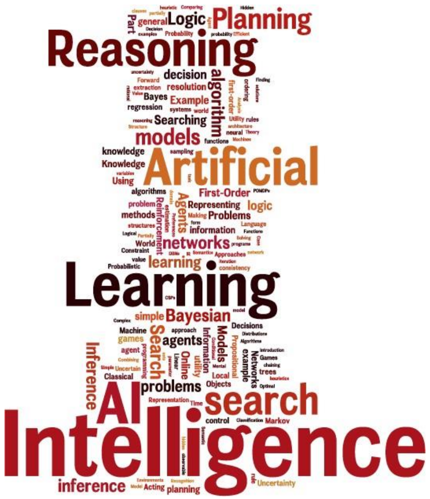
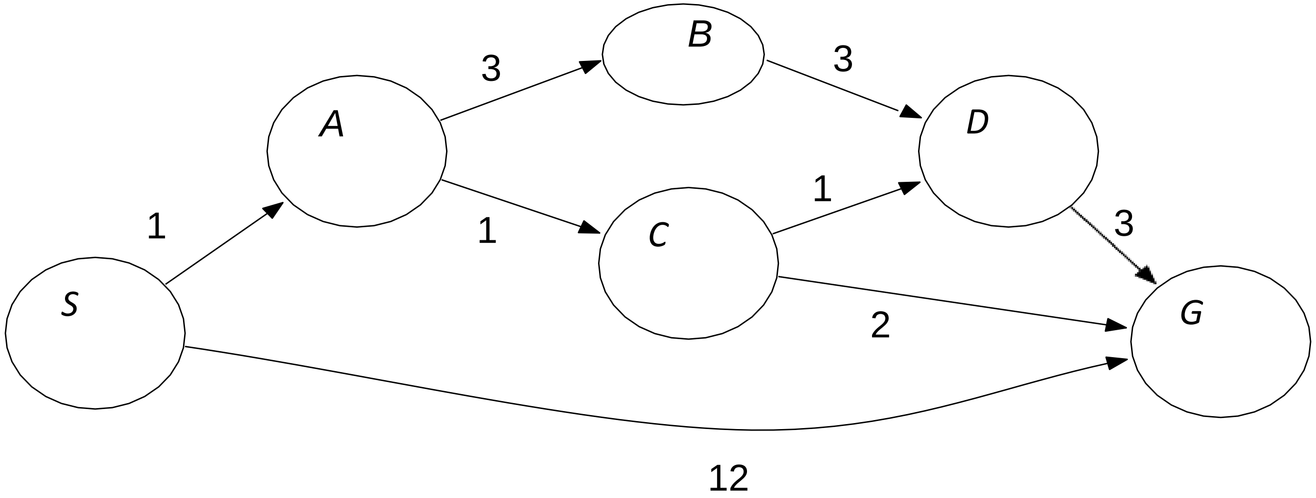
Search Exercise





Answer the following questions about the search problem shown above. Break any ties alphabetically. For the questions that ask for a path, please give your answers in the form '$S - A - D - G$.'

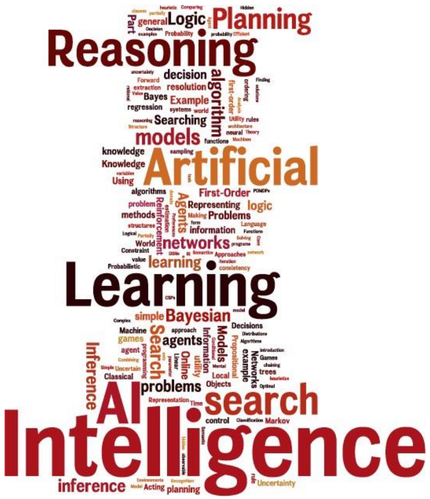
(a) What path would breadth-first graph search return for this search problem?

