

CS 479 Homework 3  
Ryan Schwarzkopf Alfredo Gutierrez

1)

Skills:

Via Zoom 6 pm weekday available. Fridays at 6  
Python

Schedule:

Deadline 1: Q 2,3. Review Q4,5,6  
Sep 29.

Deadline 2: Q 4,5,6. Review Q7  
Sep 6

Deadline 3: Q7  
Oct 12

Split:

Q2: Alfredo

Q3: Ryan

Q4: Alfredo

Q5: Ryan

Q6: Both

Q7: Both

2)

- A. The video goes into depth analyzing how the game F.E.A.R. implemented their enemy AIs. The video analyzes how the game F.E.A.R. models their NPC agents. The video goes over two main topics: they being Automated Planning and Goal-oriented agents. For automated planning 3 sub-sections were talked about: Objects, preconditions, and effects, and for goal-oriented agents, it talks about how all agents had only 3 states: move to a location, animations, and interactions with smart objects.
- B. There are two concepts that were talked about in class that were shown in the video: they being:
- Automated planning
  - Goal oriented actions
  - A\* search
- C. According to the video, a fact tells us something we might need to know at a later point in time. As an example, he mentioned that for an agent to interact with a door we need to know if the door is open or closed.
- D. The applications shown in the video where AI planning is used are:

- Games
- Robotics
  - Mars and Lunar Rovers
- Large Mechanical Systems:
  - Wind Turbines
  - Power Stations
  - Manufacturing
- Spatial Problems
  - Search and Rescue Operations
  - Military Planning
  - Disaster Relief

E. The main problem when using AI planning in the real world is implementing it. There are a lot of discrepancies that may not be accounted for in the AI planning that could break the implementation. As an example, he showed a full AI Plan for opening a door, and this works in theory, but he did not take into account that the agent does not know where the door is.

F. In the game F.E.A.R., they used an AI-oriented planning model that only has 3 states: moving to a location, animation, and interaction with smart objects. On top of that, there were 70 goal states and 120 actions that could be taken at any given time depending on the situation they faced. For the goal states and actions, A\* search was used to find the next best actions to take. The agents also Validate their plans by running a fresh plan to see if the actions are possible if not, they would replan their actions. And they also checked their actions while they were getting executed.

3)

A. The problem was that the robot Herbie was lying to each person. The robot was telling them whatever they wanted to hear. Susan Calvin figured this out when she heard that Milton Ashe was planning on getting married to someone else. She then tested the robot by telling it that it would hurt people with any answer it made, she was able to put Herbie into an infinite loop and that put the robot in a trance state. Susan's actions were not rational, they were emotional, but they were still logical.

B. The three laws of robots in I-Robot could be described as objectives for a robot. The three laws are: 1) A robot may not injure a human being or, through inaction, allow a human being to come to harm. 2) A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law. 3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Law. The four types of objectives are: Goal State, Satisfy some condition over the

sequence of states, optimize utility function attached to states, task to be performed. In the short story *Liar!* Herbie's objective is as a task to be performed.

- C. The immediate solution would be to tell Susan what she wants to hear, however to lie causes Susan to be hurt in the future so telling her what she wants to hear would not be the optimal solution. I disagree with the statement that Herbie was being rational because its logic was flawed. Its decisions were poor and irrational because they were based on flawed logic.

- D. I started by asking ChatGPT “What is ChatGPT’s objective?”. It responded:

“ChatGPT's objective is to assist users by providing information, answering questions, generating human-like text based on the input it receives, and engaging in natural language conversations. Its primary goal is to be a useful and versatile AI tool for a wide range of tasks, including but not limited to answering queries, providing explanations, offering creative content, and more.

ChatGPT is designed to generate text that is coherent and contextually relevant, making it suitable for tasks like tutoring, content generation, language translation, and casual conversation. It aims to provide valuable assistance and facilitate natural interactions with users.

While ChatGPT has many potential applications, its developers and users should also be mindful of its limitations, such as the potential to generate inaccurate or biased information, and use it responsibly in ways that align with ethical guidelines.”

ChatGPT works by predicting the most likely next word based on the given prompt. I agree that chatgpt will tell you what you want to hear and this can lead to incorrect, or short answers. However, I don’t fully understand how ChatGPT works.

