Learning Objectives

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.

State-space Search

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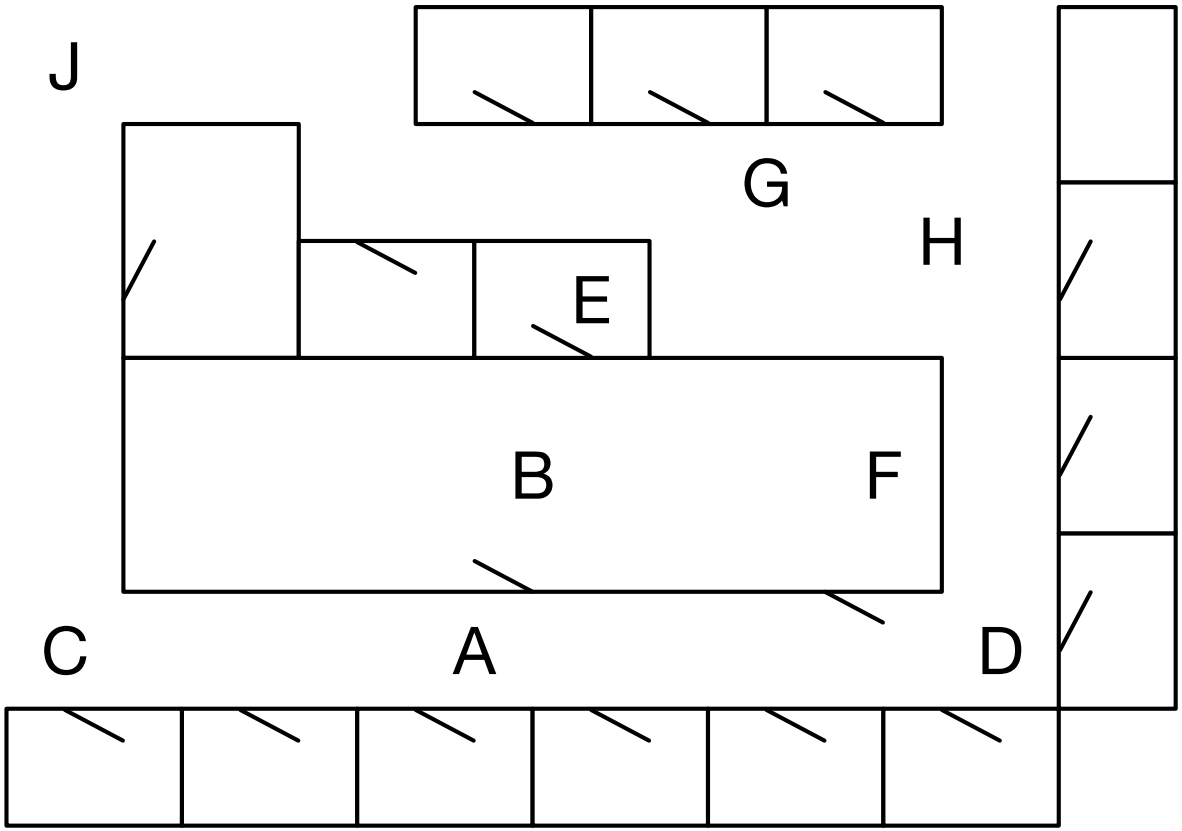
- a criterion that specifies the quality of an acceptable solution.

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:

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

An optimal solution is one with minimum cost.

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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.

