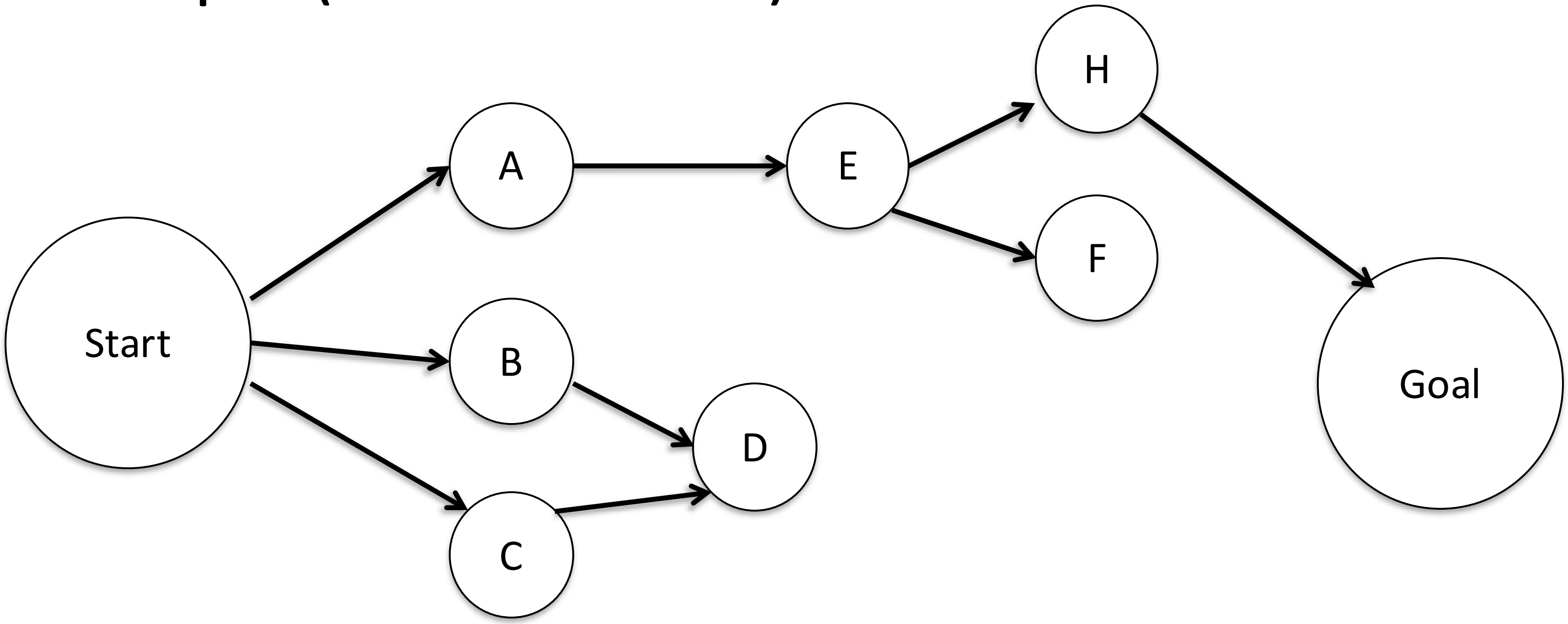
Breadth First Search

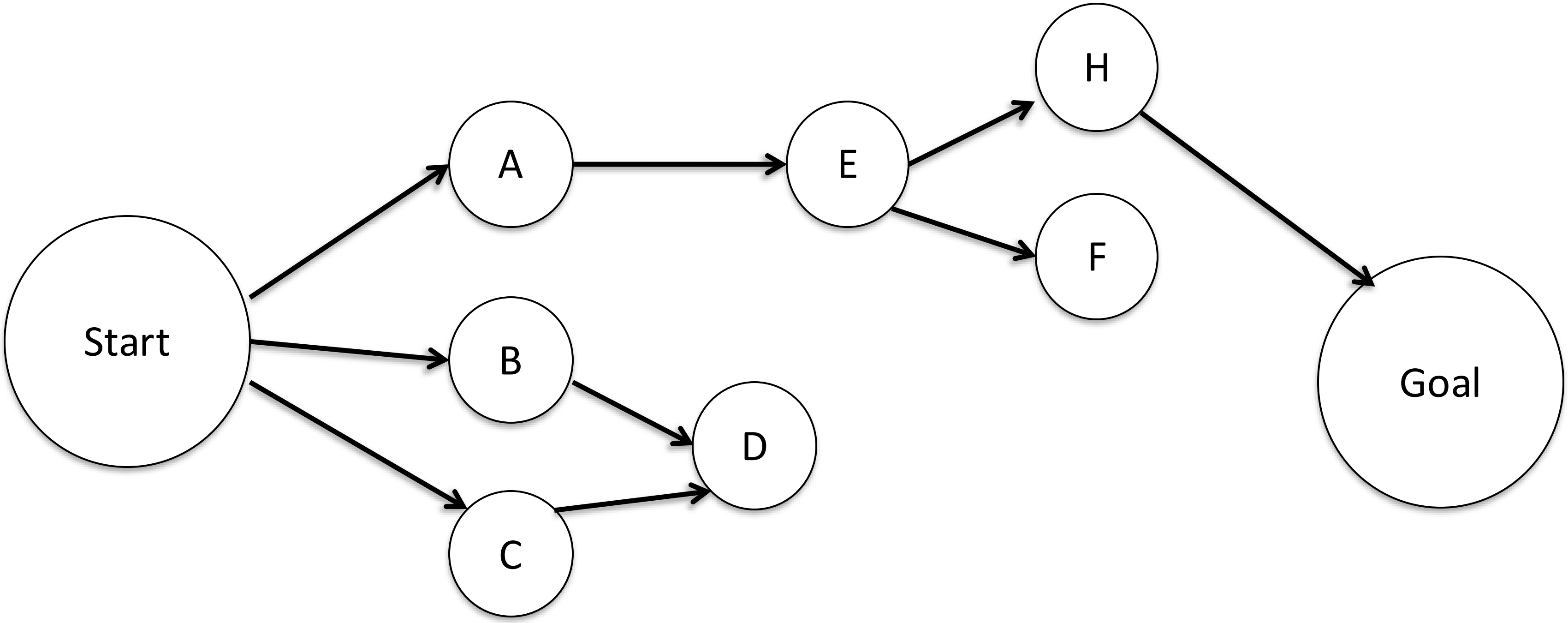
- All nodes 1 edge from start, then 2 edges from start, etc. until goal is reached

Example (costs are all 1):



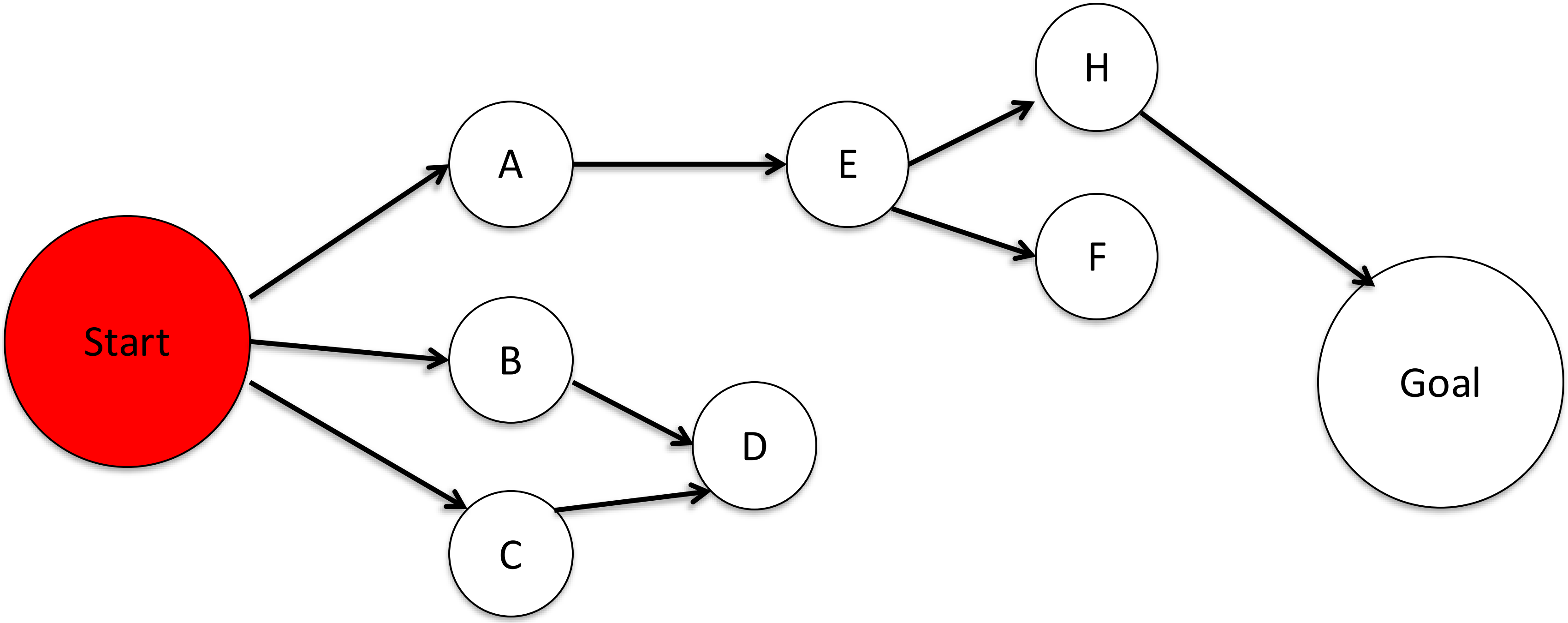
Breadth-First Search Example

Todo list: Start



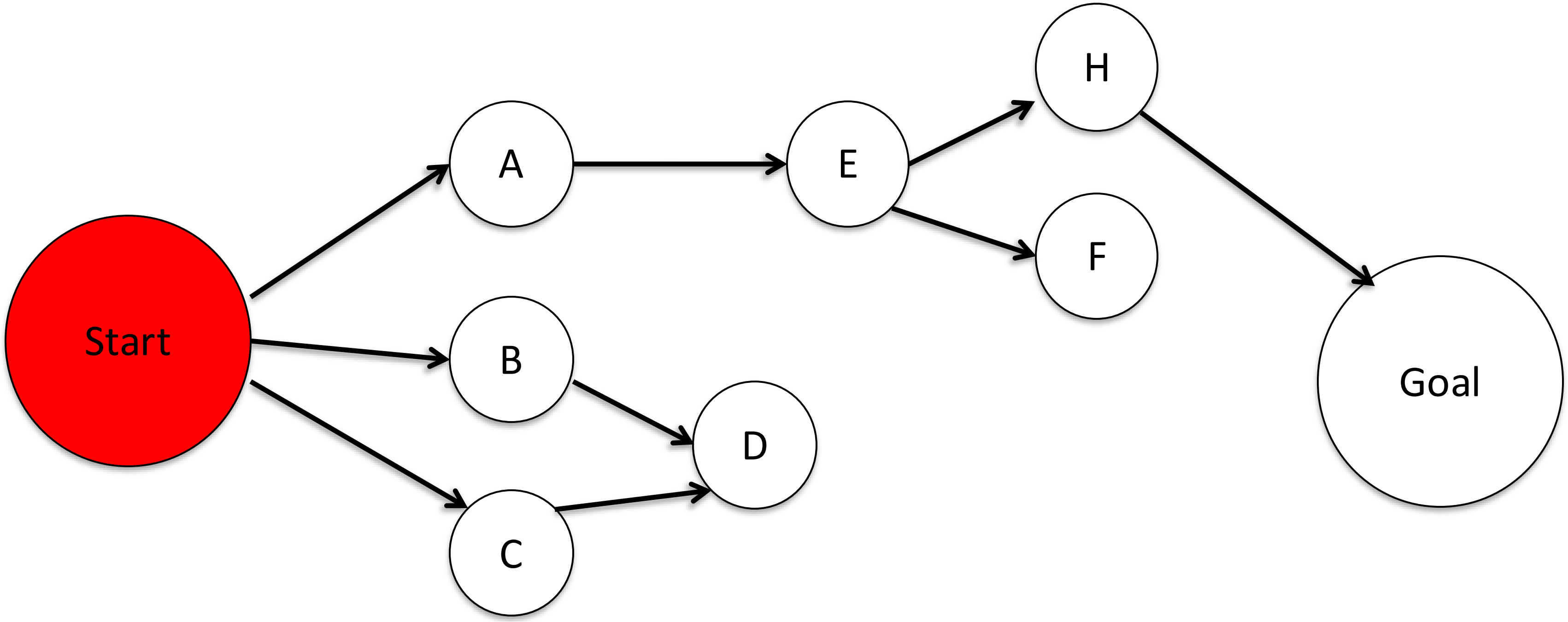
Breadth-First Search Example

Todo list:



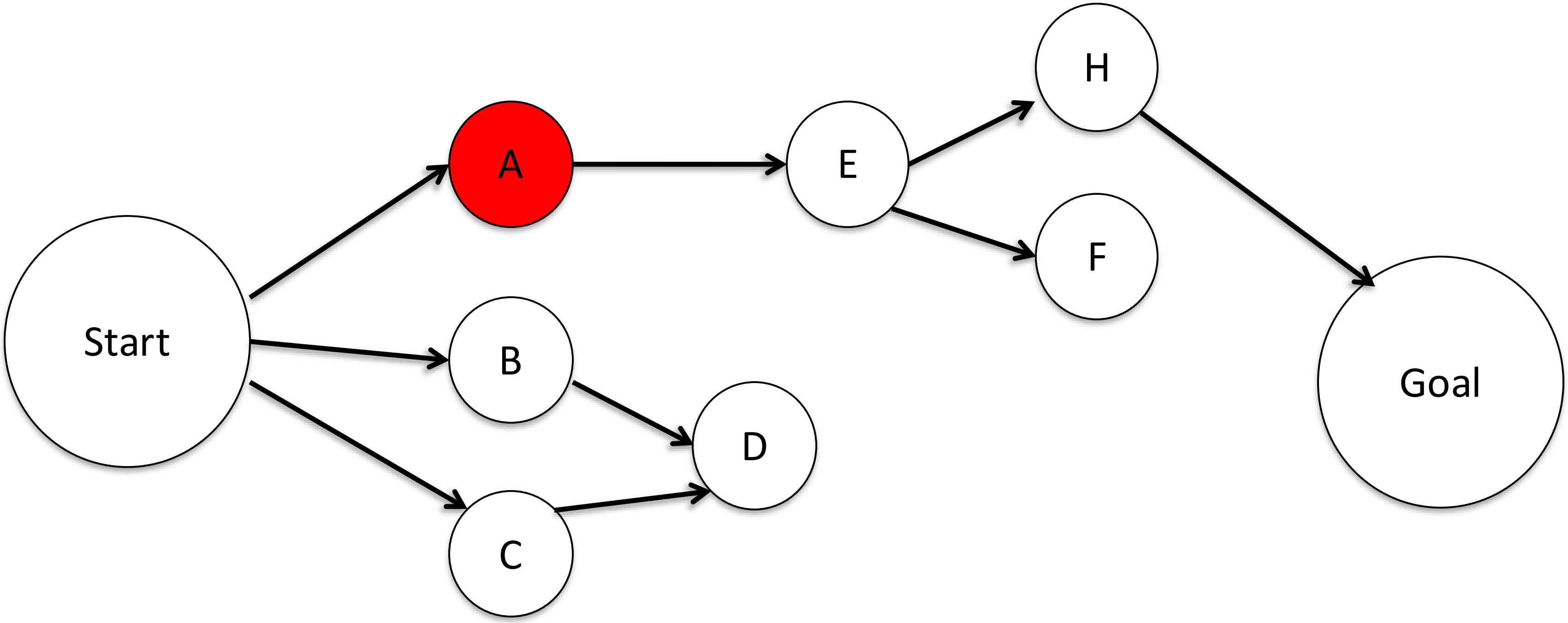
Breadth-First Search Example

Todo list: A, B, C



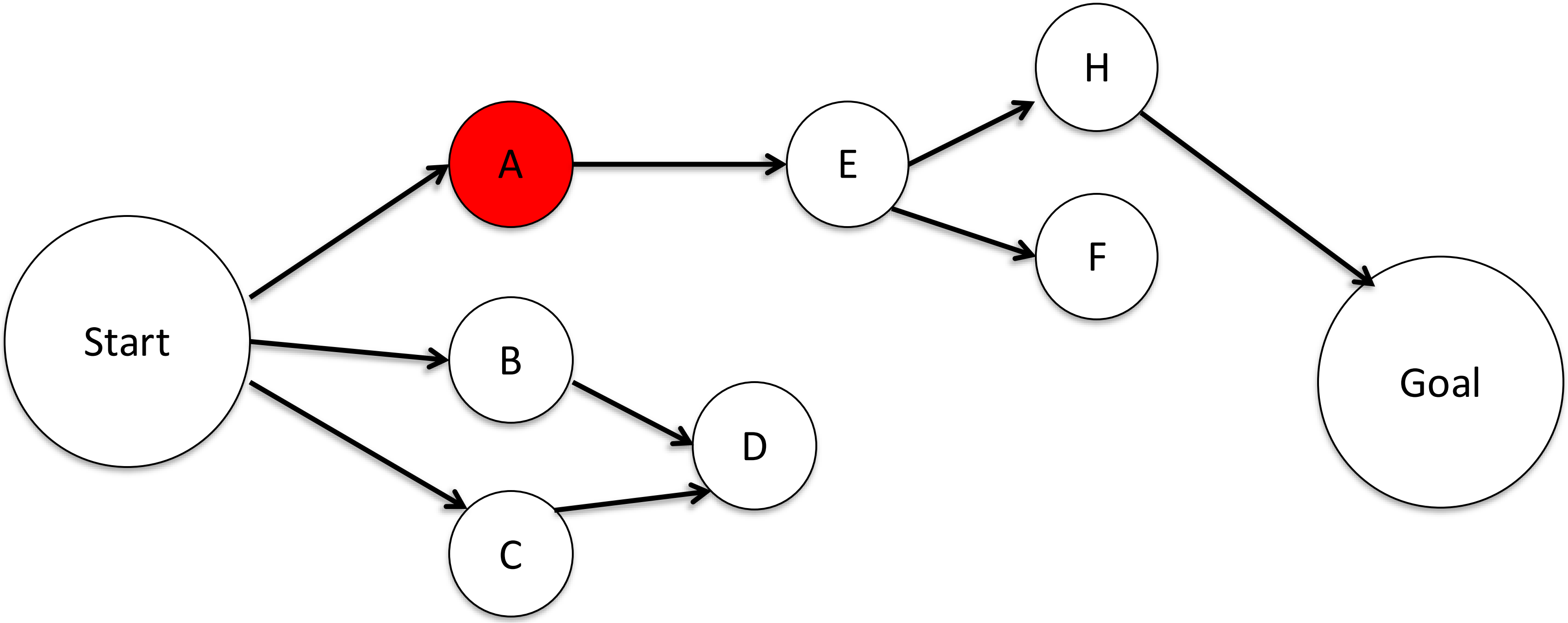
Breadth-First Search Example

Todo list: B, C



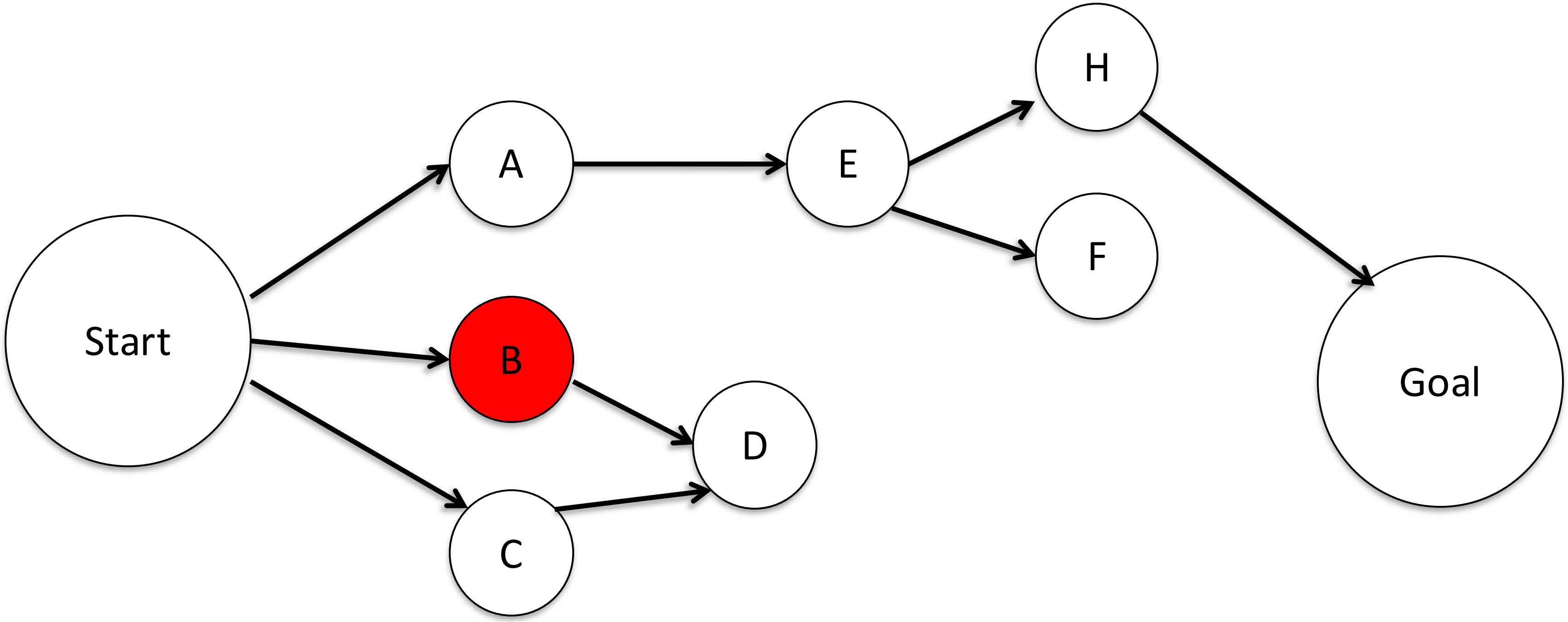
Breadth-First Search Example

Todo list: B, C, E



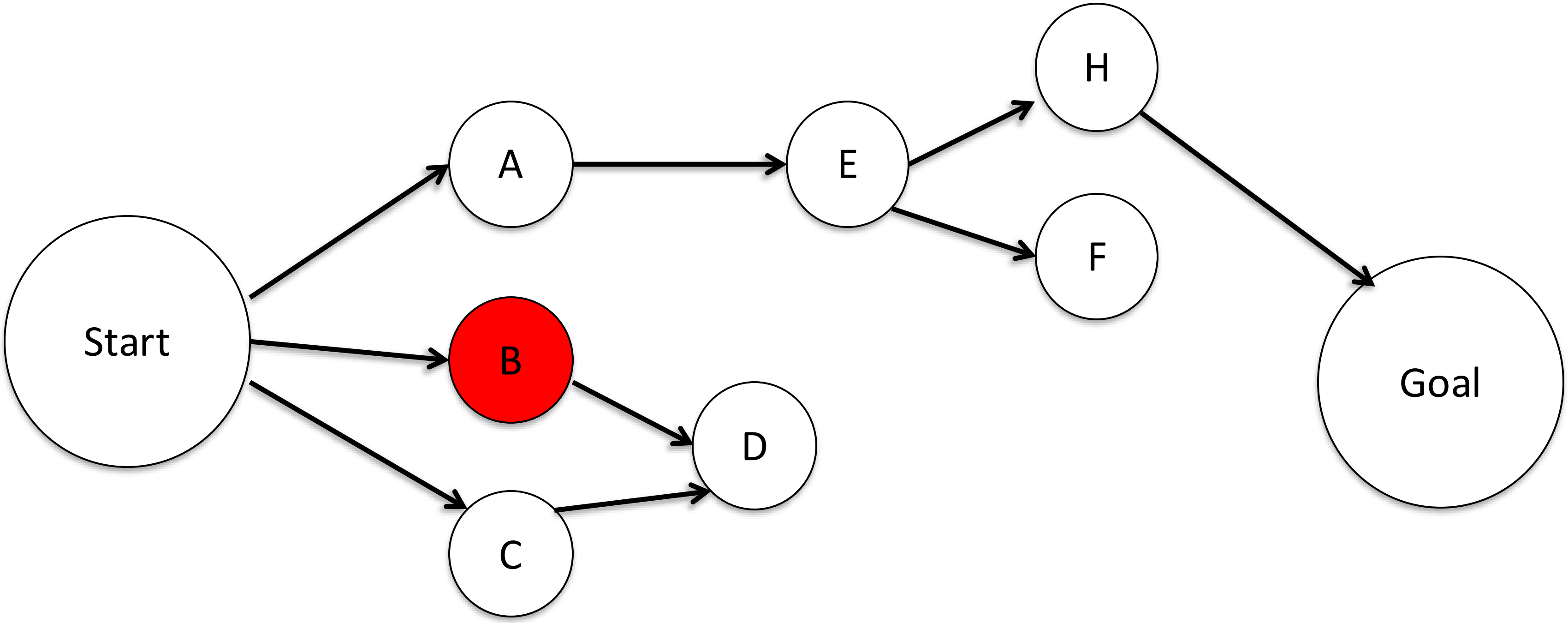
Breadth-First Search Example

Todo list: C, E



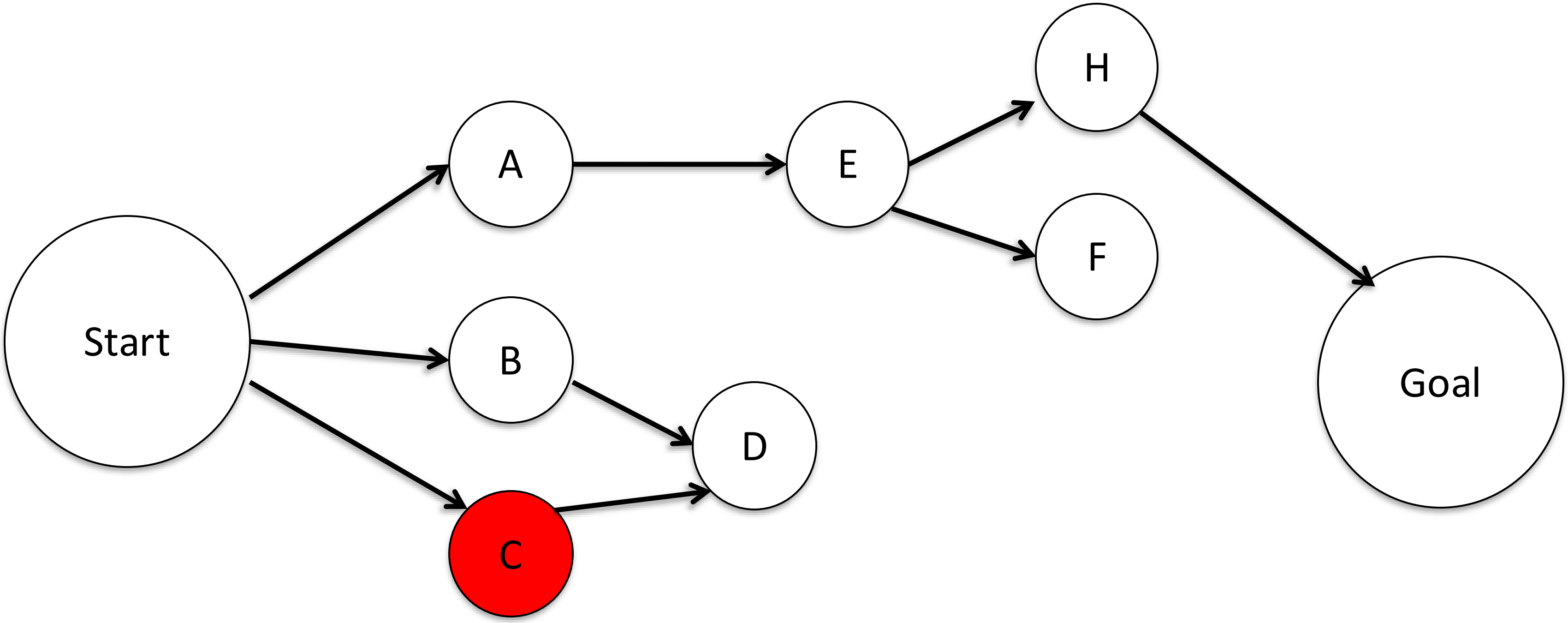
Breadth-First Search Example

Todo list: C, E, D



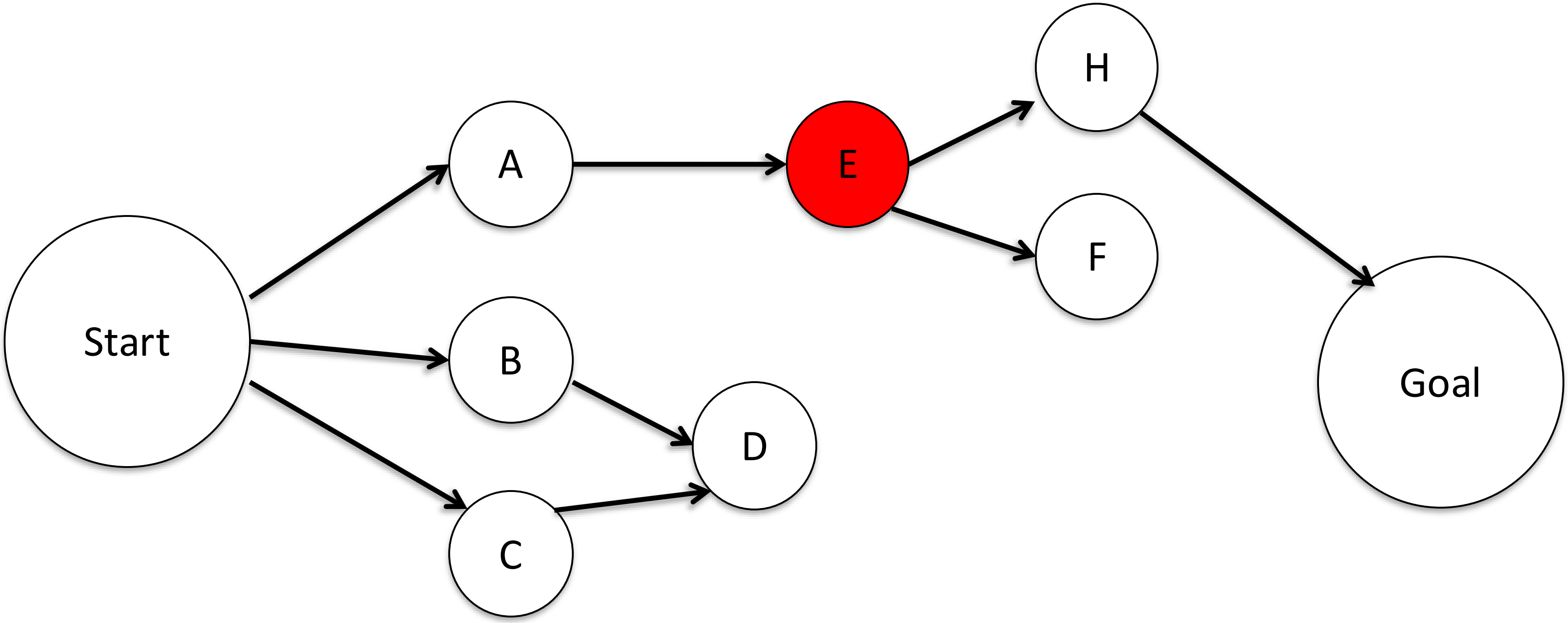
Breadth-First Search Example

Todo list: E, D



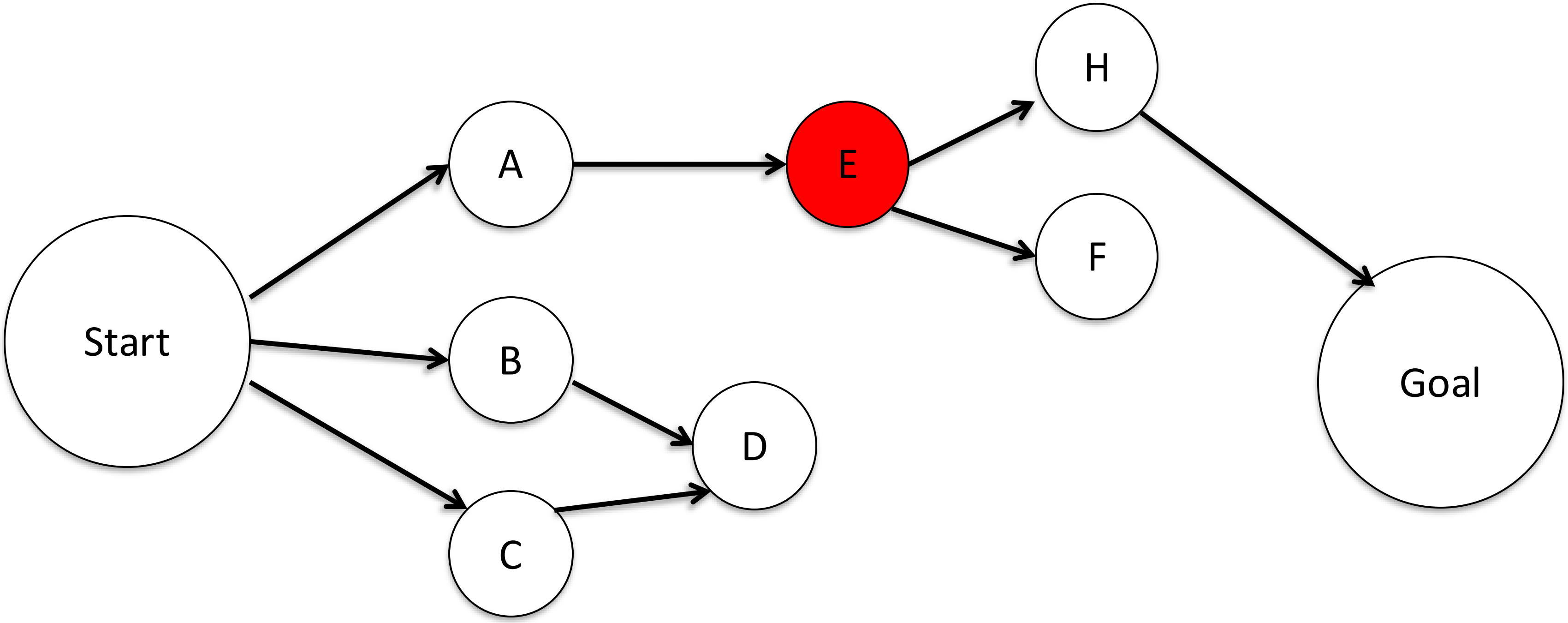
Breadth-First Search Example

Todo list: D



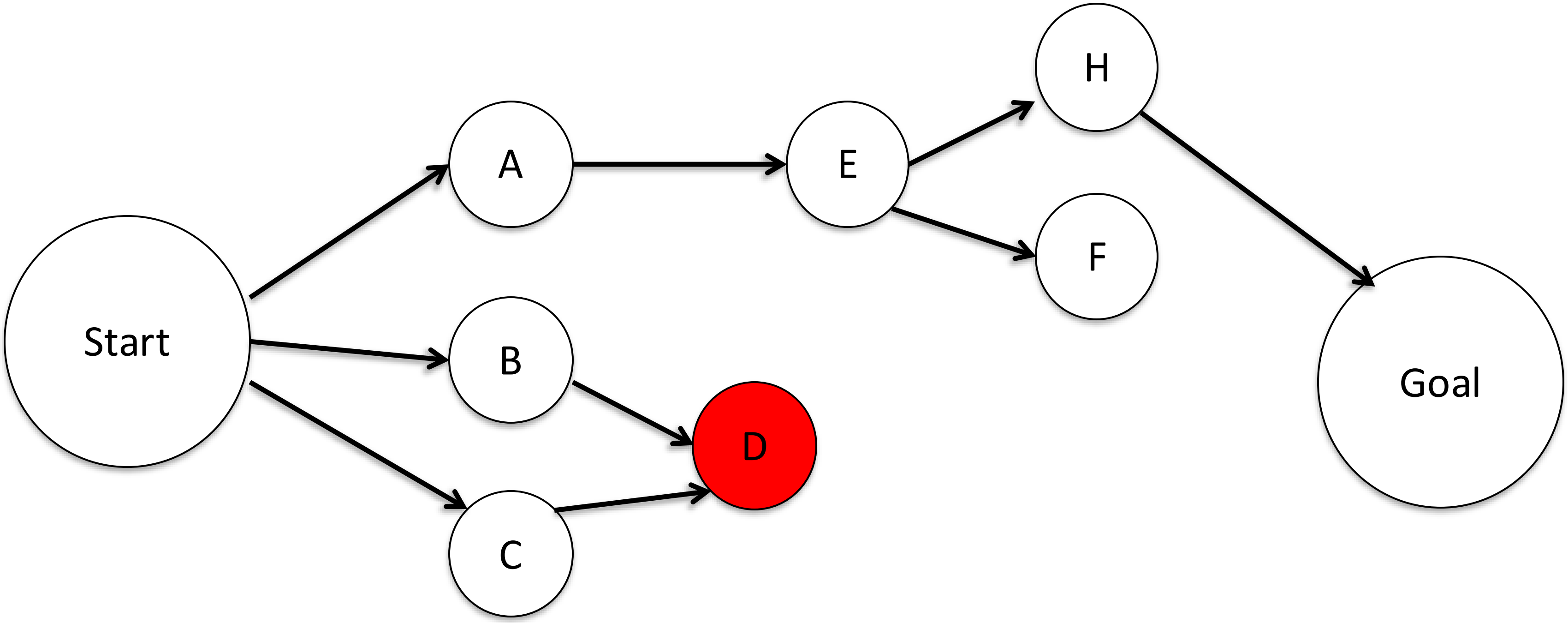
Breadth-First Search Example

