

# Search

## CS 470 Introduction To Artificial Intelligence

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# Outline

- 1 Search in AI
- 2 Uninformed search
- 3 Informed search



# Search problem in AI

## Search

- initial state
- goal state
- state transition sequence

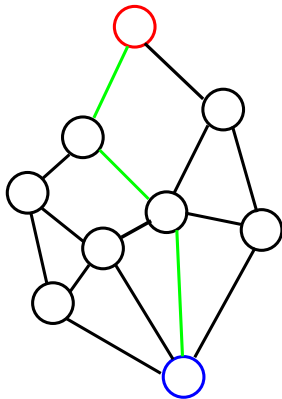




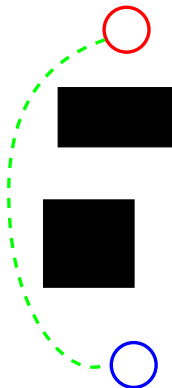
# Search problem in AI

## Problem space

### Discrete



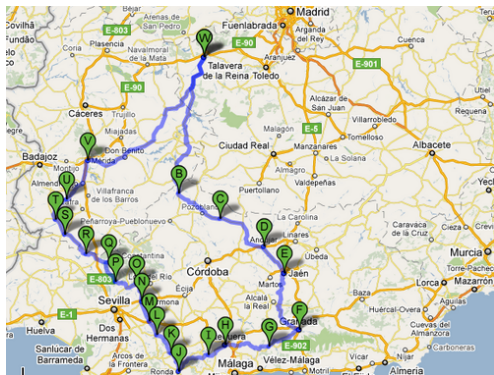
### Continuous





# Application

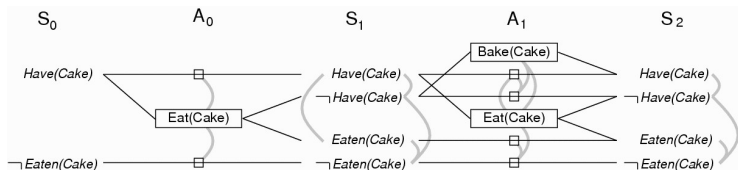
## Routing planning





# Application

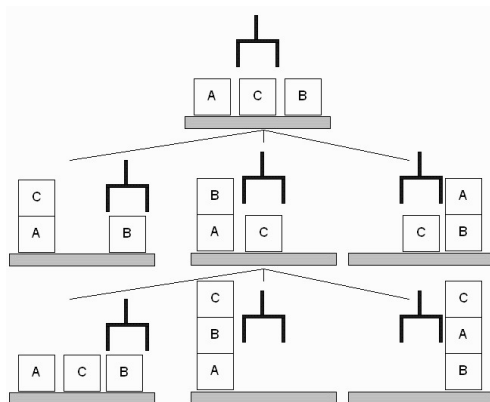
## Scheduling





# Application

## Robot action planning





# Application

## Air ticket planning

From CDG To JFK Depart 07 May Return 21 May 1 Update

Paris, France (CDG) to New York, United States (JFK)

Compare 2 In-flight Airport Baggage Fare Sort by Price

Airline	Class	Flight	Duration	Price	Options
JetBlue	Meat, Entertainment, Seat Selection, Preferred Seat, Economy Comfort	12 05 JFK - 01 15 CDG	7 hours 10 mins + 1 day	€736	inc 40 options
ATHENA AIR	Wi-Fi, TitanWard, Earn 1750 miles	12 05 JFK - 01 15 CDG	7 hours 10 mins + 1 day	€880	inc 40 options
Chronos	Economy, 20 x 17, Meal, Personal, Tea	10 15 CDG - 11 25 JFK Overn: 7 hours 10 mins	12 05 JFK - 01 15 CDG Overn: 7 hours 10 mins + 1 day	€984	inc 40 options
flyapollo	Olympus Alliance, Earn 1072 miles	13 05 CDG (via ORD) 16 15 JFK overn: 10 hours 10 mins	12 05 JFK (via ORD) 05 15 CDG overn: 10 hours 10 mins + 1 day	€1.168	inc 40 options

