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1i)

<u>Fluents</u>

Vans: $V_1, V_2, …, V_n$

Grid: $s_0, s_1, …, s_g$

Package: $P_1, P_2, …, P_k$

Direction: up, down, left, right

<u>Predicates</u>

Van(v), Grid(s), Package(p), Direction(d) tells what type each fluent is.

At(o, s) tells if a van or package, o, is at a grid location, s.

Available(s) tells if a grid location is empty.

Facing(v, d) tells if van, v is facing a direction, d.

FaceLeft(d_1, d_2), FaceRight(d_1, d_2) tells if direction d_2 is the new direction to face if a left or right is taken from d_1.

Left(a, b, d), Right(a, b, d), Front(a, b, d) tells if given a specific direction, d, to face, is grid location b to the left, right, or front of a.

Carrying(v, p) tells if a van, v is carrying a package, p.

Full(v) tells if a van cannot carry any more packages.

1ii)

<u>Primitive actions</u>

Action: TurnLeft(v, from, to, d_1, d_2)

Precond: Van(v) ^ Grid (from) ^ Grid(to) ^ Direction(d_1) ^ Direction(d_2) ^ At(v, from) ^ Available(to) ^ Facing(v, d_1) ^ Left(from, to, d_1) ^ FaceLeft(d_1, d_2)

Effect: ~Available(to) ^ Available(from) ^ ~At(v, from) ^ At(v, to) ^ ~Facing(v, d_1) ^ Facing(v, d_2)

Action: TurnRight(v, from, to, d_1, d_2)

Precond: Van(v) ^ Grid (from) ^ Grid(to) ^ Direction(d_1) ^ Direction(d_2) ^ At(v, from) ^ Available(to) ^ Facing(v, d_1) ^ Right(from, to, d_1) ^ FaceRight(d_1, d_2)

Effect: ~Available(to) ^ Available(from) ^ ~At(v, from) ^ At(v, to) ^ ~Facing(v, d_1) ^ Facing(v, d_2)

Action: GoForward(v, from, to, d)

Precond: Van(v) ^ Grid (from) ^ Grid(to) ^ Direction(d) ^ At(v, from) ^ Available(to) ^ Facing(v, d) ^ Front(from, to, d)

Effect: ~Available(to) ^ Available(from) ^ ~At(v, from) ^ At(v, to)

Action: Load(p, v, s)

Precond: Van(v) ^ Package(p) ^ Grid(s) ^ ~Full(v) ^ At(v, s) ^ At(p, s)

Effect: ~At(p, s) ^ Carrying(v, p) ^ Full(v)

Action: Unload(p, v, s)

Precond: Van(v) ^ Package(p) ^ Grid(s) ^ At(v, s) ^ Carrying(v, p)

Effect: At(p, s) ^ ~Carrying(v, p) ^ ~Full(v)
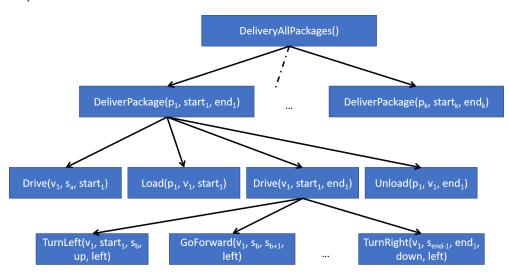
High Level Actions

Action: DeliverAllPackages()

Action: DeliverPackage(p, start, end)

Precond: At(p, start)

Action: Drive(v, start, end)

Precond: At(v, start)

1iii)

2)

EU(Game) = $\sum_{i=1} P(1st\ head\ on\ the\ ith\ toss) * 2^i$

= $0.5^1(2^1) + 0.5^2(2^2) + 0.5^3(2^3) + \dots$

= 1 + 1 + 1 + …

= ∞

3)

Assuming if a move is invalid, the agent will stay in the same place,

P(4,3) = P(Right, Right, Up, Up, Right) + P(Up, Up, Right, Right, Right)

= (0.8*0.8*0.1*0.8*0.1) + (0.1*0.1*0.8*0.1*0.1)

= 0.0052

P(4,2) = P(Right, Right, Right, Up) + P(Right, Right, Up, Right) + P(Down, Right, Right, Right, Up) + P(Down, Right, Right, Up, Right) + P(Right, Down, Right, Right, Up) + P(Right, Down, Right, Up, Right) + P(Right, Up, Right, Right, Up) + P(Right, Up, Right, Up, Right) + P(Right, Right, Down, Right, Up) + P(Right, Right, Down, Up, Right) + P(Right, Right, Right, Right, Up) + P(Right, Right, Up, Left, Right)

= (0.8*0.8*0.8*0.8) + (0.8*0.8*0.1*0.1) + (0.1*0.8*0.8*0.1*0.8) + (0.1*0.8*0.8*0.8*0.1) + (0.8*0.1*0.8*0.1*0.8) + (0.8*0.1*0.8*0.8*0.1) + (0.8*0.1*0.8*0.1*0.8) + (0.8*0.1*0.8*0.8*0.1) + (0.8*0.8*0.1*0.1*0.8) + (0.8*0.8*0.1*0.8*0.1) + (0.8*0.8*0.8*0.1*0.8) + (0.8*0.8*0.1*0.1*0.1)

= 0.49856