Todo list: D, H, F



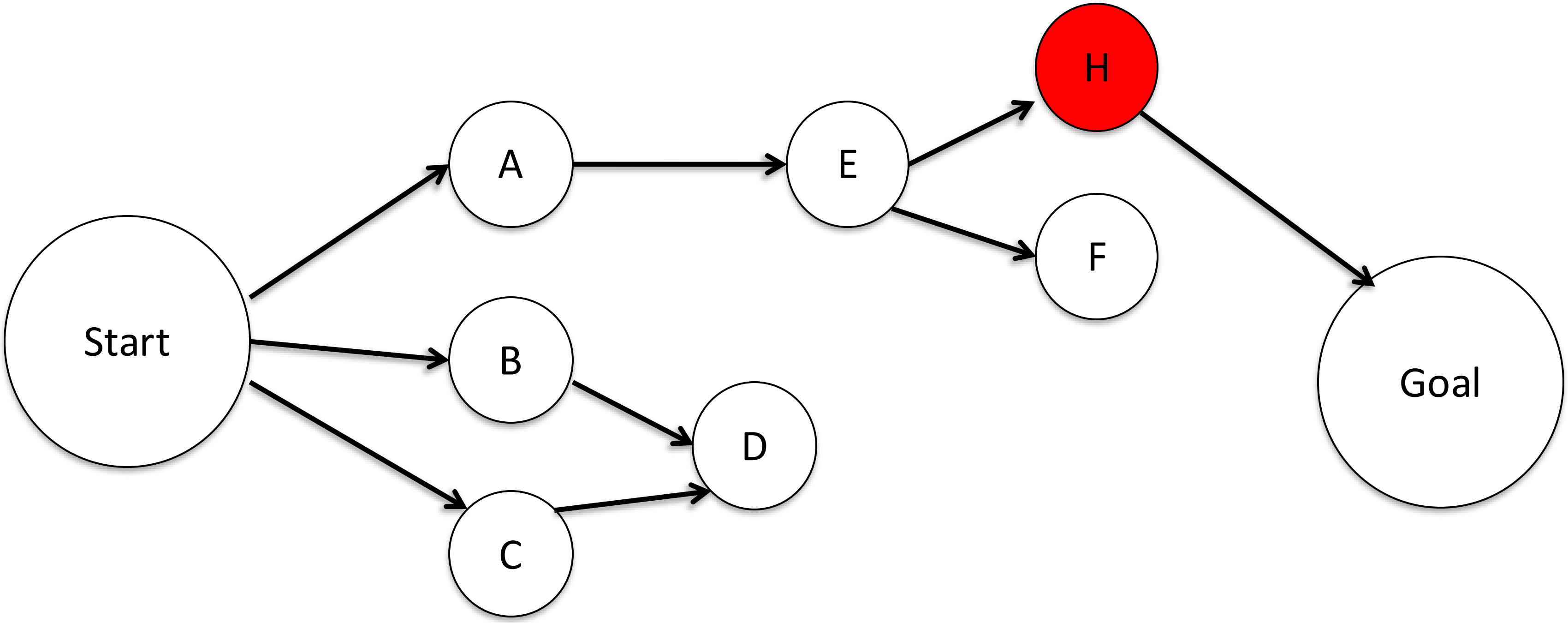
Breadth-First Search Example

Todo list: H, F



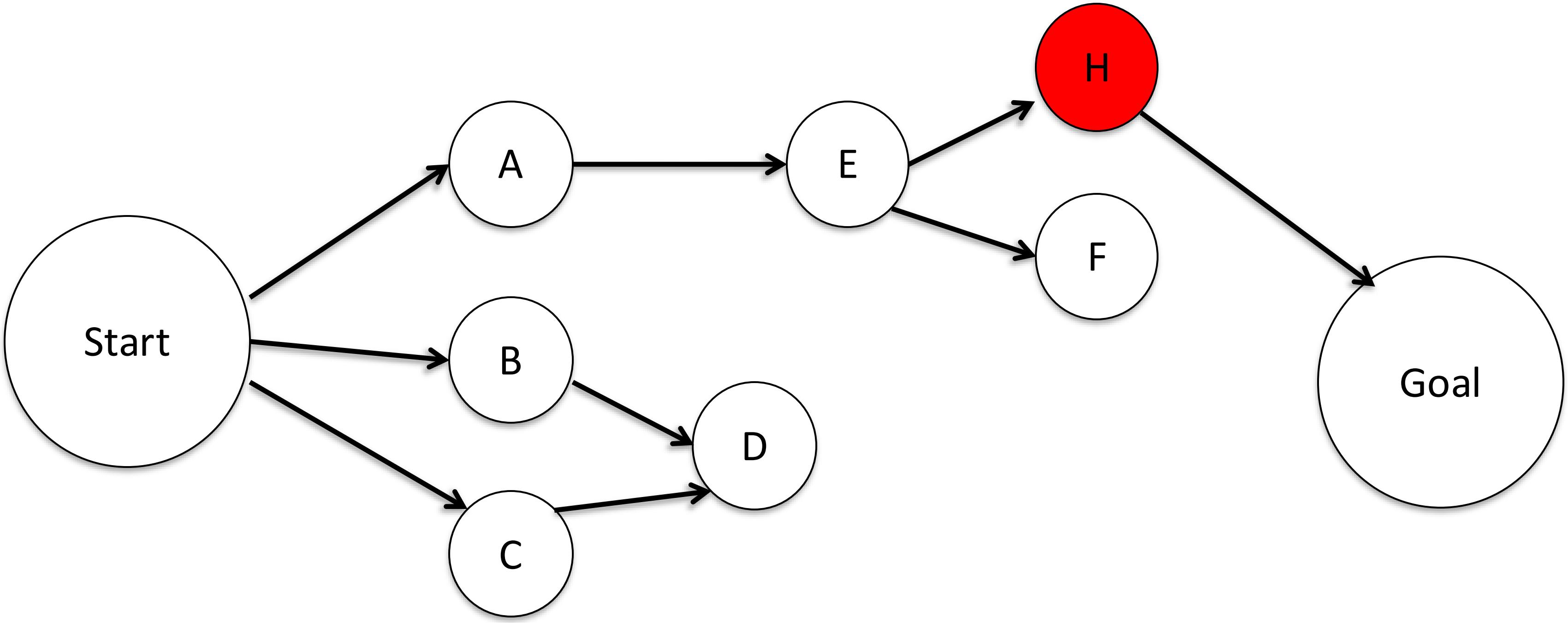
Breadth-First Search Example

Todo list: F



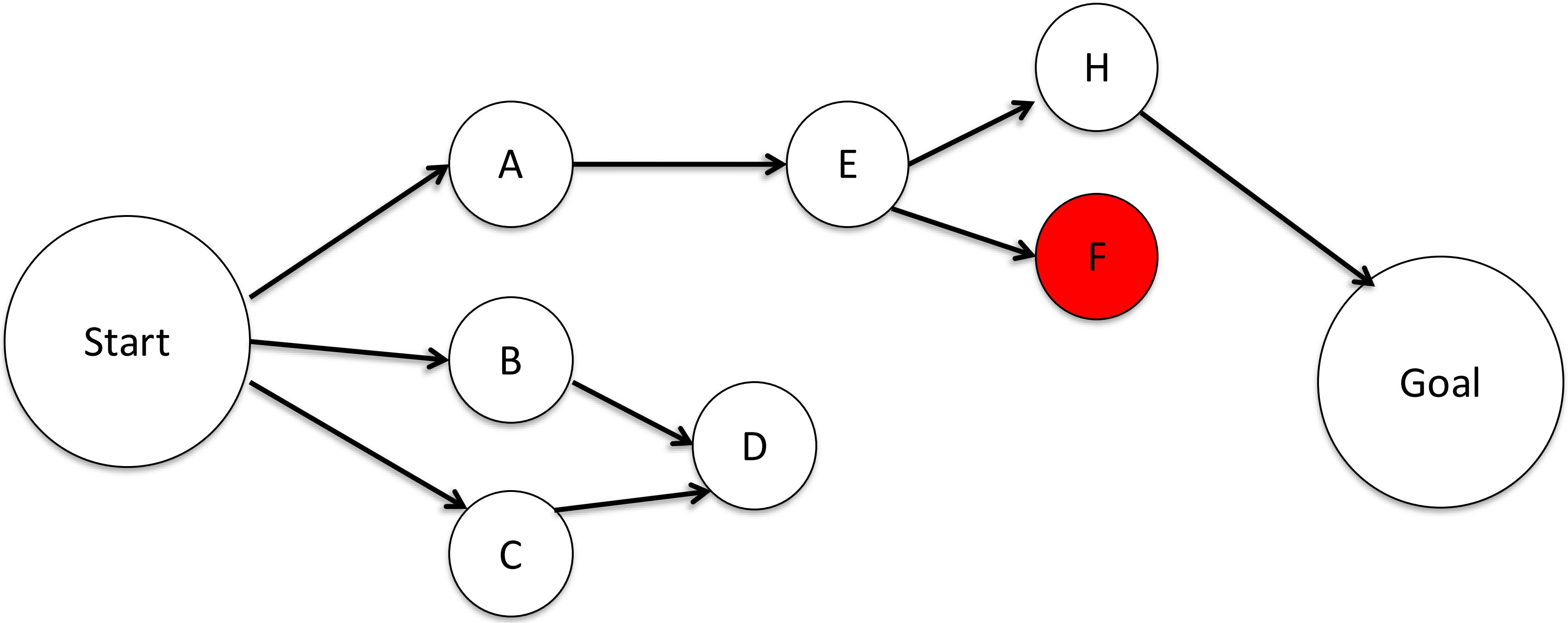
Breadth-First Search Example

Todo list: F, Goal



Breadth-First Search Example

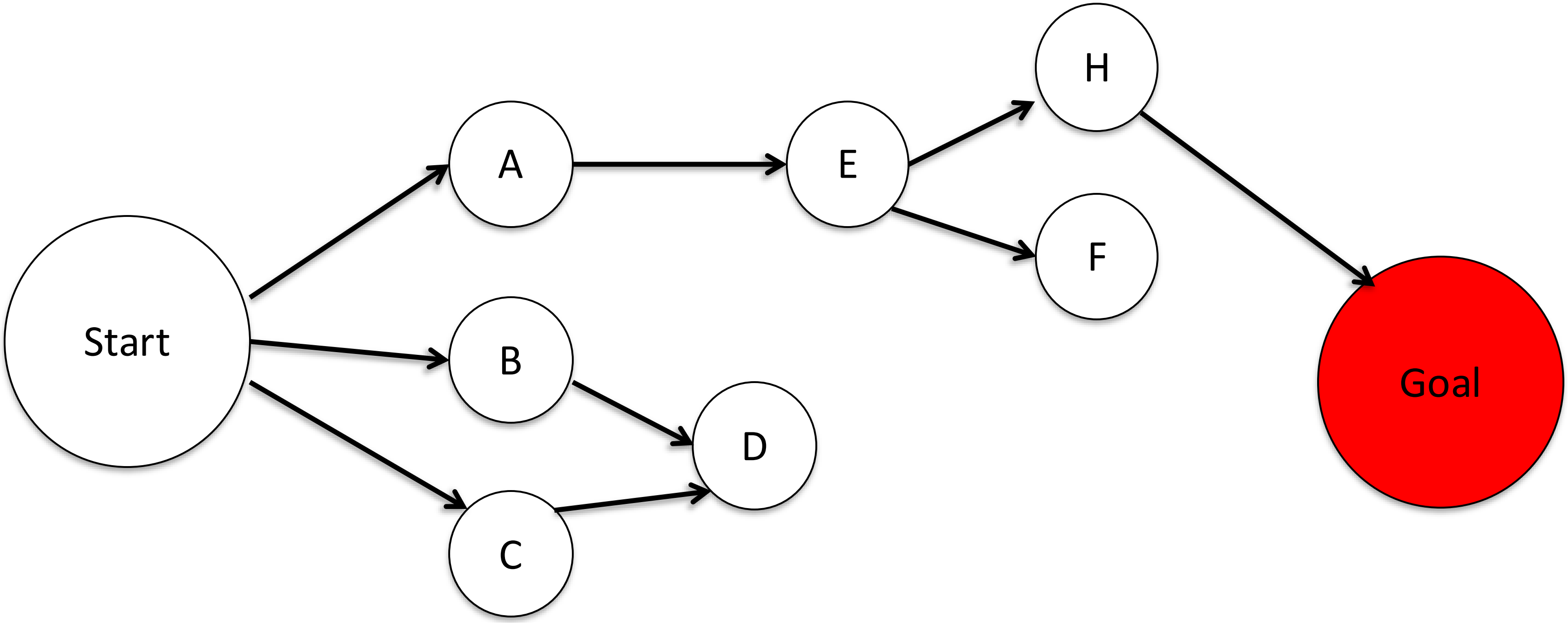
Todo list: Goal



Breadth-First Search Example

Todo list:

Victory!!



Breadth First Search

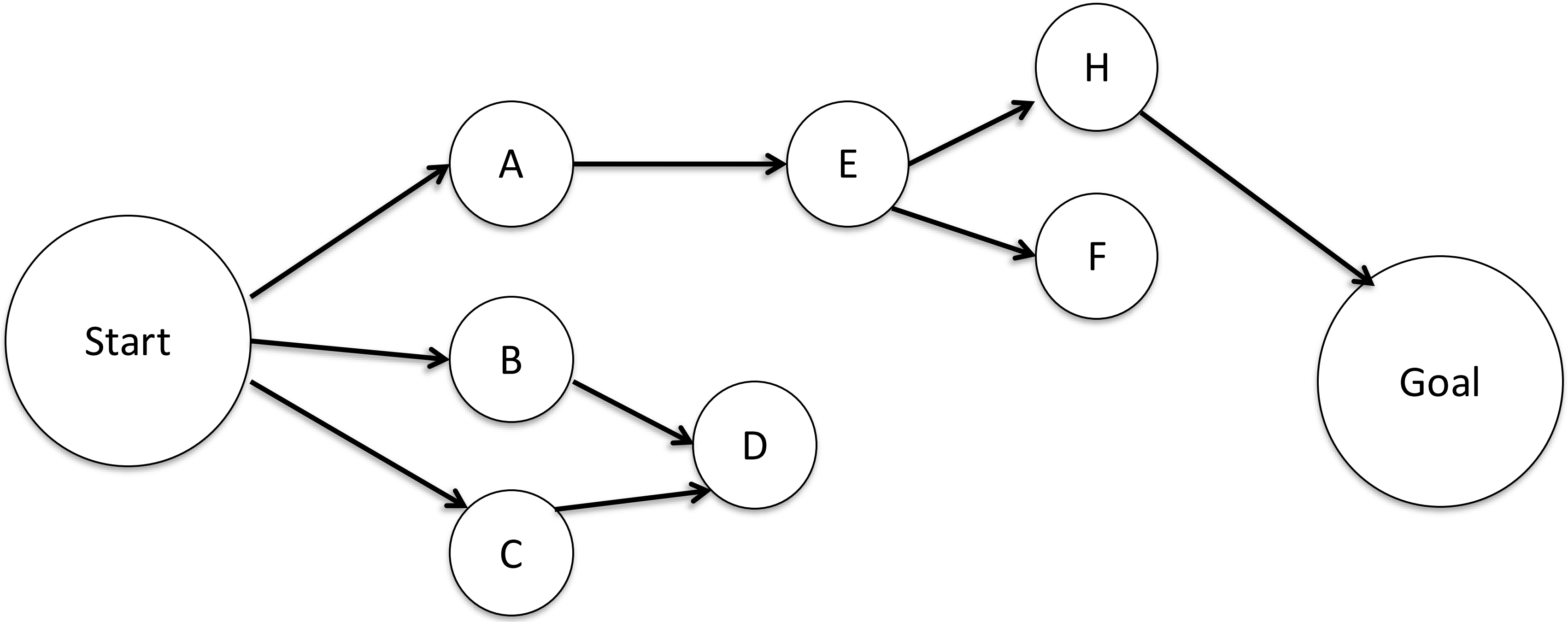
- Guaranteed to find shortest (in number of steps path to the goal)
- To recover the path just requires some additional bookkeeping
- How many operations does it take to complete?

