University of Puerto Rico
Department of Electrical and Computer Engineering
ICOM5015 Artificial Intelligence

Agents and Task Management

Group C

Manuel Alejandro Umaña Rodriguez -Undergraduate Computer Engineering
Dahyna Martínez Pérez -Undergraduate Computer Engineering
Jan Luis Pérez de Jesús -Undergraduate Computer Engineering
Christopher Hans Mayens Matías -Undergraduate Computer Engineering

For: Profesor José Fernando Vega Riveros
Date: March 7, 2025

Agenda

01 Purpose of experiment

02 Hypothesis

03 Concepts

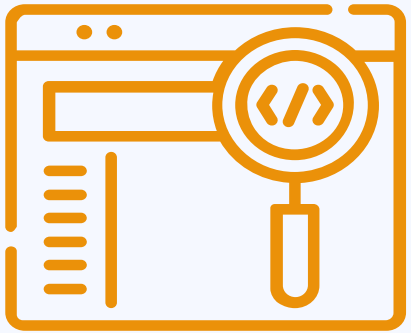
04 Experiments set up

05 Information

06 Conclusion

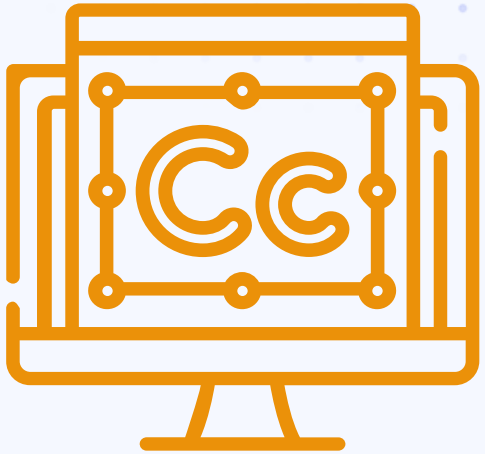
07 Credits & References

01
Purpose of experiment



- Investigate the agents in different kinds of environments to better comprehend the functionality of agents in artificial intelligence practices.

- Study the performance and efficiency of different agents in various environments, both with and without memory



02 Key questions and hypothesis

Does the memory of a reflex agent affect its performance and efficiency?

- How does the implementation of a No-op affect the efficiency of the agent?
- Is memory necessary to have a completely rational environment?
- Do different environmental states affect an agent's efficiency and performance?
- Hypothesis: Since a reflex agent only knows its current state, adding memory would provide context, reducing errors and improving performance.

03 Concepts

Experimental concepts

Platform

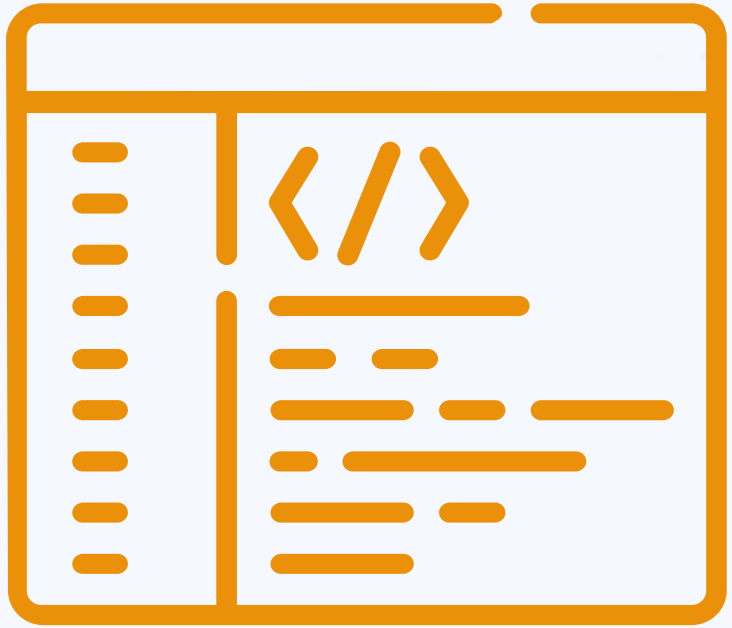
Python: Programming language of high level. Emphasizes code readability with the use of indentation.

Subject

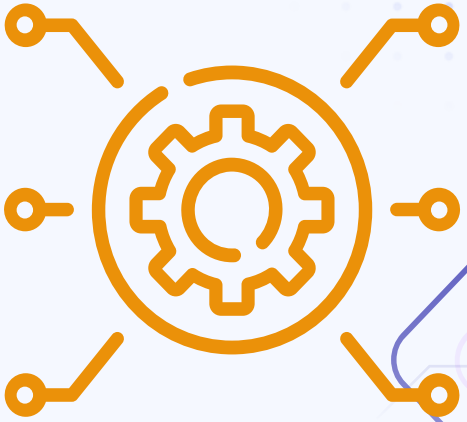
The agent's (vacuum) ability to clean an unknown environment.

