
 expected, **55**, 62, 387, 528, **529**, 534
 function, **54**, 55, 147, 529, 532–539
 independence, **544**
 of money, 534–536
 multiattribute, 540–544, 557
 multiplicative, **544**
 node, **545**
 normalized, **533**
 ordinal, **532**
 theory, 10, **387**, 529–532, 557
 utility-based agent, 55
 utopia, 1022
 UWL (planning system), 383
-
- V**
-
- vacuum tube, 17
 vacuum world, 37, 39
 erratic, 122
 kindergarten, 132
 slippery, 125
 VAE, *see* autoencoder, variational
 vagueness, 459, 824
 Valdés, V., 822, *1036*
 Valiant, L., 717, *1064*
 validation set, **666**
 validity, **222**, 246
 Vallati, M., 381, *1064*
 value (of a variable), **59**
 in a CSP, 180
 VALUE-ITERATION, **573**
 value alignment problem, **5**, **1003**
 value function, **532**
 additive, **543**
 value iteration, **572**, 572–576, 595
 point-based, 598
 value node, *see* utility node
 value of computation, 1019
 value of information, 547–553, 557, 589, 1019
 value of perfect information (VPI), **548**
 value symmetry, **203**
 value vector (in transformers), **869**
 VAMPIRE (theorem prover), 312, 313
 van Beek, P., 204–207, 340, 381, *1035*, *1051*, *1060*, *1064*
 van Bentham, J., 279, *1064*
 Vandenbergh, L., 143, *1037*
 van Doorn, A. J., 923, *1051*
 van Harmelen, F., 343, *1064*
 van Heijenoort, J., 313, *1064*
 van Hoes, W.-J., 205, *1064*
 Vanhoucke, V., 849, 854, 978, *1037*, *1048*
 vanishing gradient, 863
 vanishing point, **884**
 van Kleef, P., 339, *1052*
 van Lambalgen, M., 340, *1064*
 van Maaren, H., 249, *1036*
 van Nunen, J. A. E. E., 596, *1064*
 van Run, P., 207, *1035*
 Vanschoren, J., 719, *1048*
 Van den Broeck, G., 527, *1046*, *1050*
 van den Driessche, G., 27, 30, *1061*
 van den Oord, A., 29, 779, 787, 849, *1064*
 van der Gaag, L., 410, *1053*
 van der Maaten, L., 1009, *1046*
 Van Gysel, C., 850, *1034*
 Van Hentenryck, P., 205, *1064*
 Van Ooyen, B., 852, *1038*
 Van Roy, B., 805, 820, *1064*
 Van Roy, P. L., 294, 311, *1064*
 Vapnik, V. N., 26, 717, 718, 720, 786, 922, *1037*, *1040*, *1052*, *1064*
 Varaiya, P., 61, 822, *1044*, *1051*
 Vardi, M. Y., 341, *1043*, *1064*
 variable, **59**
 atemporal, **238**
 elimination, **430**, 430–433, 454, 456, 490
 in a CSP, 180
 in continuous state space, **120**
 indicator, **740**
 irrelevant, 433
 in logic, **261**
 ordering, 193, 432
 random, 390, 417
 Bernoulli, 390
 Boolean, 390
 continuous, 391, 422, 455
 unmodeled, **451**
 Varian, H. R., 29, 649, 719, *1054*, *1059*, *1064*
 variance, **655**, 670, **1028**
 variational approximation, 458
 variational autoencoder, 787
 variational lower bound, **778**
 variational parameter, 458
 variational posterior, **778**
 Varoquaux, G., 720, *1058*
 Varshney, K. R., 995, 996, 1009, 1010, *1036*, *1047*
 Varshney, L., 880, *1050*
 Varzi, A., 340, *1039*
 Vasilache, N., 1018, *1064*
 Vasserman, L., 995, *1055*
 Vaswani, A., 850, 868, 880, *1064*
 Vaucanson, J., 976
 Vaughan, J. W., 995, *1045*
 Vazirani, U., 142, 720, *1034*, *1050*
 Vazirani, V., 648, *1057*
 Vazquez, D., 822, *1059*
 VC dimension, **717**
