

Creating a Road Network Graph

Course 4, Module 3, Lesson 1

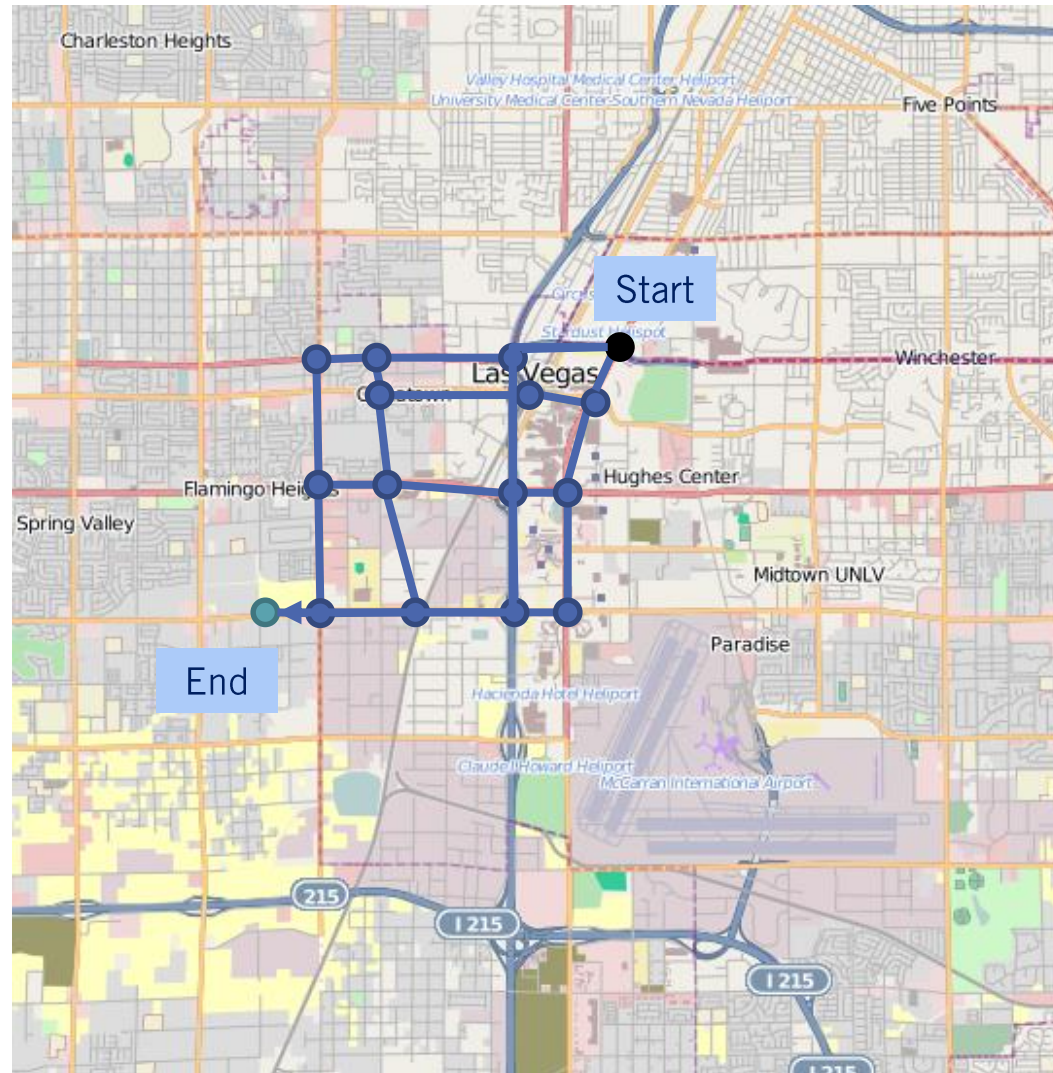


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Learning Objectives

