

At the end of the class you should be able to:

- define a directed graph
- represent a problem as a state-space graph

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- Many AI problems can be abstracted into the problem of finding a path in a directed graph.
- Often there is more than one way to represent a problem as a graph.

- **flat** or modular or hierarchical
- **explicit states** or features or individuals and relations
- static or finite stage or **indefinite stage** or infinite stage
- **fully observable** or partially observable
- **deterministic** or stochastic dynamics
- **goals** or complex preferences
- **single agent** or multiple agents
- **knowledge is given** or knowledge is learned
- **perfect rationality** or bounded rationality

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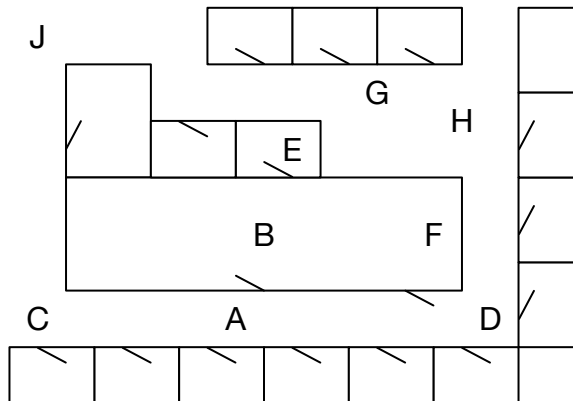
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- a criterion that specifies the quality of an acceptable solution.

Example Problem for Delivery Robot

The robot is at A and the goal is to get to G:



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- When there is a **cost** associated with arcs, the cost of a path is the sum of the costs of the arcs in the path:

$$\text{cost}(\langle n_0, n_1, \dots, n_k \rangle) = \sum_{i=1}^k \text{cost}(\langle n_{i-1}, n_i \rangle)$$

An **optimal solution** is one with minimum cost.

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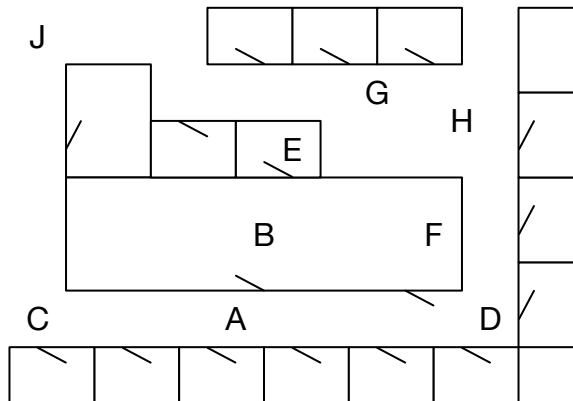
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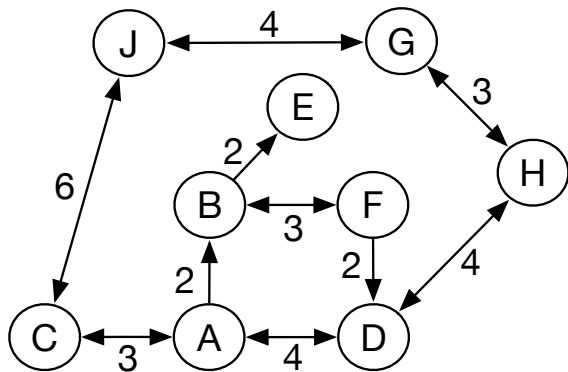
Often there are many options for what to include in the state.
Keep the states as simple as possible but no simpler.

Example Problem for Delivery Robot

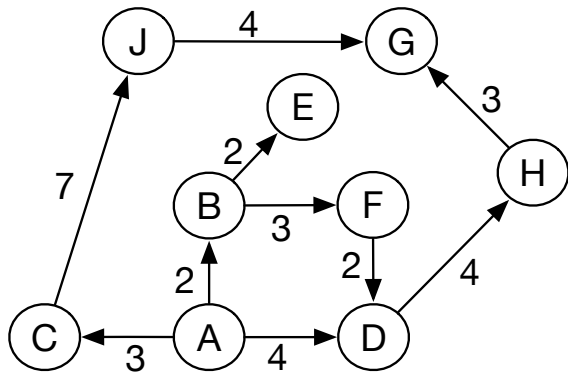
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State-Space Graph for the Delivery Robot



State-Space Graph for the Delivery Robot (Acyclic)



Example: Google Maps

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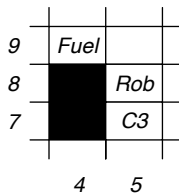
- single start location and goal location
- cost is estimated time
- state

Example: Google Maps

- single start location and goal location
- cost is estimated time
- state needs to include direction because the cost depends on directions (e.g., turning left).

Partial Search Space for a Video Game

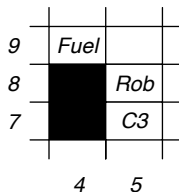
Grid game: Rob is on a grid and can move up, down, left or right and needs to collect coins C_1 , C_2 , C_3 , C_4 , without running out of fuel, and end up at location (1, 1):



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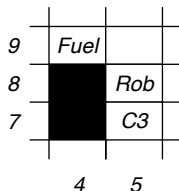
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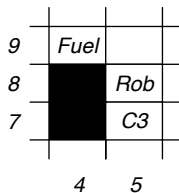
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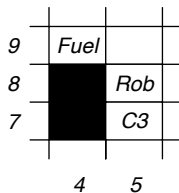
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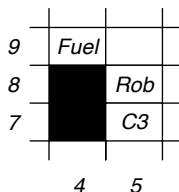


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Goal:

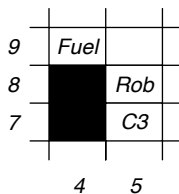


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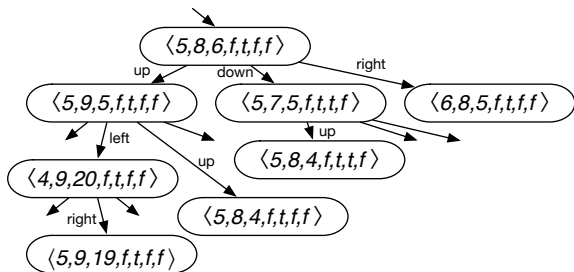
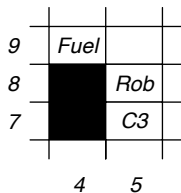


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- robot actions:
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- How many states are there? What are they?