CS3243 : Introduction to Artificial Intelligence

Tutorial 1

NUS School of Computing

June 30, 2022

A bit about me

- I'm Sumanth Yalamarty (you can call me Sumanth)
- Studying Computer Science here at NUS

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- Studying Computer Science here at NUS
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Admin

- Telegram Group
- Weekly DQ (due Fridays) and Tutorial Assignment (due Sundays)
- Clarifications, Ideas, Doubts, Consultations

Review

- Building the right intuition about Artificial Intelligence
- Study of the design of *Rational/Intelligent agents*

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- Study of the design of *Rational/Intelligent agents*

- Agents? Rationality? Intelligence? (last two pretty subjective topics in general)

Review

- Various kinds of Agents
- Properties of the Task Environment
- Search Space
- Graph and Tree-based search implementations
- Uninformed search strategies : BFS, UCS, DFS, DLS, IDS

Tutorial Question 1(a)

- Sudoku is a popular number puzzle that works as follows: we are given a 9×9 square grid; some squares have numbers, while some are blank. Objective is to fill in the blanks with numbers from $1 - 9$ such that each row, column and the highlighted 3×3 squares contain no duplicate entries.

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- Sudoku puzzles can solved easily after being modelled as a CSP (which we will cover later in the module). We will consider the problem of generating Sudoku puzzles.

Tutorial Question 1(a)

Environment Characteristic	**Sudoku Puzzle**
Fully *vs* Partially Observable	
Deterministic *vs* Stochastic	
Epsodic *vs* Sequential	
Discrete *vs* Continuous	
Single *vs* Multi-agent	
Static *vs* Dynamic	

Tutorial Question 1(a)

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Key Takeaway : Getting to know about the problem in a more proper/formal way

Tutorial Question 1(b)

- State Representation : A state in this problem is a (partial) valid representation of the sudoku puzzle. More formally, it would be a matrix $A \in \{0...9\}^{9\times 9}$ with 0 representing a blank square.

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2	5	8	7	3	6	9	4	1
6	1	9	8	2	4	3	5	7
4	3	7	9	1	5	2	6	8
3	9	5	2	7	1	4	8	6
7	6	2	4	9	8	1	3	5
8	4	1	6	5	3	7	2	9
1	8	4	3	6	9	5	7	2
5	7	6	1	4	2	8	9	3
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- Initial and Goal state?
- The initial state is a completely filled out grid of numbers, where the grid is valid : all rows, columns and 3×3 squares contain all numbers between $\{1...9\}$. Note that any state in the problem will be a valid goal state.

Tutorial Question 1(b)

- An action would be removing a number from the grid. More formally, we take as input a matrix A and a matrix $E_{i,j}(a)$ where $E_{i,j}(a) \in \{0...9\}^{9\times 9}$ is a matrix of all zeros except for a non-zero value $a \in \{1...9\}$ at coordinate (i, j). An action would be setting $A - E_{i,j}(a)$. Note that actions must not result in boards with two or more solutions.

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- **Key Takeaway** : Right representation of the problem at hand

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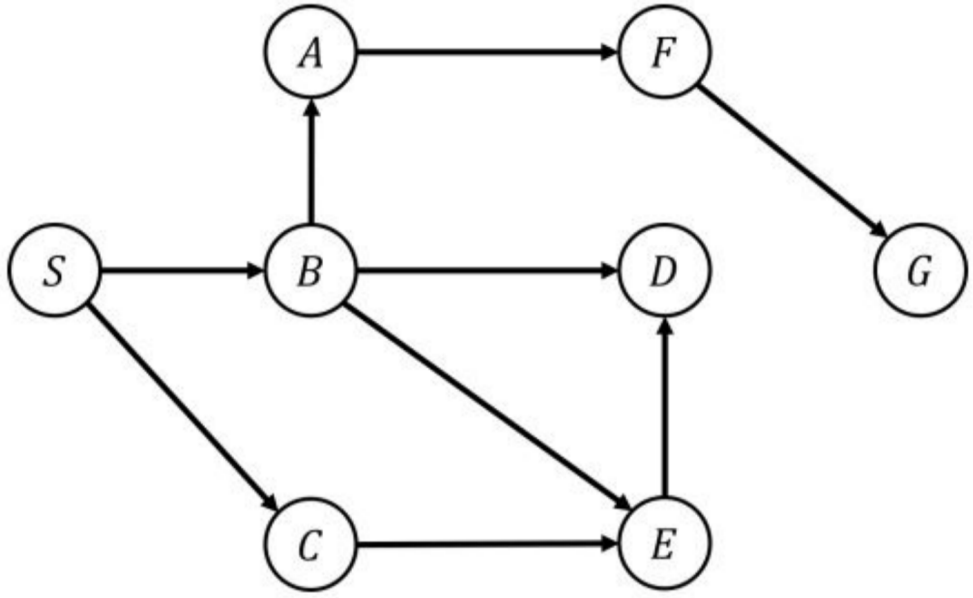
- **Key Takeaway** : The difference between states and nodes (often undermined)