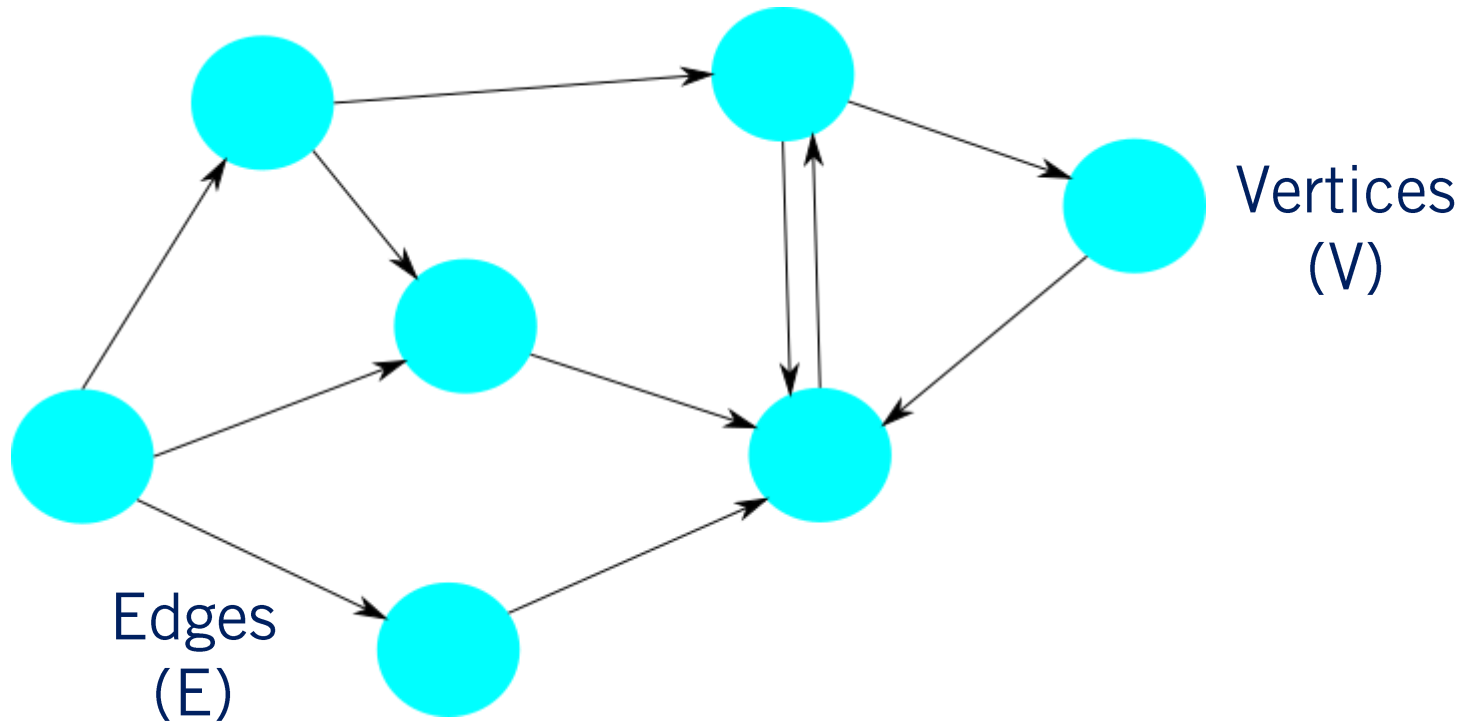
- Understand the mathematical concept of a graph
- Use a directed graph to represent a road network
- Implement Breadth-First Search

