Previous class
- Uniform cost search
- When to do the goal test?
- Tree and graph search algorithms
- Heuristic "Informed" search

Today
- Best-first search
  - Greedy search \( f(n) = h(n) \)
  - A* search (uses an admissible heuristic)

\[ f(n) = g(n) + h(n) \]

- \( g(n) \) is the actual cost so far to the goal
- \( h(n) \) is the estimated cost from \( n \) to the goal

- Frontier
  - Ordered with respect to a "desirability" value

- \( h(n) \) for \( n \):
  - Optimal goal
Greedy search orders the frontier with respect to the "h" values only.

A* search is a best-first search with an admissible heuristic:

\[ f(n) = g(n) + h(n) \]

is admissible

\( h(n) \) is never an overestimation of the cost to the goal from \( n \).

\( h(n) \leq h^*(n) \)

if \( n \) is the goal, then the distance to the goal from \( n \) is 0.

an admissible heuristic always returns 0 at the goal.

How can we move from an argument (informal) to a formal proof?
For every suboptimal goal there will always be a node that has a lower cost (that node will take us to the optimal goal)

\[ G_1 \quad \text{optimal goal} \quad G_2 \quad \text{suboptimal goal} \]

\[ f(G_1) = f(G_2) \quad \text{they would both be optimal} \]

\[ f(G_2) > f(G_1) \]

Can this happen?

Can this happen?

Can we prove that this cannot happen using \( f, g, \) and \( h \)?

\[ f(G_1) < f(G_2) \]

\[ f(G_1) = \]

\[ f(n) \text{ will always be lower than} \]

\[ f(G_1) \quad \text{and} \quad f(G_2) \]
$G_i$ is an end $h(G_i) = 0$

$f(G_1) < f(G_2)$  $h(G_1) = 0$  $h(G_2) = 0$

we are trying to prove:

$G_2$ not expanded before $n$

$f(G_2) < f(n)$ should not happen

If $G_2$ and $n$ are always in the frontier, $f(n) \leq f(G_2)$ prove this

$f(G_1) < f(G_2)$

$f(n)$ leads to $G_1$

$f(n) = g(n) + h(n) \leq g(n) + h^*(n)$

\[ f(G_1) \leq f(G_2) \]

Therefore the node containing $G_2$ will never be picked so over node $n$. 