Measure

The agent's performance and effectiveness in cleaning the environment within the fewest moves.



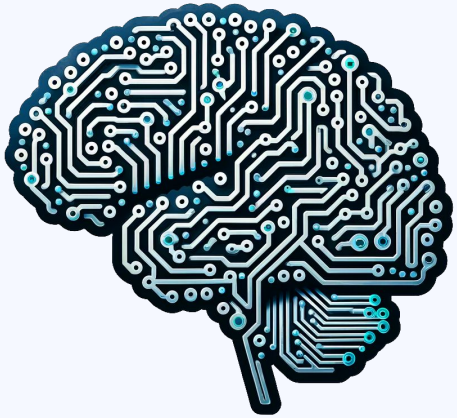
04 Experiments set up.



Tools and Resources Utilized

The following tools and resources were used:

- **Aimacode Repository**: The core repository containing foundational code and algorithms for both problems.
- **For Problem 2.11**: The *"vacuum_agent.py"* file served as the base code for the implementation and testing of this specific problem.
- **For Problem 2.14**: The *"xy_vacuum_environment.py"* file was used as the foundational code for this problem, providing the necessary environment setup.



Method for comparing

Criteria Used for Comparison:

- **Performance:** Measures how well the agent makes the necessary steps to achieve its goal.
- **Efficiency:** Evaluates the percentage of used resources (movements) for the agent performs its tasks.

In **Problem 2.14**, the same criteria was used to compare three different cases:

1. **Reflex Agent with Randomness**
2. **Reflex Agent with Randomness in Complex Environments**
3. **Reflex Agent with randomness with no Memory State and with Memory State**

Method for graph creation

How the Data for the graph was collected and used.

- For exercise 2.11 the graphs were created by gather the performance and efficiency of each state of the vacuum cleaner within the environment.

- Performance - Add 10 when the agent cleans a dirty locations. Subtract 1 when an agent moves and does not reach the goal state of state 7 and 8.

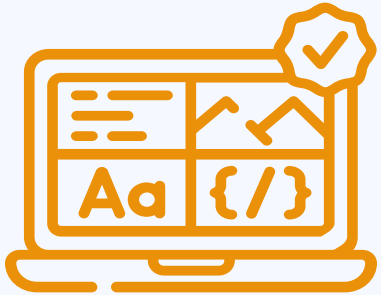
- Efficiency - The number of dirt that has been sucked divided by the number of steps required to complete the task.

Method for graph creation

How the Data for the graph was collected and used.

- For exercise 2.14 the graphs were created by performance and the efficiency of the agent.
- Performance - Add 100 when the agent cleans a dirty locations. Subtract 1 when an agent moves until all the dirt has been cleaned or timeout at 500 moves.
- Efficiency - The number of dirt that has been sucked divided by the number of steps required to complete the task.
- Data was collected by running 5 test for each agent, with memory and without memory, for each of the 4 environments.

05



Information.

Information of the states for simple 1 by 2 Vacuum Environment

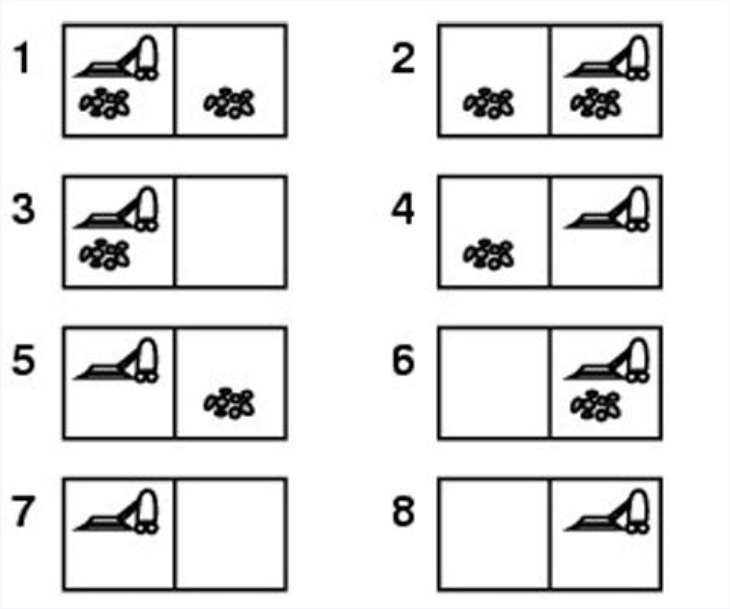


Figure 1. Possible states for vacuum cleaner environment.