Mission Planning



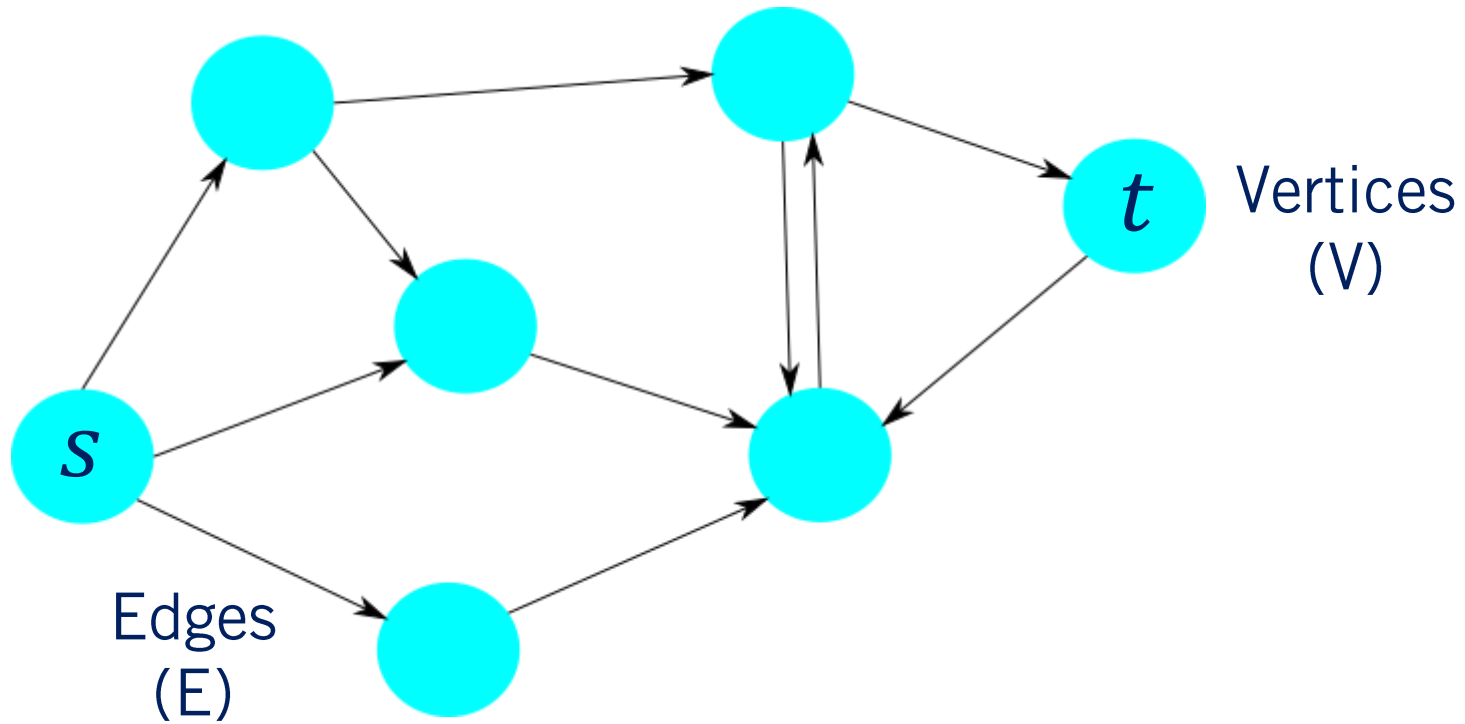
Graphs

Graph: $G = (V, E)$



Graphs

Graph: $G = (V, E)$



Breadth First Search (BFS)

Algorithm BFS(G, s, t)