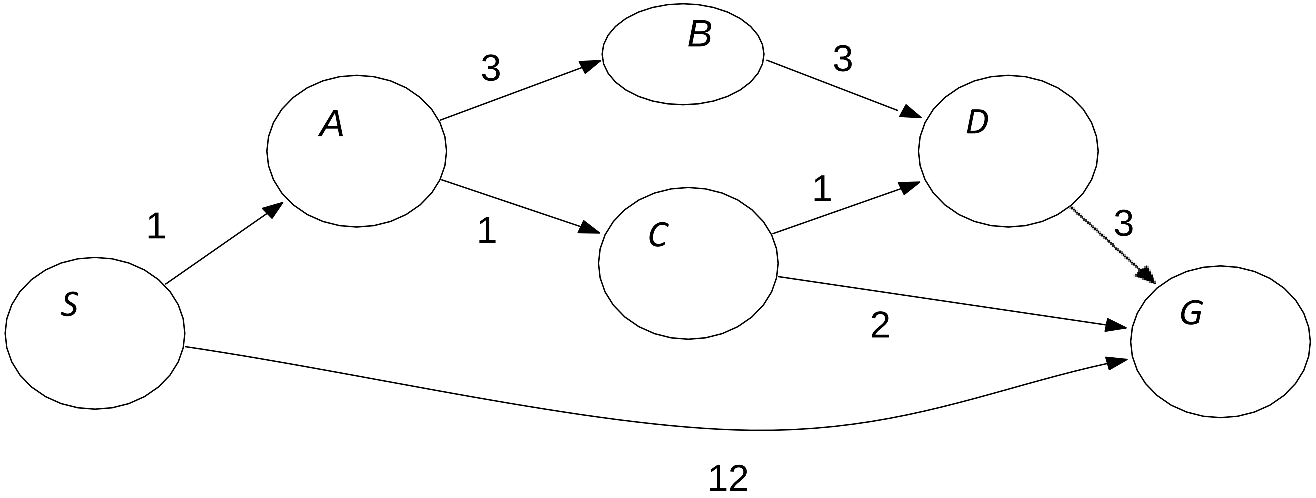
(b) What path would uniform cost graph search return for this search problem?

(c) What path would depth-first graph search return for this search problem?

(d) What path would A* graph search, using a consistent heuristic, return for this search problem?

Search Exercise





Answer the following questions about the search problem shown above. Break any ties alphabetically. For the questions that ask for a path, please give your answers in the form '*S* − *A* − *D* − *G*.'

(a) What path would breadth-first graph search return for this search problem?

S − *G*

(b) What path would uniform cost graph search return for this search problem?

S − *A* − *C* − *G*

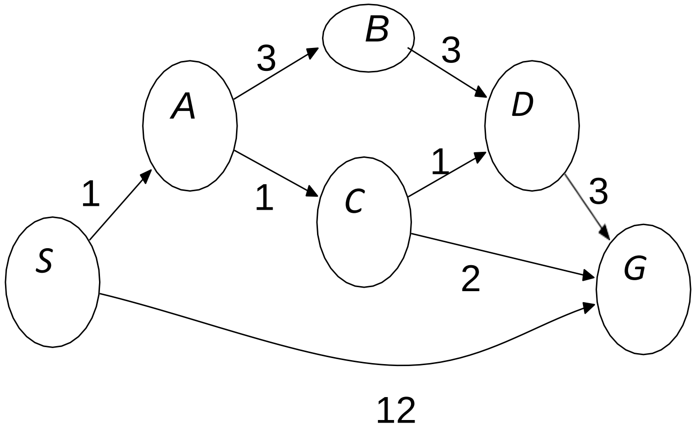
(c) What path would depth-first graph search return for this search problem?

S − *A* − *B* − *D* − *G*

(d) What path would A* graph search, using a consistent heuristic, return for this search problem?

S − *A* − *C* − *G*

(e) Consider the heuristics for this problem shown in the table below.



State	h_1	h_2
S	5	4
A	3	2
B	6	6
C	2	1
D	3	3
G	0	0

(i). Is h_1 admissible?

No

(ii). Is h_1 consistent?

