CS 188 Discussion 2:

Informed Search

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Slides inspired by Sashrika Pandey and Regina Wang

Administrivia

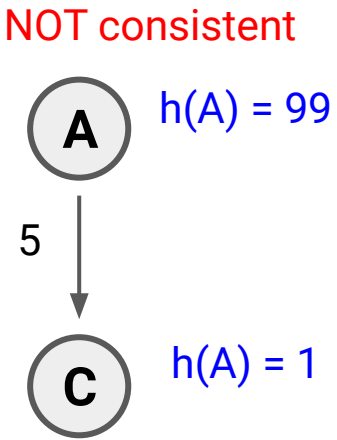
- Project 1 due this Friday, Sep 8
- Homework 1 due next Tuesday, Sep 12
- We have office hours pretty much all day every weekday (12-7), come to Soda 341B!
- Reminder: Need extensions? We will give you extensions!

Today’s Topics

- Heuristics
  - Admissible Heuristics
  - Consistent Heuristics
- A* Search

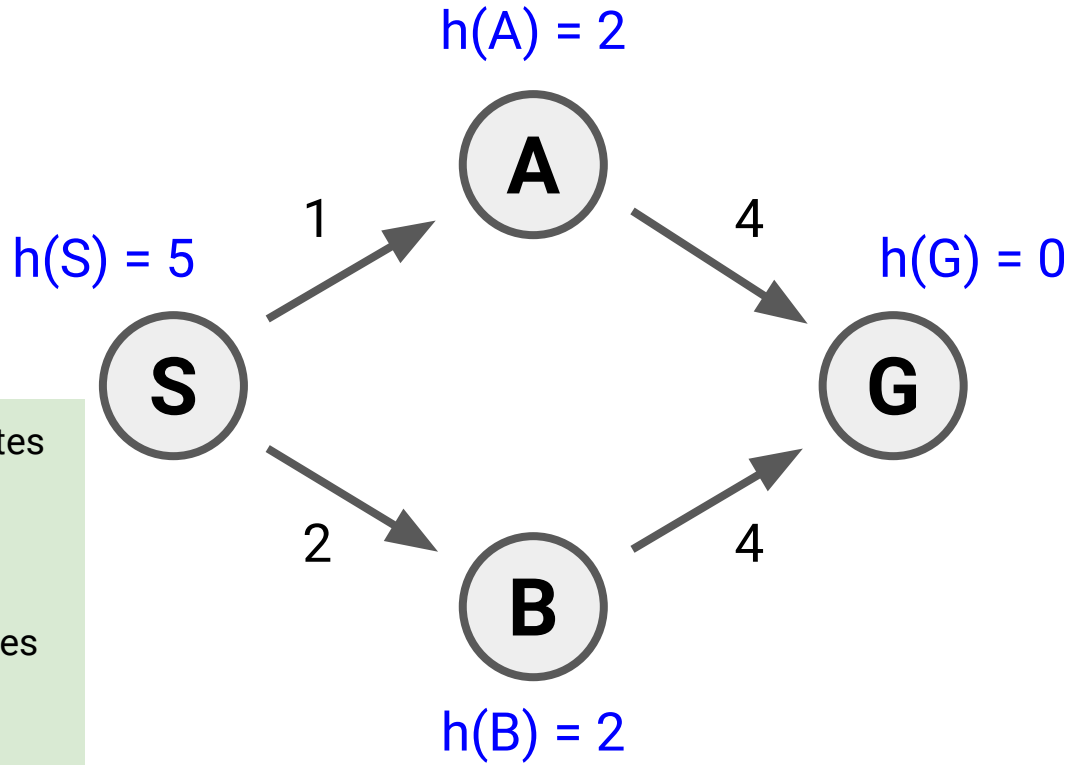
Heuristics

- **Heuristic:** Quick estimate of cost to get from node n to goal state h(n)
  - Common example you might use: Manhattan distance from node n to goal in a maze
- **Admissible:** heuristic always underestimates (≤) true cost
  - $\forall$ n, $0 \leq h(n) \leq h^*(n)$
  - $h^*(n)$ is the true best cost to get from n to goal
- **Consistent:** heuristic always underestimates all *arc costs*
  - $\forall$ a, c, $h(a) - h(c) \leq cost(a, c)$
  - Consistency is stronger than admissibility
  - Consistency implies admissibility, but not the other way around
  - Most admissible heuristics are consistent, especially if they come from relaxed problems



Heuristics: Practice Question

- Is h(n) *admissible*?
- Is h(n) *consistent*?



- **Admissible:** heuristic always underestimates (≤) true cost
  - ∀ n, 0 ≤ h(n) ≤ h*(n)
- **Consistent:** heuristic always underestimates all *arc costs*
  - ∀ a, c, h(a) - h(c) ≤ cost(a, c)

A* Search

- **A* Search:** A (good!) search algorithm
  - Uniform Cost Search is good. It uses a priority queue for the fringe where

    p(n) = g(n)

    where g(n) is the *backwards cost* or *path cost* (total cost to get to node n)
  - **A* Search** is similar to Uniform Cost Search, but adds a **heuristic** term to the priorities.

    p(n) = g(n) + h(n)
  - A* *tree* search is optimal with any *admissible* heuristic
  - A* *graph* search (won't visit the same node twice) is only optimal with a *consistent* heuristic

Worksheet

Summary

- **Heuristic:** Estimate of cost to get from node n to goal state h(n)

- **Admissible:** heuristic always underestimates (≤) true cost
  - ∀ n, 0 ≤ h(n) ≤ h*(n)
  - h*(n) is the true best cost to get from n to goal

- **Consistent:** heuristic always underestimates all *arc costs*
  - ∀ a, c, h(a) - h(c) ≤ cost(a, c)
  - Consistency is stronger than admissibility
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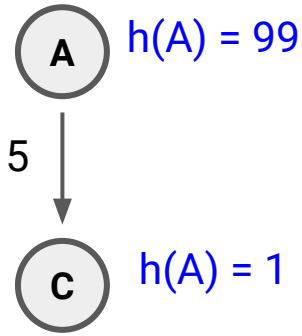
NOT consistent



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  - **A* Search** is similar to Uniform Cost Search, but adds a **heuristic** term to the priorities.
    p(n) = g(n) + h(n)
  - A* *tree* search is optimal with any *admissible* heuristic
  - A* *graph* search (won't visit the same node twice) is only optimal with a *consistent* heuristic

Thank you for attending!

Attendance link:

- https://tinyurl.com/cs188fa23

Week No: 2

Remember my name is Kenny

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