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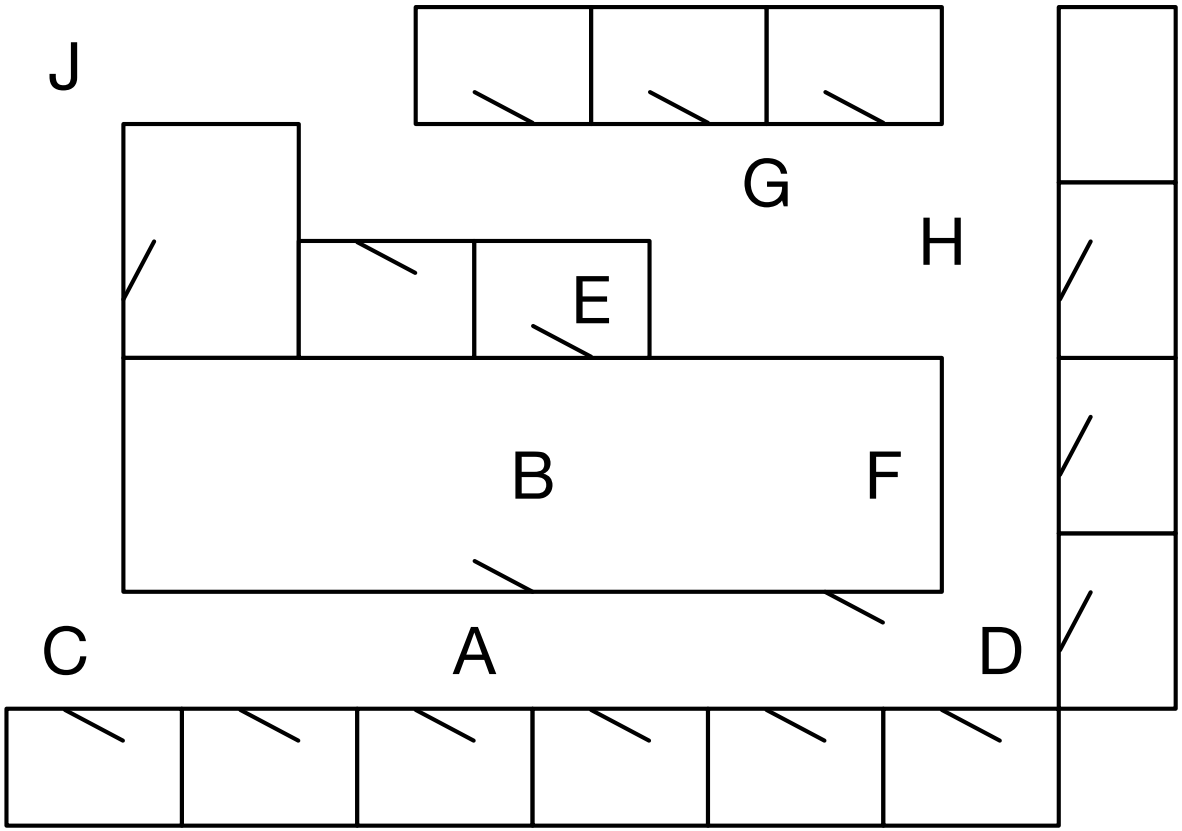