No

(iii). Is h_2 admissible?

Yes

(iv). Is h_2 consistent?

No

An admissible heuristic must underestimate or be equal to the true cost.

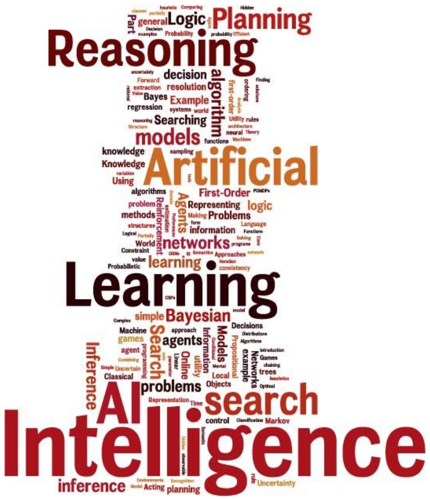
A consistent heuristic must satisfy $h(N) - h(L) \leq \text{path}(N \rightarrow L)$ for all paths and nodes N and L.

$h1$ overestimates the cost $S \rightarrow G$ as 5 when it is 4, so it is inadmissible.

$h1$ is not consistent because $h(S) - h(A) \leq \text{path}(S \rightarrow A)$ is violated as $5 - 3 \leq 1$.

$h2$ does not overestimate costs and is admissible.

$h2$ is not consistent because $h(S) - h(A) \leq \text{path}(S \rightarrow A)$ is violated as $4 - 2 \leq 1$.



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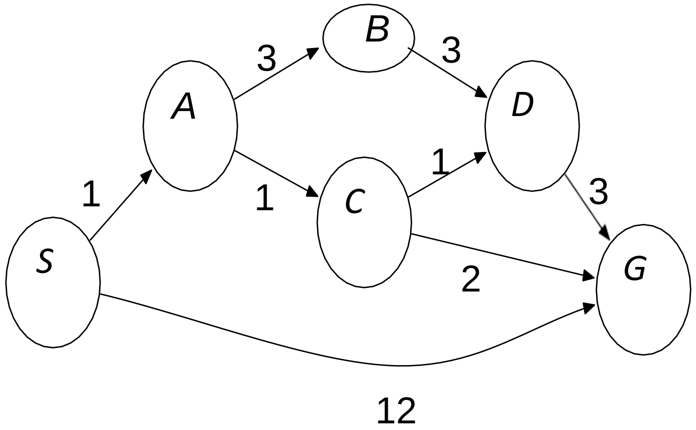
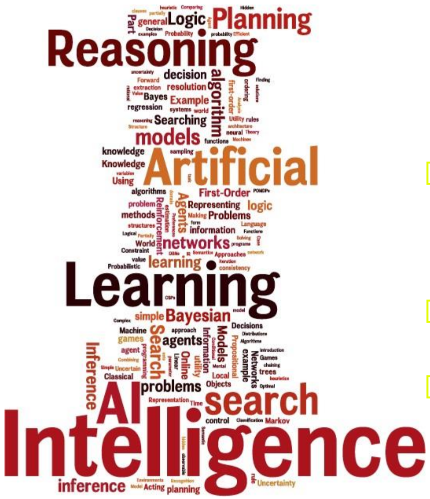