 Vckay, E., 822, *1049*
 Veach, E., 457, *1064*
 Vecchi, M. P., 142, 206, *1050*
 Vecchione, B., 995, *1045*

- vector, **1025**
vector field histogram, **978**
Veeramachaneni, K., 719, *1050*
Veinott, A. F., 597, *1050*
Veit, A., 1009, *1035*
Velooso, M., 179, 979, *1034*, *1061*
Veness, J., 598, 820, 822, *1036*, *1055*, *1061*
Venkataraman, S., 597, *1046*
Venkatesh, S., 411, *1064*
Venn, J., 409
Venugopal, A., 880, *1067*
Venugopalan, S., 30, *1046*, *1053*
Vere, S. A., 383, *1064*
verification, **309**
 hardware, 276
verification and validation, **996**
Verma, S., 1009, *1064*
Verma, T., 455, 456, 747, *1045*, *1057*
Verma, V., 498, *1064*
Verweij, G., 998, *1059*
Vetterling, W. T., 142, *1058*
Vickrey, W., 636
Vickrey–Clarke–Groves mechanism (VCG), **638**
video game, 179
 Atari, 28, 178, 784, 816
Viegas, E., 719, *1046*
Viégas, F., 719, *1065*
Vienna Circle, 7
Vig, L., 990, *1054*
Vihma, T., 143, *1062*
Vincent, P., 878, *1036*
Vinge, V., 12, *1064*
Vinyals, O., 30, 179, 716, 779, 786, 787, 822, 849, 878–880, *1046*, *1049*, *1053*, *1063*, *1064*, *1067*
Viola, P., 922, *1064*
Virasoro, M., 142, *1055*
Virochsiri, K., 822, *1045*
virtual count, **731**
visibility graph, **943**, **978**
vision, 2, 12, 20, 204, 882–919
Visser, U., 179, *1064*
Visser, W., 309, *1047*
visual programming, **968**
Vitali set, 393
Vitányi, P., 717, *1053*
Viterbi, A. J., 497, *1064*
Viterbi algorithm, **473**, **830**
Vlassis, N., 598, 650, *1062*, *1065*
Vlimant, J.-R., 1018, *1056*
VLSI layout, 70, 107, 115
Vogt, D. M., 1013, *1056*
Volk, K., 748, *1045*
von Mises, R., 409, *1065*
von Neumann, J., 10, 16, 17, 531, 558, 647, 648, *1065*
von Stengel, B., 621, 647, *1051*
von Winterfeldt, D., 558, *1065*
von Linne, C., 339
Vorhees, E., 850, *1034*
Voronkov, A., 279, 312, 313, *1059*
Voronoi diagram, **944**
Voronoi graph, **944**
Vossen, T., 381, *1065*
voted perceptron, 718
voting, 640
VPI (value of perfect information), **548**
VQA (question answering visual), 28, **910**
-
- W**
-
- Wadsworth, C. P., 278, *1046*
wafer scale engine (WSE), 15
Wagner, D., 108, *1042*
Wagner, S. K., 30, *1053*
Wahba, G., 716, *1046*
Wainwright, M., 249, 458, 822, *1036*, *1054*, *1065*
Waldinger, R., 278, 279, *1054*
Walker, E., 29, *1040*
Walker, G., 787, *1065*
Walker, H., 748, *1045*
Walker, R. J., 205, *1065*
WALKSAT, **235**
Wall, R., 853, *1042*
Wallace, A. R., 118, *1065*
Wallach, H. M., 995, *1045*
Walpole, R. E., 411, *1065*
Walras, L., 10
Walsh, M. J., 143, *1044*
Walsh, T., 205, 207, 249, 998, *1036*, *1060*, *1062*, *1065*
Walsh, W., 649, *1065*
Walter, G., 976
Walter, M. R., 979, *1063*
Waltz, D., 20, 204, 717, *1062*, *1065*
WAM (Warren Abstract Machine), 311
Wang, A., 879, 880, *1065*
Wang, D. Z., 850, 855, *1038*
Wang, E., 342, *1063*
Wang, H., 879, *1063*
Wang, J., 176, *1065*
Wang, L., 786, *1042*
Wang, S., 879, *1063*
Wang, T., 15, 1018, *1066*
Wang, Z., 821, *1066*
Wanner, E., 253, *1065*
Ward, T., 822, *1036*
Warde-Farley, D., 787, *1046*
Warmuth, M., 106, 717, *1037*, *1059*
Warner, C., 852, *1036*
WARPLAN (planning system), 380