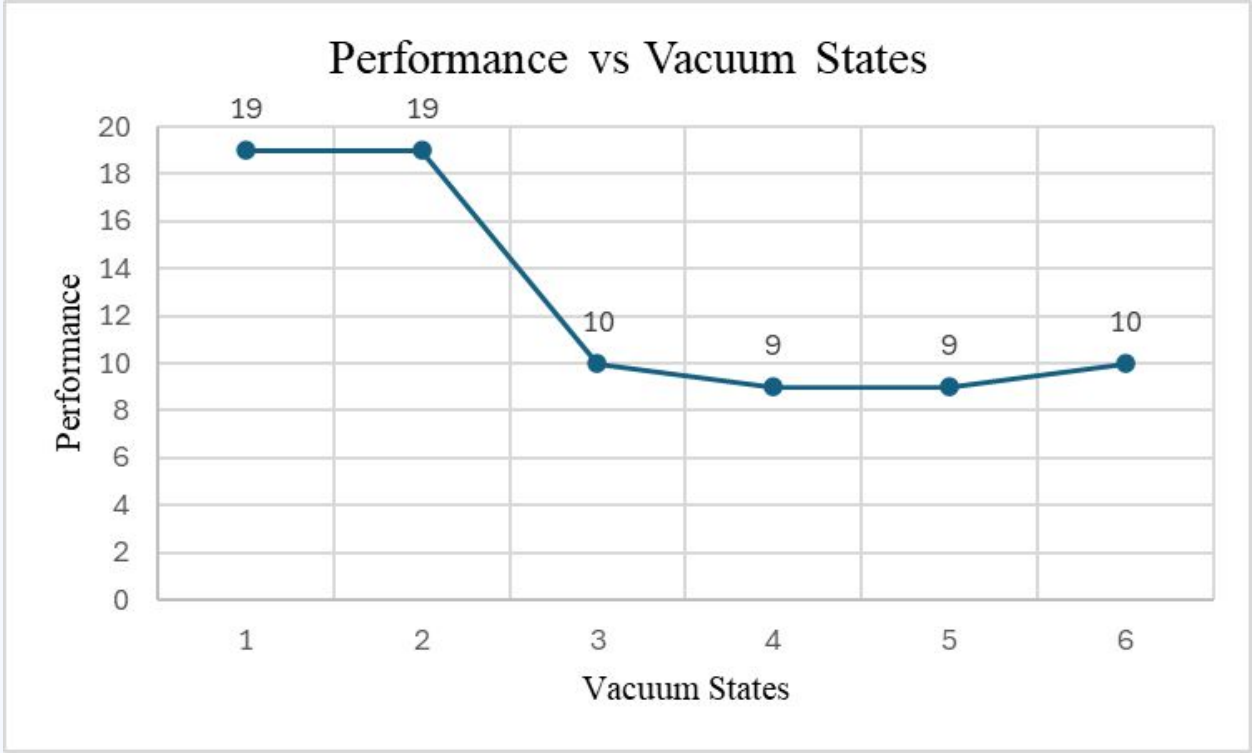
Information for simple 1 by 2 Vacuum Environment

State	Performance	Dirt Cleaned	Steps taken	Efficiency
1	19	2	3	66.67%
2	19	2	3	66.67%
3	10	1	1	100%
4	9	1	2	50%
5	9	1	2	50%
6	10	1	1	100%

Table 1. Time Execution data of 1D Array Multiplications for Graph 1 for 1 attempt.