State	h_1	h_2
S	5	4
A	3	2
B	6	6
C	2	1
D	3	3
G	0	0

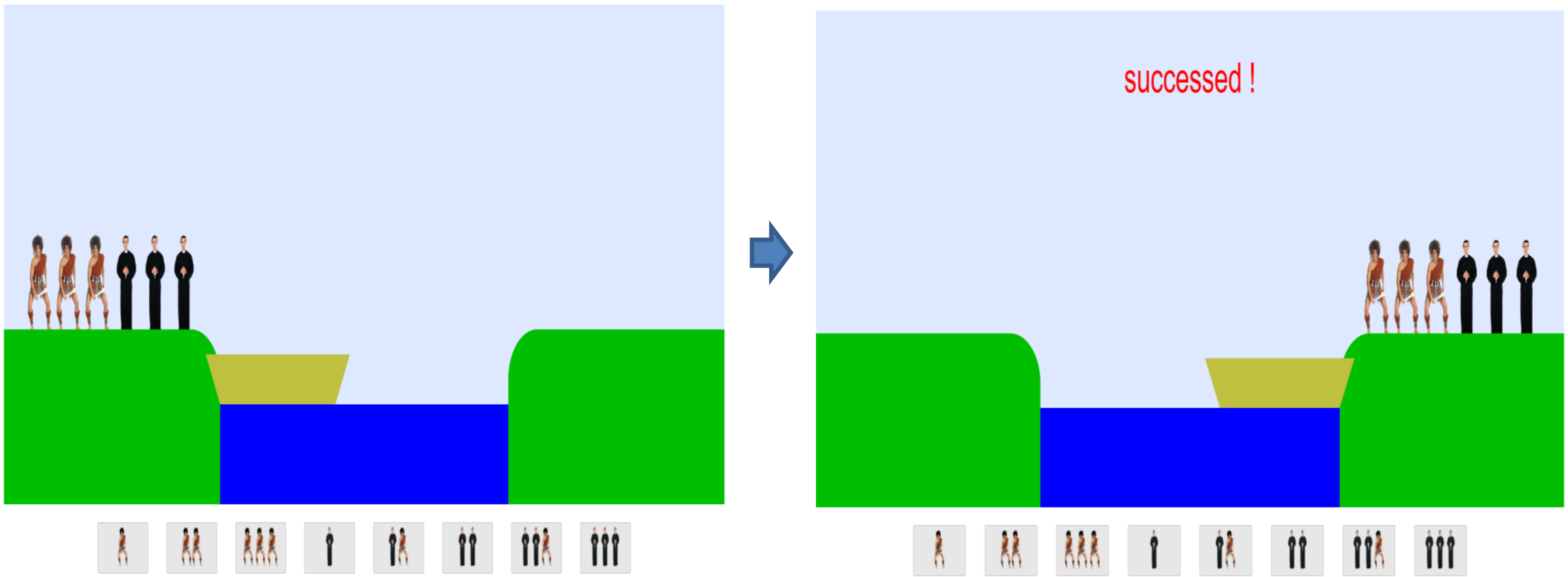
(v). What is the final cost (path-cost) using the A* (A-star) algorithm to reach from the start state (S) to the goal state (G) using the transaction costs given on the edges and heuristic values h_1?

(vi). What is the final cost (path-cost) using the A* (A-star) algorithm to reach from the start state (S) to the goal state (G) using the transaction costs given on the edges and heuristic values h_2?



Missionaries & Cannibals

- Both missionaries and cannibals must cross the river safely.
- Boats can ride up to three people.
- If the number of cannibals is more than the number of missionaries anywhere, missionaries will be eaten.
- Check on this link:
  - https://javalab.org/en/boat_puzzle_en/



Problem Formulation

- States:
  - <m, c, b> representing the # of missionaries and the # of cannibals, and the position of the boat
- Initial state:
  - <3, 3, 0>
- Actions:
  - take 1 missionary, 1 cannibal, 2 missionaries, 2 cannibals, or 1 missionary and 1 cannibal across the river
- Transition model:
  - state after an action
- Goal test:
  - <0, 0, 1>
- Path cost:
  - number of crossing

Question

How can a sequence of boat trips be performed that will get everyone to the other side of the river without any missionaries being eaten? Or What would be the solution to move from the initial state to the goal state if run on the search graph?

Problem Formulation

- States:
  - <m, c, b> representing the # of missionaries and the # of cannibals, and the position of the boat
- Initial state:
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Solution

(MM 2 0)	Two Missionaries cross the river.
(MC 1 1)	One Missionary and one Cannibal.
(CC 0 2)	Two Cannibals.
(M 1 0)	One Missionary.
(C 0 1)	One Cannibal.

Missionaries/Cannibals Search Graph