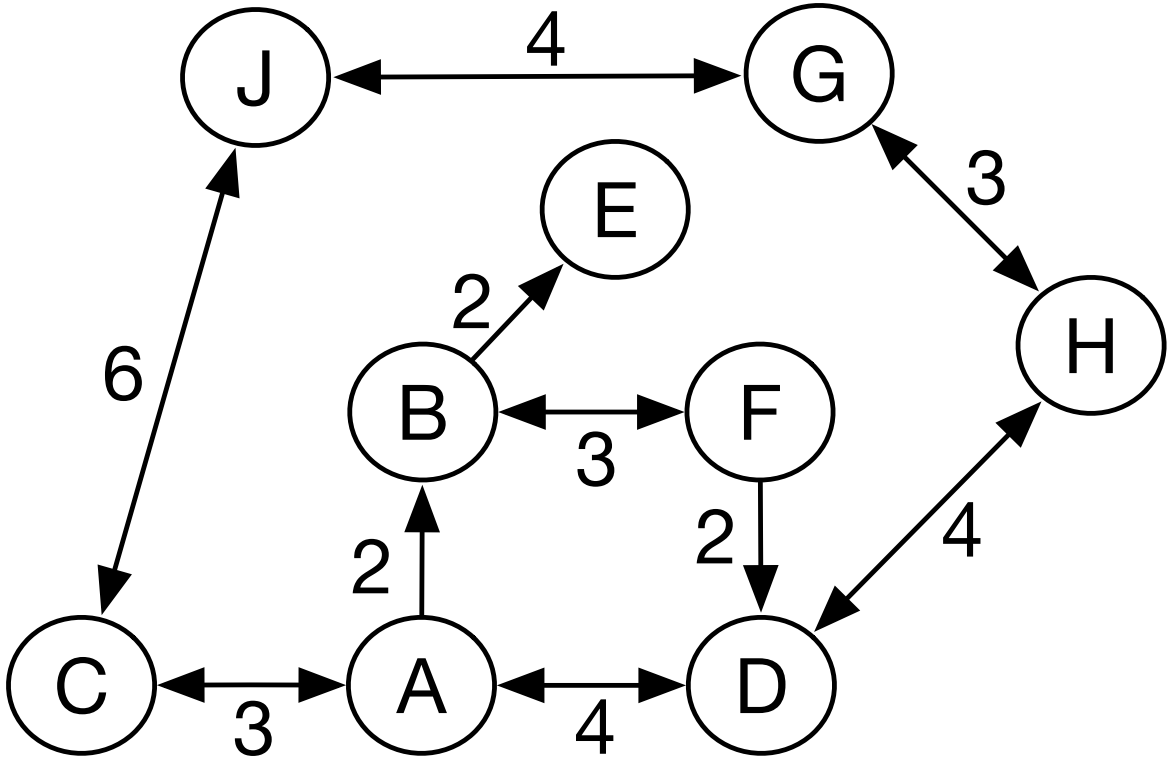
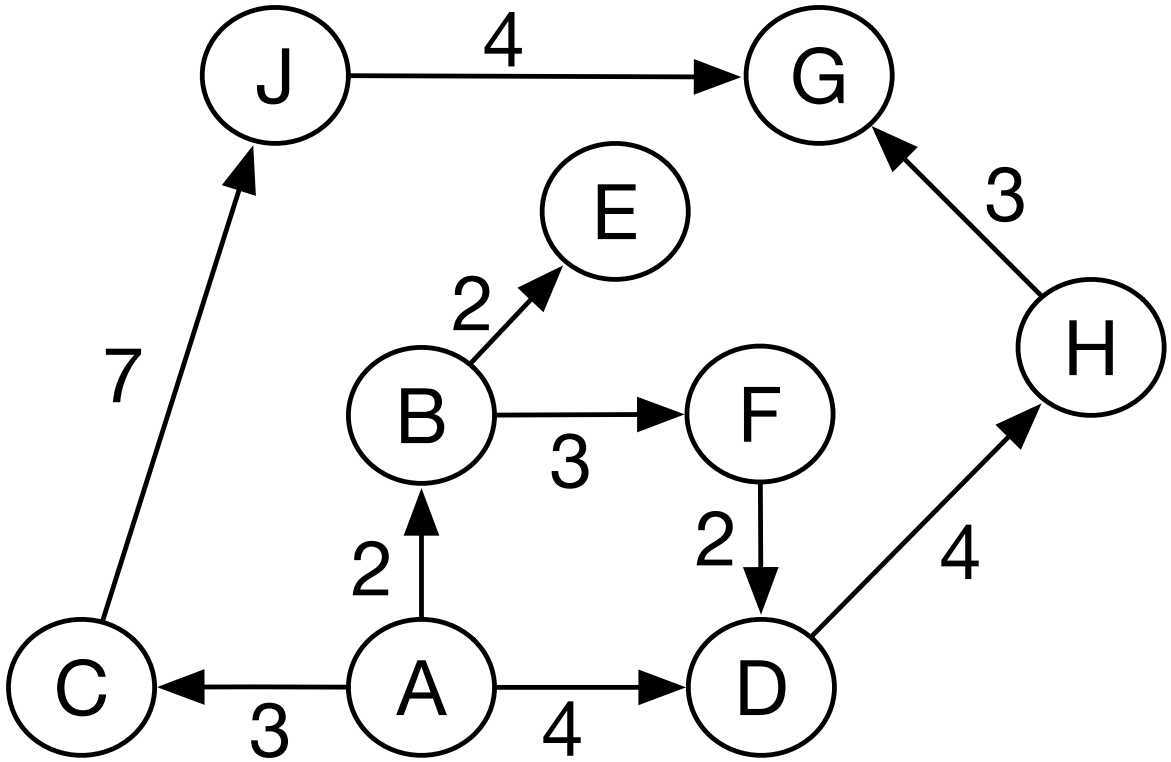