Tutorial Question 2(b)

- Finding paths



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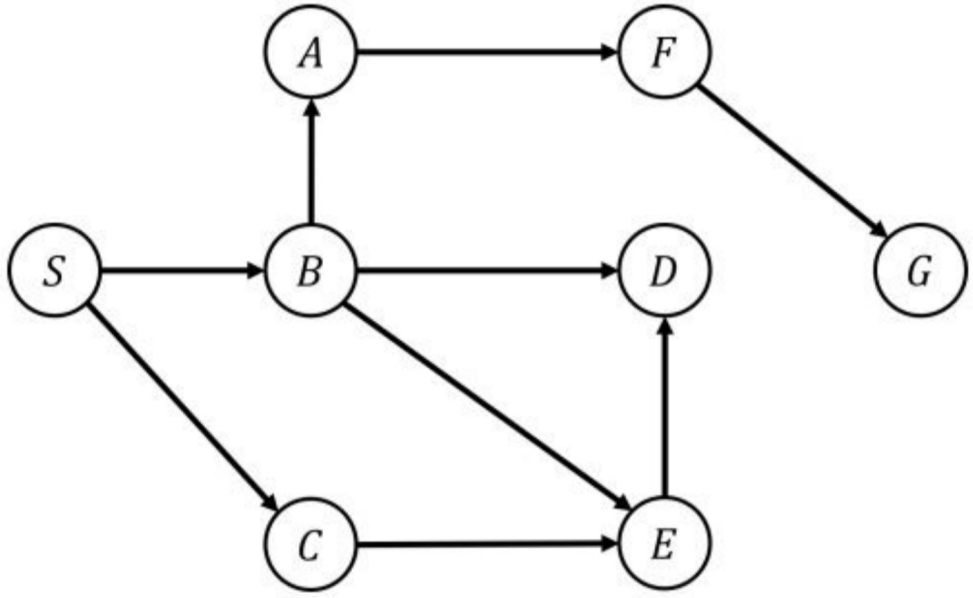

- DFS with tree-based implementation

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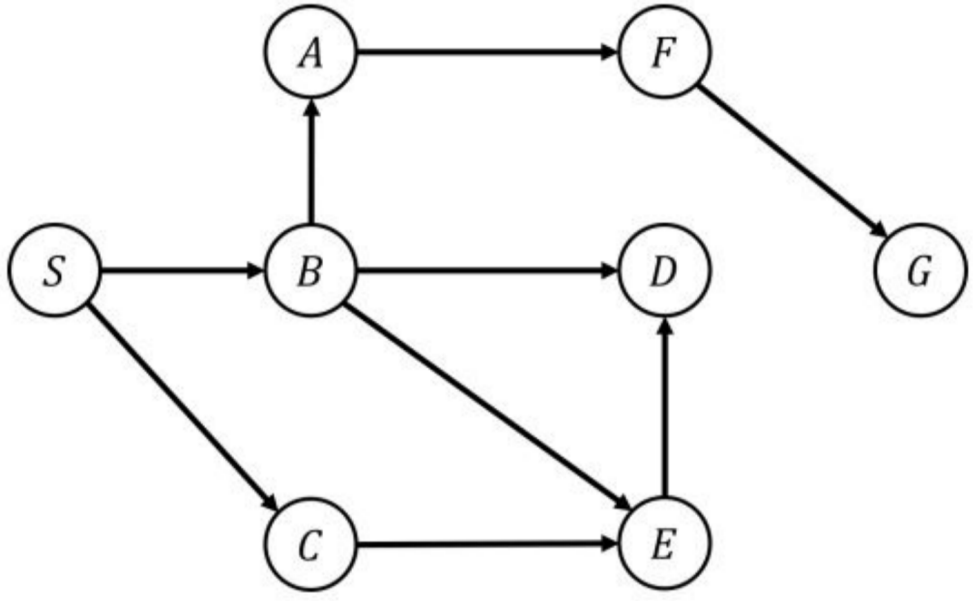