Warren, D. H. D., 294, 311, 380, *1058*, *1065*
Warren, D. S., 311, *1063*
Warren Abstract Machine (WAM), 311
Washington, G., 325
wasp, sphex, 41, 374
Wasserman, L., 720, *1065*
watched literal, **248**
Watkins, C. J., 596, 820, *1065*
Watson (question-answering system), 26
Watson, J., 13
Watson, J.-P., 206, *1036*
Watson, J. D., 118, *1065*
Watt, J., 16
Wattenberg, M., 143, 719, *1049*, *1065*
Watts, M., 1013, *1058*
Waugh, K., 30, 178, 648, *1056*, *1065*
WaveNet, 779, 787
WaveNet (speech generation software), 849
Way, D. H., 30, *1053*
Waymo, 28, 924, 972, 973
Wayne, G., 979, *1047*
Wayne, K., 1029, *1061*
WBRIDGE5 (bridge program), 178
weak AI, **981**, 1005, 1006
weak domination, **607**
weakly supervised learning, **705**, 1017
weak method, **22**
weapon
 lethal autonomous, 1008
 lethal autonomous, 31, 987
Weaver, W., 661, 715, 720, 851, 880, *1061*
Weber, J., 498, *1048*
Webster, D. R., 30, *1053*
Wefald, E. H., 109, 175, 1019, *1060*
Wegbreit, B., 977, *1055*
Weglarz, J., 384, *1037*
Wei, J. N., 920, *1060*
Wei, X., 855, *1058*
Weibull, J., 648, *1065*
Weidenbach, C., 312, *1065*
weight, **676**
weight decay, **771**
WEIGHTED-SAMPLE, **440**
weighted A* search, **91**
weighted linear function, **157**
weight space, **677**
Weinstein, S., 716, *1057*
Weiss, D., 853, *1034*
Weiss, G., 62, 650, *1065*
Weiss, R., 720, 849, *1039*, *1058*
Weiss, S., 852, *1034*
Weiss, Y., 458, 499, 690, *1056*, *1064*–*1066*
Weissbrod, O., 456, *1061*
Weissman, V., 278, *1046*
Weizenbaum, J., 1001, *1065*
Weld, D. S., 144, 339, 342, 380–384, 854, 855, 1008, *1040*, *1043*, *1052*, *1058*, *1062*, *1065*, *1066*

- Welinder, P., 979, *1034*
 well calibrated, **993**
 Welling, M., 787, *1050*
 Wellman, M. P., 455, 460, 498, 525, 559,
 596, 648, 649, 978, *1041, 1048,*
1065
 Welty, C., 30, 339, *1043, 1062*
 Wen, M., 341, 1014, *1053*
 Werbos, P., 596, 597, 785, 786, 820, *1065*
 Wermuth, N., 455, *1052*
 Werneck, R. F., 108, *1045*
 Wertheimer, M., 921
 Wesley, M. A., 978, *1065*
 West, Col., 287
 West, D. M., 1011, *1065*
 West, M., 499, *1053*
 West, S. M., 995, *1065*
 Westinghouse, 383
 Weston, L., 872, *1064*
 Wexler, Y., 456, *1065*
 Weymouth, T., 976, *1040*
 Wheatstone, C., 921, *1065*
 White, C., 787, *1065*
 White, J., 720, *1040*
 White, J. L., 309, *1047*
 Whitehead, A. N., 17, 310, *1065*
 Whitehouse, D., 176, *1038*
 Whiter, A. M., 383, *1063*
 Whitney, W. F., 179, *1044*
 Whittaker, M., 995, *1065*
 Whittaker, W., 28, 977, *1050, 1064*
 Whittle, P., 581, *1065*
 Whorf, B., 252, 278, *1065*
 Widner, K., 30, *1046*
 Widrow, B., 21, 785, 819, *1065*
 Widrow–Hoff rule, **804**
 Wiedijk, F., 313, *1065*
 Wiegley, J., 144, *1065*
 Wiener, N., 16, 18, 33, 39, 175, 497, 785,
 880, 1008, 1011, *1059, 1065*
 Wierstra, D., 784, 787, 790, 820, 822,
 979, *1053, 1055, 1059*
 Wiesel, T. N., 786, 922, *1048*
 wiggly belief state, 243
 Wijmans, E., 822, *1060*
 Wikipedia, 316, 823, 825
 Wilcox, S., 309, *1035*
 Wild, P. P., 457, *1045*
 Wildes, R. P., 1013, *1050*
 Wilensky, R., 23, *1065*
 Wilfong, G. T., 976, *1040*