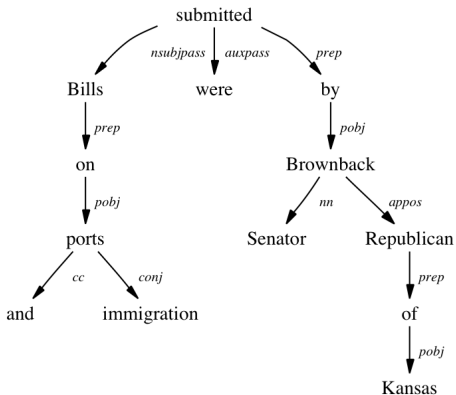
www.2627.hackucsp.com/ata/ata.html





# Application

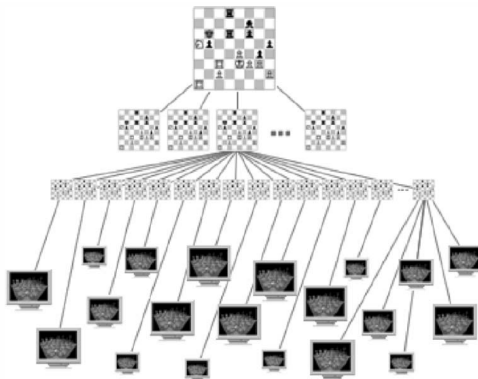
## Nature language generation





# Application

## Game



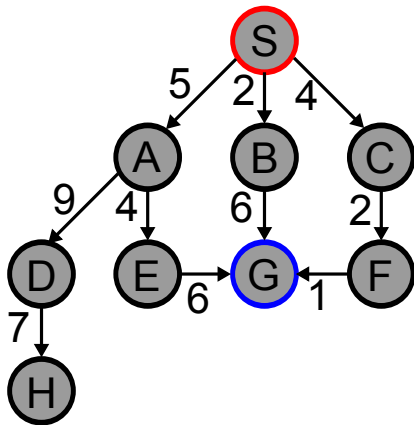


# Search method

- Breadth-First Search
- Depth-First Search
- Uniform-Cost Search
- Depth-limited search
- Iterative-Deepening Search
- Bi-directional search