- DFS with tree-based implementation
- S–C–E–D–B–E–D–D–A–F–G

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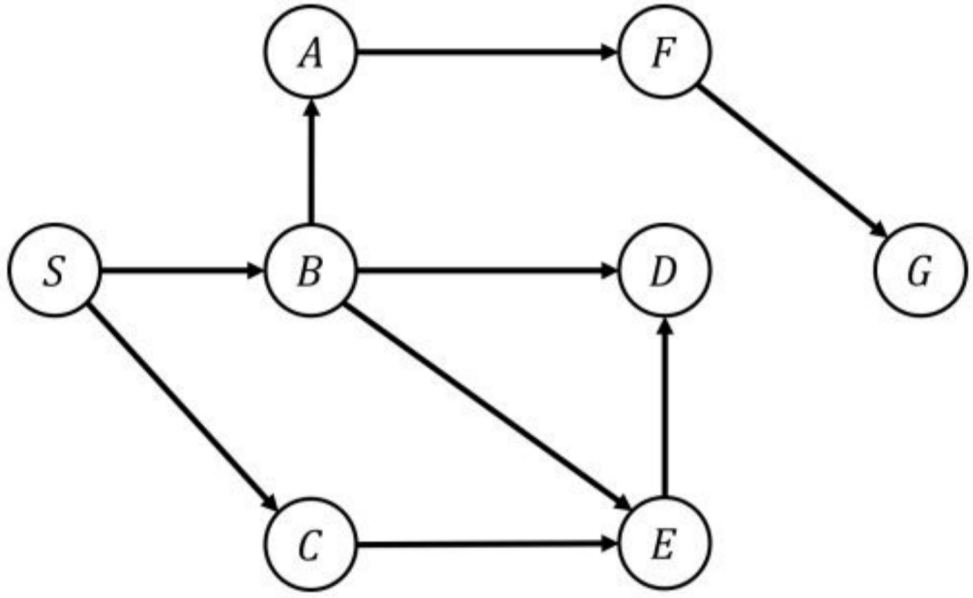

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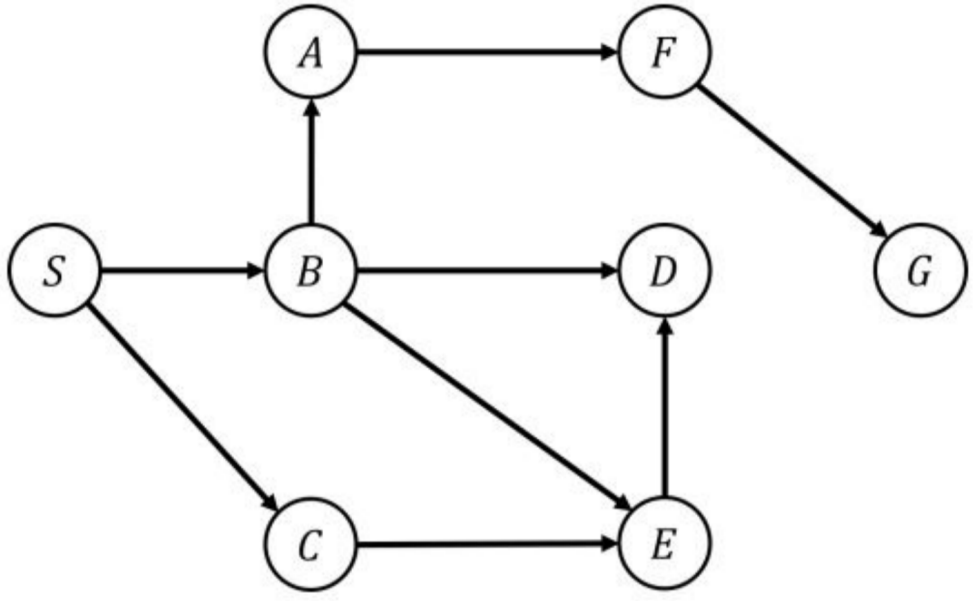