 Wilkins, D. E., 383, *1065*
 Wilks, Y., 1010, 1011, *1065*
 Williams, A., 880, *1065*
 Williams, B., 249, 342, 384, *1056, 1065*
 Williams, C. K. I., 748, *1059*
 Williams, J., 598, *1066*
 Williams, R. J., 596, 785, 786, 812, 820,
 821, *1058, 1060, 1065*
 Williamson, J., 340, *1056*
 Williamson, M., 383, *1043*
 Willighagen, E. L., 340, *1056*
 Wilmer, E. L., 497, *1052*
 Wilson, A., 852, *1052*
 Wilson, D. H., 1001, *1065*
 Wilson, R., 204, *1065*
 Wilson, R. A., 3, 1007, *1065*
 Wilt, C. M., 108, *1066*
 Wiltschko, A. B., 920, *1060*
 Windows (operating system), 455
 Winfield, A., 142, 997, *1038, 1042*
 Wingate, D., 527, 596, *1066*
 Winikoff, M., 61, *1057*
 Winker, S., 313, *1066*
 Winkler, R. L., 537, 559, *1062*
 winner’s curse, **559**
 Winograd, S., 20, *1066*
 Winograd, T., 20, 23, 854, *1066*
 Winograd Schema Challenge, 877
 Winston, P. H., 20, 32, *1036, 1066*
 Wintermute, S., 311, *1066*
 Winternitz, L., 29, *1066*
 Witbrock, M., 339, *1054*
 Witten, D., 720, *1049*
 Witten, I. H., 720, 820, 851, 852, *1066*
 Witten–Bell smoothing, 851
 Wittgenstein, L., 7, 216, 248, 249, 320,
 339, *1066*
 Wohlhart, P., 978, *1037*
 Wojciechowski, W. S., 309, *1066*
 Wojcik, A. S., 309, *1066*
 Wolf, A., 853, *1046*
 Wolf, T., 879, *1060*
 Wolfe, J., 144, 176, 382, *1054, 1060,*
1066
 Wolpert, D., 649, 715, *1064, 1066*
 Wolsey, L. A., 561, *1056*
 Wolski, F., 979, *1034*
 Wong, C., 719, *1066*
 Wong, K. W., 984, *1049*
 Wong, W.-K., 747, *1056*
 Wood, D. E., 108, *1052*
 Wood, F., 457, 498, 527, *1052, 1057*
 Wood, R. J., 1013, *1056*
 Woodruff, A., 1009, *1036*
 Woods, W. A., 341, 854, *1066*
 Wooldridge, M., 61, 62, 648, 650, *1039,*
1040, 1059, 1066
 Woolsey, K., 816
 word, 403, 824
 out-of-vocabulary, 827
 WORD2VEC (word embedding software),
 857, 875, 878
 word embedding, 783, 828, **857**
 positional, **870**
 WordNet, **828**
 WordNet (lexical database), 339
 work, future of, 998–1000
 workspace, **939**
 world model, in disambiguation, 848
 world state, 66
 World War II, 10, 454, 497
 worst possible catastrophe, 533
 Worswick, S., 1006
 Wos, L., 312, 313, *1066*
 Wossnig, L., 1018, *1042*
 Wray, R. E., 311, *1066*
 Wright, S., 143, 454, *1066*
 WSE (wafer scale engine), 15
 Wu, D., 30, *1046*
 Wu, E., 850, 855, *1038*
 Wu, F., 339, *1066*
 Wu, H., 879, *1063*
 Wu, I.-C., 176, *1065*
 Wu, J., 879, *1059*
 Wu, L., 29, *1066*
 Wu, S., 995, *1055*
 Wu, Y., 29, 499, 527, 783, 786, 849, 850,
 865, 878, 995, *1039, 1043, 1049,*
1066
 wumpus world, **210**, 210–213, 220, 250,
 270–271, 315, 404–408, 833
 Wundt, W., 12, 920
 Wurman, P., 649, *1065*
-
- X**
-
- XAI (explainable AI), 719, **997**
 XCON (expert system), 292
 Xiong, C., 880, 1021, *1047, 1050*
 Xiong, W., 29, *1066*
 XLM (multilingual language model), 879
 XLNET (natural language system), 879
 xor, 219
 Xu, B., 787, *1046*
 Xu, J., 311, *1066*
 Xu, P., 852, 880, *1037*
-
- Y**
-
- Yahtzee, 168
 Yakimovsky, Y., 558, *1043*
 Yale, 23
 Yampolskiy, R. V., 1010, *1066*
 Yan, D., 383, *1044*
 Yang, B., 850, *1055*
 Yang, G., 498, *1066*
