

PUI PDDL Modeling Bridge and Torch problem

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Domain

Terms:

- `guy`, `island`: representing guys and locations in the domain.

Predicates:

- `at(guy, island)`: represents if guy is on specific island
- `hasTorch(guy)`: represents if guy has a torch
- `connected(from, to)`: represents the connection between two islands
- `greater(guy1, guy2)`: represents inequality between crossing speed of two guys

Functions:

- `guyCost(guy)`: represents crossing speed of a guy
- `totalCost`: represents metric we want to minimise

Actions:

- `cross`
 1. *parameters*: `guy1`, `guy2`, `from`, `to`
 2. *precondition*: $\mathbf{at}(\text{guy1}, \text{from}) \wedge \mathbf{at}(\text{guy2}, \text{from}) \wedge \mathbf{connected}(\text{from}, \text{to}) \wedge (\mathbf{hasTorch}(\text{guy1}) \vee \mathbf{hasTorch}(\text{guy2})) \wedge \mathbf{greater}(\text{guy1}, \text{guy2})$
 3. *effect*: $\neg \mathbf{at}(\text{guy1}, \text{from}) \wedge \neg \mathbf{at}(\text{guy2}, \text{from}) \wedge \mathbf{at}(\text{guy1}, \text{to}) \wedge \mathbf{at}(\text{guy2}, \text{to})$
- in action `cross` we also increase `totalCost` by `guyCost(guy1)`
- `giveTorch`

1. *parameters*: giver, receiver, location
2. *precondition*: $\mathbf{at}(\text{giver}, \text{location}) \wedge \mathbf{at}(\text{receiver}, \text{location}) \wedge \mathbf{hasTorch}(\text{giver}) \wedge \neg \mathbf{hasTorch}(\text{receiver})$
3. *effect*: $\mathbf{hasTorch}(\text{receiver}) \wedge \neg \mathbf{hasTorch}(\text{giver})$

Problem 01

Objects

- a b c d - guy; l r - island

Initialization

- location of guys: $\mathbf{at}(a, l) \wedge \mathbf{at}(b, l) \wedge \mathbf{at}(c, r) \wedge \mathbf{at}(d, r)$
- torch: $\mathbf{hasTorch}(a)$
- connection between islands: $\mathbf{connected}(l, r) \wedge \mathbf{connected}(r, l)$
- comparison between crossing speed: $\mathbf{greater}(d, a) \wedge \mathbf{greater}(d, c) \wedge \mathbf{greater}(d, b) \wedge \mathbf{greater}(d, a) \wedge \mathbf{greater}(d, d) \wedge \mathbf{greater}(c, b) \wedge \mathbf{greater}(c, a) \wedge \mathbf{greater}(c, c) \wedge \mathbf{greater}(b, a) \wedge \mathbf{greater}(b, b) \wedge \mathbf{greater}(a, a)$
- crossing speed of each guy: $\mathbf{guyCost}(a)=1 \wedge \mathbf{guyCost}(b)=2 \wedge \mathbf{guyCost}(c)=5 \wedge \mathbf{guyCost}(d)=8$

Goal state

- $\mathbf{at}(a, r) \wedge \mathbf{at}(b, r) \wedge \mathbf{at}(c, r) \wedge \mathbf{at}(d, r)$

Result

- cross b a l r (2)
- cross a a r l (1)
- givetorch a c l (0)
- cross d c l r (8)
- givetorch c b r (0)
- cross b b r l (2)
- cross b a l r (2)
- plan length: 7 steps
- plan cost: 15

Problem 02

Objects

- a b c d e f - guy; l r - island

Initialization

- location of guys: at(a, l) at (b, l) at (c, l) at (d, l) at (e, l) at(f, l)
- torch: has-torch(a); torch: has-torch(b)
- connection between islands: connected(l, r) connected(r, l)
- comparison between crossing speed: greater(f, a) greater(f, b) greater(f, c) greater(f, d) greater(f, e) greater(f, f) greater(e, a) greater(e, b) greater(e, c) greater(e, d) greater(e, e) greater(d, a) greater(d, c) greater(d, b) greater(d, a) greater(d, d) greater(c, b) greater(c, a) greater(c, c) greater(b, a) greater(b, b) greater(a, a)
- crossing speed of each guy: guy-cost(a)=1 guy-cost(b)=2 guy-cost(c)=3 guy-cost(d)=4 guy-cost(e)=5 guy-cost(f)=6

Goal state

- $\text{at}(a, r) \wedge \text{at}(b, r) \wedge \text{at}(c, r) \wedge \text{at}(d, r) \wedge \text{at}(e, r) \wedge \text{at}(f, r)$

Result

- givetorch a e l (0)
- cross b a l r (2)
- cross f e l r (6)
- givetorch e a r (0)
- givetorch a c l (0)
- cross d c l r (4)
- cross b a l r (2)
- plan length: 8 steps
- plan cost: 16

Problem 03

Objects

- a b c d e f - guy; i1 i2 i3 i4 - island

Initialization

- location of guys: $\text{at}(a, i1)$ $\text{at}(b, i1)$ $\text{at}(c, i1)$ $\text{at}(d, i1)$ $\text{at}(e, i1)$ $\text{at}(f, i1)$
- torch: $\text{has-torch}(a)$; torch: $\text{has-torch}(f)$
- connection between islands: $\text{connected}(i1, i2)$ $\text{connected}(i2, i1)$ $\text{connected}(i2, i3)$ $\text{connected}(i3, i2)$ $\text{connected}(i2, i4)$ $\text{connected}(i4, i2)$
- comparison between crossing speed: $\text{greater}(f, a)$ $\text{greater}(f, b)$ $\text{greater}(f, c)$ $\text{greater}(f, d)$ $\text{greater}(f, e)$ $\text{greater}(f, f)$ $\text{greater}(e, a)$ $\text{greater}(e, b)$ $\text{greater}(e, c)$ $\text{greater}(e, d)$ $\text{greater}(e, e)$ $\text{greater}(d, a)$ $\text{greater}(d, c)$ $\text{greater}(d, b)$ $\text{greater}(d, a)$ $\text{greater}(d, d)$ $\text{greater}(c, b)$ $\text{greater}(c, a)$ $\text{greater}(c, c)$ $\text{greater}(b, a)$ $\text{greater}(b, b)$ $\text{greater}(a, a)$
- crossing speed of each guy: $\text{guy-cost}(a)=1$ $\text{guy-cost}(b)=2$ $\text{guy-cost}(c)=3$ $\text{guy-cost}(d)=4$ $\text{guy-cost}(e)=5$ $\text{guy-cost}(f)=6$

Goal state

- $\text{at}(a, i3) \wedge \text{at}(b, i3) \wedge \text{at}(c, i3) \wedge \text{at}(d, i4) \wedge \text{at}(e, i4) \wedge \text{at}(f, i4)$

Result

- cross f e i1 i2 (6)
- cross b a i1 i2 (2)
- givetorch f b i2 (0)
- cross b a i2 i1 (2)
- givetorch a c i1 (0)
- cross d c i1 i2 (4)
- cross b a i1 i2 (2)
- cross c a i2 i3 (3)
- givetorch c a i3 (0)
- cross a a i3 i2 (1)
- cross d a i2 i4 (4)
- cross a a i4 i2 (1)
- givetorch a e i2 (0)
- cross f e i2 i4 (6)
- cross b a i2 i3 (2)

- plan length: 15 steps
- plan cost: 33