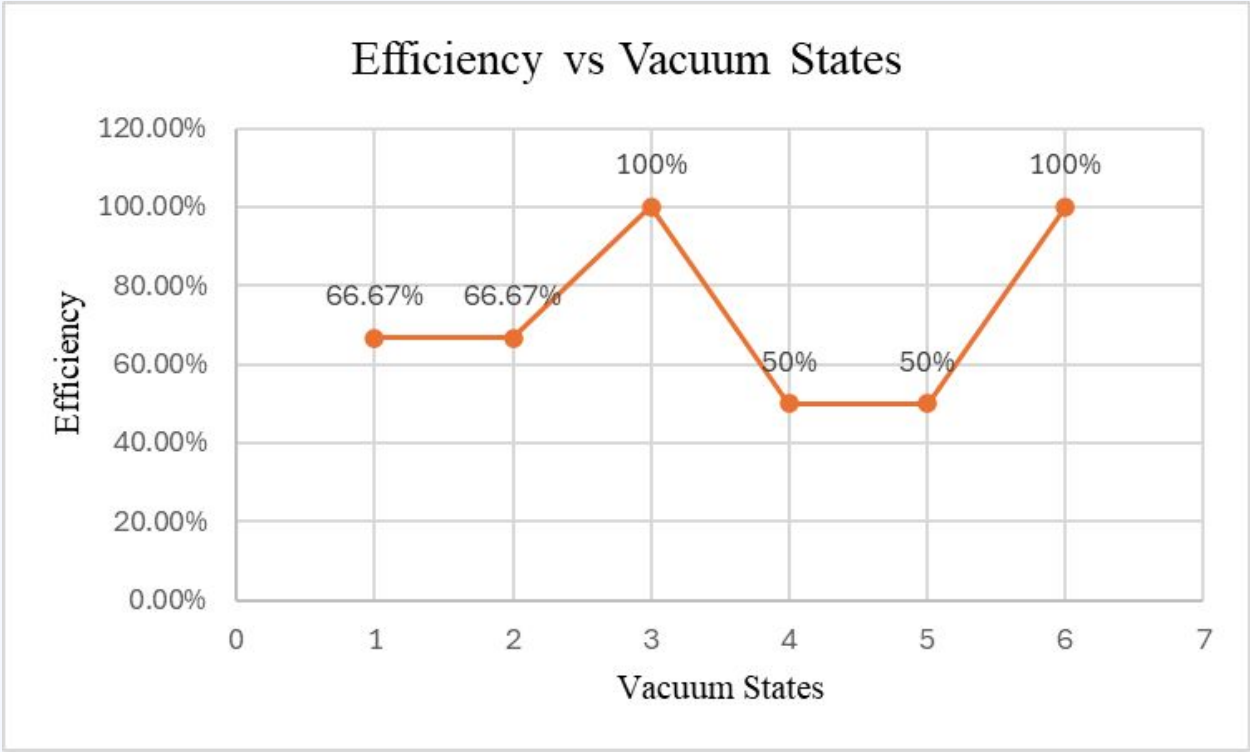
Graphs

Graph 1. Comparison of performance in different vacuum states.



Graphs

Graph 2. Comparison of efficiency in different vacuum states.



Information of the states for simple XY Vacuum Environment

Figure 2: Environment for exercise 2.14 all dirt around the agent.

Figure 3: Walls in some areas around the agent.

Figure 4: Environment variation test.

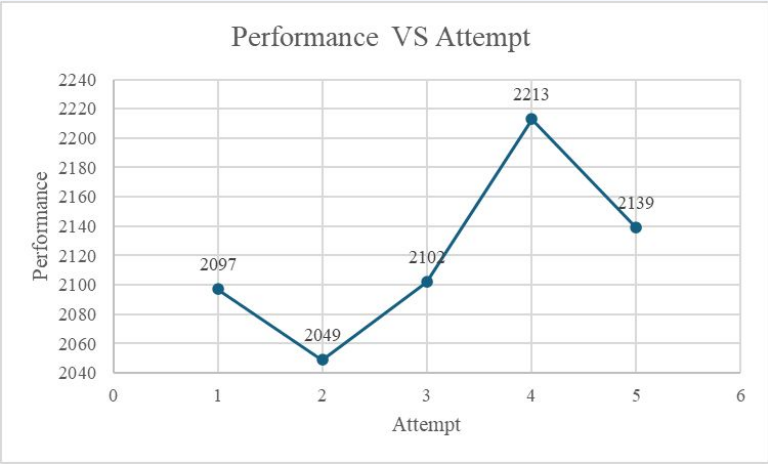
Figure 5: Final environment for testing.

Information for simple XY Vacuum Environment

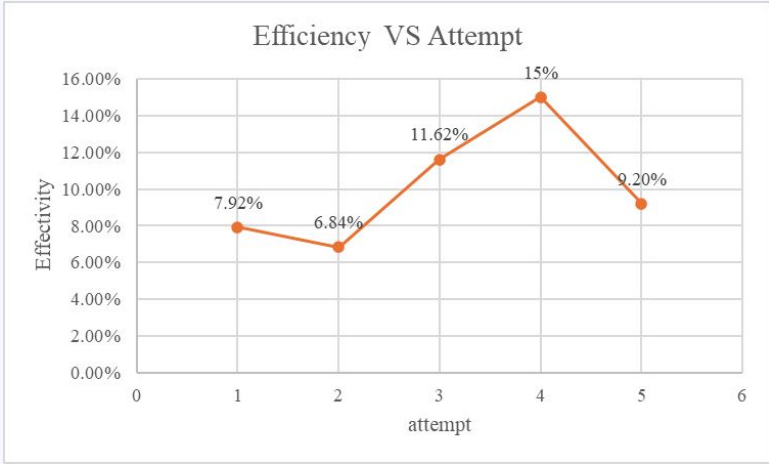
Test for figure 2 with no state					
Attempt	Performance	Dirt cleaned	Steps taken	Efficiency	Complete cleaned dirt
1	2097	24	302	7.92%	Yes
2	2049	24	351	6.84%	yes
3	2102	24	198	11.62%	yes
4	2213	24	180	15%	yes
5	2139	24	261	9.20%	yes

Table 2: Measured performance and efficiency of different attempts for the vacuum environment with the agent having no record of previous states for the scenario in Figure 2.