 Yang, X.-S., 142, *1066*
 Yang, Y., 787, 879, *1053, 1066*
 Yang, Z., 879, *1066*
 Yannakakis, M., 144, 206, *1036, 1057*
 Yao, L., 29, *1067*
 Yao, X., 142, *1053*
 Yap, R. H. C., 312, *1049*
 Yarowsky, D., 26, 855, *1066*
 Yates, A., 855, *1043*
 Ye, K. E., 411, *1065*
 Ye, N., 598, *1035*

- Ye, X., 822, 1045
 Ye, Y., 596, 1066
 Yedidia, J., 458, 1066
 Yeo, H.-S., 1013, 1066
 Ying, C., 15, 1018, 1066
 Yip, K. M.-K., 342, 1066
 Yngve, V., 853, 1066
 Yob, G., 250, 1066
 Yoon, C. J. M., 1009, 1044
 York, S., 822, 1036
 Yoshida, Y., 786, 1055
 Yoshikawa, T., 978, 1066
 You, Y., 821, 1066
 Young, C., 652, 1018, 1041, 1049
 Young, H. P., 650, 1066
 Young, S., 598, 1066
 Young, T., 888
 Younger, D. H., 835, 853, 1066
 Yu, B., 455, 1039
 Yu, D., 788, 849, 854, 1042, 1048, 1066
 Yu, F. X., 992, 1051
 Yu, H.-F., 718, 1066
 Yu, K., 787, 1066
 Yudkowsky, E., 33, 1010, 1066
 Yule, G. U., 787, 1066
 Yule–Walker equations, **779**
 Yvanovich, M., 384, 1041
-
- Z**
- Z-3 (early computer), 14
 Zadeh, L. A., 459, 460, 1066
 Zadeh, R. B., 720, 1059
 Zahavi, U., 88, 1043
 Zaldivar, A., 995, 1055
 Zapp, A., 28, 923, 977, 1042
 Zaremba, W., 787, 822, 979, 1034, 1038, 1049, 1063
 Zaritskii, V. S., 498, 1066
 Zaykov, Y., 526, 1055
 Zecchina, R., 249, 1057
 Zeckhauser, R., 559, 1066
 Zeeberg, A., 782, 1066
 Zeilinger, M. N., 821, 1034
 Zelle, J., 854, 1066
 Zemel, R., 995, 1009, 1043, 1066
 Zemelman, B. V., 11, 1067
 Zen, H., 779, 787, 849, 1064
 Zeng, H., 278, 1055
 Zermelo, E., 647, 1067
 zero-sum game, **147**, 600, **610**
 Zettlemoyer, L., 527, 845, 854, 876, 879, 1053, 1055, 1058, 1067
 Zeuthen strategy, **644**
 Zhai, X., 786, 1042
 Zhang, B., 28, 1046
 Zhang, C., 716, 1067
 Zhang, F., 1009, 1064
 Zhang, H., 248, 1067
 Zhang, J., 880, 1059
 Zhang, L., 206, 248, 456, 1056, 1067
 Zhang, M., 853, 1067
 Zhang, N. L., 456, 1067
 Zhang, S., 29, 849, 1067
 Zhang, T. W., 979, 1063
 Zhang, W., 109, 316, 1042, 1051
 Zhang, X., 786, 852, 1047, 1067
 Zhang, Y., 849, 850, 853, 855, 996, 1009, 1036, 1038, 1067
 Zhang, Z., 88, 1043
 Zhao, J., 852, 1067
 Zhao, K., 845, 853, 854, 1045, 1067
 Zhao, Y., 206, 248, 822, 1056, 1060
 Zhao, Z., 916, 1042
 Zhou, K., 560, 1067
 Zhou, R., 109, 1067
 Zhou, T., 914, 1049
 Zhou, Y., 879, 1059
 Zhu, B., 787, 1067
 Zhu, C., 717, 1038
 Zhu, D. J., 977, 1067
 Zhu, J., 853, 1067
 Zhu, J.-Y., 879, 914, 915, 1049, 1067
 Zhu, M., 853, 1067
 Zhu, T., 176, 1065
 Zhu, W. L., 316, 1062
 Ziebart, B. D., 817, 963, 979, 1067
 Zilberstein, S., 144, 371, 383, 1047
 Zilles, S., 96, 108, 109, 1034, 1039, 1043, 1052
 Zimdars, A., 647, 1060
 Zimmermann, H.-J., 459, 1067
 Zinkevich, M., 647, 966, 1059, 1067
 Zipf’s Law, 878
 Zipf, G., 878, 1067
 Zipser, D., 786, 1065
 Zisserman, A., 716, 923, 924, 1036, 1047, 1056
 Zlot, R., 142, 1042
 Zlotkin, G., 649, 650, 1060
 Zobrist, A. L., 177, 1067
 Zollmann, A., 880, 1067
 Zoph, B., 787, 1058, 1067
 Zucker, M., 951, 978, 1059
 Zuckerman, D., 114, 1053
 Zufferey, J. C., 1013, 1044
 Zuse, K., 14, 175, 1067
 Zweben, M., 384, 1041
 Zweig, G., 498, 1067
 Zwicker, W. S., 648, 1063
 zyzzyva, 825