Depth-First Search

Same as breadth first search, but we structure our todo list differently to prioritize visiting children (i.e. connected by an arrow) of the node we are processing

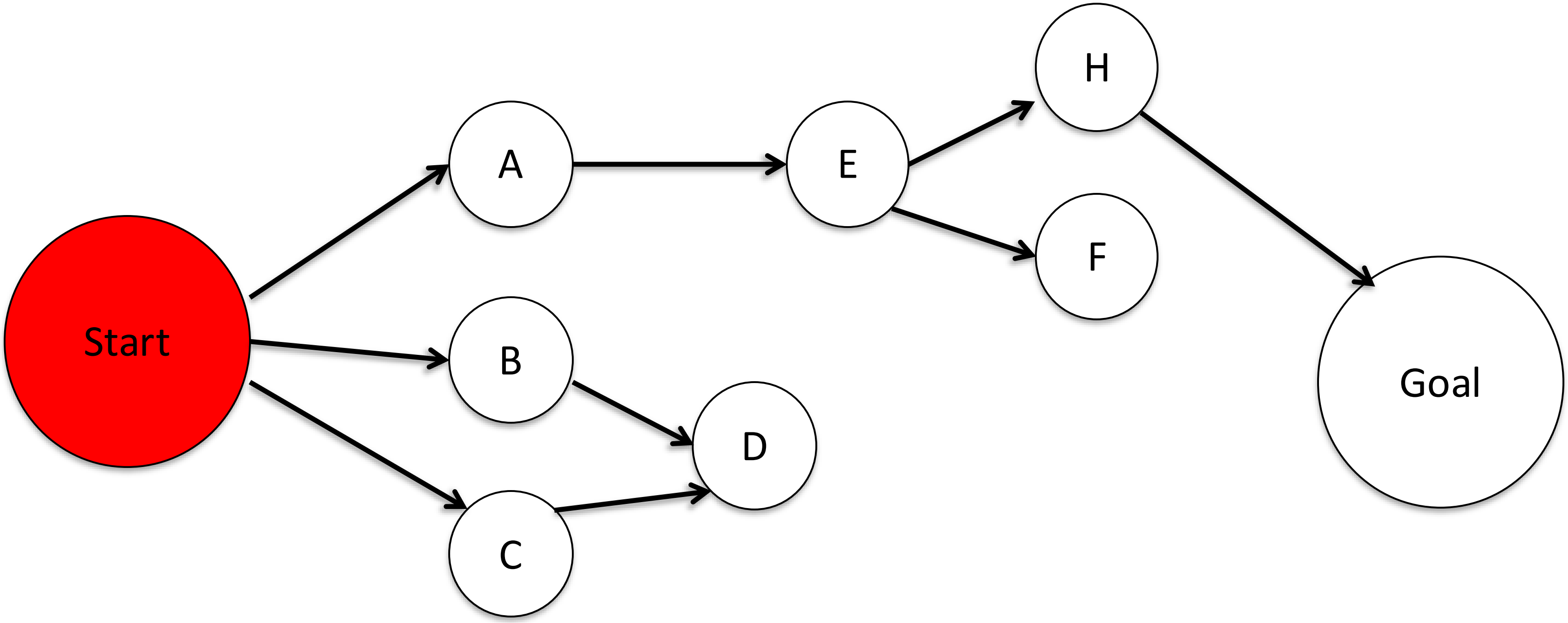
Depth-First Search Example

Todo list: Start



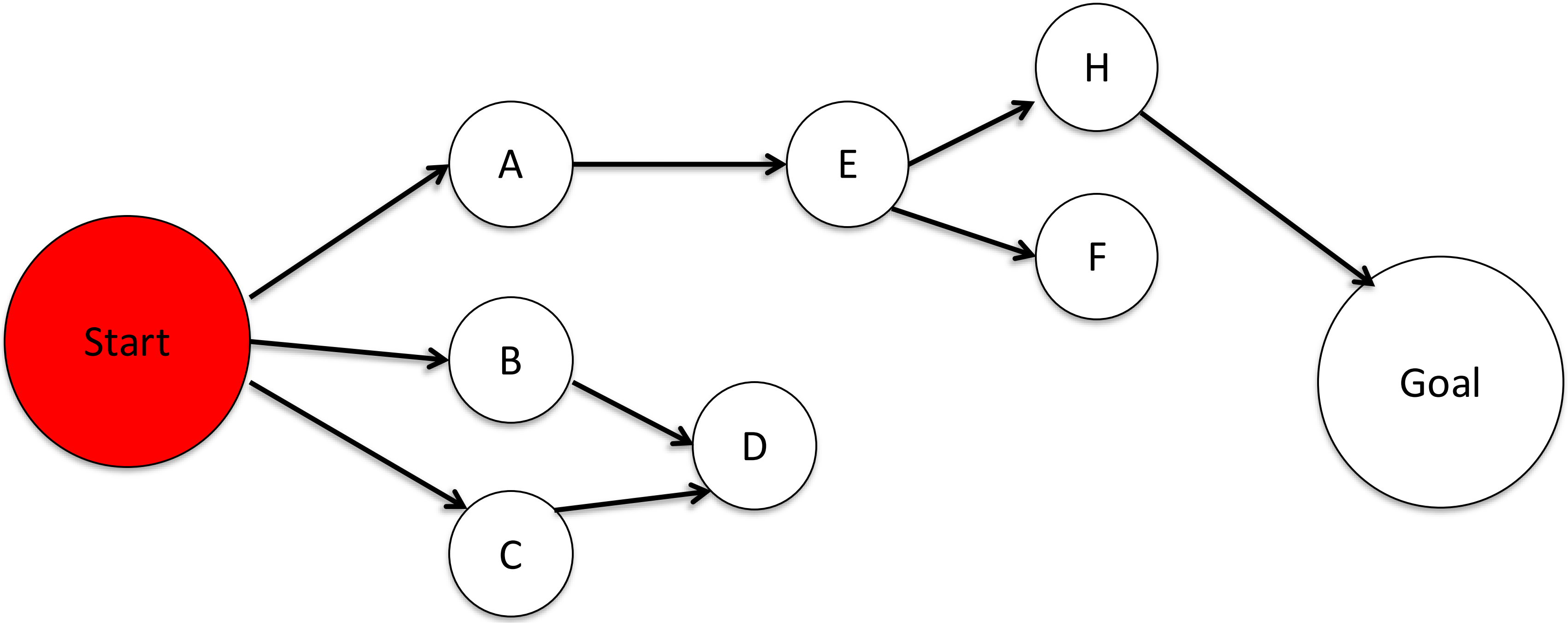
Depth-First Search Example

Todo list:



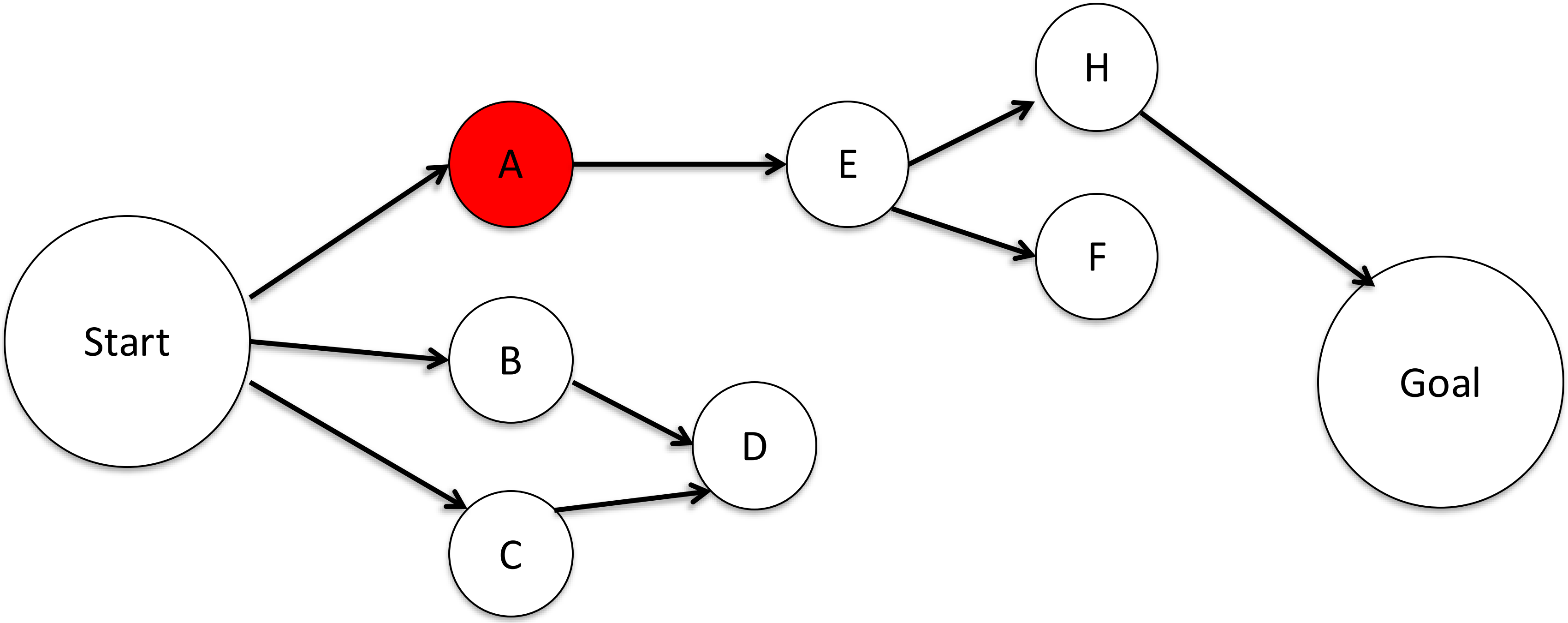
Depth-First Search Example

Todo list: A, B, C



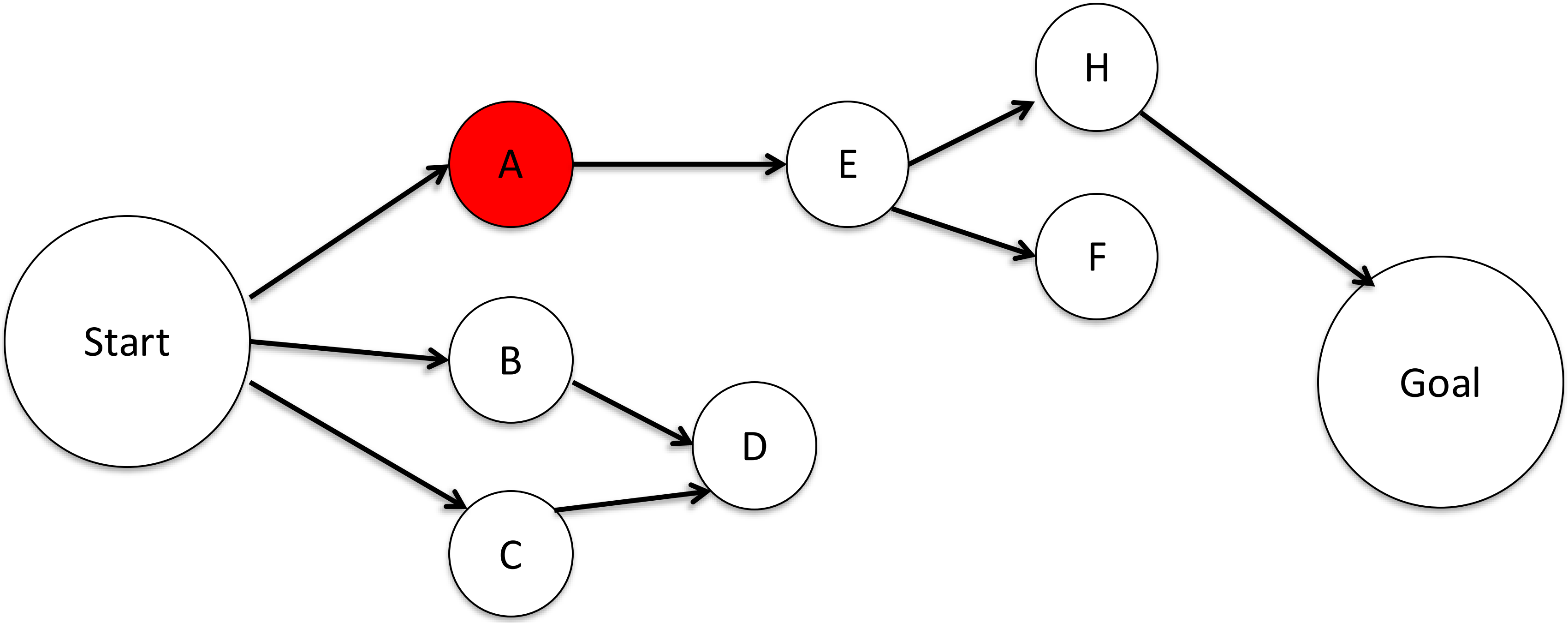
Depth-First Search Example

Todo list: B, C



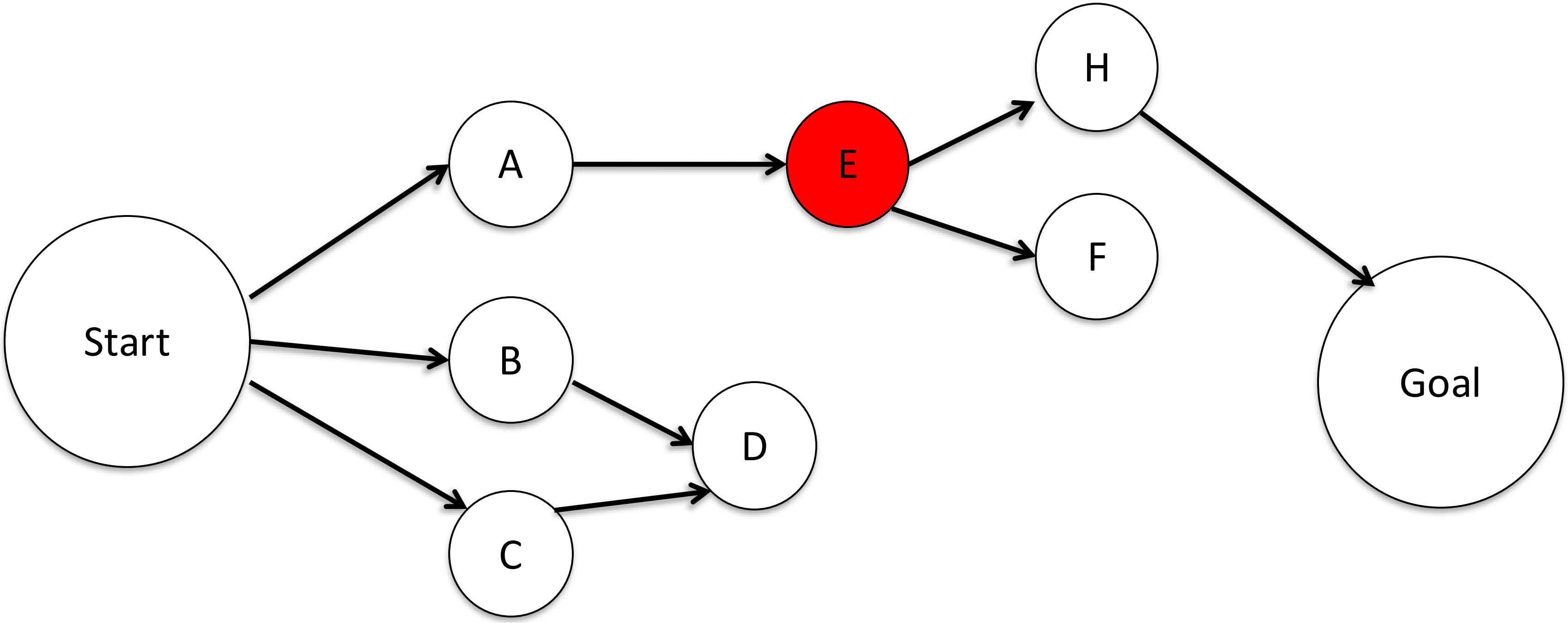
Depth-First Search Example

Todo list: E, B, C



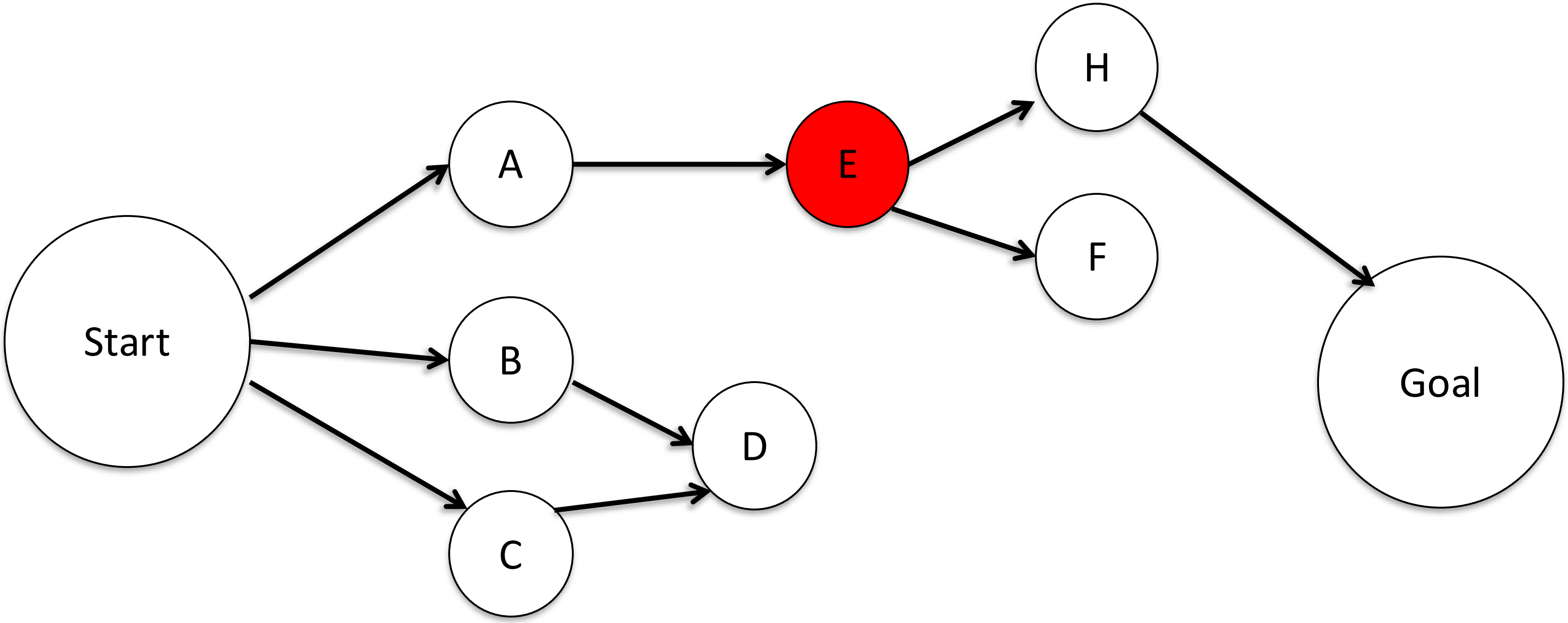
Depth-First Search Example

Todo list: B, C



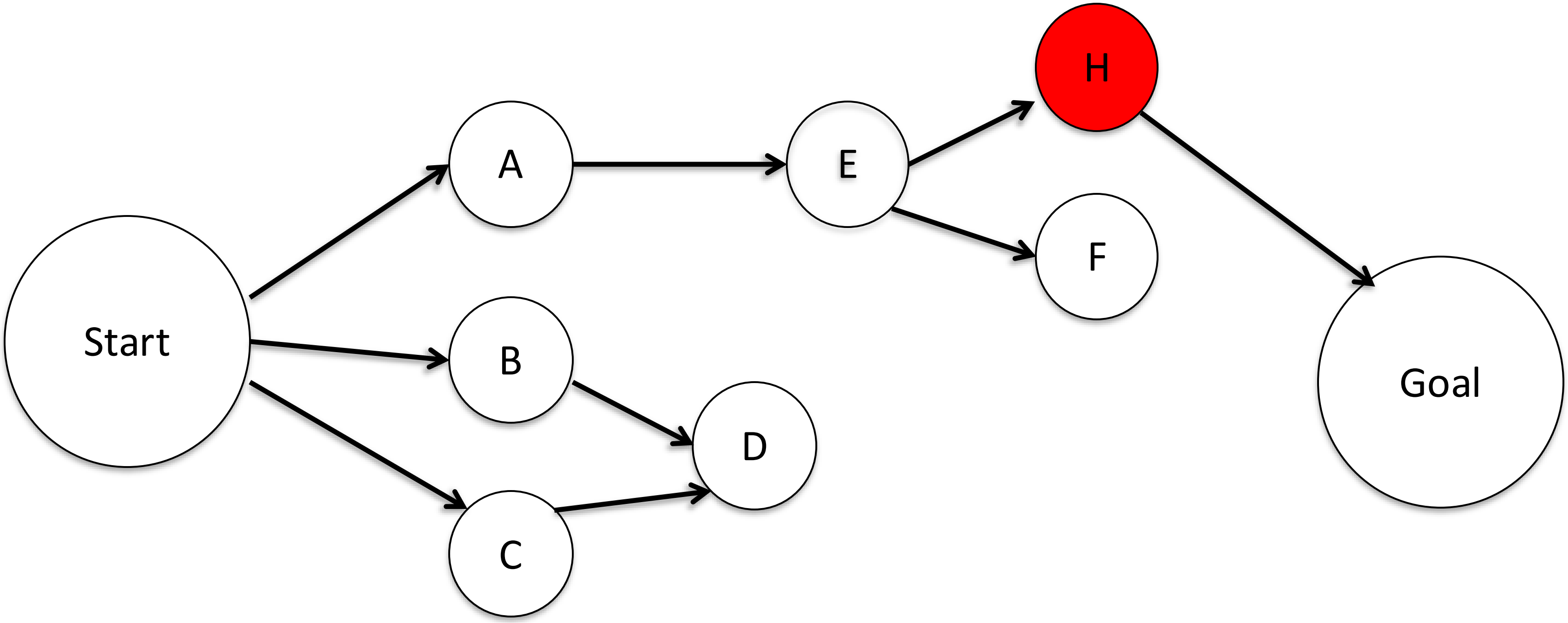
Depth-First Search Example

Todo list: H, F, B, C



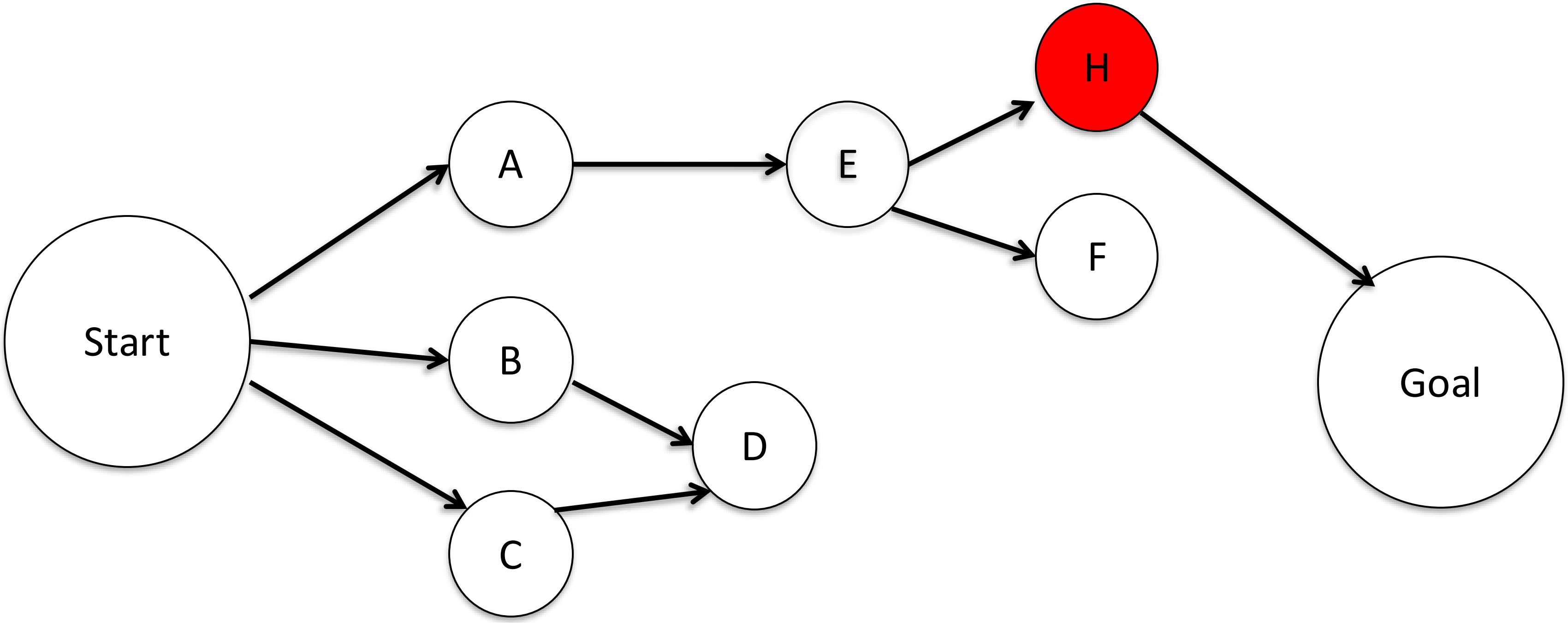
Depth-First Search Example

Todo list: F, B, C



Depth-First Search Example

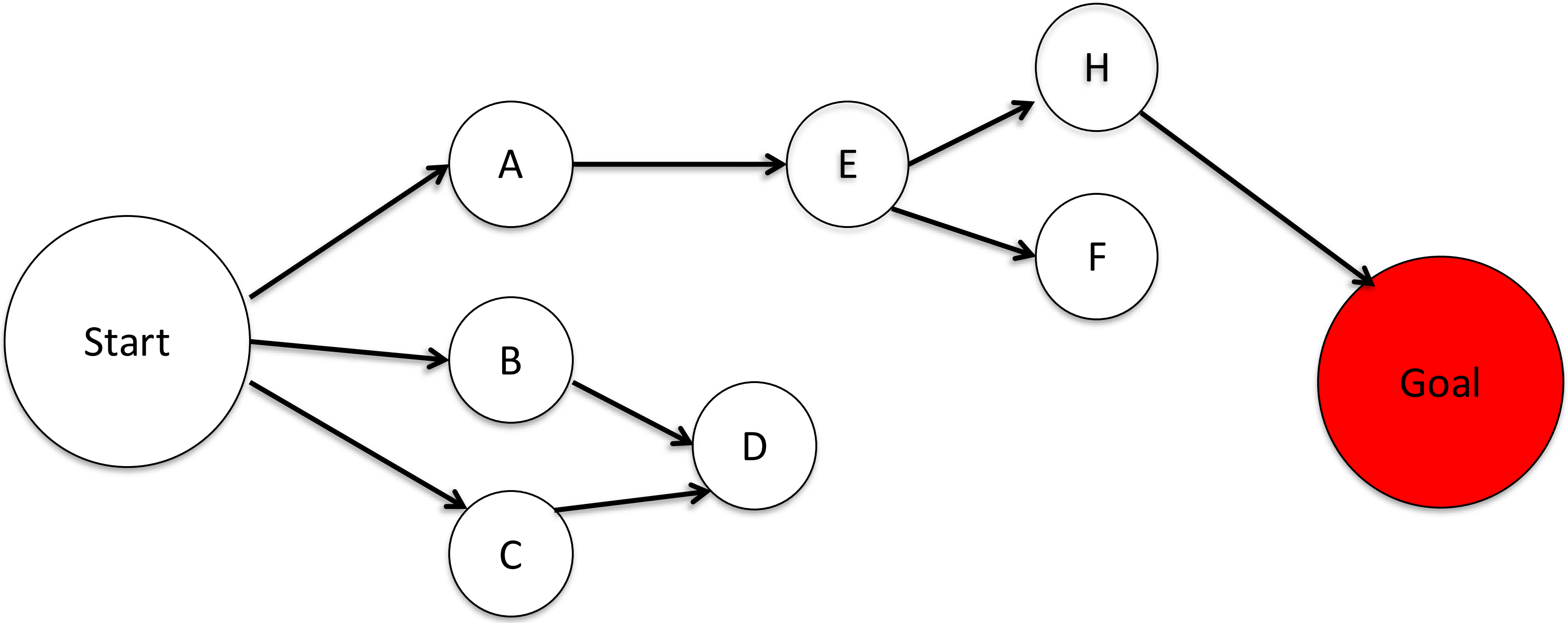
Todo list: Goal, F, B, C



Depth-First Search Example

Todo list: F, B, C

Victory!!



Similarities

- Both algorithms are very similar, except for the storage of the todo list
- Connects very nicely to data structures (BFS uses FIFO todo list, DFS uses LIFO todo list)
- FIFO = queue, LIFO = stack
- Next, we will define a more general formulation of graph search that will help us learn two more algorithms for path planning

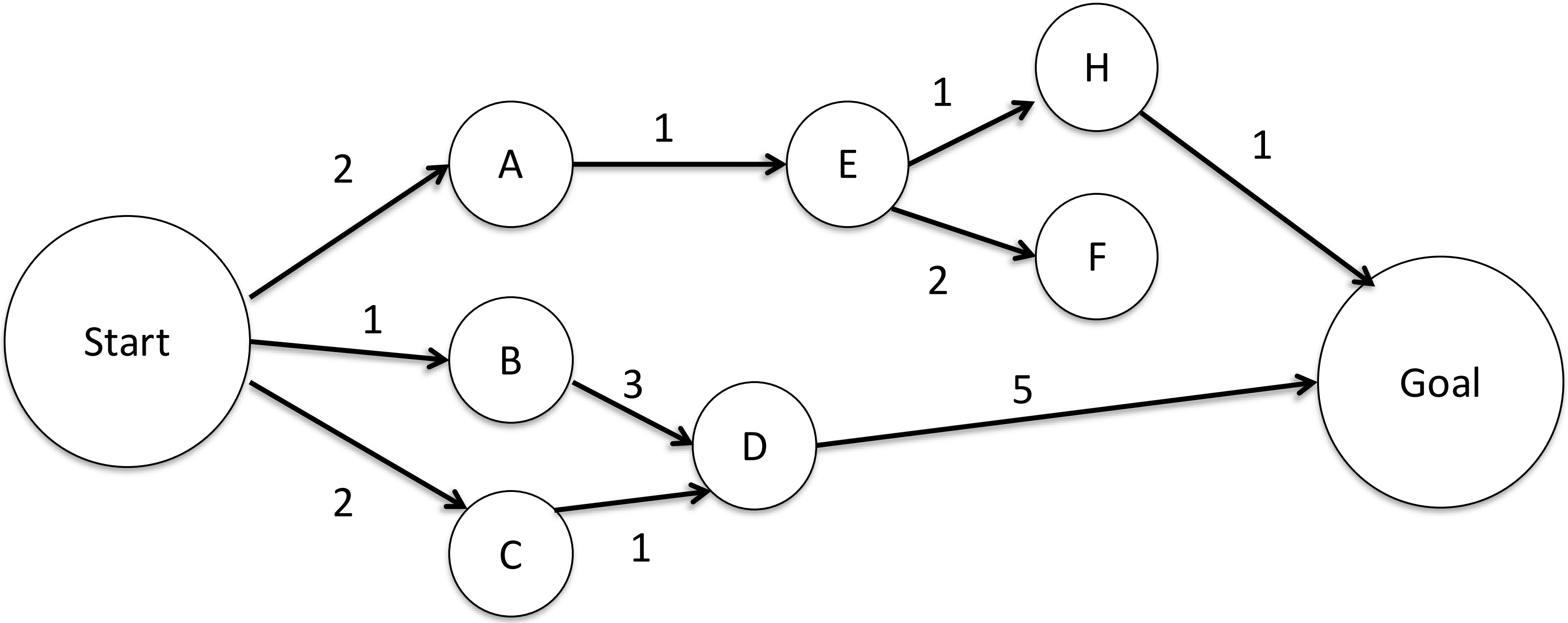
Dijkstra’s Algorithm

- Considers edge costs (not done in BFS or DFS)
- Guaranteed to find optimal path (minimum sum of costs)
- **Key idea:** store a tentative cost to each node in the todo list, update if possible (example will clarify)

Dijkstra’s Example

Todo list: (Start, 0)

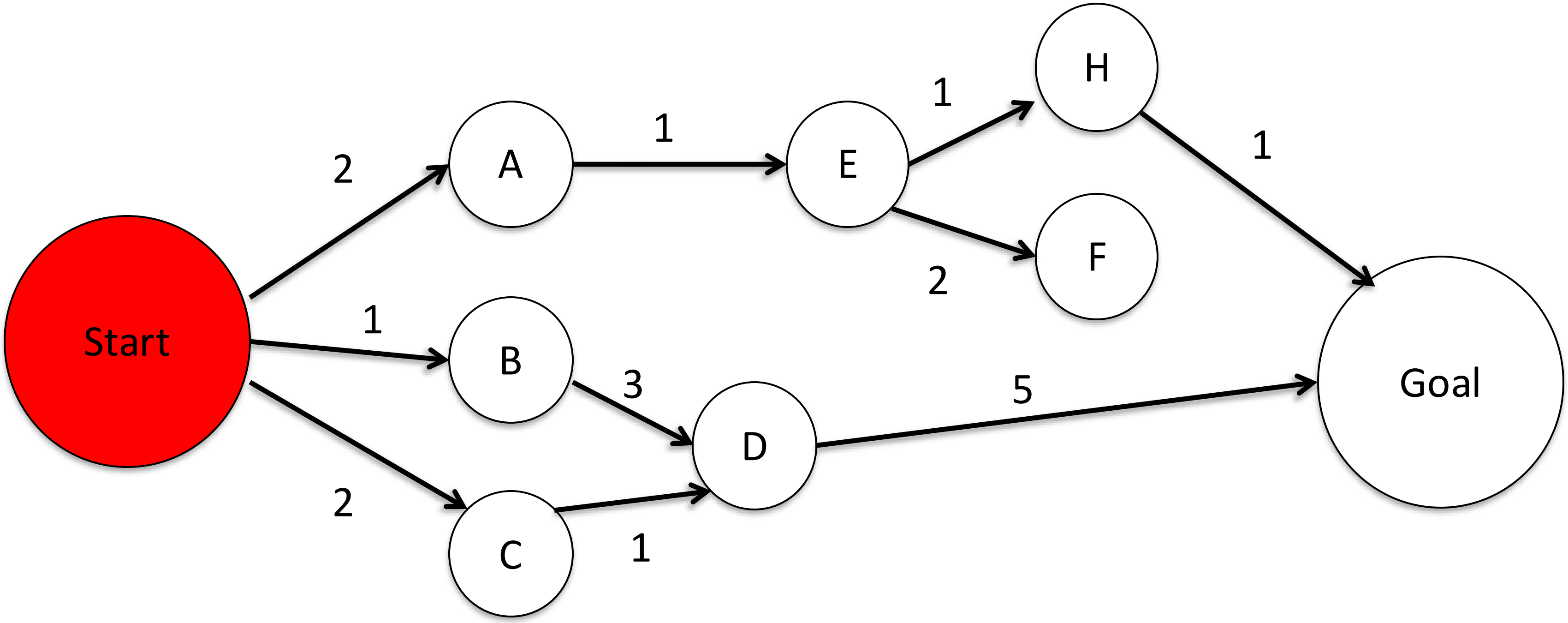
Dead nodes:



Dijkstra’s Example

Todo list:

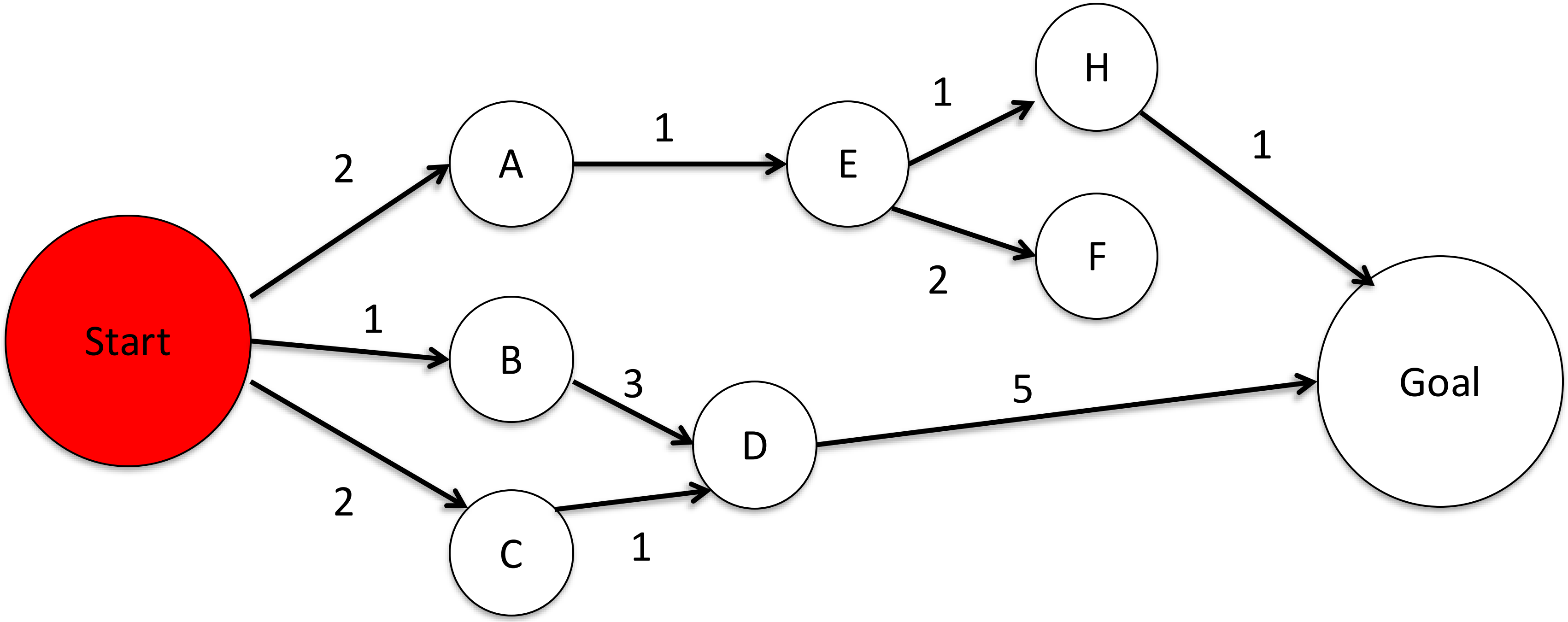
Dead nodes:



Dijkstra’s Example

Todo list: (B, 1), (A, 2), (C, 2)

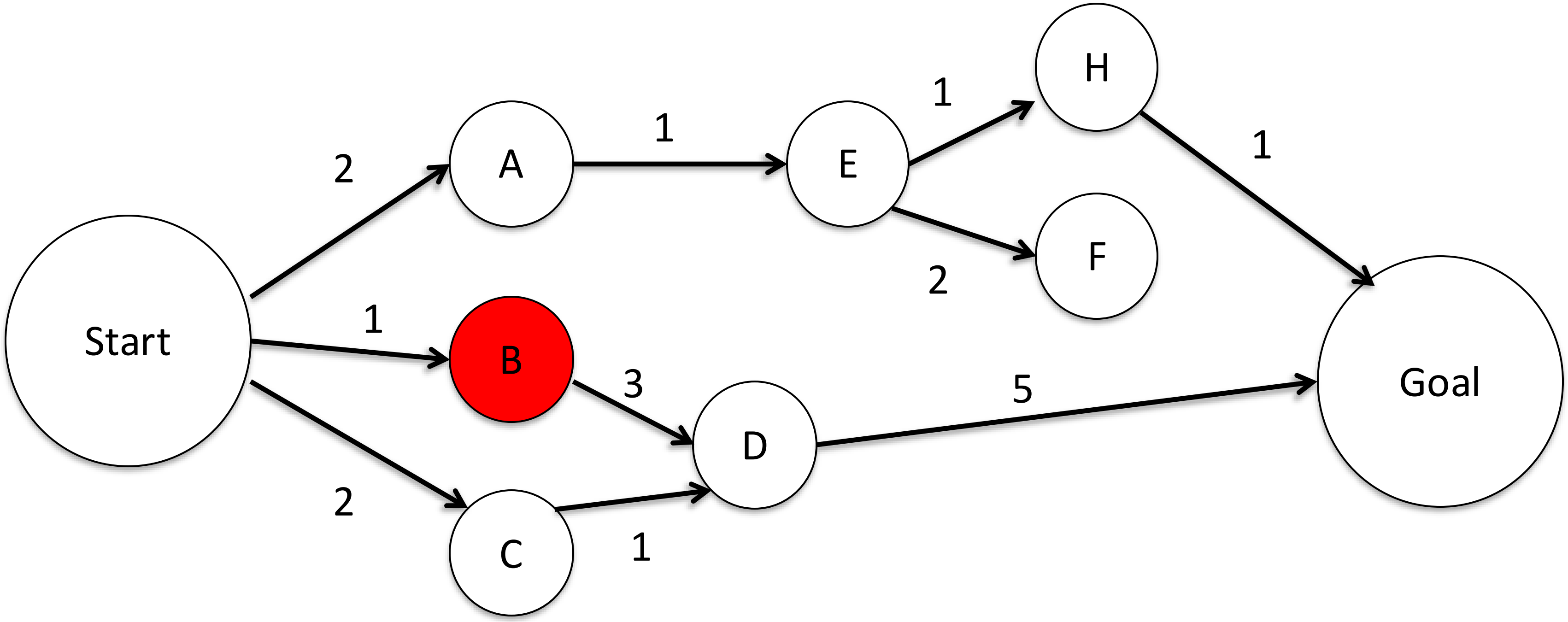
Dead nodes: (Start)



Dijkstra’s Example

Todo list: (A, 2), (C, 2)

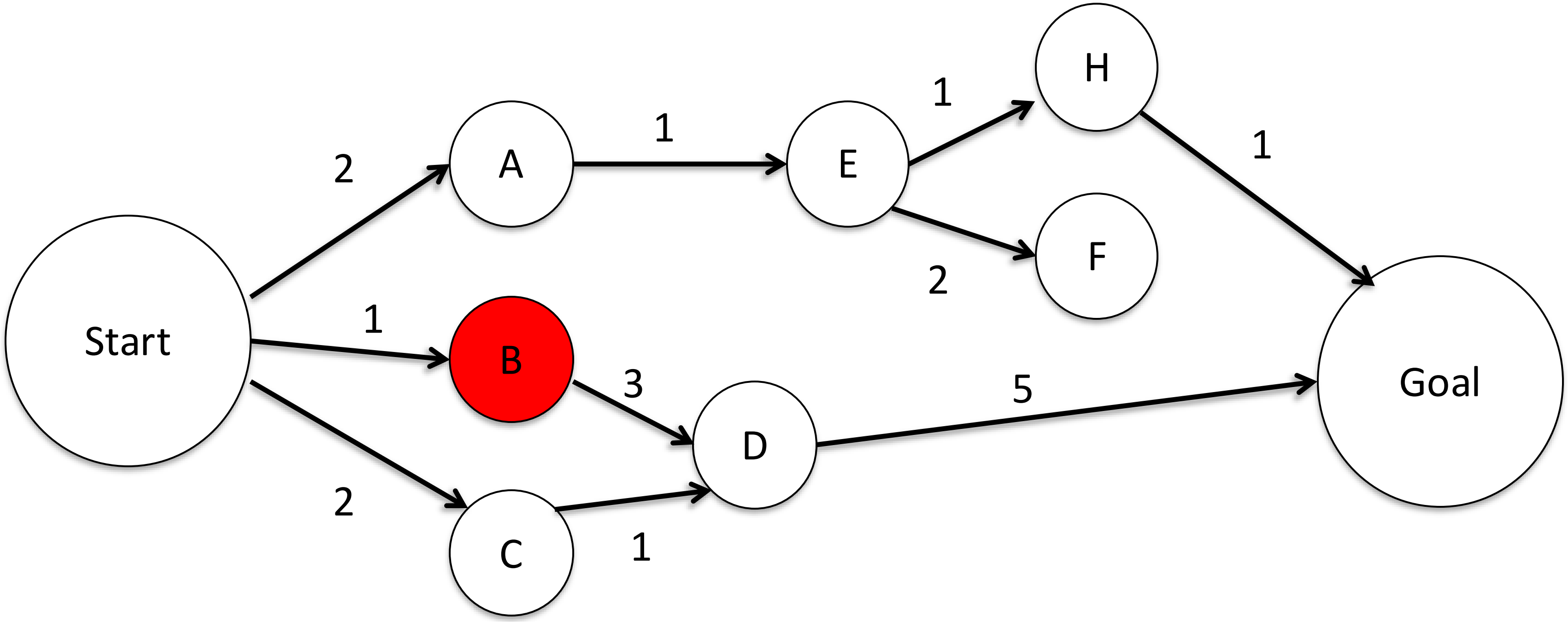
Dead nodes: (Start)



Dijkstra’s Example

Todo list: (A,2), (C, 2), (D,4)

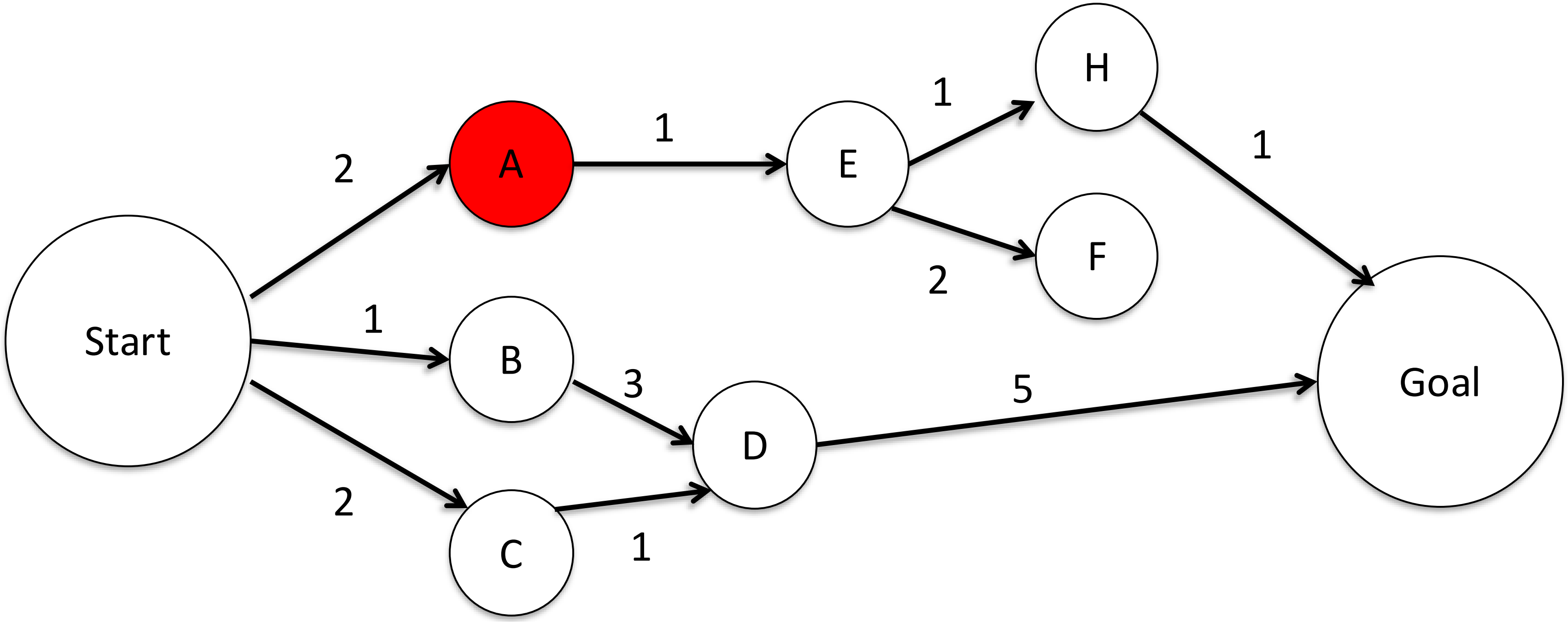
Dead nodes: (Start, B)



Dijkstra’s Example

Todo list: (C, 2), (D,4)

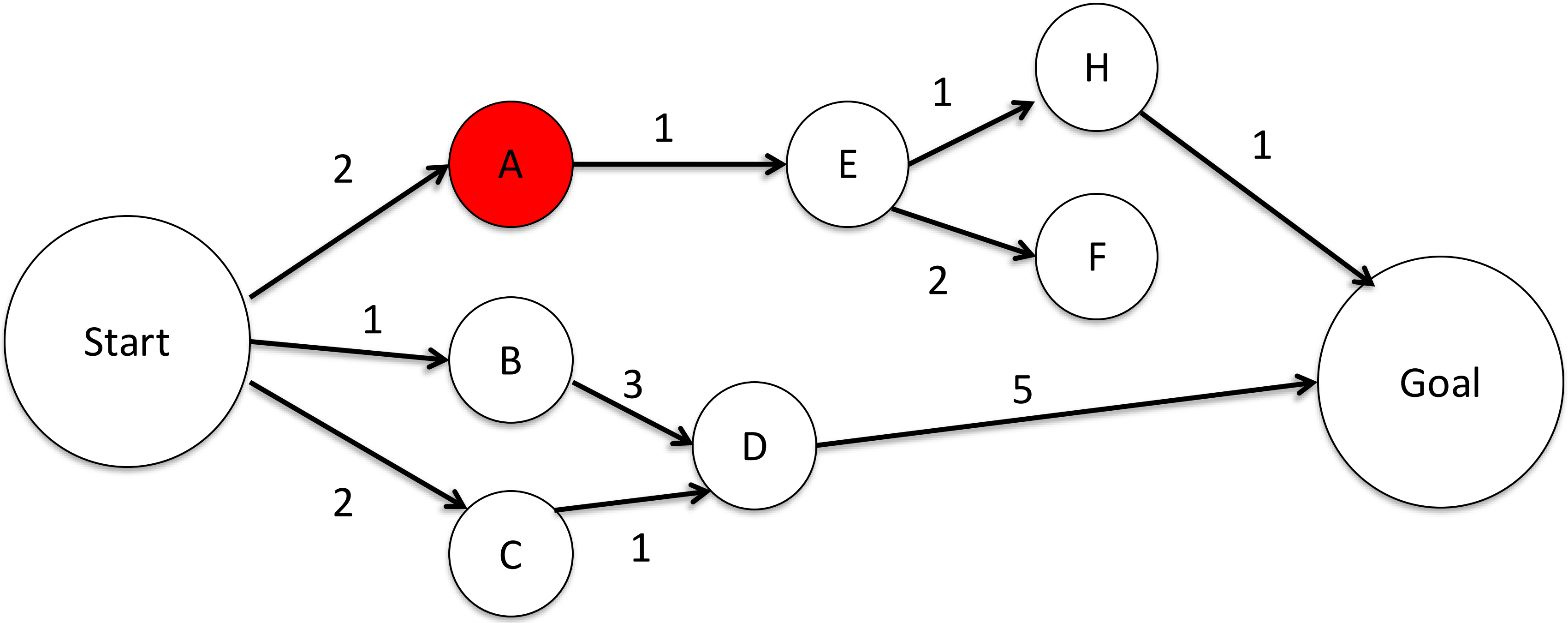
Dead nodes: (Start, B)



Dijkstra’s Example

Todo list: (C, 2), (E, 3), (D, 4)