Graphs



Graph 3. Comparison of performance in different attempts regarding the amount of steps with the agent having no recording of its states for the scenario in Figure 2.



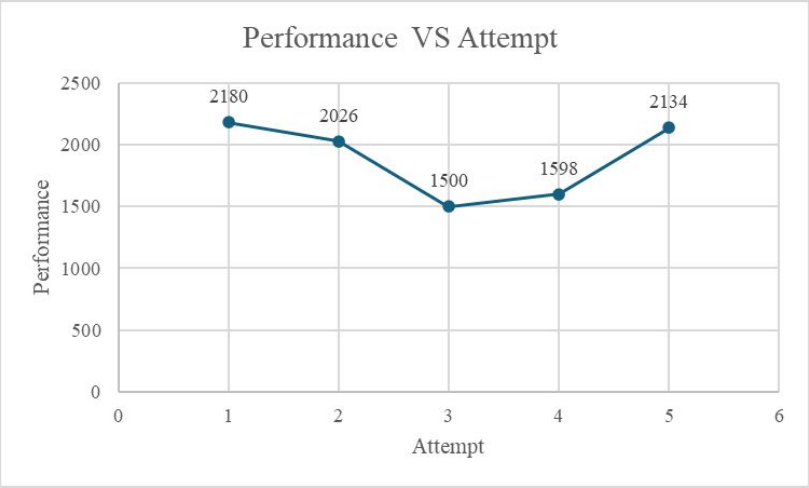
Graph 4. Comparison of efficiency in vacuum steps with no recording of states for the scenario in Figure 2.

Information for simple XY Vacuum Environment

Test for figure 2 with state					
Attempt	Performance	Dirt cleaned	Steps taken	Efficiency	Complete cleaned dirt
1	2180	24	220	11%	yes
2	2026	24	374	6.42%	yes
3	1500	20	500	4%	no
4	1598	21	500	4.18%	no
5	2134	24	166	13.86%	yes

Table 3: Measured performance and efficiency of different attempts for the vacuum environment with agent having record of previous states for the scenario in Figure 2.

Graphs



Graph 5. Comparison of performance in different attempts regarding the amount of steps with agent having records of its states for the scenario in Figure 2.

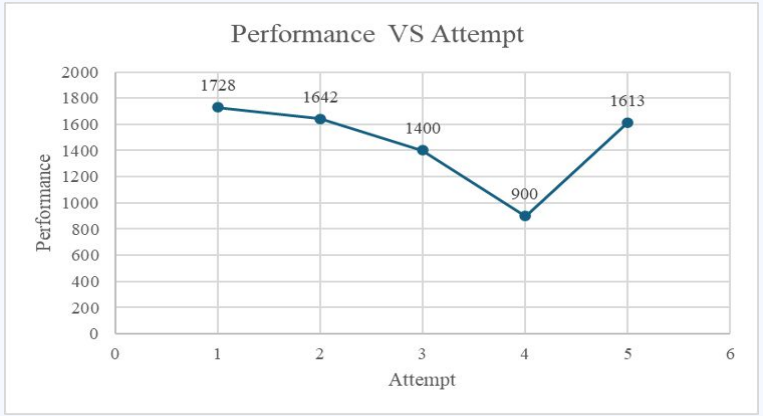
Graph 6. Comparison of efficiency in vacuum steps with recording of states for the scenario in Figure 2.

Information for simple XY Vacuum Environment

Test for figure 3 with no state					
Attempt	Performance	Dirt cleaned	Steps taken	Efficiency	Complete cleaned dirt
1	1728	20	272	7.35%	yes
2	1642	20	358	5.60%	yes
3	1400	19	500	3.80%	no
4	900	14	500	2.80%	no
5	1613	20	387	5.17%	yes

Table 4: Measured performance and efficiency of different attempts for the vacuum environment with the agent having no records of previous states for the scenario in Figure 3.

Graphs



Graph 7. Comparison of performance in different attempts regarding the amount of steps with agent not having records of its states for the scenario in Figure 3.