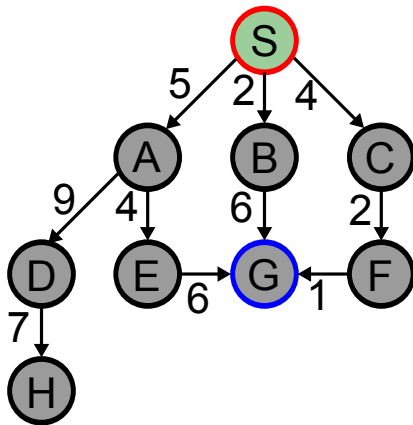


# Breadth-first search



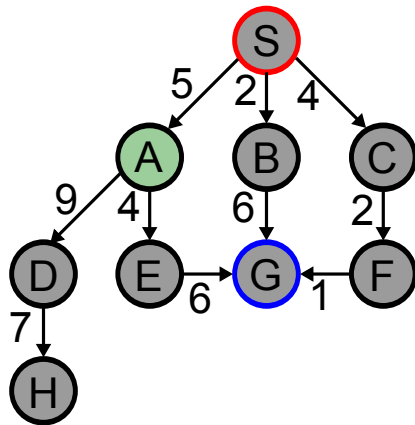


# Breadth-first search



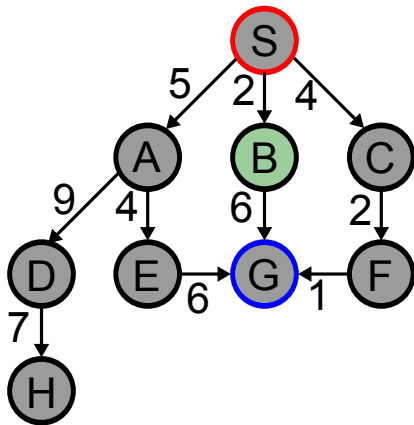


# Breadth-first search



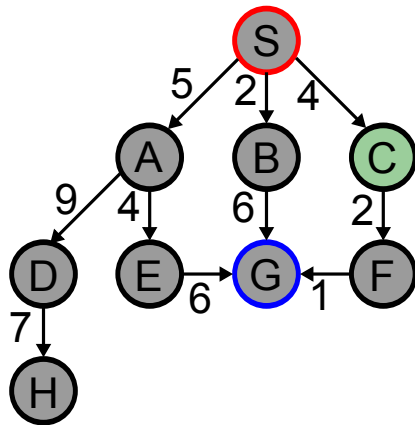


# Breadth-first search





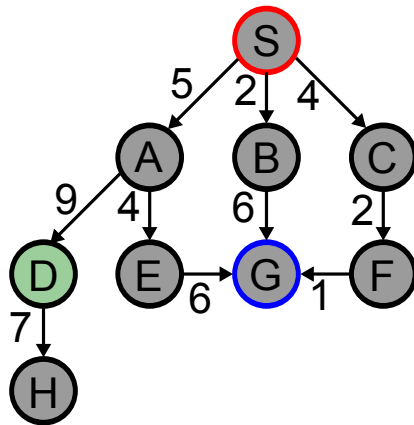
# Breadth-first search





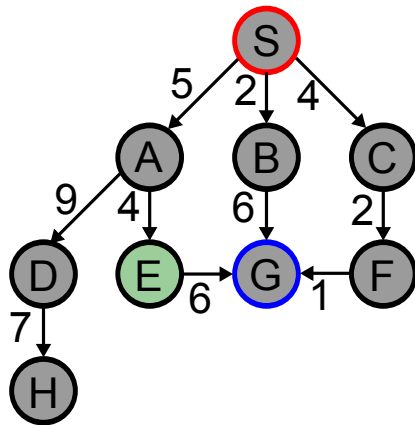


# Breadth-first search



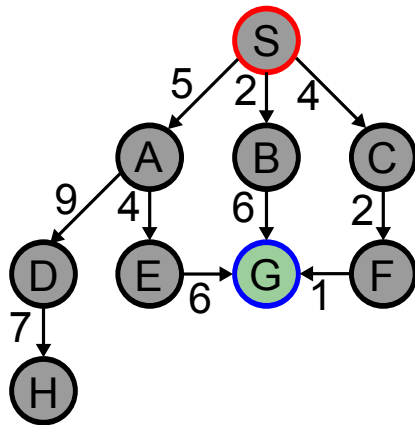


# Breadth-first search



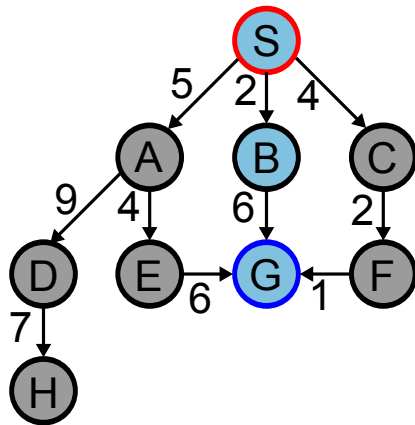


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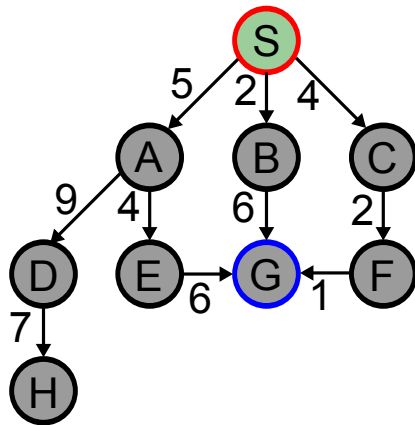