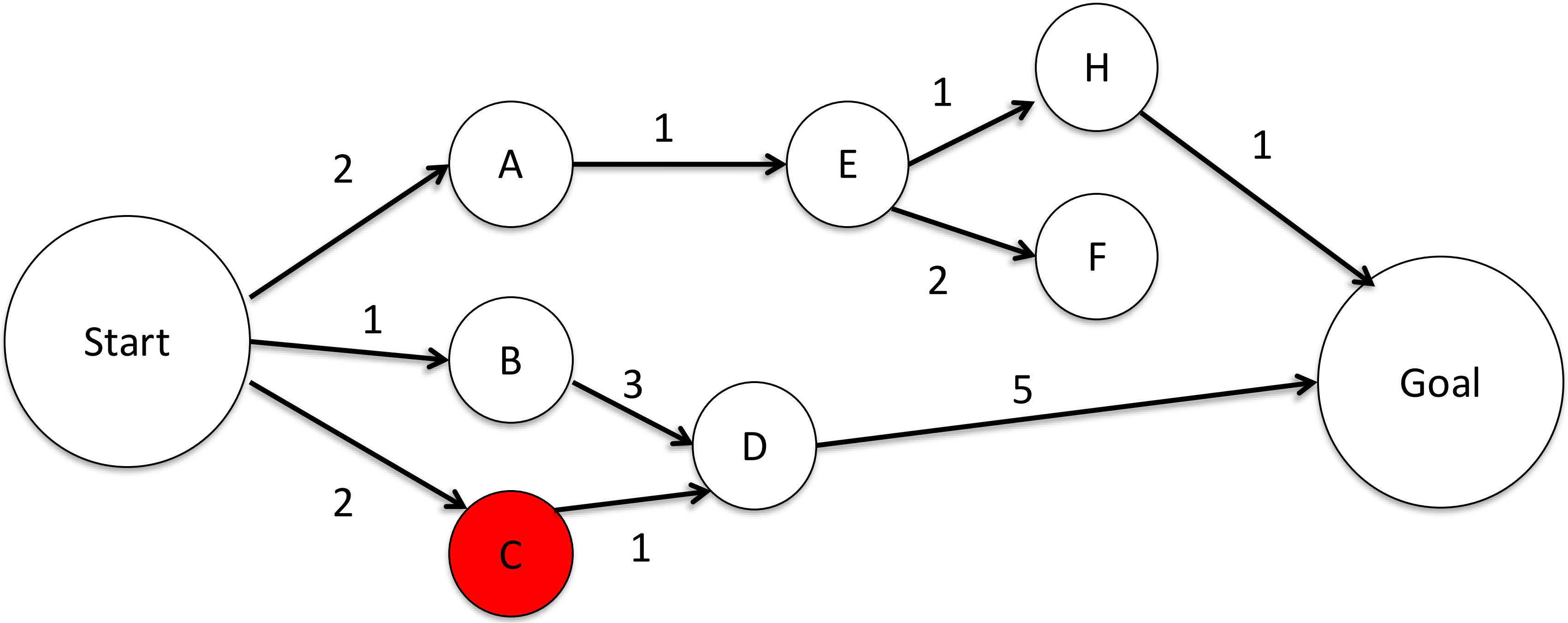
Dead nodes: (Start, B, A)



Dijkstra’s Example

Todo list: (E, 3), (D, 4)

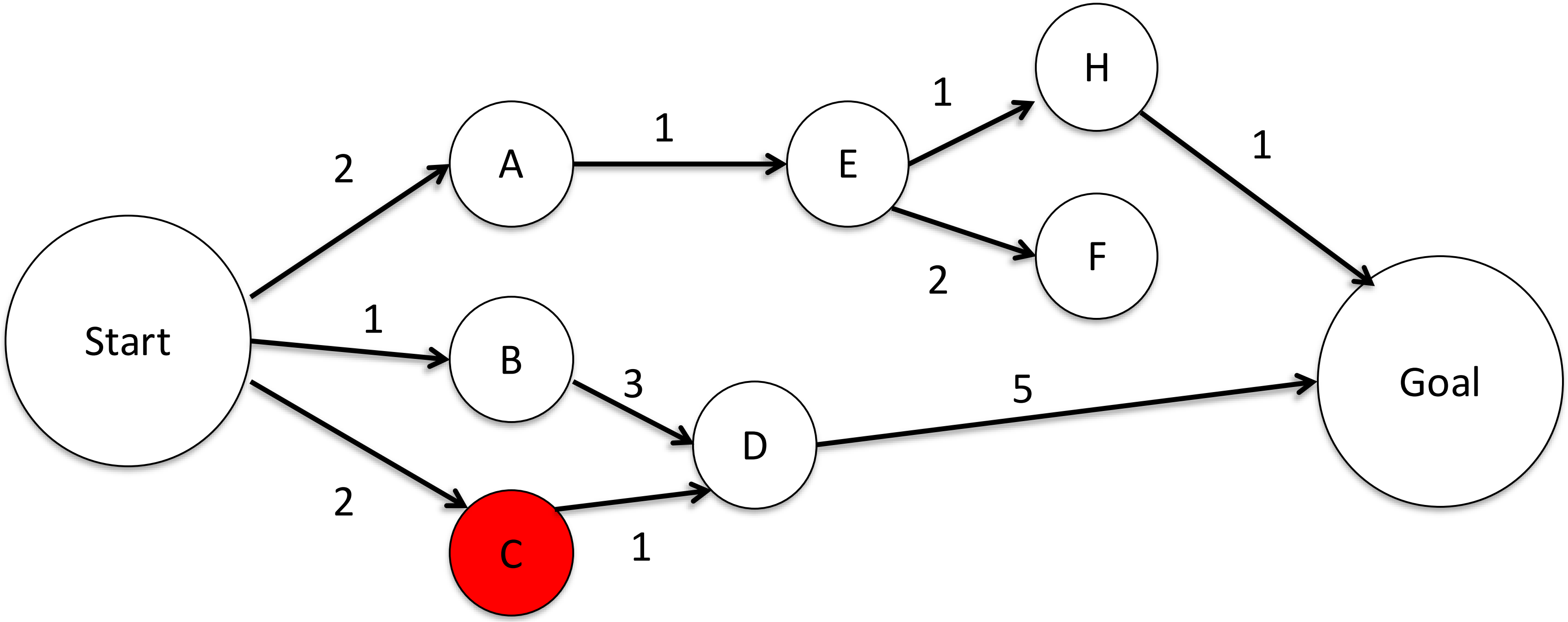
Dead nodes: (Start, B, A)



Dijkstra's Example

Todo list: (E, 3), (D, 3)

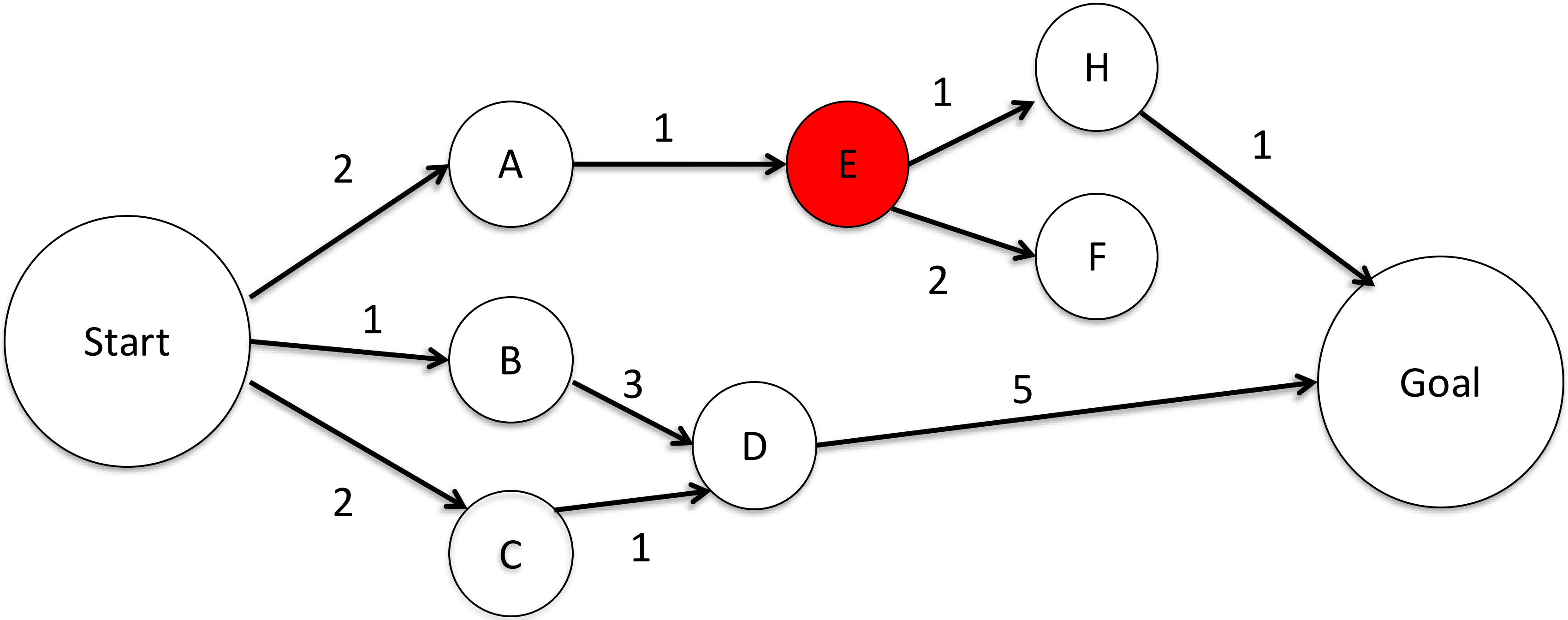
Dead nodes: (Start, B, A, C)



Dijkstra’s Example

Todo list: (D, 3)

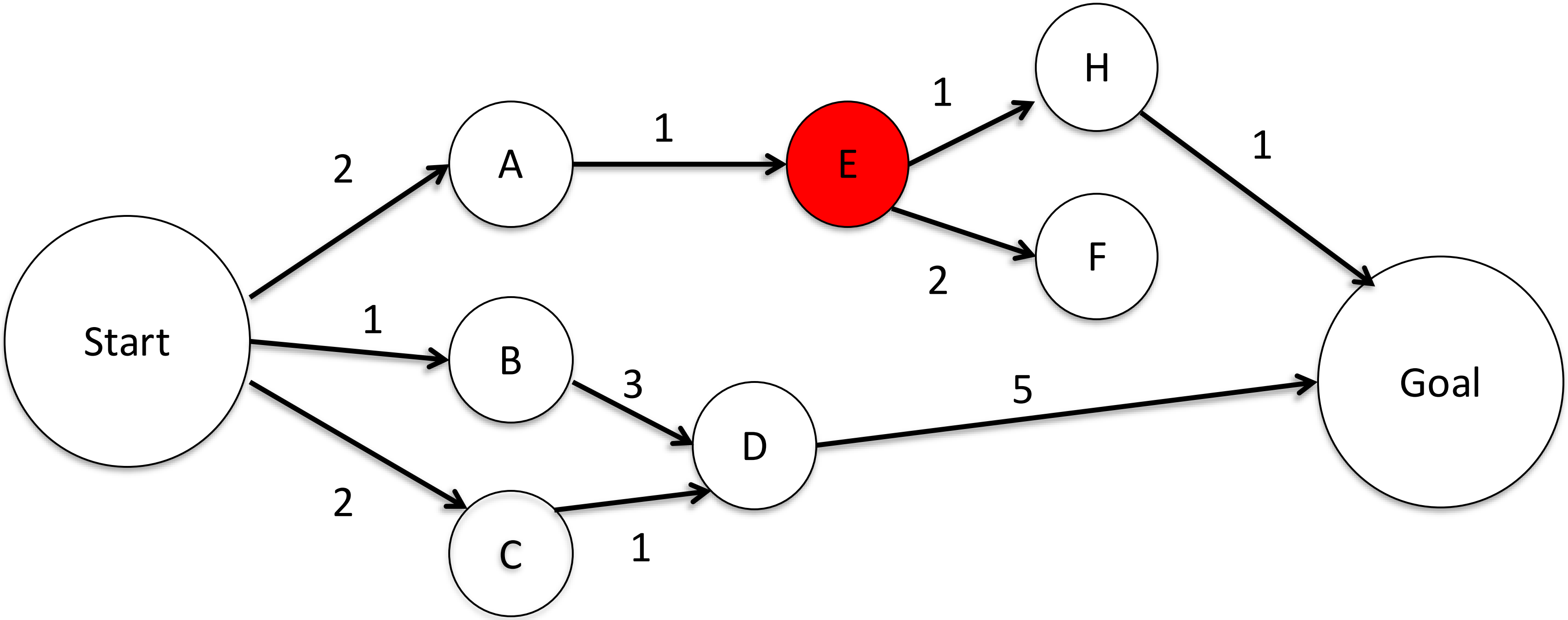
Dead nodes: (Start, B, A, C)



Dijkstra’s Example

Todo list: (D, 3), (H, 4), (F, 5)

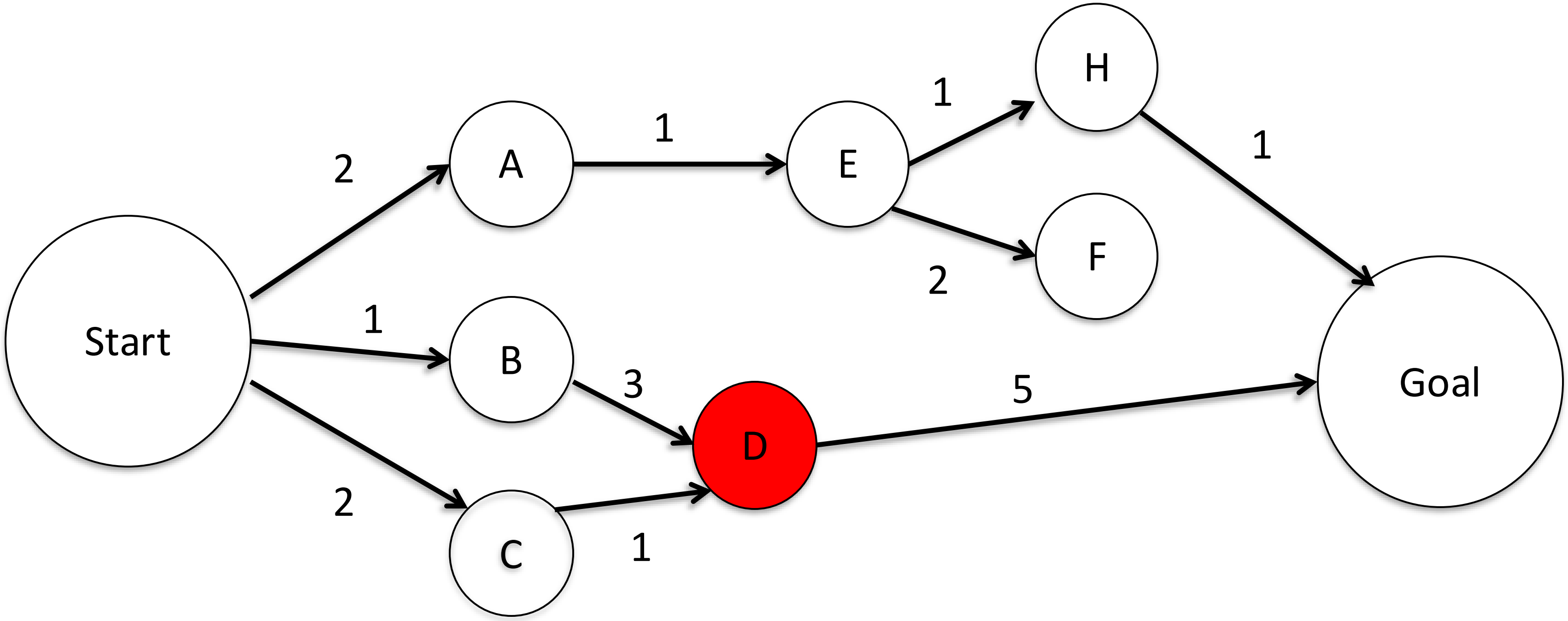
Dead nodes: (Start, B, A, C, E)



Dijkstra’s Example

Todo list: (H, 4), (F, 5)

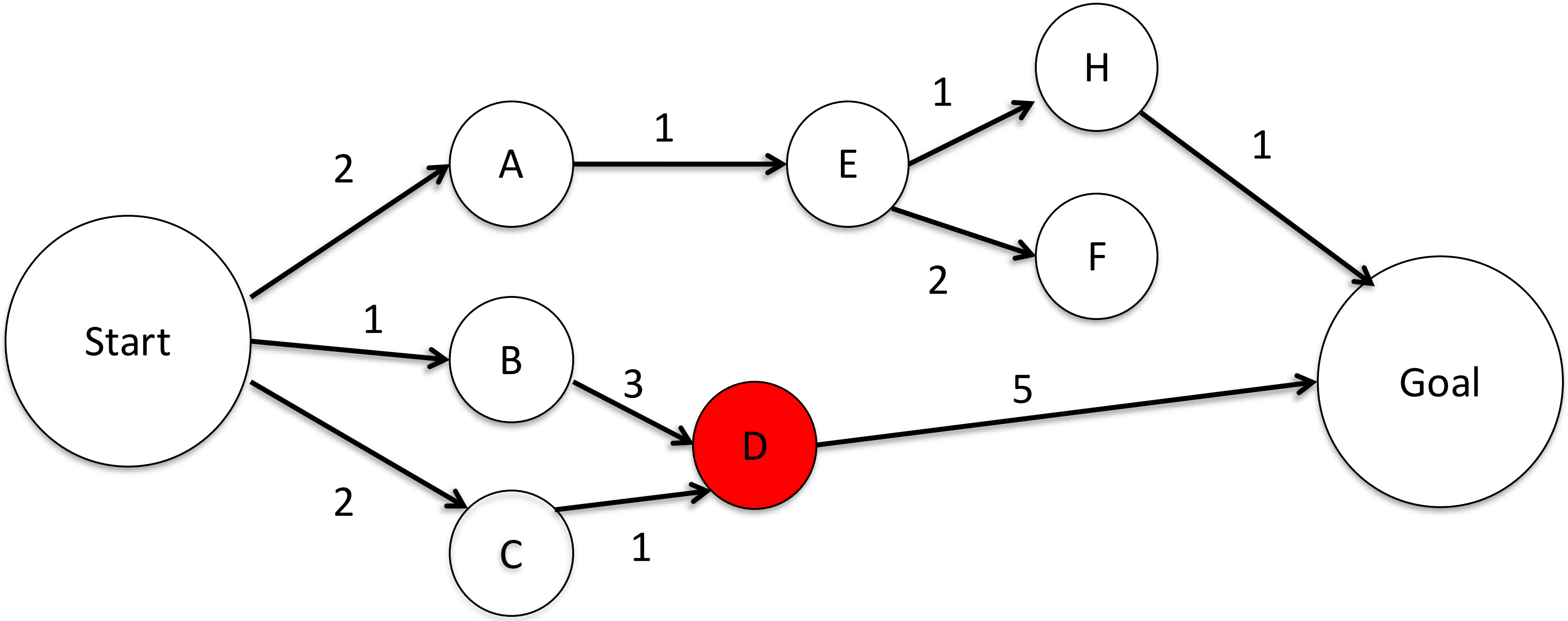
Dead nodes: (Start, B, A, C, E)



