

RN, Chapter
2—5



Search Summary



Search Summary #1

- Problem Solving as Search
- Blind Search Techniques
 - Breadth-first (uniform cost)
 - Depth-first
 - “Iterative Deepening”
 - Bi-Directional
 - Time/ Space Complexity:
Size of search space: $\approx 10^{11}$ nodes



Search Summary #2

- Heuristic Search Techniques
 - ... using “Distance to Goal”
 - Best-First
 - A*: provably optimal!
Search space $\approx 10^{25}$ nodes (IDA*)
 - Heuristic Functions



Search Summary #3

- Constraint Satisfaction Problems
 - Intro CSP (Def'n, Types, Examples)
 - Complexity
 - Tricks for "Grow" approach
 - (arc) consistency + propagation
 - Backward checking (DFS)
 - Forward Checking
 - Variable / Value ordering
 - Constraint *Optimization* Problems



Search Summary #4

- Iterative Algorithms
 - Framework, Examples
 - Hill-climbing / Gradient Descent
 - Problem / Issues
 - GSAT, WalkSat
 - Other approaches
 - Simulated Annealing, Tabu, Random Restarts, Genetic Algorithms
- ⇒ Search space $\approx 10^{100}$ to 10^{1000}



Search Summary #5

- Adversary Search / Game Playing
 - Minimax
 - $\approx 10^{10}$ nodes, 6-7 ply in chess
 - Alpha-beta Pruning
 - $\approx 10^{20}$ nodes, 14 ply in chess
 - provably “optimal”



Other Topics

- wrt Search
 - Iterative BROADENING
 - Memory Bounded Search – SMA*
 - Beam Search
 - Island Hopping – abstraction
 - ...
- wrt CSPs
 - Backjump
 - Dynamic Orderings
 - Special cases (eg, when arc-consistency is sufficient)



Search and AI

Q: Why such a central role?

A: As many AI tasks are
ill-specified and/or **intractable**,
Search is ONLY approach

- Many applications of search:
Learning, Reasoning, Planning, Design,
GamesPlaying, NLU, Vision, ...
- Good news:
Tremendous recent progress
 10^{30} feasible; often to 10^{1000}
- QUALITATIVE DIFFERENCE from only a few
years ago!!