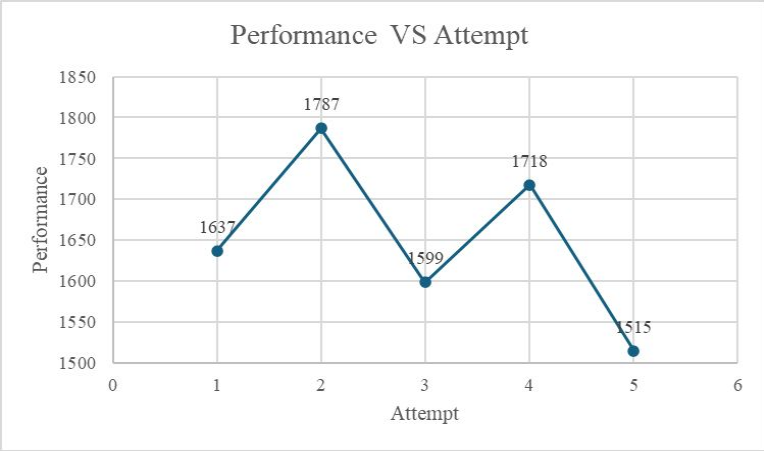
Graph 8. Comparison of efficiency in vacuum steps with no recording of states for the scenario in Figure 3.

Information for simple XY Vacuum Environment

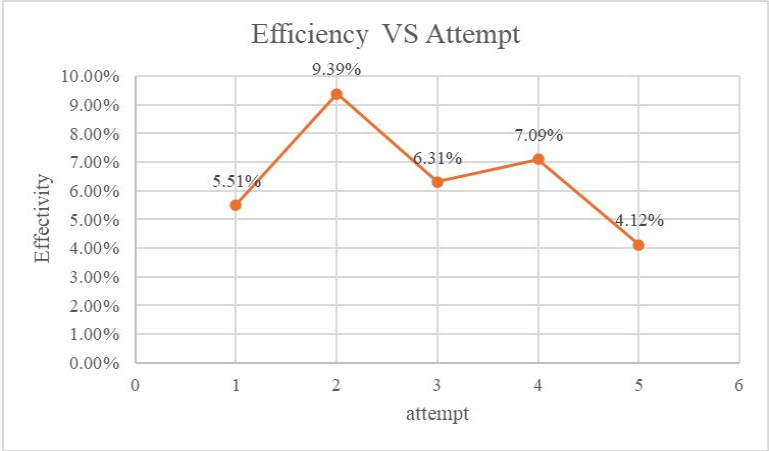
Test for figure 3 with state					
Attempt	Performance	Dirt cleaned	Steps taken	Efficiency	Complete cleaned dirt
1	1637	20	363	5.51%	yes
2	1787	20	213	9.39%	yes
3	1599	20	301	6.31%	yes
4	1718	20	282	7.09%	yes
5	1515	20	485	4.12%	yes

Table 5: Measured performance and efficiency of different attempts for the vacuum environment with agent having records of previous states for the scenario in Figure 3.

Graphs



Graph 9. Comparison of performance in different attempts regarding the amount of steps with agent having records of its states for the scenario in Figure 3.



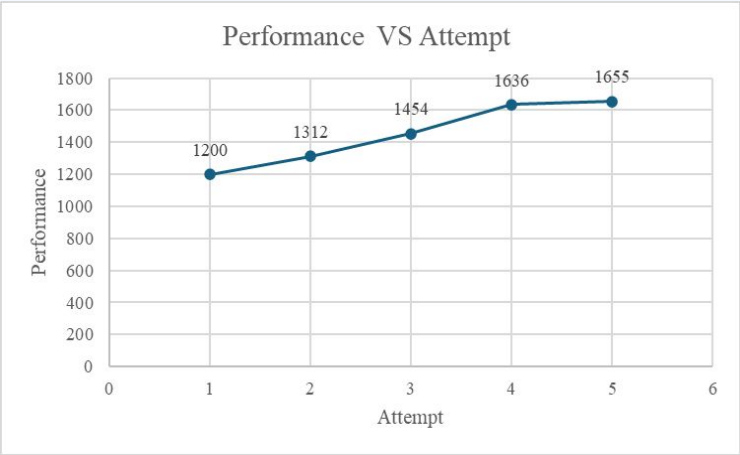
Graph 10. Comparison of efficiency in vacuum steps with recording of states for the scenario in Figure 3.

Information for simple XY Vacuum Environment

Test for figure 4 with no state					
Attempt	Performance	Dirt cleaned	Steps taken	efficiency	Complete cleaned dirt
1	1200	17	500	3.40%	no
2	1312	18	488	3.69%	yes
3	1454	18	346	5.20%	yes
4	1636	18	164	10.98%	yes
5	1655	18	145	12.41%	yes

Table 6: Measured performance and efficiency of different attempts for the vacuum environment with agent having no records of previous states for the scenario in Figure 4.

Graphs



Graph 11 . Comparison of performance in different attempts regarding the amount of steps with agent not having records of its states for the scenario in Figure 4.