Dijkstra’s Example

Todo list: (H, 4), (F, 5), (Goal, 8)

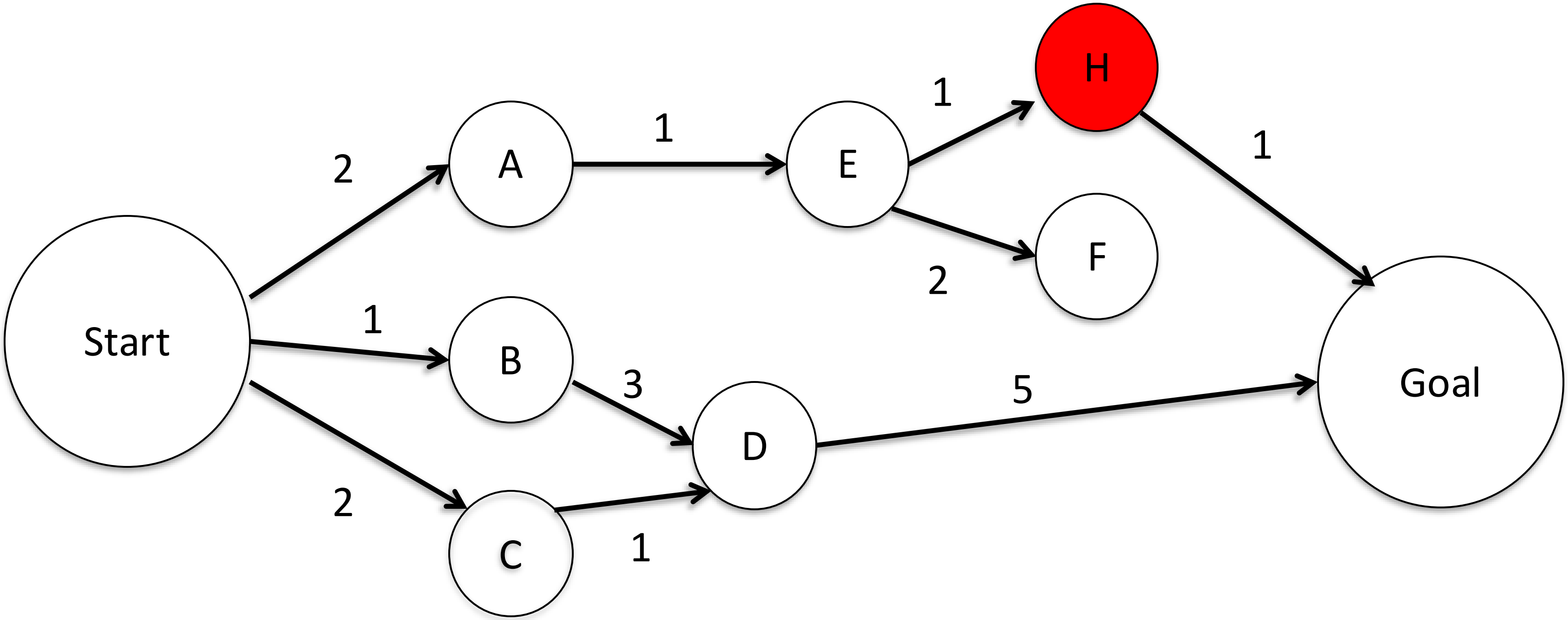
Dead nodes: (Start, B, A, C, E, D)



Dijkstra’s Example

Todo list: (F, 5), (Goal, 8)

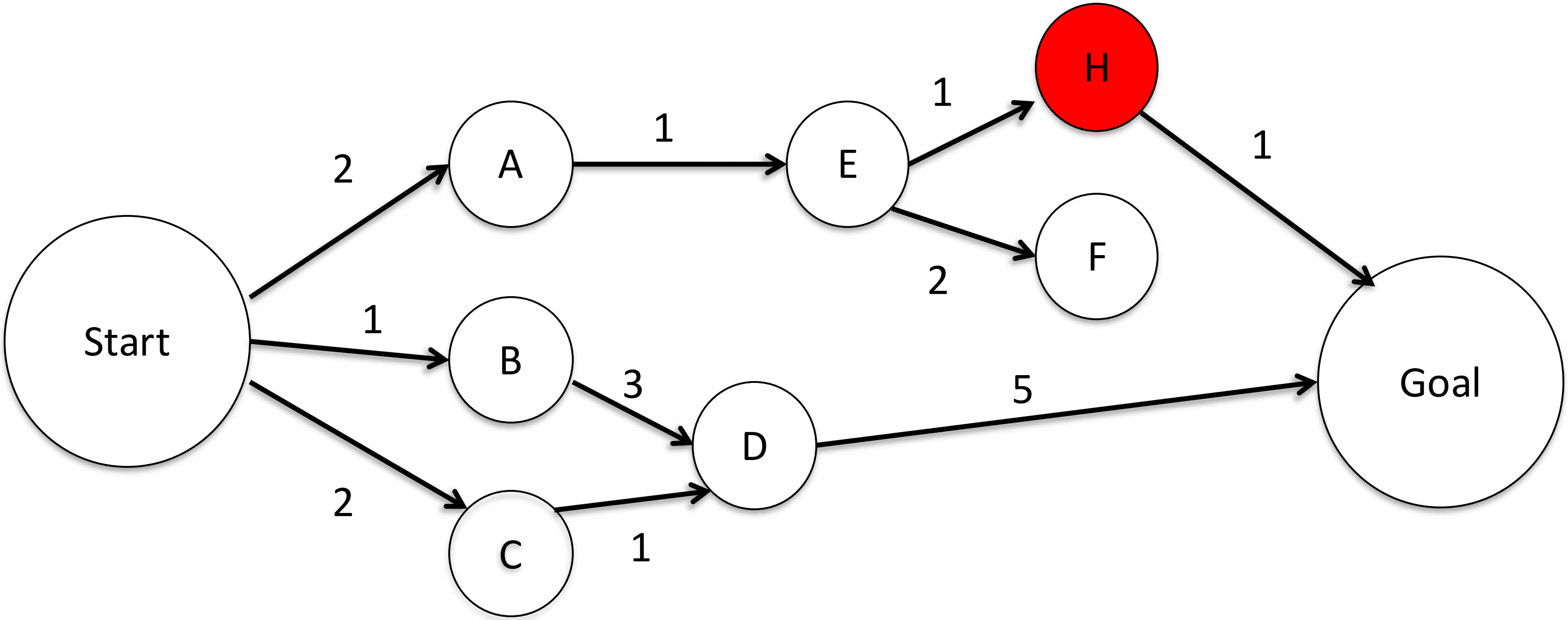
Dead nodes: (Start, B, A, C, E, D)



Dijkstra’s Example

Todo list: (F, 5), (Goal, 5)

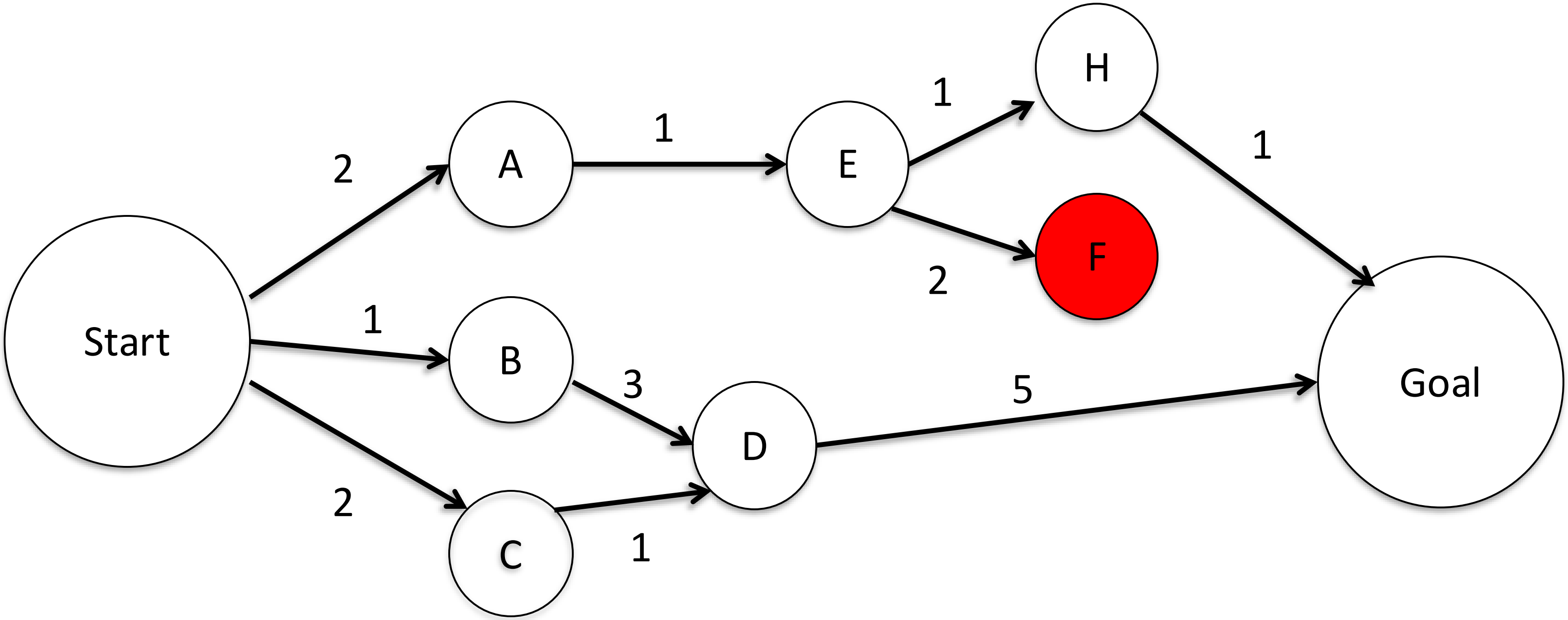
Dead nodes: (Start, B, A, C, E, D, H)



Dijkstra’s Example

Todo list: (Goal, 5)

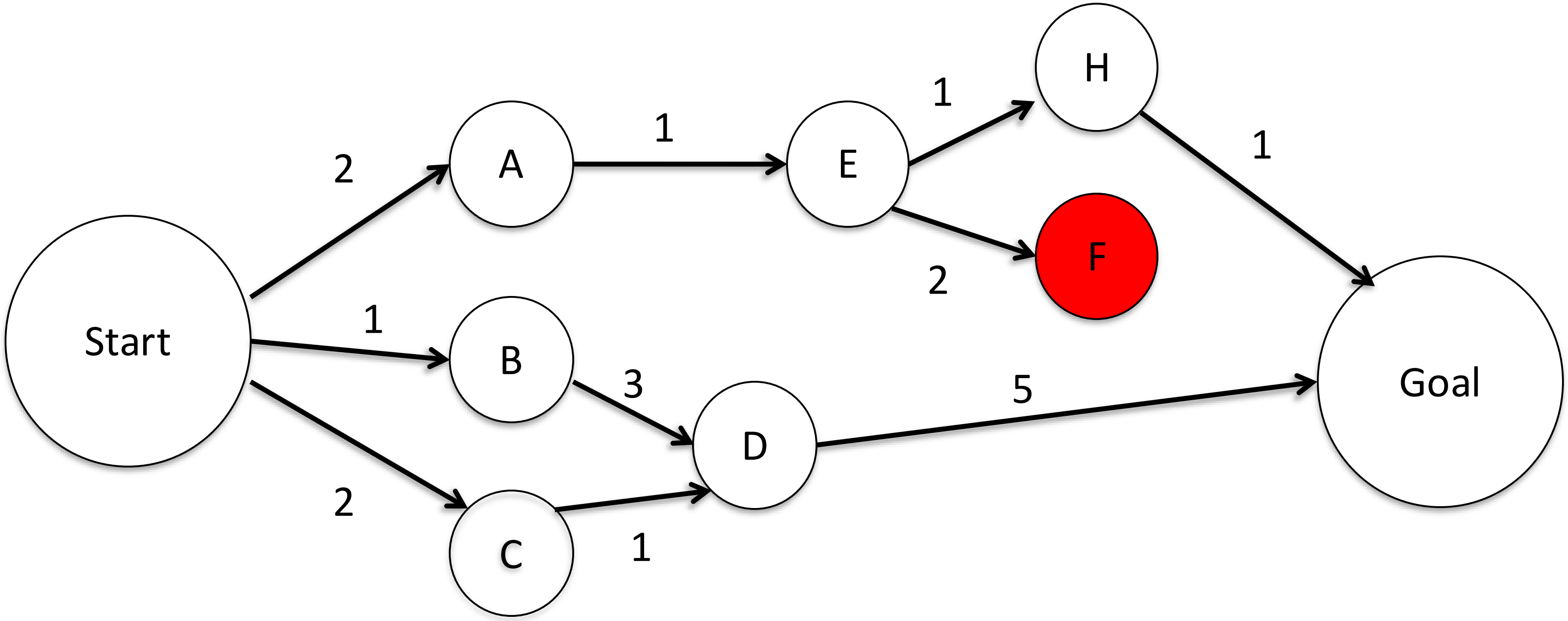
Dead nodes: (Start, B, A, C, E, D, H)



Dijkstra’s Example

Todo list: (Goal, 5)

Dead nodes: (Start, B, A, C, E, D, H, F)

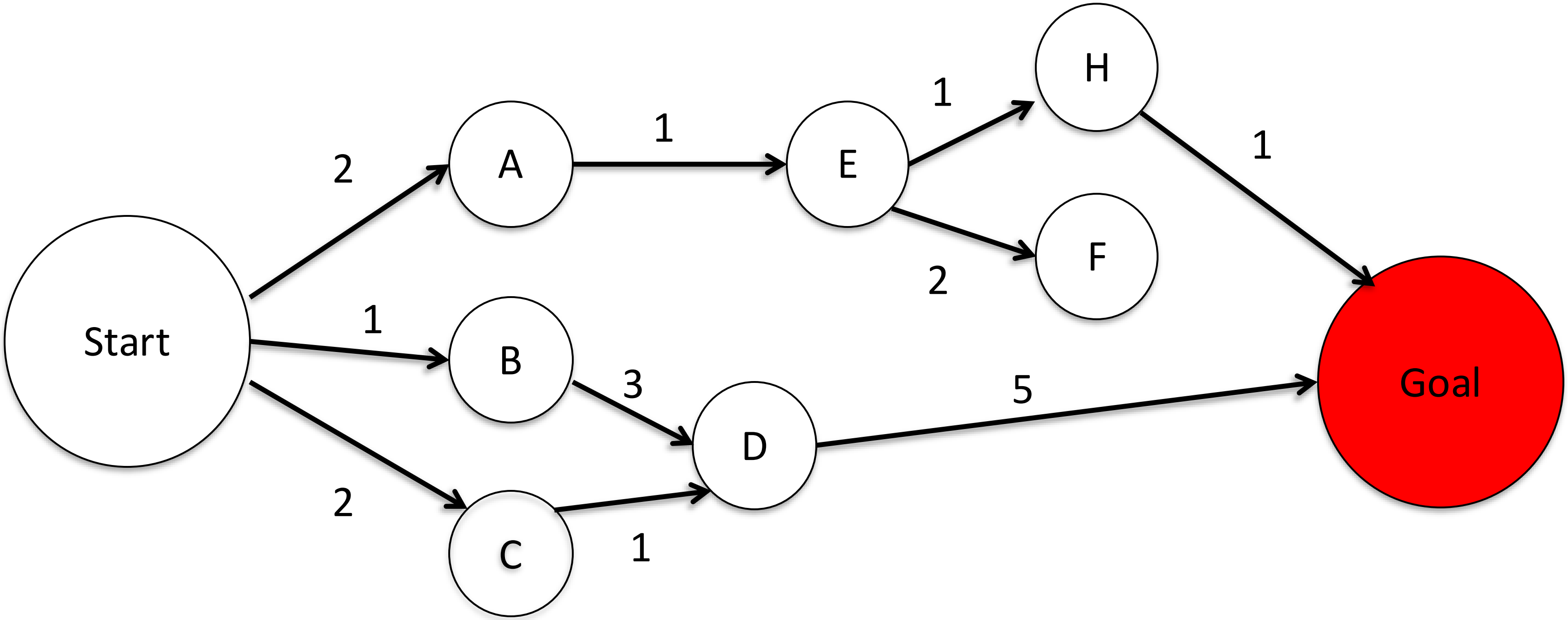


Dijkstra’s Example

Todo list:

Dead nodes: (Start, B, A, C, E, D, H, F)

Victory!!


H
1
1
A
E
1
2
F
2
Start
1
B
3
5
Goal
D
2
C
1