# Breadth-first search



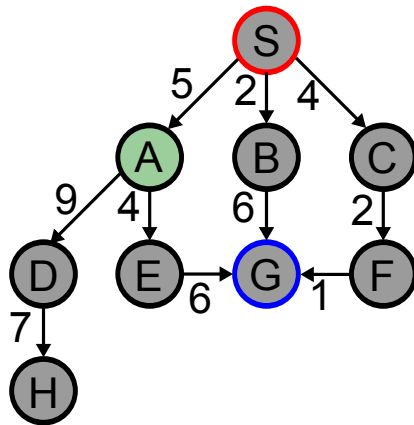


# Depth-first search



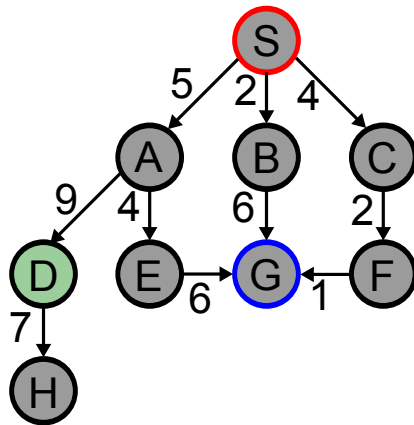


# Depth-first search



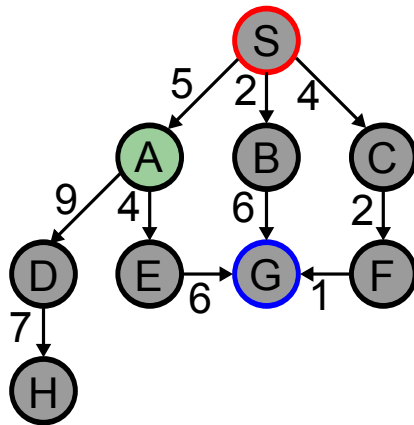


# Depth-first search





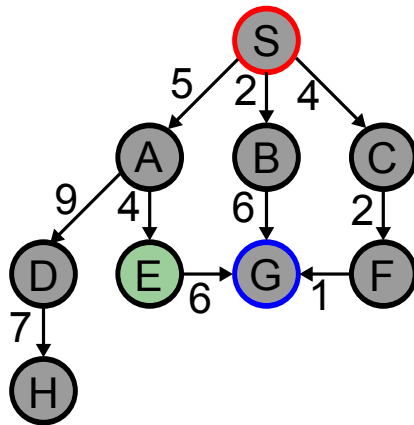
# Depth-first search





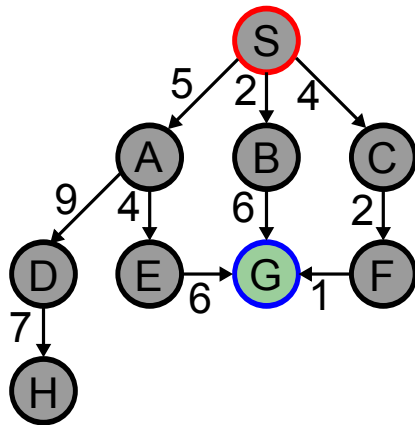


# Depth-first search



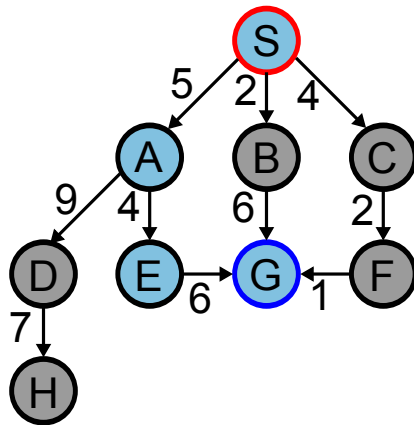


# Depth-first search



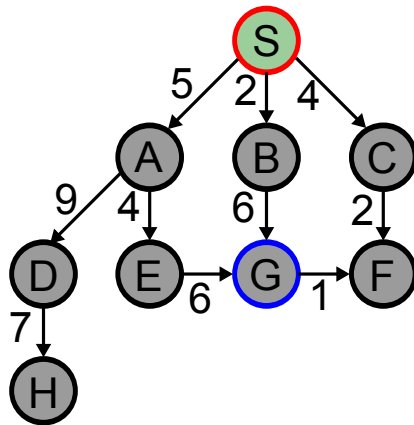


# Depth-first search



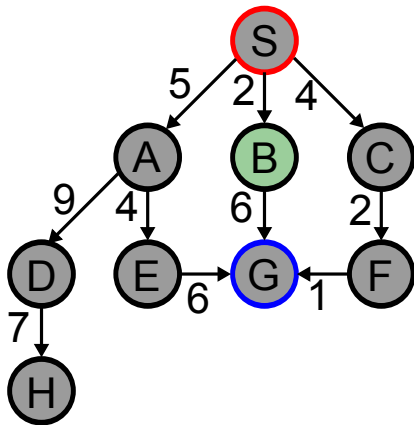


# Uniform-cost search



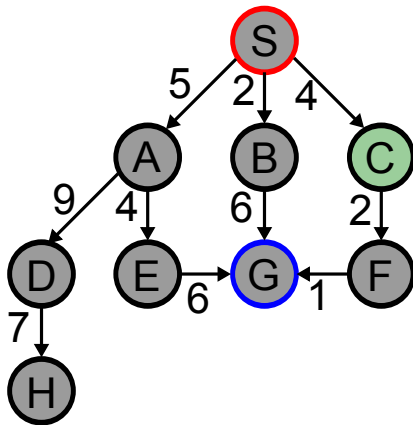


# Uniform-cost search



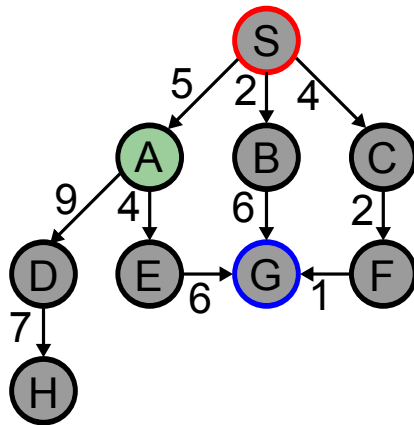


# Uniform-cost search



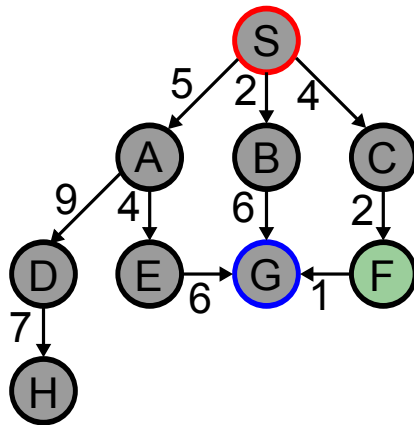


# Uniform-cost search





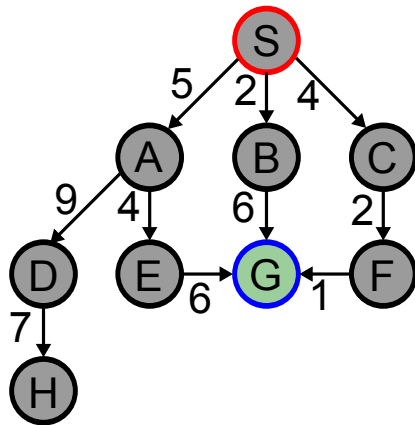
# Uniform-cost search





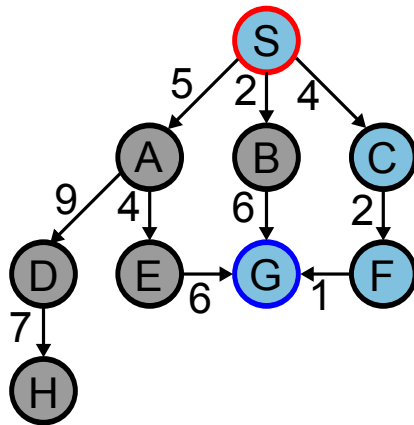