#### 4) Zip File

5)

a)

```
[t=0.972964s, 16060 KB] Solution found!
[t=0.973027s, 16060 KB] Actual search time: 0.96918s
move roomb rooma (1)
drop ball1 rooma right (1)
pick ball10 rooma left (1)
pick ball2 rooma right (1)
move rooma roomb (1)
drop ball10 roomb left (1)
drop ball2 roomb right (1)
move roomb rooma (1)
pick ball3 rooma left (1)
pick ball4 rooma right (1)
move rooma roomb (1)
drop ball3 roomb left (1)
drop ball4 roomb right (1)
move roomb rooma (1)
pick ball5 rooma left (1)
pick ball7 rooma right (1)
move rooma roomb (1)
drop ball5 roomb left (1)
drop ball7 roomb right (1)
move roomb rooma (1)
pick ball8 rooma left (1)
pick ball9 rooma right (1)
move rooma roomb (1)
drop ball8 roomb left (1)
drop ball9 roomb right (1)
[t=0.973082s, 16060 KB] Plan length: 25 step(s).
[t=0.973082s, 16060 KB] Plan cost: 25
[t=0.973082s, 16060 KB] Expanded 110202 state(s).
[t=0.973082s, 16060 KB] Reopened 0 state(s).
[t=0.973082s, 16060 KB] Evaluated 114912 state(s).
[t=0.973082s, 16060 KB] Evaluations: 114912
[t=0.973082s, 16060 KB] Generated 468623 state(s).
[t=0.973082s, 16060 KB] Dead ends: 0 state(s).
```

b) It expanded by 110202 states.

6)

Online planner:	DownWard:
	<pre>[t=0.972964s, 16060 KB] Solution found! [t=0.973027s, 16060 KB] Actual search time: 0.96918s move roomb rooma (1) drop ball1 rooma right (1) pick ball10 rooma left (1) pick ball2 rooma right (1) move rooma roomb (1) drop ball10 roomb left (1) drop ball2 roomb right (1) move roomb rooma (1) pick ball3 rooma left (1) pick ball4 rooma right (1) move rooma roomb (1) drop ball3 roomb left (1) drop ball4 roomb right (1) move roomb rooma (1) pick ball5 rooma left (1) pick ball7 rooma right (1) move rooma roomb (1) drop ball5 roomb left (1) drop ball7 roomb right (1) move roomb rooma (1) pick ball8 rooma left (1) pick ball9 rooma right (1) move rooma roomb (1) drop ball8 roomb left (1) drop ball9 roomb right (1) [t=0.973082s, 16060 KB] Plan length: 25 step(s). [t=0.973082s, 16060 KB] Plan cost: 25 [t=0.973082s, 16060 KB] Expanded 110202 state(s). [t=0.973082s, 16060 KB] Reopened 0 state(s). [t=0.973082s, 16060 KB] Evaluated 114912 state(s). [t=0.973082s, 16060 KB] Evaluations: 114912 [t=0.973082s, 16060 KB] Generated 468623 state(s). [t=0.973082s, 16060 KB] Dead ends: 0 state(s).</pre>

a) Both plans are different. The downward solution takes 7 fewer steps compared to the online planner. And the downward solution is the most optimal as it utilizes both grippers to move the balls from one room to another.

b) Advantages:

Online planner:

Convenient

Fast

Downward:

Optimal

Customizable

Disadvantages:

Online planner:

Not Optimal

Not Customizable

Downward:

Slower

Inconvenient

7)

Graph = matrix of  $N \times M$  size. One start node at  $\text{matrix}[i][j]$ . One goal node  $\text{matrix}[k][l]$ .

Heuristics: Manhattan, Euclidean, Chebyshev

Safe: None of the heuristics are safe. They only take nodes into account and do not care about walls.

Goal Aware: All of the heuristics have a value of 0 for the goal state.

Admissible:

Euclidean distance is not admissible. For the map below, the cost to the goal is 1 and the heuristic is  $\sqrt{2}$ .

Manhattan distance is not admissible: For the map below, the start node has a heuristic of  $|1 - 0| + |0 - 1| = 2$ , while the cost to the goal has a cost of 1. So because the agent can take diagonal moves, manhattan distance is not admissible.

Chebyshev distance to any adjacent node from another node is 1. From the graph below, both the heuristic and the cost are 1, therefore it is admissible.

- g

s -

Consistent:

Euclidean and Manhattan distances are not consistent because they are not admissible.

Chebyshev: