Informed Search
- Uses knowledge to order nodes in frontier
  \( f(n) \) - evaluation function

Best-First Search
- Frontier is a: Priority Queue with keys = \( f(n) \)
- Always delete node with lowest \( f(n) \)

Different approaches based on how we define \( f(n) \)

\( f(n) \) depends on (another) heuristic function \( h(n) \):
  \( h(n) \):
  - Uses problem-specific knowledge from the world.
  - Estimates how "good" a state is (i.e. how close to goal)
    - \( h(n) > 0 \) : \( h(n) = 0 \) \( n \) is goal
    - Lower the better: \( h(n) = \infty \) goal cannot be reached from \( n \)
Good heuristic for route-finding?
- straight line distance from node to goal

S-Puzzle?
- number of misplaced tiles.

Note: information is not part of the problem

Simplest thing is to set \( f(n) = h(n) \)
\[ \Rightarrow \text{Just order priority queue based on heuristic.} \]

Greedy Best First Search:
- \( f(n) = h(n) \)

Let's apply to route-finding

ex': X to B; \( h(n) = \) straight-line dist from n to goal(B)

A somewhat obvious that this won't be optimal since it does not take the edge costs into account at all.
Still useful to get insight into how to improve?
Initial state

\[ S(\text{Expanded Node}) \quad (\text{Expanded}) \quad (\text{write}) \]

\[ X \quad X \]

\[ F \]

(36) (17) (19) (3)

\[ B \quad (0) \]

Path: X - F - B; cost = 99 + 211 = 310

Optimal?: X - R - P - B; cost = 80 + 97 + 101 = 278

Note: Contrast with UCS which would have also searched (A)

Ideas to improve?

- Also take into account path costs.
- Specifically cost to get to next node.

\[ g(n): \text{cost to reach node } n \]

A* Search:

\[ f(n) = g(n) + h(n) \]
\[ h(A) = 253 \]

\[ h(X) = 366 \]

\[ h(R) = 193 \]

\[ h(B) = 141 \]

**Frontier**

\[ S \]

\[ \Sigma X^3 \]

\[ R \]

\[ \Sigma A, F, R \]

\[ 506, 275, 273 \]

\[ \Sigma A, E, P \]

\[ 277 \]

\[ \Sigma A, E, P \]

\[ 311 \]

\[ 1278 \]

\[ B \in \text{goal} \]

---

\[ f(A) = 140 + 366 = 506 \]

\[ f(F) = 99 + 176 = 275 \]

\[ f(R) = 80 + 193 = 273 \]

**expand (R)**

\[ f(B) = (80 + 97) + 100 \]

\[ = 277 \]

**expand (B)**

\[ f(B) = (99 + 211) + 0 \]

\[ = 311 \]

\[ f(B) = (80 + 97 + 101) + 0 \]

\[ = 278 \]

\[ \Rightarrow \text{if (n in Frontier with higher f(n)), update f(n) for B.} \]

\[ \Rightarrow \text{if (n in Frontier with higher f(n)), update f(n).} \]