IT 567 - Lab Exercise 1
Winter 2024-2025

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Problem 1: Recycling Robot

The solution to Problem 1 is below. The solution is scanned and attached. (see next page)

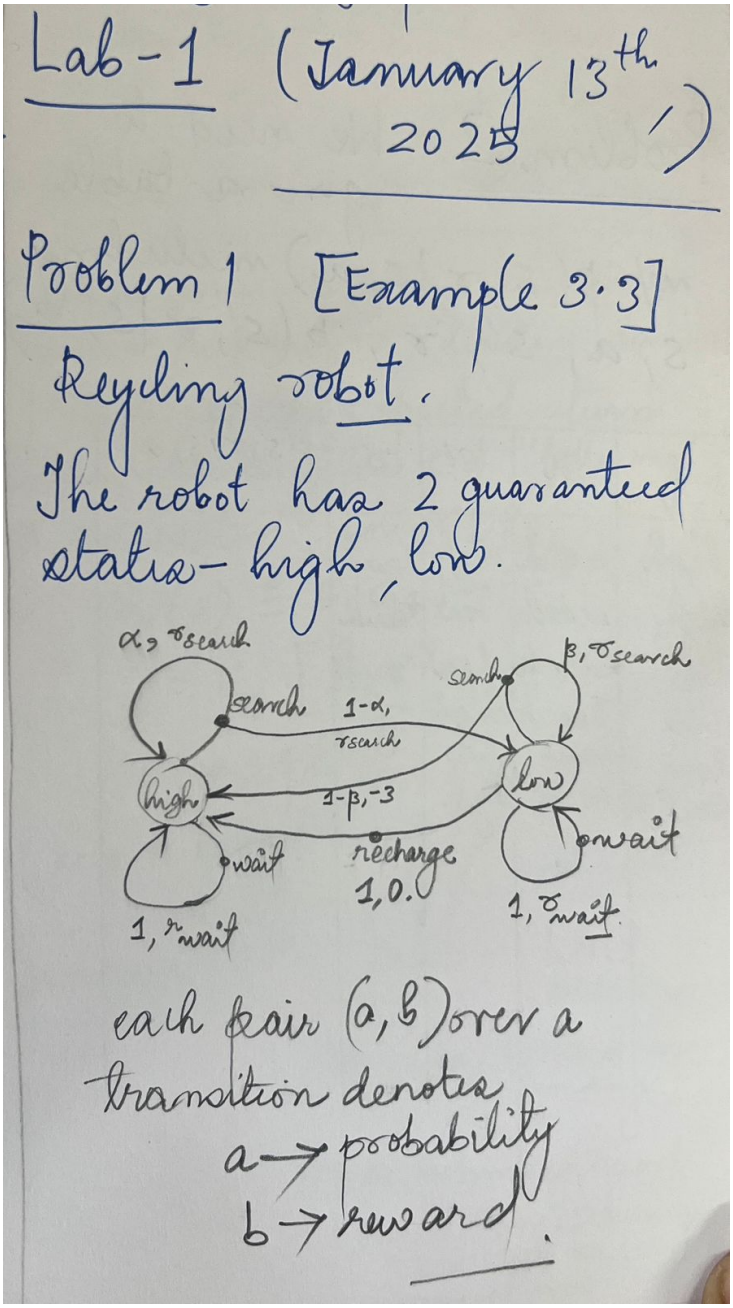

Figure 1: First part of solution for problem 1.

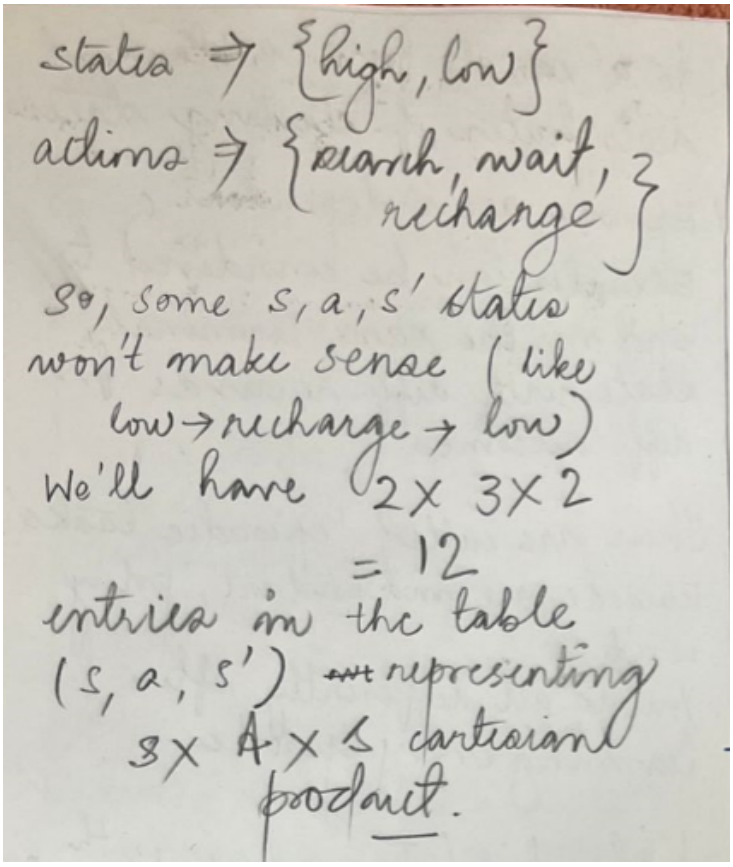

Figure 2: Second part of solution for p roblem 1.