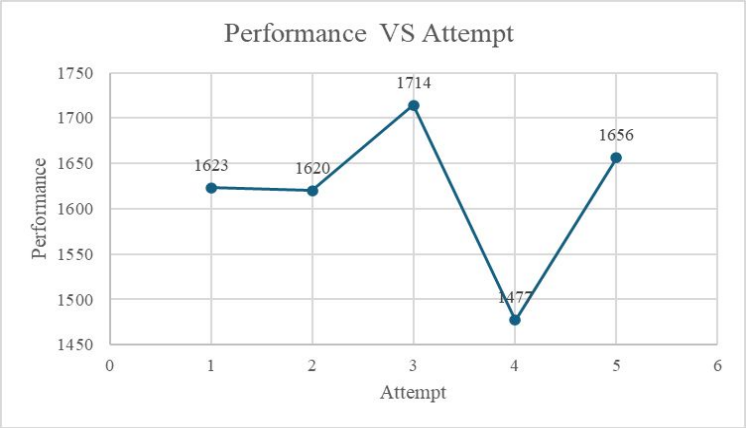
Graph 12. Comparison of efficiency in vacuum steps with no recording of states for the scenario in Figure 4.

Information for simple XY Vacuum Environment

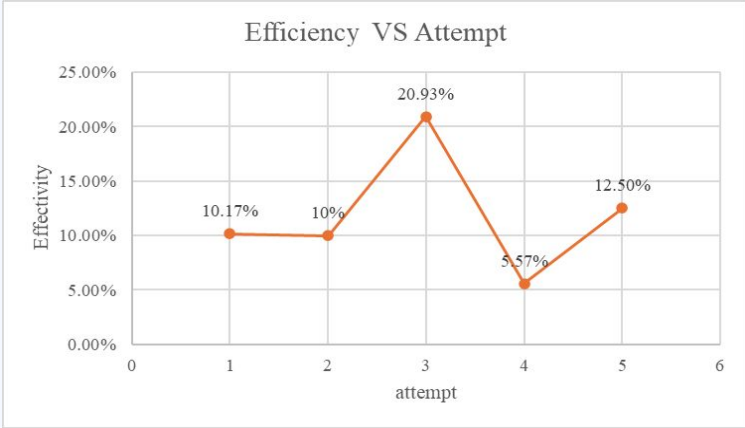
Test for figure 4 with state					
Attempt	Performance	Dirt cleaned	Steps taken	Efficiency	Complete cleaned dirt
1	1623	18	177	10.17%	yes
2	1620	18	180	10%	yes
3	1714	18	86	20.93%	yes
4	1477	18	323	5.57%	yes
5	1656	18	144	12.50%	yes

Table 7: Measured performance and efficiency of different attempts for the vacuum environment with agent having records of previous states for the scenario in Figure 4.

Graphs



Graph 13. Comparison of performance in different attempts regarding the amount of steps with agent having records of its states for the scenario in Figure 4.



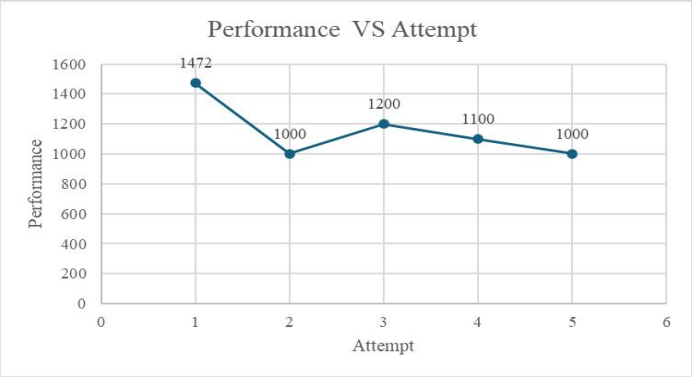
Graph 14. Comparison of efficiency in vacuum steps with recording of states for the scenario in Figure 4.

Information for simple XY Vacuum Environment

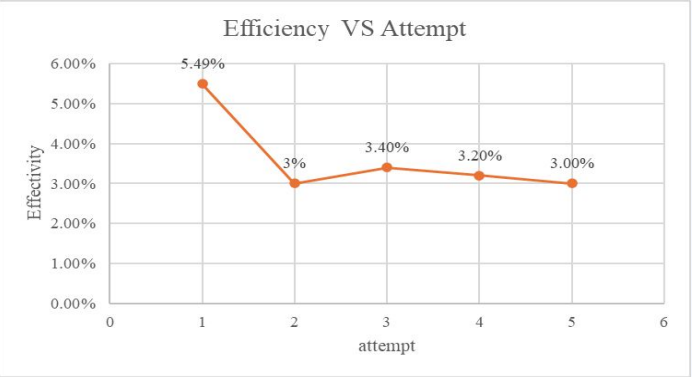
Test for figure 5 with no state					
Attempt	Performance	Dirt cleaned	Steps taken	Efficiency	Complete cleaned dirt
1	1472	18	328	5.49%	yes
2	1000	15	500	3%	no
3	1200	17	500	3.40%	no
4	1100	16	500	3.20%	no
5	1000	15	500	3.00%	no

Table 8: Measured performance and efficiency of different attempts for the vacuum environment with agent having no records of previous states for the scenario in Figure 5.