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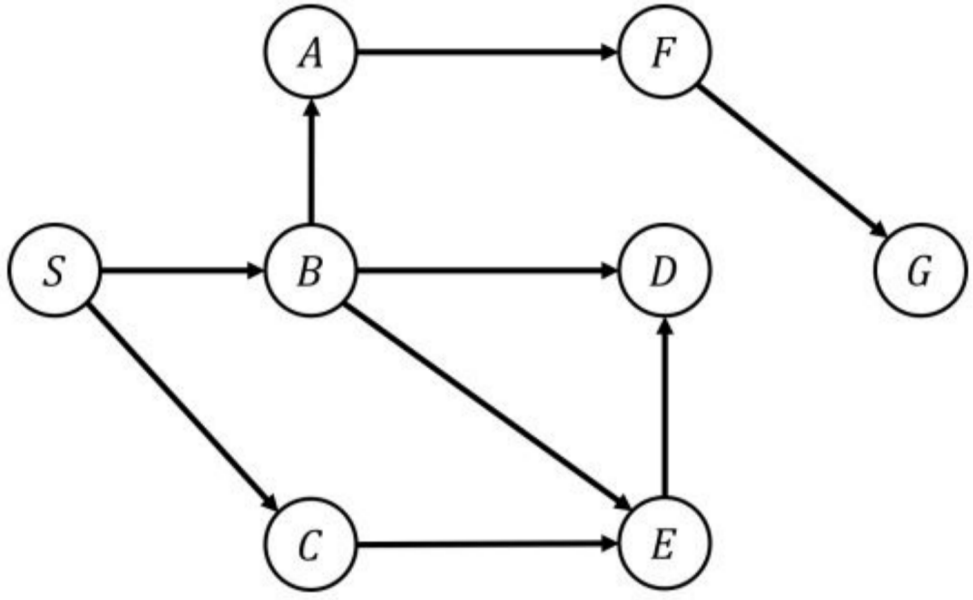

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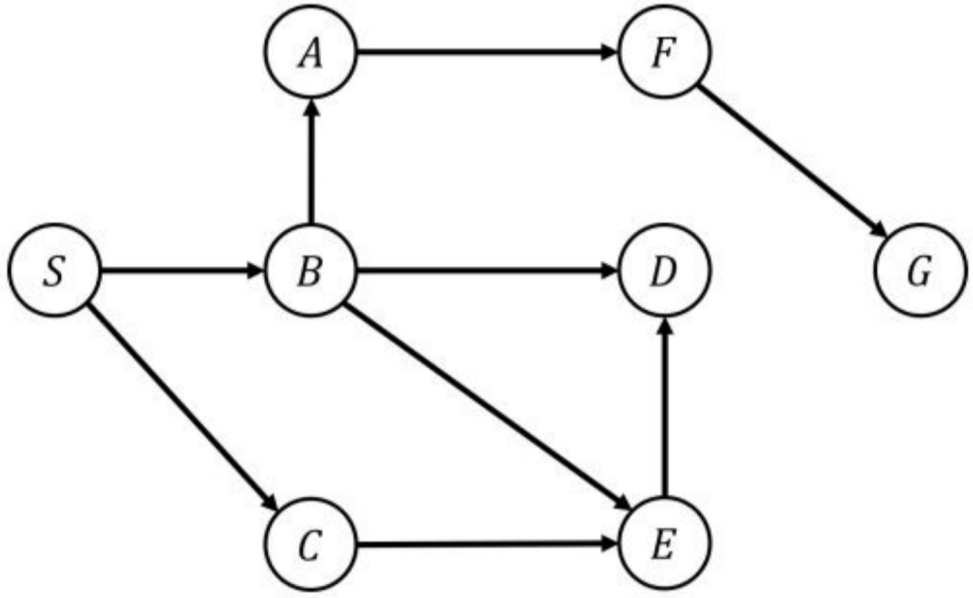

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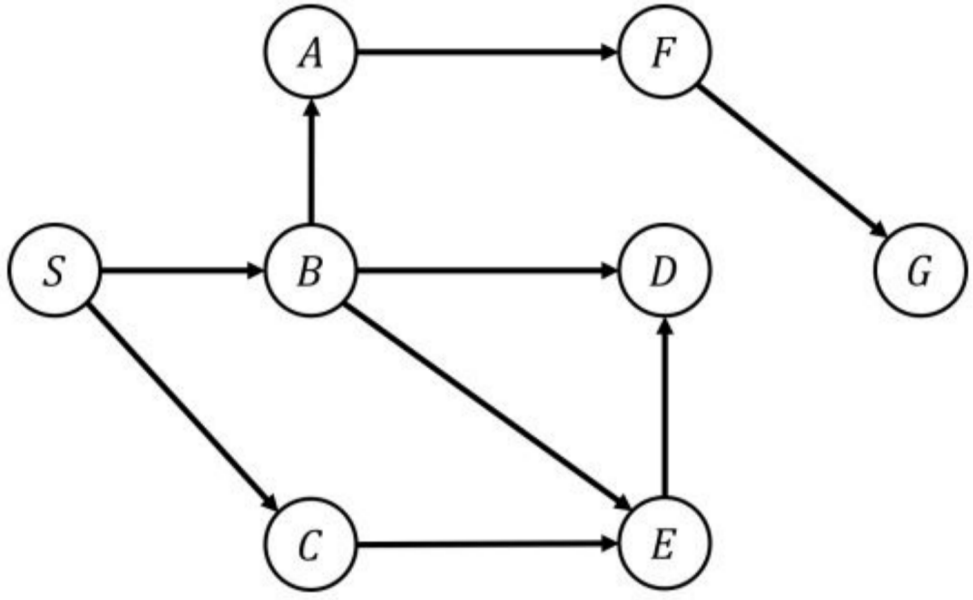

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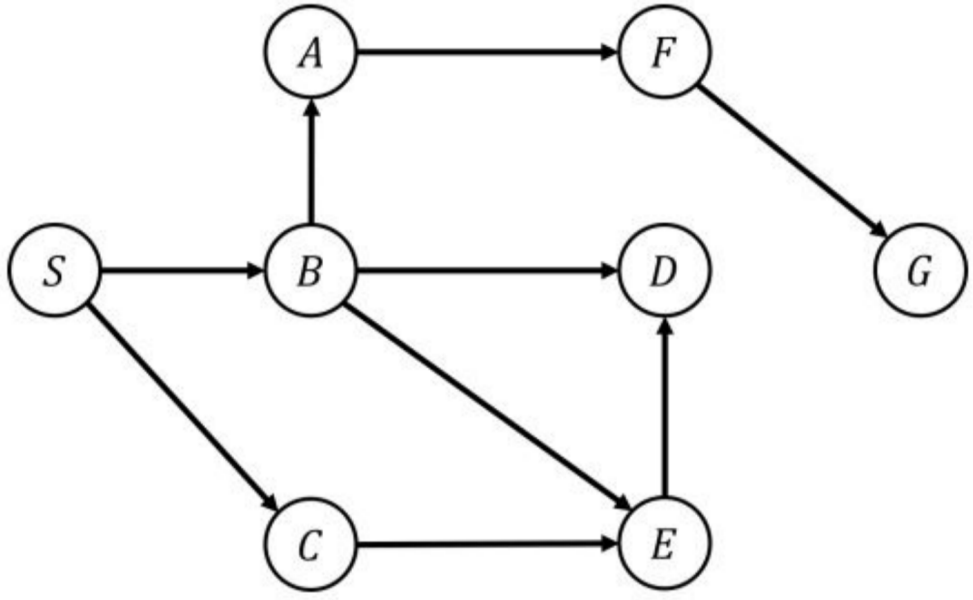

