Search / Criteria	BreadthFirst	DepthFirst	IterativeDeepening
Completeness?	Yes	No	Yes
Optimality?	Yes	No	Yes
Time	b^d	b^m	b^d
Space	b^d b^d	bm bm	bd bd

b - maximum branching factor of the search tree

d - depth of the least-cost solution

m - maximum depth of state space (may be ∞)

Properties of Greedy Best-First – without *g*

Complete ?? No, can get stuck in loops

Optimal?? No

Time complexity ?? $O(b^m)$

Space complexity ?? $O(b^m)$, keep all nodes in memory

Properties of A*

- h(n) never overestimate cost

Complete ?? Yes

Optimal?? Yes - *if h(n) is both admissible & consistent for graph*

Time complexity ?? $O(b^m)$

Space complexity ?? $O(b^m)$, keep all nodes in memory

Criteria	Characteristics
completeness	does it always find a solution if one exists?
optimality	does it always find a least-cost solution?
time complexity	number of nodes generated/expanded
space complexity	maximum number of nodes in memory

Main issue of A* : run out of memory - not practical for many large scale problems

Properties of Minimax

有限

Complete ?? Yes, if tree is finite (Chess has specific rules)
Optimal?? Yes, against an optimal opponent
Time complexity ?? $O(b^m)$
Space complexity ?? $O(b*m)$ (depth-first exploration)

Chess: b =35, m=100 for 'reasonable" games
⇒ Exact solution completely infeasible

But do we need to explore every path ?
=> Search efficiency is crucial

Properties of Alpha-beta

Pruning **does not** affect final result

time $b^{\frac{m}{2}}$

Good move ordering improves effectiveness of pruning

With "perfect ordering," time complexity $= O(b^{m/2})$
⇒ **doubles** solvable depth

A simple example of the value of reasoning about which computations are relevant (a form of metareasoning)

Unfortunately, 35^{50} is still impossible!

When Brute Force Minimax/Alpha-Beta are no longer applicable, how could it possibly "plan" ahead when there are so many potential moves and counter moves in GO?

	complete	optimal	time	space
BFS	Yes	Yes	b^d	b^d
DFS	No	No	b^m	$b \cdot m$
IDS	Yes	Yes	b^d	$b \cdot d$
Greedy-BF	No	No	b^m	b^m
A*	Yes	Yes	b^m	b^m if h(n) admissiable
Minimax	Yes	Yes	b^m	$b \cdot m$ (类 DFS)
α-β prune	Yes	Yes	$b^{\frac{m}{2}}$	$b \cdot m$