

# Relaxations

PAH (Planning and Games)

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# Relaxations

- General approach to computing heuristic estimates
- *Relax* some constraints
  - I.e. Ignore delete effects
- Compute or estimate cost/length of (optimal) *relaxed plan*

# Quiz

- Heuristic  $h$  **dominates**  $h'$  when
  1.  $h \leq h'$  for all states
  2.  $h \geq h'$  for all states
  3.  $h \neq h'$  for all states

Answer:

2.  $h \geq h'$  for all states

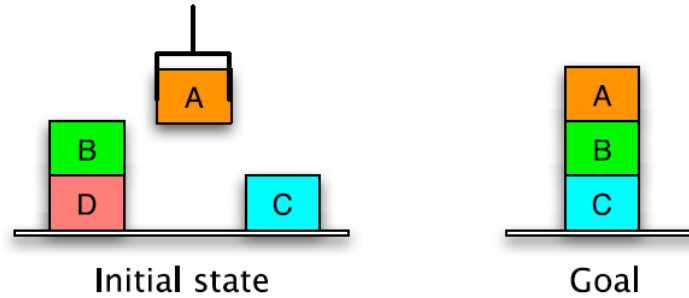
# Quiz

- What is the most commonly used relaxation of a STRIPS action  $a = \langle pre(a), add(a), del(a) \rangle$ ?:
  1.  $a^+ = \langle \emptyset, add(a), del(a) \rangle$
  2.  $a^+ = \langle pre(a), \emptyset, del(a) \rangle$
  3.  $a^+ = \langle pre(a), add(a), \emptyset \rangle$

Answer:

3.  $a^+ = \langle pre(a), add(a), \emptyset \rangle$

# Quiz



- Relaxed plan for:

1. put-A-on-B, pickup-B, put-B-on-C, put-A-on-B
2. put-A-on-C, pickup-B, put-B-on-C, put-A-on-B
3. pickup-B, put-B-on-C, put-A-on-B

Answer:

1. put-A-on-B, pickup-B, put-B-on-C, put-A-on-B

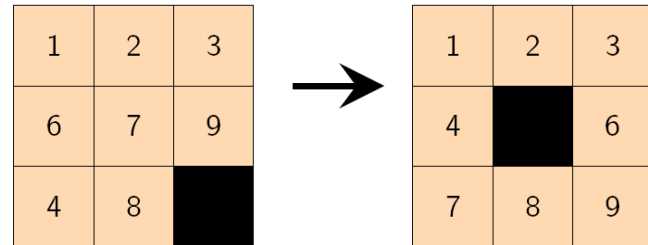
# Quiz

- Optimal relaxed plan for:

1. 9d, 7l, 7d, 4u, 6r, 6r
2. 9d, 7r, 6r, 6r, 4u, 7l, 7l, 7d
3. 9d, 8r, 7d, 6r, 6r, 4u, 7l

Answer:

3. 9d, 8r, 7d, 6r, 6r, 4u, 7l



# Quiz

- What is not true:
  1. Relaxations of plans are relaxed plans.
  2. Relaxations are no harder to solve than the original task.
  3. Optimal relaxed plans may be longer than optimal plans for original tasks.

Answer:

3. Optimal relaxed plans **may be** longer than optimal plans for original tasks.

# Quiz

- What heuristic is defined by
  - $cost(p) = \min(cost(a_1), \dots, cost(a_n))$
  - $cost(a) = \max(cost(p_1), \dots, cost(p_n))$ :
    1.  $h_{\max}$
    2.  $h_{\text{add}}$
    3.  $h_{\text{STRIPS}}$

Answer:

1.  $h_{\max}$



# Quiz

- For hadd is **not** true.
  1. Assumes independence of facts.
  2. All facts are assumed to be achieved by the cheapest action.
  3. Is admissible.

Answer:

3. Is **not** admissible.

# Quiz

- Which heuristic is typically the most informative?:
  1.  $h_{\max}$
  2.  $h_{\text{add}}$
  3.  $h_{\text{STRIPS}}$

Answer:

1.  $h_{\text{add}}$

# Quiz

- Which heuristic is **admissible**?:
  1.  $h_{\max}$
  2.  $h_{\text{add}}$
  3.  $h_{\text{STRIPS}}$

Answer:

1.  $h_{\max}$