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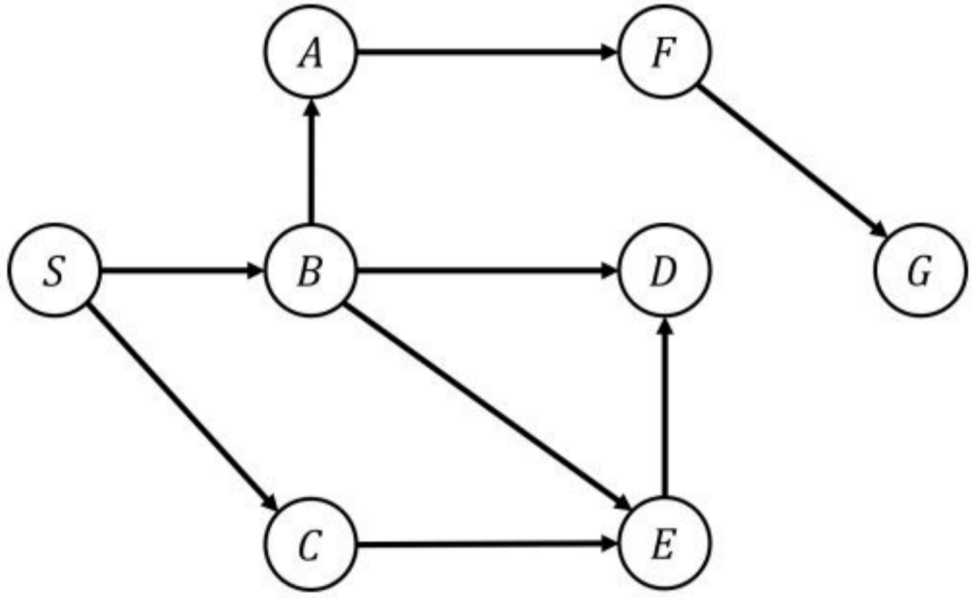

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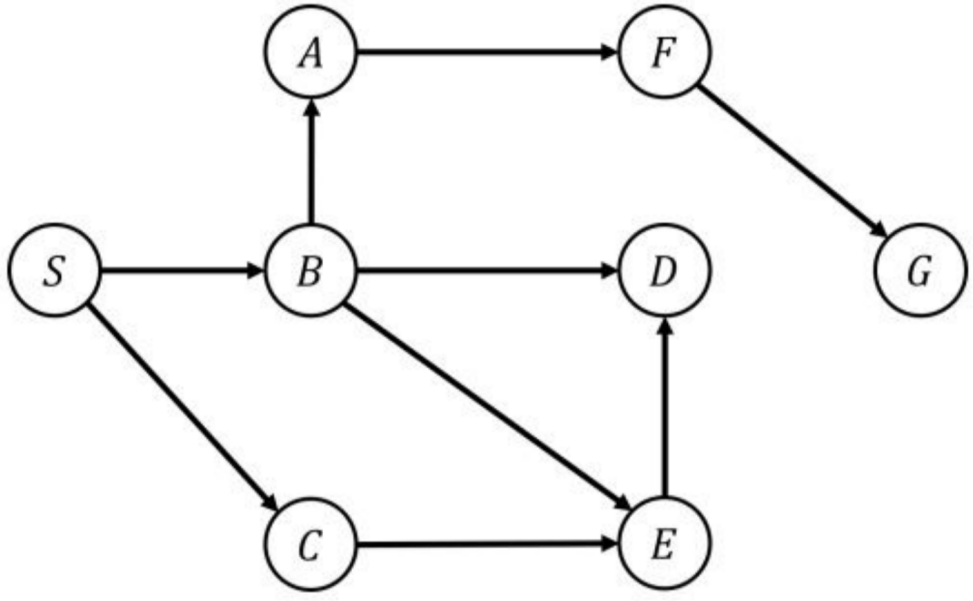

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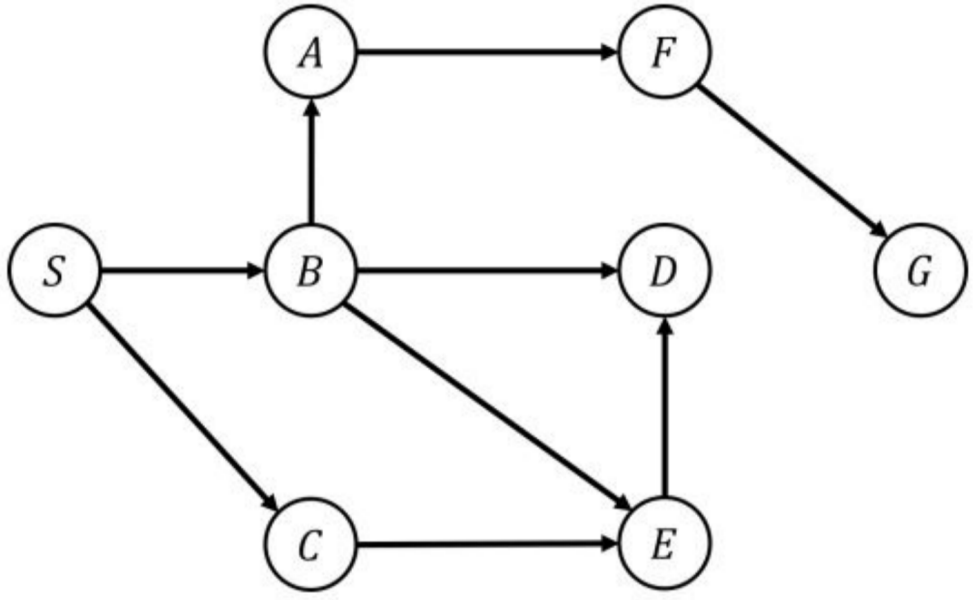

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- Claim : Whenever UCS expands a node n, the optimal path to that node has been found.

Tutorial Question 3

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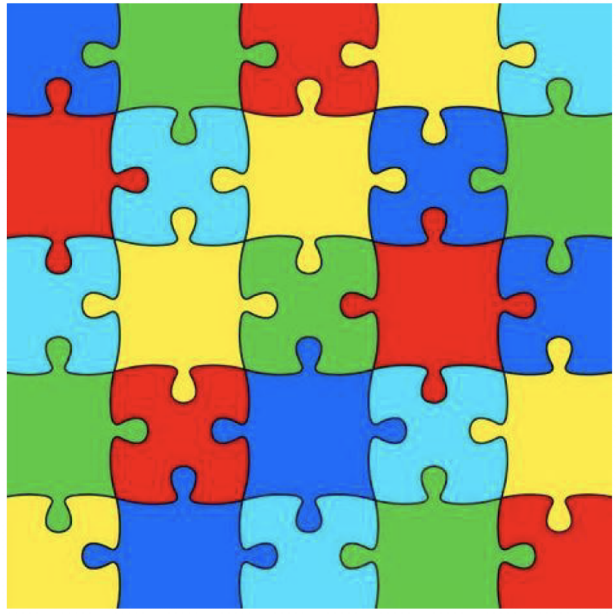
- Something to think about : Would UCS be optimal with tree-based implementation?

Tutorial Question 4

- Jigsaw puzzle



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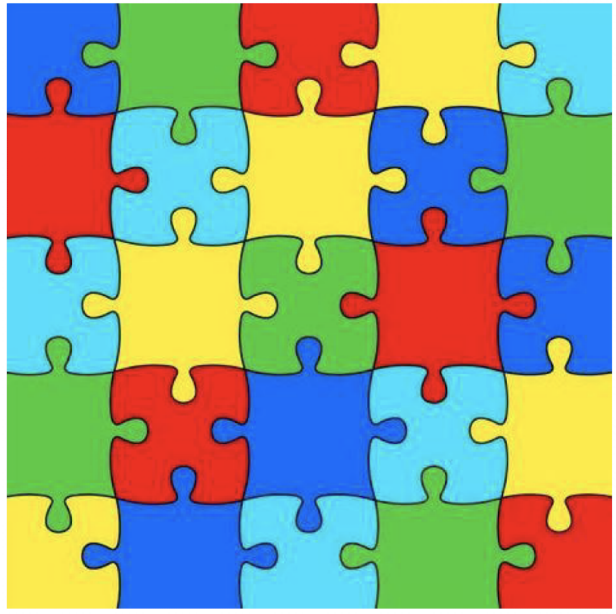

- Some thoughts

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  - Keeps track of the connections between connected puzzle pieces

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- Actions
  - Taking two unconnected puzzle pieces and establishing a connection between them. Note that you must mention that the pair of puzzle pieces picked can be legally connected (i.e., you cannot simply take any two puzzle pieces).

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- Transition model
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- Step costs are 1 (or any positive constant value, cannot be 0)
- Goal test
  - Depending on the representation, either the connected set is full, or the unconnected set if empty
  - Check that for every puzzle piece, there should not be more connections than its number of available legal connections

Thank you!

If you have any questions, please don't hesitate. Feel free to ask!
We are here to learn together!