
UNIVERSITY OF SCIENCE, VNU-HCM
A* Algorithm
Group 14 - CSC10004

SINCERELY, THANKS!!

Teacher Đinh Bá Tiến
Teacher Hồ Tuấn Thanh
Teacher Nguyễn Lê Hoàng Dũng
Teacher Trương Phước Lộc

Team Member

19127216 - Đặng Hoàn Mỹ
19127544 - Nguyễn Hoàn Hoài Tâm
19127609 - Đinh Quang Tú

“WHAT??.”

Introduction

History

Terms & Data Structure

Implement

Complexity

Graph Example

Application

QUIZ!!!

What is A* Algorithm?

19127609 – Đinh Quang Tú

A* Algorithm is one of the most successful search algorithms to find the shortest path between nodes or graphs.

HOW CAN WE GO TO THE GOAL?

fast?
less consuming?
many obstacles?

A* ALGORITHM

find the shortest distance; we also want save as much time as possible

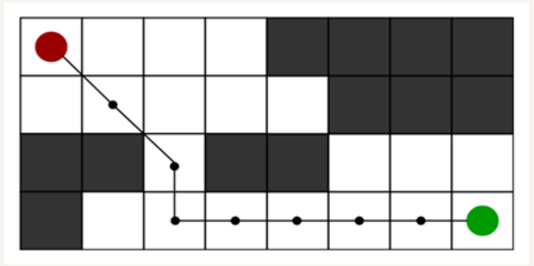
HISTORY

- **1968**
- the **Shakey project** aimed to build a mobile robot that has artificial intelligence to plan its actions
- combine heuristic approaches like Greedy Best- First-Search and formal approaches like **Dijkstra's Algorithm**.

APPLICATION

Have everything you need within reach.

- Graph Traversal & Path-findings
- Games & Web-based maps
    - ❑ Warcarft III



2D Grid having several obstacles and we start from the source red cell to reach towards a goal green cell

What is A* Algorithm?

19127216 – Đặng Hoàn Mỹ

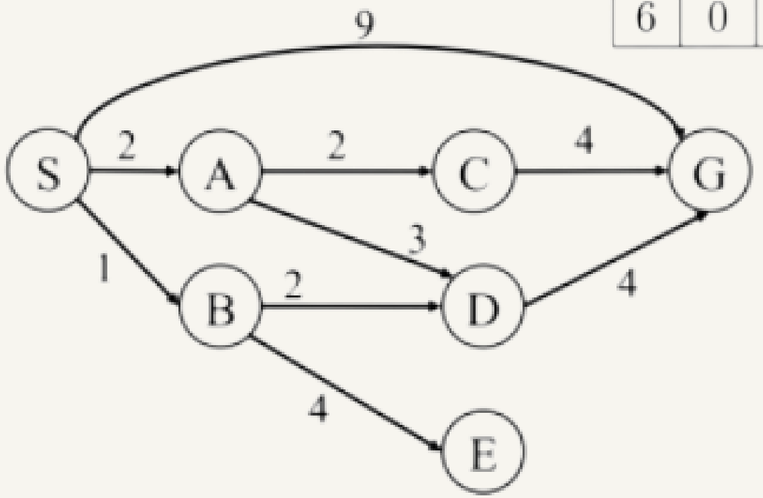
Terms

Heuristics? Cost? Admissible? Consistent?

- **Heuristics** the estimated cost of moving from the current state to the goal state.
- **Cost** the cost that we arrange on the graph (weight).