State-Space Graph for the Delivery Robot



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

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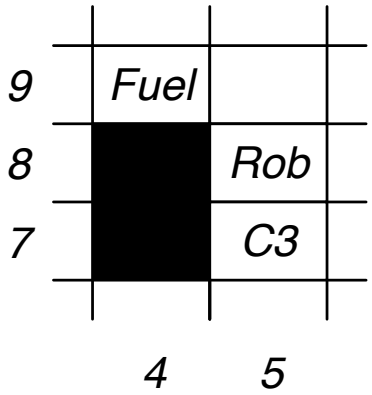
- single start location and goal location
- cost is estimated time
- state needs to include direction because the cost depends on directions (e.g., turning left).

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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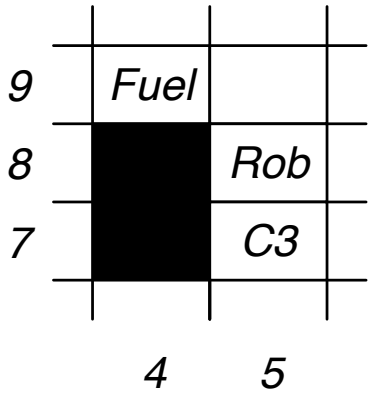

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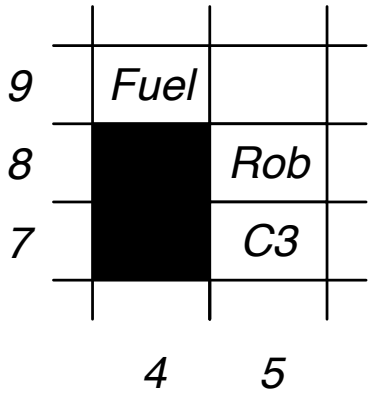

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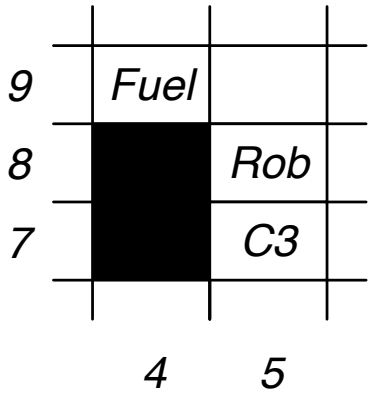

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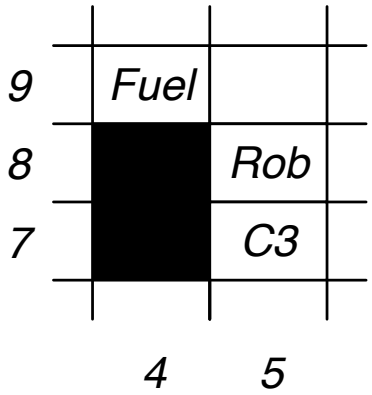

