

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
- \sqcup (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*
 Andreae, 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*
 Arnould, 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*
 Arulkumaran, 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
 Banchilhon, 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**
 Bangera, 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**
 Benzmüller, 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
 Boyen–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
 Chociej, 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
 Chrpa, 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
cryptarithmetic, 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 Farias, 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*
 Druzdzel, 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 playout 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*
 Elskens, 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
 categorial, 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

- Harabagiu, 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
 HARPY (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
 Hendeby, 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
 Leong, 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
 Kaliszyk, 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
 Kavraki, 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*
 Klempner, 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*
 Kuppuswamy, 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*
 Larochelle, 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**