Heuristic

S	A	B	C	D	E	G
6	0	6	4	1	10	0



Terms

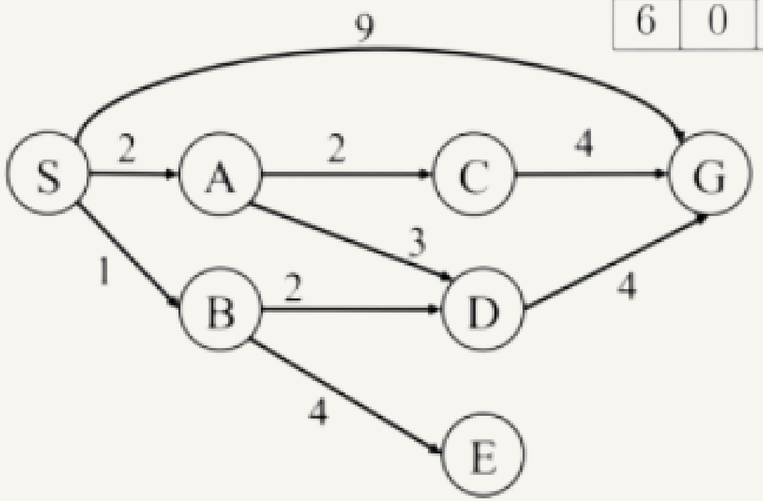
Heuristics? Cost? Admissible? Consistent?

- **Admissible heuristic** the estimated cost must always be lower than or equal to the actual cost of reaching the goal state.

$$\forall n, 0 \leq h(n) \leq h^*(n)$$

Heuristic

S	A	B	C	D	E	G
6	0	6	4	1	10	0



Terms

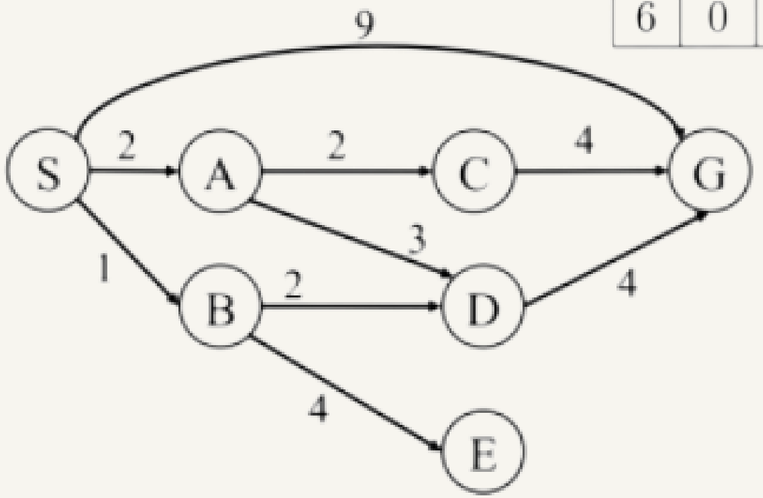
Heuristics? Cost? Admissible? Consistent?

- **Consistent heuristic** less than or equal to the estimated distance from any neighboring vertex to the goal, plus the cost of reaching that neighbor.

$$h(A) \leq cost(A, C) + h(C)$$
$$\forall A, C \; with \; C \; is \; a \; successor \; of \; A$$

Heuristic

S	A	B	C	D	E	G
6	0	6	4	1	10	0



DATA STRUCTURE

This plays important role in A*.

frontier is a priority queue

-> keep track of the node

-> rearrange that to get the best node

frontier

?

?

?

DATA STRUCTURE

This plays important role in A*.

frontier is a priority queue

-> keep track of the node

-> rearrange that to get the best node

frontier

f(n) = g(n) + (n) | V | P

f(n) = g(n) + (n) | V | P

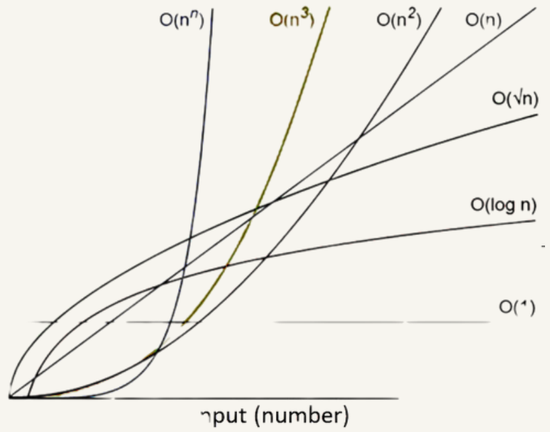
f(n) = g(n) + (n) | V | P

IMPLEMENT

The main technique for this algorithm is using frontier as a priority queue to put the nodes while waiting.

