Assignment 5

Andrew B. Moore

Due 11/13/2024

#_usf/cs/ai/assignments

> Our Mars rover has been out collecting samples, when it detects that a sandstorm is coming. It needs to return to the safety of the charging station as quickly as possible.
> It knows that over rocky terrain it can go 2 km/h. Over sandy terrain it can go **3 km/h**, and over smooth terrain it can go **5 km/h**.

I made these tables w/ GPT—I hope that's ok :) ("Convert this to a markdown table and output in raw text: 'Route 1...'")

Route	Length (km)	Sandy (%)	Smooth (%)	Rocky (%)
Route 1	5	20	30	50
Route 2	7	40	20	40
Route 3	6	50	40	10

Terrain Type	Speed (km/h)
Sandy	3
Smooth	5
Rocky	2

Part 1: Route

> Which route should we pick? Show your work. You may find it easier to convert km/hr to mins/km (how many minutes does it take to go 1km on each surface?)

Route 3.

Route 1

Sandy (20% prob.)

5 km * 20 min/km = 100 min

Smooth (30% prob.)

5 km * 12 min/km = 60 min

Rocky (50% prob.)

5 km * 30 min/km = 150 min

Predicted Time

(0.2 * 100) + (0.3 * 60) + (0.5 * 150) = 113 minutes

Route 2

Sandy (40% prob.)

7 km * 20 min/km = 140 min

Smooth (20% prob.)

7 km * 12 min/km = 84 min

Rocky (40% prob.)

7 km * 30 min/km = 210 min

Predicted Time

(0.4 * 140) + (0.2 * 84) + (0.4 * 210) = 156.8 minutes

Route 3

Sandy (50% prob.)

6 km * 20 min/km = 120 min

Smooth (40% prob.)

6 km * 12 min/km = 72 min

Rocky (10% prob.)

6 km * 30 min/km = 180 min

Predicted Time

(0.5 * 120) + (0.4 * 72) + (0.1 * 180) = 106.8 minutes

Part 2: Crater & Bridge

Route 1 contains a crater. If the wall of the crater is intact, we can take a shortcut through the

> crater, which will save 20 minutes. If the wall has been damaged, we will need to go around, which will add 15 minutes to our journey. There is a 30% chance that the wall is damaged. Route 3 contains a bridge. If that bridge is damaged, we will need to repair it, which will add 40 minutes to our time. There is a 60% chance that the bridge is damaged.

Route	Obstacle	Condition	Impact	Probability (%
Route 1	Crater	Wall intact	Save 20 minutes	70
Route 1	Crater	Wall damaged	Add 15 minutes	30
Route 3	Bridge	Bridge intact	No time impact	40
Route 3	Bridge	Bridge damaged	Add 40 minutes	60

Route 1.

Route 1

Sandy (20% prob.)

0.7(100 - 20) + 0.3(100 + 15) = 90.5 min

Smooth (30% prob.)

0.7(60 - 20) + 0.3(60 + 15) = 50.5 min

Rocky (50% prob.)

0.7(150 - 20) + 0.3(150 + 15) = 140.5 min

Predicted Time

(0.2 * 90.5) + (0.3 * 50.5) + (0.5 * 140.5) = 103.5 minutes

Route 2

Predicted Time (Same as above)

(0.4 * 140) + (0.2 * 84) + (0.4 * 210) = 156.8 minutes

Route 3

Sandy (50% prob.)

0.6(120 + 40) + 0.4(120 + 0) = 144 min

Smooth (40% prob.)

0.6(72 + 40) + 0.4(72 + 0) = 96 min

Rocky (10% prob.)

0.6(180 + 40) + 0.4(180 + 0) = 204 min

Predicted Time

(0.5 * 144) + (0.4 * 96) + (0.1 * 204) = 130.8 minutes

Part 3: Satellite

> Now we have an additional piece of potential information. There is an orbiting satellite that can tell us whether route 2 is rocky or not. If not, that would be great news, and would make it much more appealing! The only problem is that the satellite is not yet in position. How long should we wait for the satellite?

Time if not Rocky

Sandy (40% prob.)

7 km * 20 min/km = 140 min

Smooth (20% prob.)

7 km * 12 min/km = 84 min

Predicted Time

(2/3 * 140) + (1/3 * 84) = 121.3 minutes

Probability not Rocky

1 - 0.4 = 0.6

= 60%

If Route 2 is Rocky

Pick Route 1 (103.5 min).

How long to wait for Satellite

Probability	State	Route
60%	Not Rocky	**2** (121.3 minutes)
40%	Rocky	**1** (103.5 minutes)

(0.6 * 121.3) + (0.4 * 103.5) = 114.18 minutes

Route 1 will always be faster than Route 2, whether it's rocky or not, so there is no point in waiting for the satellite.