# Uniform-cost search



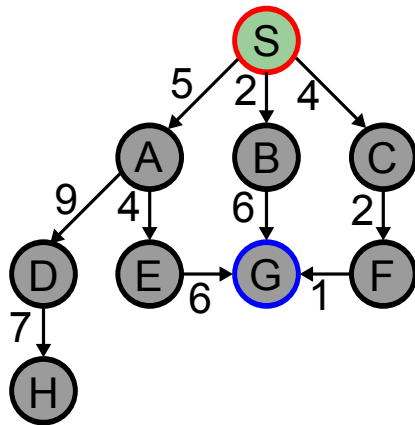


# Uniform-cost search



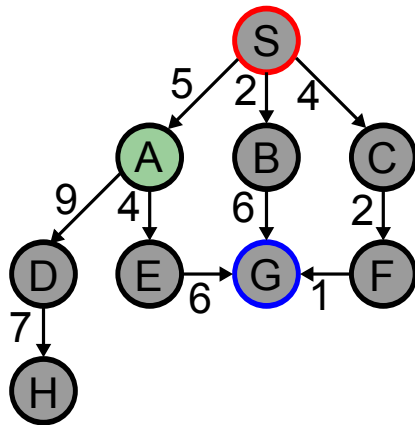


# Iterative-Deepening Search



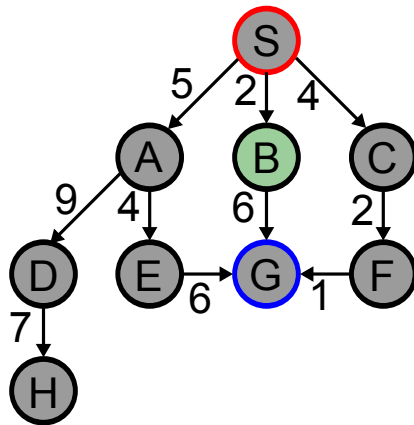


# Iterative-Deepening Search



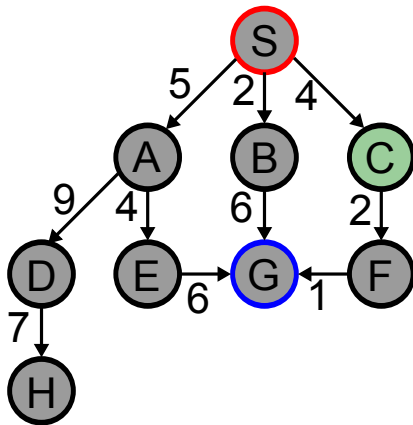


# Iterative-Deepening Search



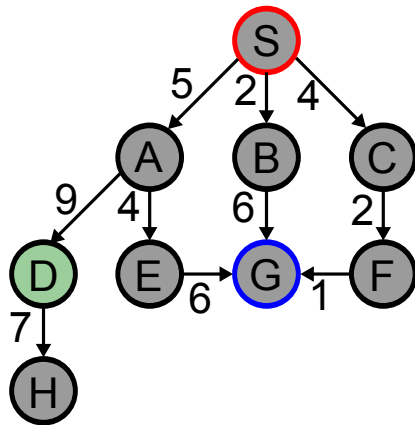


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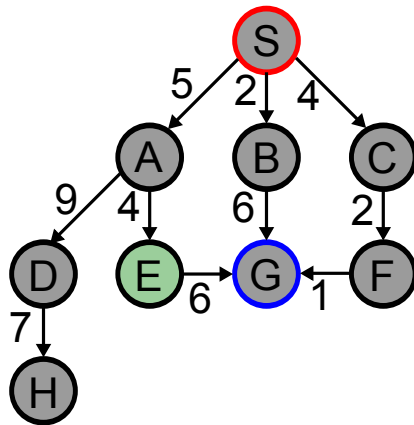