- get the smallest cost of a path from that and put in the visited to mark up what has been visited
- catch the goal, we start to reverse the path (the parents of visited nodes) that we saved in the expanded
- there is no goal, we traverse all the children of that node and put it in the frontier with the formula

$$f(n) = g(n) + h(h)$$

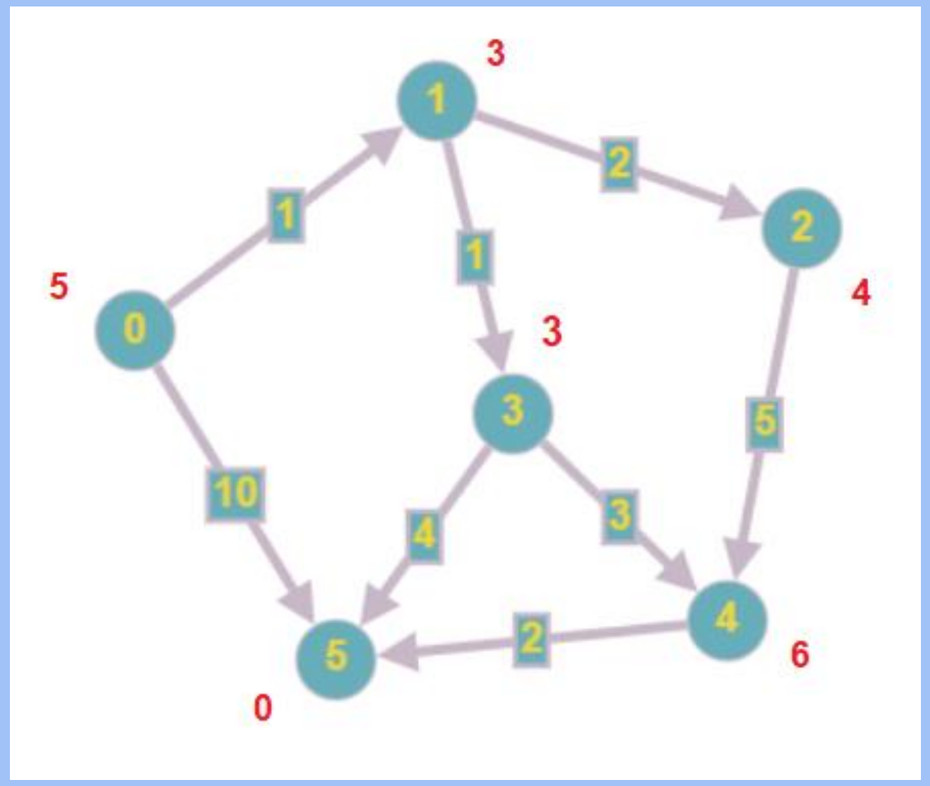


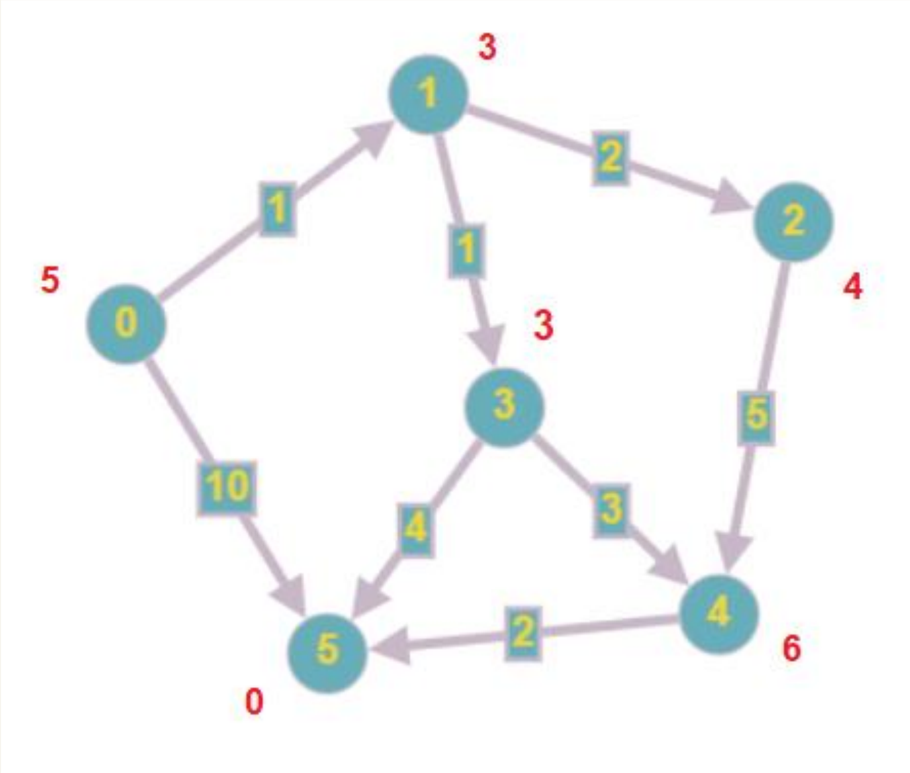
COMPLEXITY

The number of nodes expanded is exponential in the depth of the solution (the shortest