Unit 4 - Week 2

Assignment 2

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-08-21, 23:59 IST.

Week 2: State Space Search, DFS, BFS and DFID

Several problems of interest can be modeled as a state-space search problem, this is how it is done: choose a problem, determine what constitutes a state, define the start state and the goal states, identify the operations/actions to define a state transition function (neighborhood function that maps a state to a set of neighboring states, a.k.a. MoveGen).

In a state-space model a solution is a path from start-state to any goal state, to find a solution begin at the start node and explore the state-space (in some order) until a goal node is found.

State-spaces have properties:

Finite: state-spaces may be finite or infinite.

Exponential: finite state-spaces may be very very large -- exponential and beyond. And the search space associated with a search algorithm may increase exponentially with depth.

Branching Factor: may be constant or bounded or finite or large-and-finite.

Reversible: some state-spaces are reversible, i.e., every state transition is reversible. Most real-world problems do not have this property, but have regions that are reversible, and regions that are not, and in sum total it is not reversible.

Connectedness: All kinds of connectivity from graph theory apply here. The whole state-space may be completely connected, or may have several connected components which are mutually disjoint. A search algorithm can only explore the connected component in which the start node lies. The 8-puzzle, for example, has two connected components, and the Rubik's cube has twelve.

Metric Space: States (and/or transitions) may provide a metric (say Euclidean distance, Manhattan distance, etc.) as a measure of fitness or direction or distance to a goal state.

1) Chess is a two person game, later we will study search methods for two person games. *1 point*
For now, we will look at the state-space of the game of chess.

The chess board with its places, their positions and who to move next (Black or White) constitute a state.
A chess move (that takes us from one board position to another) defines a state transition.

Question: Which of the following properties are true about the state-space of the game of chess?

- Exponentially growing search space
- Decimal representation of the number PI (ratio of circumference to radius of a circle) has more digits than the number of states in the game of chess
- The state-space is not reversible
- There are subspaces (subsets of the state-space) which are reversible
- A pawn move, and independently, a piece capture are irreversible state transitions
- Every state has at least one incoming edge
- There are several states that have no outgoing edges

No, the answer is incorrect.
Score: 0
Accepted Answers:
Exponentially growing search space
Decimal representation of the number PI (ratio of circumference to radius of a circle) has more digits than the number of states in the game of chess
The state-space is not reversible
There are subspaces (subsets of the state-space) which are reversible
A pawn move, and independently, a piece capture are irreversible state transitions
Every state has at least one incoming edge
There are several states that have no outgoing edges

BEGIN GROUP: Q2 – Q8

Water jug puzzle: An eight liter jug is filled with water, you are required to divide it into 4 + 4 liters. You may use two empty jugs of size 5 and 3 liters for this purpose. There is no other way of measuring water except by the size of the jugs, i.e., one can either empty a jug into another or fill another jug to its brim

Initial State (8,0,0) Goal State (4,4,0)

Model this puzzle as a state-space search problem. A state is represented by a tuple (A,B,C), where A is the amount of water in 8L jug, B is the amount of water in 5L jug and C is the amount of water in 3L jug.

The initial state is (8,0,0), if you transfer water from 8L jug to 5L jug we reach (3,5,0) state, and if you transfer the remaining water from 8L jug to 3L jug we reach (5,5,3) state. Now we can reverse these two transfers. The state-space expresses all valid states and their transitions. Build the state-space to answers the following questions.

ATTENTION: Answers to Q2 thru Q7 are integers. Spaces and punctuations are NOT ALLOWED.

2) Starting from (8,0,0), what is the least number of transfers required to reach (4,4,0)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 7

1 point

3) What is the size of the state-space of water jug puzzle?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 16

1 point

4) Starting from (8,0,0), what is the least number of transfers required to measure 6 liters?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 3

1 point

5) Starting from (8,0,0), what is the least number of transfers required to measure 1 liter?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 4

1 point

6) Starting from (8,0,0), what is the least number of transfers required to measure 7 liters?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 5

1 point

7) Starting from (8,0,0), what is the least number of transfers required to measure 4 liters?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 6

1 point

8) Which of the following is true about the state-space of water jug puzzle? *1 point*

- State-space is reversible
- Every state is reachable from every other state
- All eight volumes from 1L to 8L are measurable
- There is at least one state that has no outgoing edge
- There is at least one state that has no incoming edge