# Iterative-Deepening Search





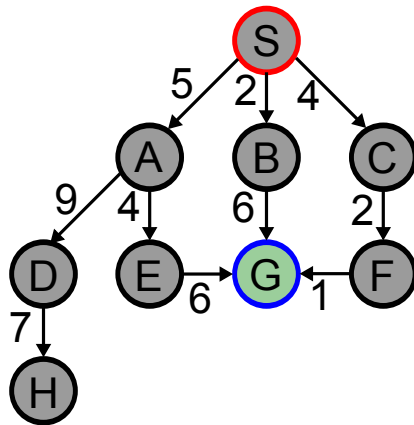
# Iterative-Deepening Search







# Iterative-Deepening Search



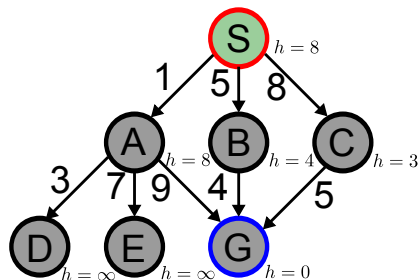


# Search method

- Greedy Best-First Search
- A\* Search
- IDA\* Search
- SMA\* Search

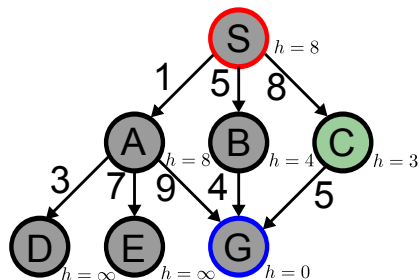


# Greedy Best-First Search



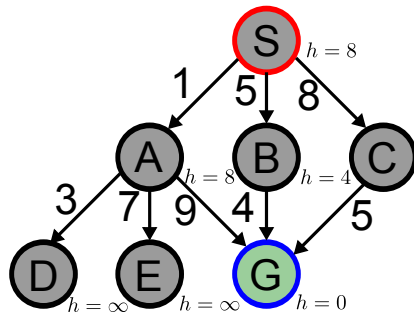


# Greedy Best-First Search



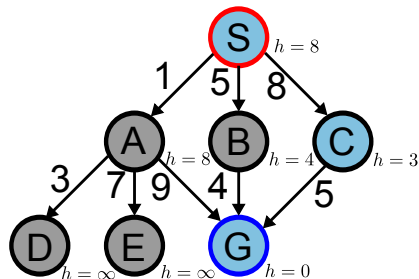


# Greedy Best-First Search





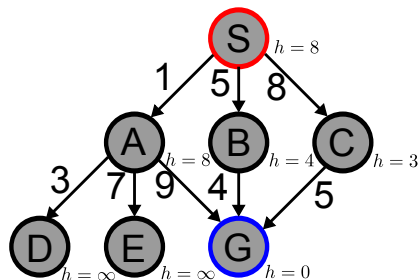
# Greedy Best-First Search





A\*

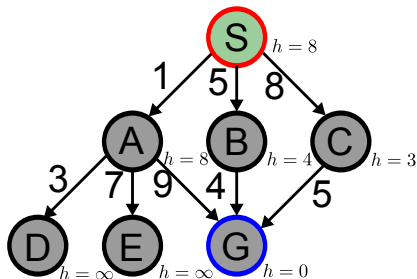
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S	0	8	8
A			
B			
C			
D			
E			
G			





A\*

Node	$g$	$h$	$f$
S	0	8	8
A	1	8	9
B	5	4	9
C	8	3	11
D			
E			
G			

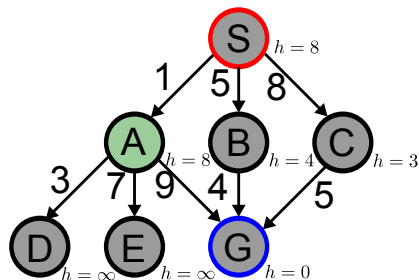






A\*

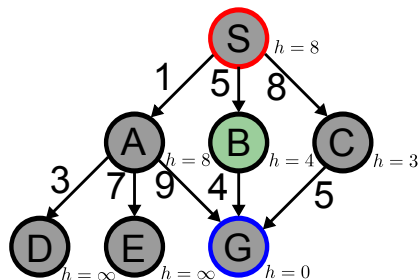
Node	$g$	$h$	$f$
S	0	8	8
A	1	8	9
B	5	4	9
C	8	3	11
D	4	$\infty$	$\infty$
E	8	$\infty$	$\infty$
G	10	0	10





A\*

Node	$g$	$h$	$f$
S	0	8	8
A	1	8	9
B	5	4	9
C	8	3	11
D	4	$\infty$	$\infty$
E	8	$\infty$	$\infty$
G	9	0	9



 $A^*$ 