Graphs



Graph 15 . Comparison of performance in different attempts regarding the amount of steps with agent not having records of its states for the scenario in Figure 5.



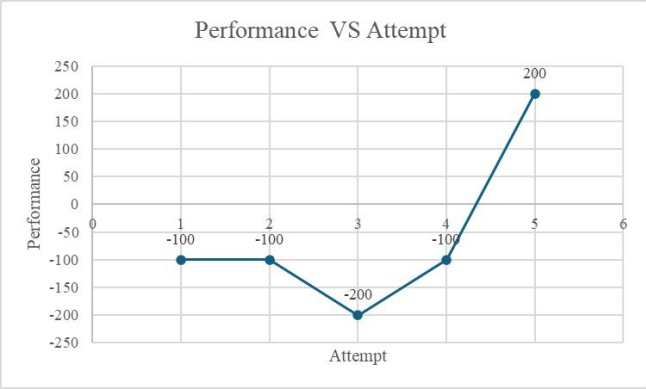
Graph 16. Comparison of efficiency in vacuum steps with no recording of states for the scenario in Figure 5.

Information for simple XY Vacuum Environment

Test for figure 5 with state					
Attempt	Performance	Dirt cleaned	Steps taken	Efficiency	Complete cleaned dirt
1	-100	4	500	0.80%	no
2	-100	4	500	0.80%	no
3	-200	3	500	0.60%	no
4	-100	4	500	0.80%	no
5	200	7	500	1.40%	no

Table 9: Measured performance and efficiency of different attempts for the vacuum environment with agent having records of previous states for the scenario in Figure 5.

Graphs



Graph 17 . Comparison of performance in different attempts regarding the amount of steps with agent having records of its states for the scenario in Figure 5.

Graph 18. Comparison of efficiency in vacuum steps with recording of states for the scenario in Figure 5.

06

Conclusion and Lessons Learned.

Conclusions and Lessons Learned

01 **Impact of Partial Observability**

Limited environmental awareness requires the agent to balance movement and verification to ensure efficient cleaning .

02 **Action Efficiency and Initial State Dependence**

The number of actions required to reach its goal depends on the agent's starting position, affecting overall performance and effectiveness. (Problem 2.11)

03 **Memory's Role in Agent Performance**

An agent with memory can significantly improve by avoiding revisiting already cleaned areas unnecessarily.

04 **Impact of Randomness on Efficiency**

The random movement of the agent significantly reduced efficiency, often causing it to waste cycles by bumping into obstacles or idling instead of following an optimal cleaning path.

Conclusions and Lessons Learned

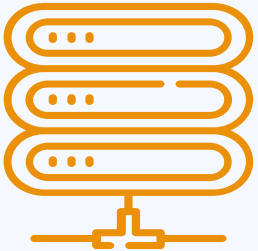
05 Strengths and Weaknesses of the State-Based Agent

The state-based agent performs better in environments with movement-limiting obstacles by avoiding repeated mistakes, but its memory constraints can trap it in loops or hinder coverage in larger areas.

06 Constraints of the Reflex Agent

A reflex agent is limited in complex environments because it can only react to its immediate surroundings and lacks the ability to plan efficient movements.

07
Credits and References.



References

[1] J. Vega, “Intelligent Agents,” *https://online.upr.edu*, Feb. 6, 2023. [Online]. Available:https://online.upr.edu/pluginfile.php/4927943/mod_resource/content/3/Chapter%202%20Video%202.pdf. [Accessed Mar. 5, 2025].

[2] M. Lynch, “Maximizing Efficiency: How AI Optimizes Environmental Performance,” *praxie.com*, June. 10, 2024. [Online]. Available:https://praxie.com/optimizing-environmental-performance-with-ai/ . [Accessed Mar. 3, 2025].

[3] Colorado State University Global, “How Does AI Actually Work?,” *csuglobal.edu*, 2019. [Online]. Available:How Does Artificial Intelligence Work? | CSU Global . [Accessed Mar. 3, 2025].

[4] Aimacode, “aimpa-python,” *github.com*, Feb. 1, 2016. [Online]. Available:https://github.com/aimacode/aima-python . [Accessed Mar. 3, 2025].