No, the answer is incorrect.
Score: 0
Accepted Answers:
Every state is reachable from every other state
All eight volumes from 1L to 8L are measurable

END GROUP: Q2 – Q8

9) In a finite state-space, if a path to goal exists then which of the following search algorithms always find the path? *1 point*

- DFS
- BFS
- DFID
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
DFS
BFS
DFID

10) In a infinite state-space, if a path to goal exists then which of the following search algorithms always find the path? *1 point*

- DFS
- BFS
- DFID
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
BFS
DFID

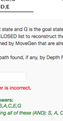
BEGIN GROUP: Q11 to Q20

ATTENTION: For Q11 thru Q20 all answers **must list the nodes in the order visited**. A node is deemed visited if it passes goal test or is closed. Type your answer in ALL CAPS comma separated list. Extra commas, blanks or other punctuations NOT ALLOWED. Type NONE if there is no suitable answer.

11) A MoveGen function and its equivalent graphical representation is given for a state-space, call it state-space 11.
Use this information to answer Q11 thru Q20.

X	MoveGen(X)
S	A,B
A	C,S
B	D,S
C	E,D,A
D	C,E,B,G
E	C,D,G
G	D,E

State Space 11 : MoveGen and its graphical representation



S is the start state and G is the goal state.
Maintain a CLOSED list to reconstruct the path to a goal.
Nodes returned by MoveGen that are present in OPEN or CLOSED are not added to OPEN again.

What is the path found, if any, by Depth First Search?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,A,C,E,G
String containing all of these (ANG): S, A, C, E, G

1 point

12) For state-space 11, what is the path found, if any, by Breadth First Search?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,B,D,G
String containing all of these (ANG): S, B, D, G

1 point

13) DFS algorithm runs on state-space 11 and adds only new nodes to OPEN list. *1 point*
Identify the search tree (showing both open and closed nodes) produced by DFS algorithm when it picks up the goal node.
Here, dashed circles denote open nodes and solid circles denote closed nodes.

- Tree-1 is the DFS search tree
- Tree-2 is the DFS search tree
- Tree-3 is the DFS search tree
- Tree-4 is the DFS search tree
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
Tree-3 is the DFS search tree

14) BFS algorithm runs on state-space 11 and adds only new nodes to OPEN list. *1 point*
From the trees in Q13, identify the search tree (showing both open and closed nodes) produced by BFS algorithm when it picks up the goal node.

- Tree-1 is the BFS search tree
- Tree-2 is the BFS search tree
- Tree-3 is the BFS search tree
- Tree-4 is the BFS search tree
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
Tree-3 is the BFS search tree

15) Consider the case where, during node expansion, the neighbors returned by MoveGen that are present in OPEN or CLOSED are not opened again.

Now list the first eight nodes visited by DFID on state-space 11, where DFID starts from depth zero.
A node is deemed visited if it passes goal test or is closed.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,S,A,B,S,A,C,B
String containing all of these (ANG): S, S, A, B, S, A, C, B

1 point

16) What is the path found, if any, by the above version of DFID?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,A,C,E,G
String containing all of these (ANG): S, A, C, E, G

1 point

17) Consider the case where, during node expansion, the neighbors returned by MoveGen present in OPEN list are reopened (placed in the OPEN list), but neighbors already in the CLOSED list are not reopened.

Now list the first eight nodes visited by DFID on state-space 11, where DFID starts from depth zero.
A node is deemed visited if it passes goal test or is closed.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,S,A,B,S,A,C,B
String containing all of these (ANG): S, S, A, B, S, A, C, B

1 point

18) What is the path found, if any, by the above version of DFID?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,A,C,E,G
String containing all of these (ANG): S, A, C, E, G

1 point

19) Consider the case where, during node expansion, all neighbors returned by MoveGen are opened irrespective of whether they are present in OPEN or CLOSED list.

Now list the first eight nodes visited by DFID on state-space 11, where DFID starts from depth zero.
A node is deemed visited if it passes goal test or is closed.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,S,A,B,S,A,C,S
String containing all of these (ANG): S, S, A, B, S, A, C, S

1 point

20) What is the path found, if any, by the above version of DFID?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) S,B,D,G
String containing all of these (ANG): S, B, D, G

1 point

END GROUP: Q11 to Q20