path) d, where b is the branching factor (the average number of successors per state)

$$O(b^d)$$

GRAPH EXAMPLE





Frontier

f(n) = g(n) + h(n)	V	P
4 = 1 + 3	1	0
7 = 3 + 4	2	1
11 = 5 + 6	4	3
5 = 6 + 0	5	3

Expanded

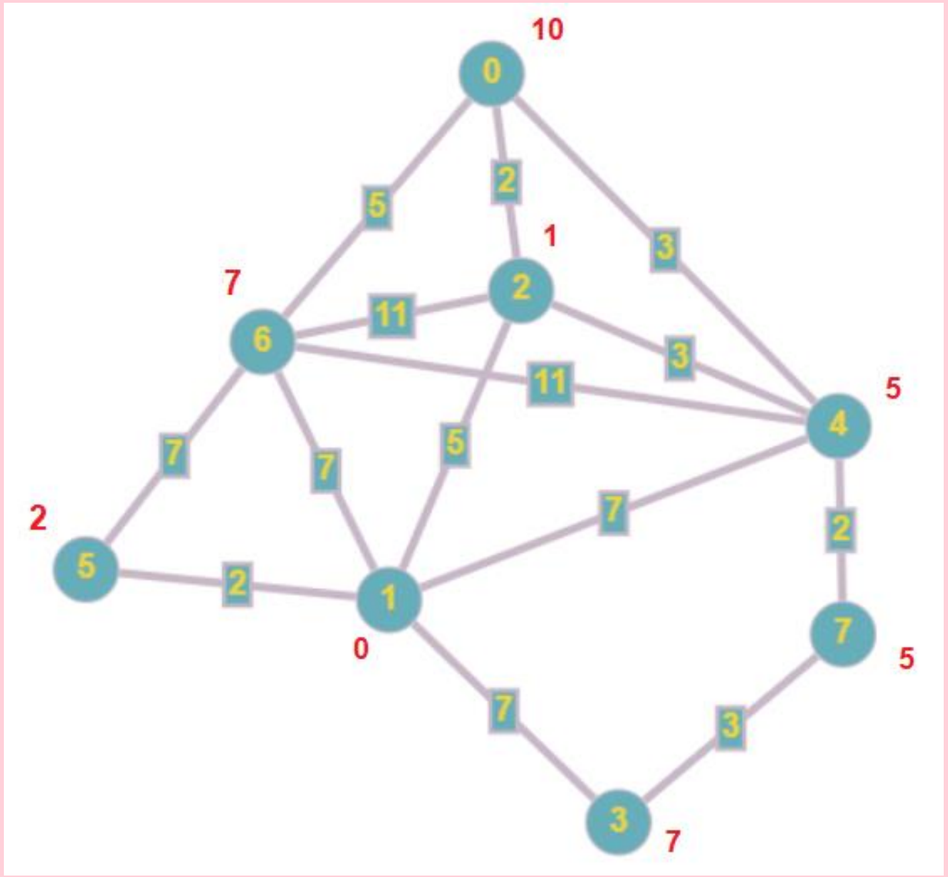
V	P

Path

0	1	3	5

Is it better than any algorithm?

BETTER?



Dijkstra's Algorithm expands double number of nodes to find the same path. (0, 2, 4, 7, 6, 1)

A* Algorithm just expands only 3 nodes which is exact the same path. (0, 2, 1)

QUIZ!!!

THANK YOU FOR LISTENING