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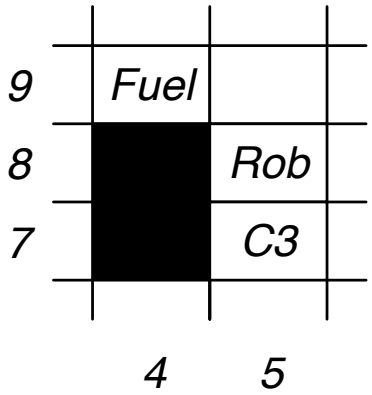

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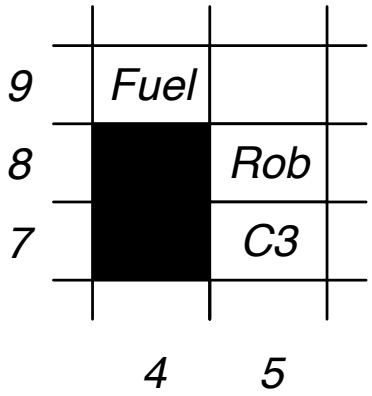

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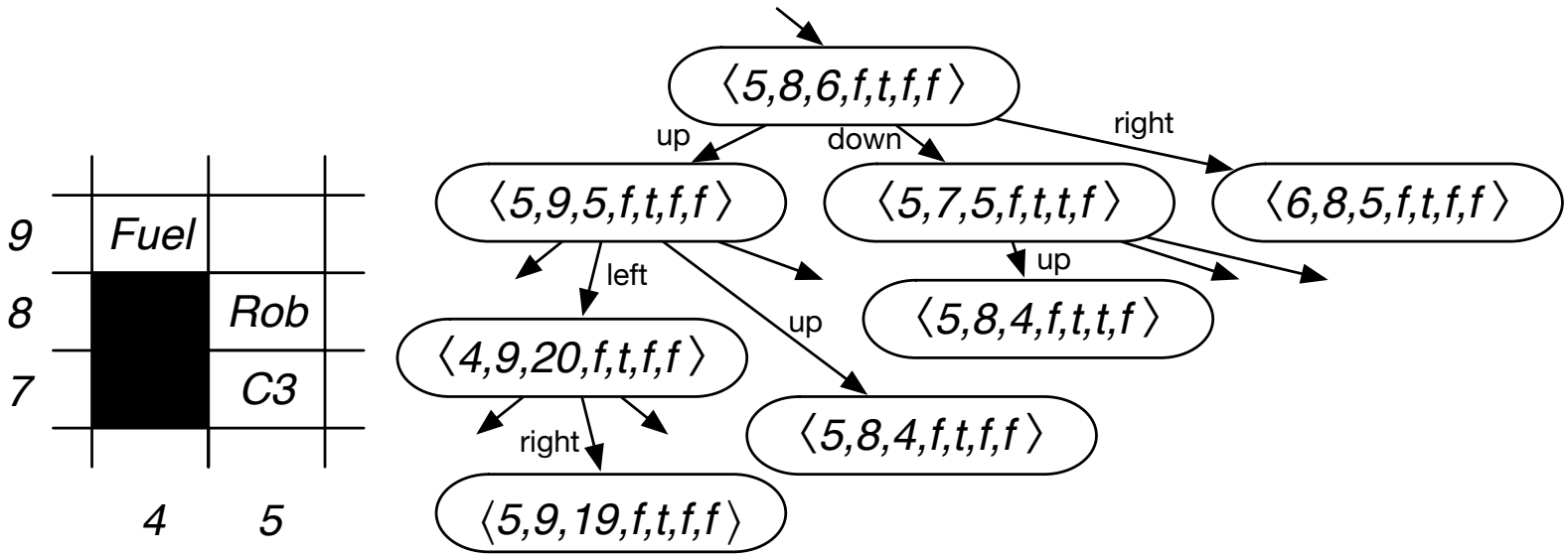

Robot Cleaner

- 2 rooms, one cleaning robot
- rooms can be clean or dirty
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- How many states are there? What are they?