COMP9016 Assignment #1

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# Task Environment

The 2D world that has been implemented is a **fully observable** (i.e. we know the final state of the grid), **deterministic** (i.e. actions have predictable effect on state), **sequential** (actions affect future outcomes i.e. the location of the agent changes), **discrete** (i.e. it is turn based, time taken doesn’t matter) and **static** (i.e. the env does not change) 2D grid of configurable height and depth.

There is one “Winning” block in the grid. If the agent lands on the “Winning” block, they are awarded 100 points, the game is declared Won, and the game is over. The **goal-state** is that the **Agent location = the Winning square location**.

There are a random number of “Penalty” block in the game. If the agent lands on a “Penalty” block, they are penalised 50 points.

There is one Obstacle block in the game on to which the agent cannot move, and must navigate around.

The agent cannot move outside the boundaries of the grid.

They can move one square per move in any of “up”, “down”, “left” or “right”, provided that the above restrictions are met.

Each move has a cost associated with it, which is the sum of the x and y coordinates of the square.

The game is considered Lost if the agent has not found the Winning block in the number of steps allowed.

When the game starts, the all “Things” are positioned at random locations.

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# 1.1 Building Your World

## Agent Types and PEAS Descriptions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Performance | Environment | Actuators | Sensors |
| Random | +100 on winning block and Win game, -50 on penalty block, -(x+y) per move, Lose game if Winning block not found in S steps | 2D grid of width w and depth d, with winning block, penalty block and obstacle block. | Move (Up, Down, Left, Right) | Current position. Percepts are ignored. |
| Reflex | As above | As above | As above | Current position, receives percepts with available directions and associated costs (not including penalty block costs) |
| Table | As above | As above | As above | As per Reflex Agent. Decides movement based on internal table. |
| Goal | As above | As above | As above | As above. Decides movement based on heuristic. |

## Advantages/Disadvantages of the different agents

|  |  |  |
| --- | --- | --- |
|  | Advantages | Disadvantages |
| Random | Very fast Easy implementation Effective in small grids | non-rational Non optimised Scales badly |
| Reflex | Low computational overhead Rational  Performs better than Random | Poor performance in large grids  Inconsistent performance  Non optimised |
| Table | Makes informed decisions  Performs better in larger grids that the other agents | Requires computational overhead Optimal implementation is difficult, how to decide how to build the table?  No proper Search or Goal Based decisions |
| Goal | Finds the goal 80%+ of the time. Finds efficient path towards winning goal. Dependent on good heuristic. | 3x slower than a random agent. |

## Ability to perform

|  |  |
| --- | --- |
|  |  |
| Random (random\_move) | This produces very erratic results, and is impossible to characterise in any rational way. The more steps this agent is allowed, the higher likelihood it has of winning. Win rates of ~40% were common. |
| Reflex (cheapest\_move) | This agent always tends to move to (0,0) and oscillate between it and (1,0), as these are the cheapest moves in this game. If either happen to be a penalty square, the cost can be huge. If the Winning square is not between the original location of the agent and (0,0) then this agent will never win. Win rates of <20% were common for this agent. |
| Table (table\_action) | This agent moves in a predictable fashion, but it is down to chance as to whether the Winning square is within the set list of moves that this agent will make. Win rates of <15% were common for this agent. |
| Goal | Best agent for winning games, win rates of >80% were common. |

## Suitability to operate in worlds of varying sizes

To evaluate this, I ran 500 games per agent in worlds of 6x6, 9x9 and 12x12.

### Time

A graph of numbers and graphs

AI-generated content may be incorrect.

As grid size increases, all agents show rising average time, with the Goal Based Agent increasing the most—indicating a trade-off between performance and computational cost.

### % Games Won

A graph of a number of people

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The Goal Based Agent outperformed the others massively across all grid sizes. The other agents effectiveness declines sharply as grid size increases, highlighting the Goal Based Agents superior adaptability and strategic effectiveness.

### Cost/Performance

A graph of different colored bars

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Again the best performing agent was the Goal Based Agent. The agent’s heuristic consistently produced the most efficient path.

# 1.2 Searching Your World

## Problem Formulation

Formulate a well defined problem statement and identify a goal-state under which  
your game is complete. Why is this important to search? As part of your solution you  
should be including the initial state, the set of actions, the transition model, a goal test  
function and a path cost function.

## Uninformed Search Techniques

Select three uninformed search techniques and discuss their appropriateness to your  
world under appropriate headings for evaluating problem-solving performance. Im-  
plement the uninformed search techniques and discuss the results

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## Performance Evaluation

Write a clear and concise report detailing the search techniques performance in your agent-  
based game for the relevant agent types. The purpose of this is to articulate an understanding  
of the underlying concepts, and limitations, being implemented both from a theoretical and  
practical perspective.

# Conclusion

* Summarize key findings
* Reflect on agent suitability and search efficiency
* Suggest improvements or future work