Python Simulation

The Python simulation for the Recycling Robot is provided below. The code simulates the model for 10 time steps.

Code:

```
import random

states = ["high", "low"]
actions_high = ["search", "wait"]
actions_low = ["search", "wait", "recharge"]

alpha = 0.9
beta = 0.1
r_search = 1
r_wait = 0.5

```

```
transition_table = {
    "high": {
        "search": [("high", alpha, r_search), ("low", 1 - alpha, r_search)],
        "wait": [("high", 1.0, r_wait)],
    },
    "low": {
        "search": [("low", beta, r_search), ("high", 1 - beta, -3)],
        "wait": [("low", 1.0, r_wait)],
        "recharge": [("high", 1.0, 0)],
    },
}

def simulate_step(current_state):
    if current_state == "high":
        action = random.choice(actions_high)
    elif current_state == "low":
        action = random.choice(actions_low)
    transitions = transition_table[current_state][action]
    next_state = random.choices(
        [t[0] for t in transitions], weights=[t[1] for t in transitions], k=1
    )[0]
    reward = next(t[2] for t in transitions if t[0] == next_state)
    return current_state, action, reward, next_state

current_state = "high"
print(f"{'Time':<5} {'State':<10} {'Action':<10} {'Reward':<10} {'Next State':<10}")
for t in range(1, 11):
    state, action, reward, next_state = simulate_step(current_state)
    print(f"{t:<5} {state:<10} {action:<10} {reward:<10} {next_state:<10}")
    current_state = next_state
```

Output:

Time	State	Action	Reward	Next State
1	high	wait	0.5	high
2	high	search	1	high

3	high	wait	0.5	high
4	high	wait	0.5	high
5	high	search	1	high
6	high	search	1	low
7	low	search	-3	high
8	high	wait	0.5	high
9	high	wait	0.5	high
10	high	wait	0.5	high

Problem 2: Exercise 3.4

The solution to Problem 2 is below. I have attached my solution in the image.

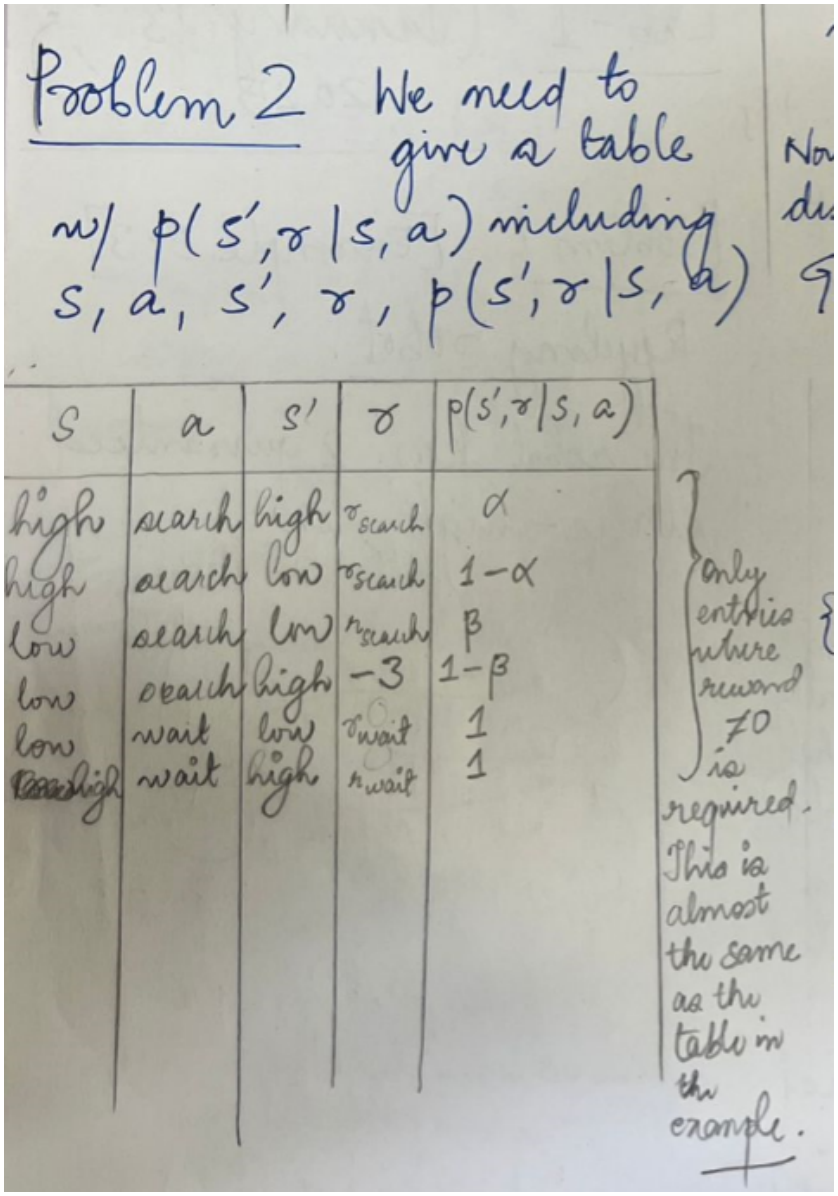

Figure 3: Handwritten solution for Problem 2.