# The Great Galactic Escape

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**Purpose and Overview**

It is interesting how a human makes decisions when thrown into an uncertain situation and asked to reach a specific goal. Typically, the human brain initially takes random paths and gradually learns from its experiences, which paths led him towards the goal. This behavior of the human brain is what we have replicated in our project, The Great Galactic Escape. Our agent starts at a specified location in the galaxy environment, traverses through certain planets (subgoals) to ultimately reach planet Earth (final goal) and attempt to stay away from the obstacles. Since the agent is not familiar with the environment, initially it chooses random paths. If it goes along the wrong path, it backtracks and tries another path. Thus, it learns from its experiences to take the near to optimal path to reach the goal, just the way a human brain does.

**Research Question**

This implementation follows uncertainty intelligence, particularly, Model Uncertainty. *Model uncertainty* is the agent's own lack of knowledge about the environment. For example, the agent is in a galaxy and has to choose between two paths: one of them leading to the planet. Before it takes that path, it cannot be certain whether the planet will be there or not. There is no environment uncertainty in this case, one of the paths led to the planet, and if you follow the same path twice, you'll get the same answer deterministically. The agent's uncertainty now stems from the fact that it has incomplete knowledge about the environment.

Our agent decides on the next path to follow either randomly or by applying the Familiarity Heuristics. The agent does a heuristic search i.e.; it selects the path that it is not familiar with, in order to detect and correct its own errors. For instance, there could be three paths that it can choose from, however in the previous two runs it has discovered that two out of those three paths do not lead it towards the goal, so during the third run it selects the path that is unfamiliar to it. The agent allows tries to deliberately explore new avenues.

Our implementation model also includes negative outcome learning. In this type of learning the agent learns from the negative feedback it gets because of the actions it chooses to take. For example, in this game, if the agent chooses the wrong path that does not lead towards the goal the distance between agent and goal increases, that is a negative feedback to the agent. Thus, every time the distance increases it knows that the path chosen is wrong. The agent then backtracks and deletes the link, which helps it to never follow that link in the future.

The indecisiveness and the uncertainty of the environment are what makes this game different from the other games out there. In this work, we have focused on the fore mentioned three concepts in cognitive science. (i) Model Uncertainty, (ii) Familiarity Heuristics and (iii) Negative feedback Learning.

**Model Description**

The environment for our agent is a galaxy which is simulated using a grid structure where every tile is a perspective position of the agent. It includes an agent spaceship, planets, Planet Earth and an alien spaceship. The figure 1 helps to understand the model better;

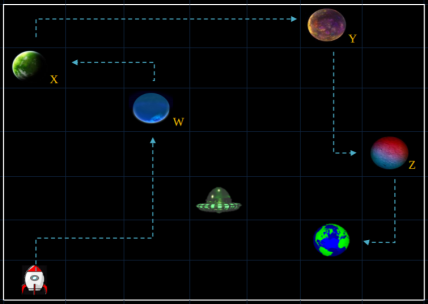


Figure 1. The space environment for the agent spaceship

The agent spaceship starts at a position P1 (bottom left corner of the grid) and traverses through the environment. The goal of the agent is to land on every planet on its way collect the token to the next planet and travel towards the next planet. The token to every planet resides on the planet before it and the first planet does not need a token. Thus, the agent also must traverse through the planets in a certain order specified.

Throughout the journey if the agent can get killed if it runs into the alien spaceship or if it runs out of fuel. In either case, the game is over. If the agent overcomes this obstacle and traverses through all the planets and reaches the planet Earth within the specified fuel, it wins.

Two approaches were used in this implementation, one is the Random Approach and the other is the Learning agent approach.

1. In the Random approach, the agent chooses any random path, hoping that it would lead towards the goal. It does not have knowledge about the previous paths it had chosen. There is also no learning in this approach, and it could so happen that agent runs around in loops, reaches the maximum number of steps and the game is over.
2. In the Learning agent approach, the agent chooses its first path randomly and then as it moves ahead it keeps track of the distance between the goal and its current and previous position. After taking a path and reaching a specific tile, if it finds that the distance has increased, it backtracks and deletes that link for the rest of the run. Thus, it learns that this path will not lead to the goal and so should not be considered in the future. This applies to the obstacle as well. If in any run the agent encounters the alien spaceship and dies, it deletes all the paths leading towards the alien spaceship so that the agent would never encounter the alien again and hence would not die. Thus, in this approach the agent reaches the goal within minimum number of steps over time.

**Conclusion**

The model satisfies the Model Uncertainty, since the agent does not know on which tile exactly does the planet or even the alien spaceship resides. Thus, it has incomplete knowledge about the environment. Using the Familiarity Heuristics, the agent learns about different paths faster and reaches the final goal in lesser number of steps over consequent runs as compared to the randomly selecting paths. As mentioned in the Learning agent approach, the agent deletes the wrong paths and the paths leading to the obstacle depending on the Negative Feedback it gets from its previous runs. Thus optimizing the model.

The complexity of the game can be increased or decreased by increasing or decreasing the number of planets, dangers and the grid environment dimensions.