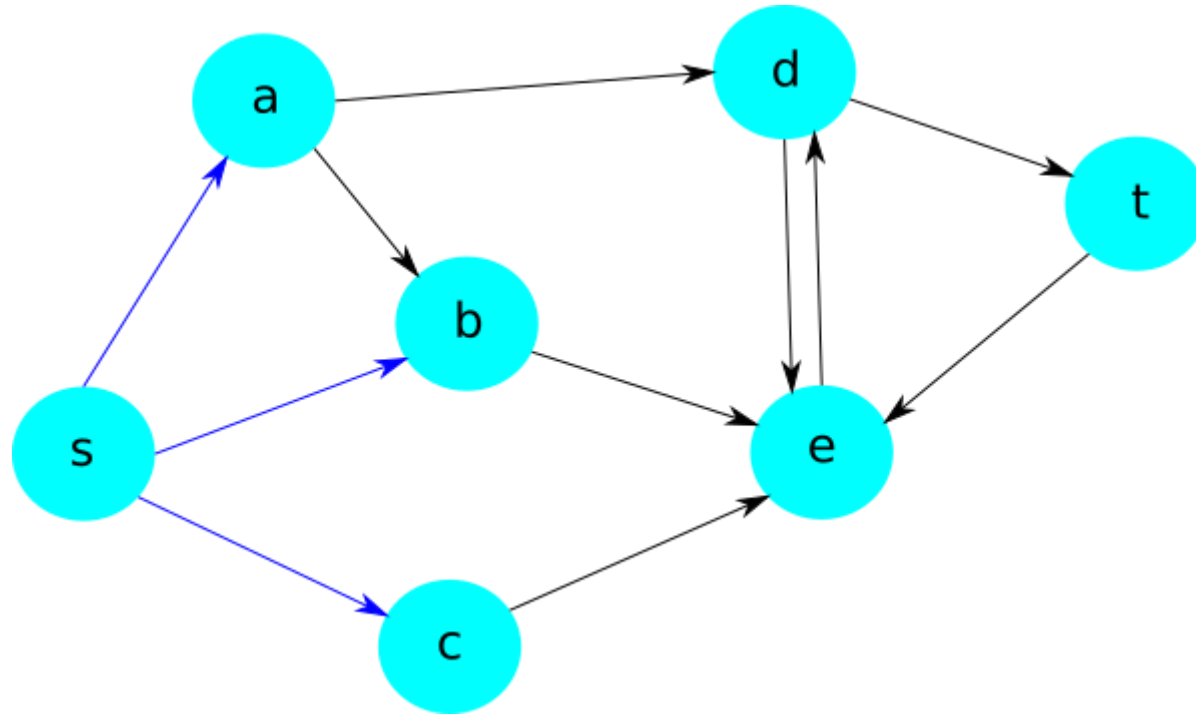
```
1.  open  $\leftarrow$  Queue()
2.  closed  $\leftarrow$  Set()
3.  predecessors  $\leftarrow$  Dict()
4.  open.enqueue( $s$ )
5.  while !open.isEmpty() do
6.     $u \leftarrow$  open.dequeue()
7.    if isGoal( $u$ ) then
8.      return extractPath( $u$ , predecessors)
9.    for all  $v \in u$ .successors()
10.     if  $v \in$  closed or  $v \in$  open then
11.       continue
12.     open.enqueue( $v$ )
13.     predecessors[ $v$ ]  $\leftarrow u$ 
14.  closed.add( $u$ )
```

Example - First Wavefront

Open Queue:

a
b
c

Closed Set: s



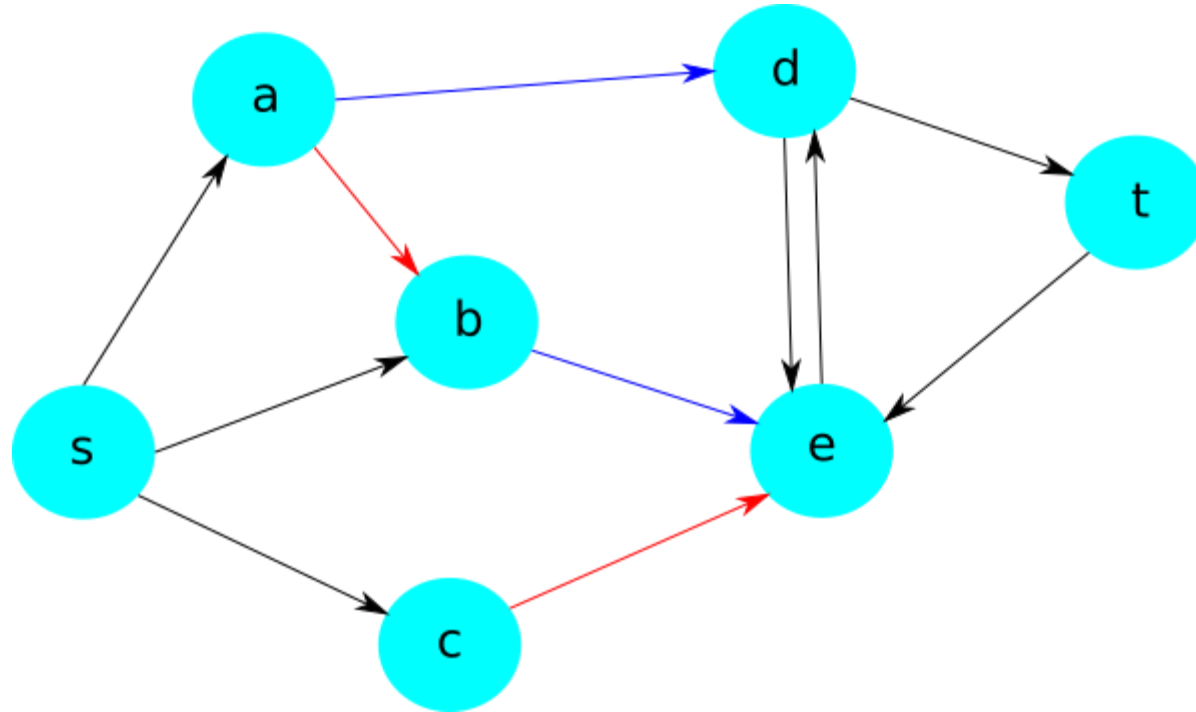
Example - Second Wavefront

Open Queue:

d
e

Closed Set: s

a
b
c



Example - Third Wavefront

Open Queue:

t

Closed Set:

s

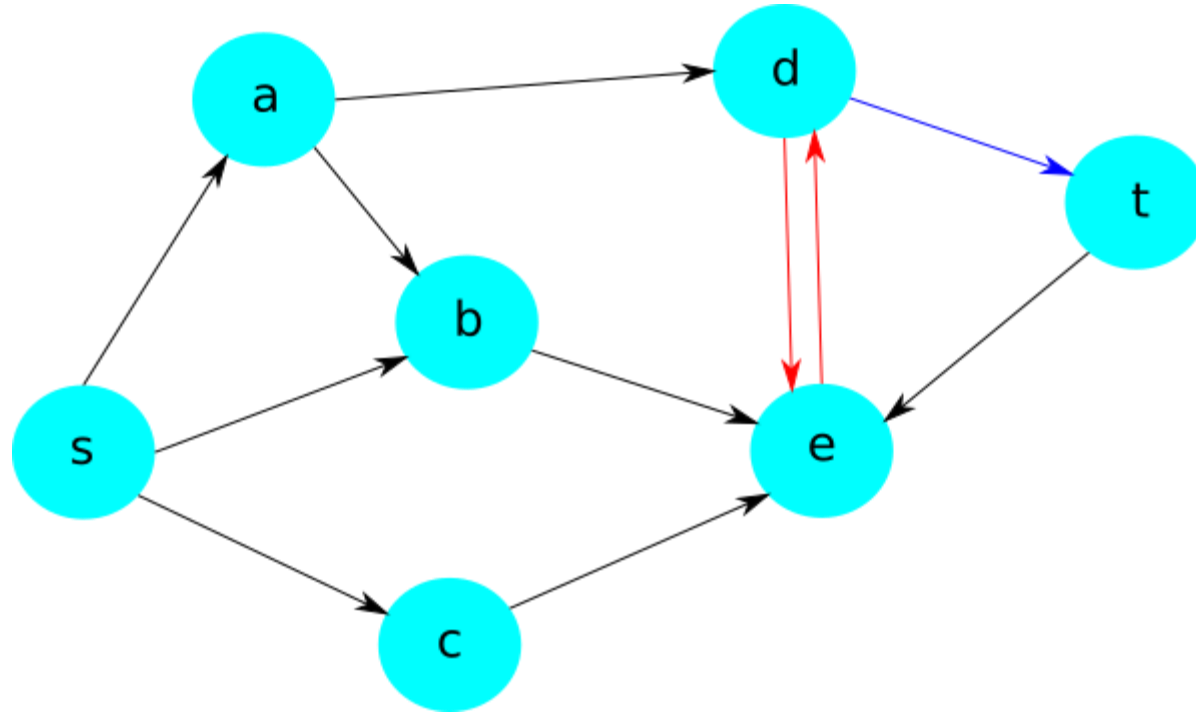
a

b

c

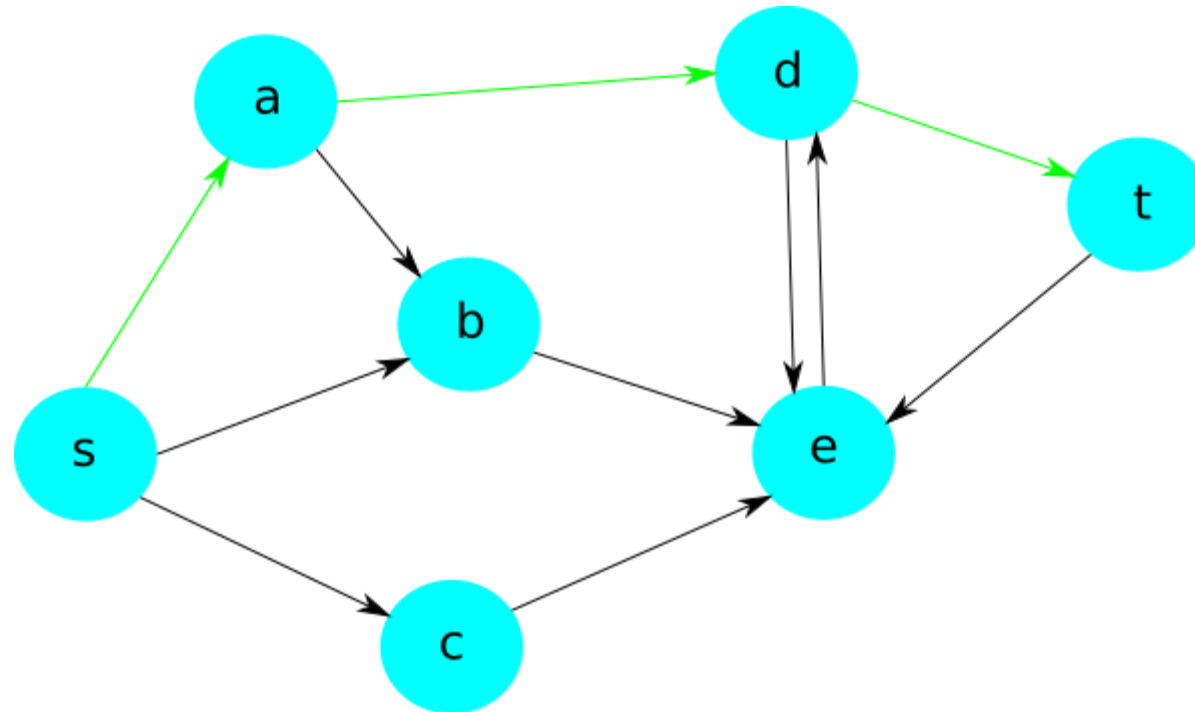
d

e



Example - Optimal Path

Final Path: s
a
d
t



Summary

- Recognize the mission planning problem as a map-level navigation problem
- Learned how to embed a graph in the map
 - Vertices connected by road segments, which correspond to edges
- Learned how to use BFS to search an unweighted graph for the shortest path to the destination



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