

# F29AI Coursework 1 Part 3

Underwater Exploration

Hamza Mooraj - H00390746

## Domain

The domain file highlights the world of the agent in terms of predicates and actions. The predicates are statements that are either true or false, and they describe possible situations of the world. The actions are events that can take place or that the agent can perform that would change the world (by changing the truth of predicates).

The predicates I've defined outline the following about the world:

- For a Location:
  - It can be land, shallow or deep. Shallow and deep locations are typed to be water to avoid confusion. It can be tagged as marine protected or kraken housing, which can prevent or allow actions from taking place in that location. Considering this is a grid-based world with no diagonal movements, a predicate to ensure two locations are adjacent to one another is necessary for some actions
- For a Submarine:
  - A submarine in this world is the only form of transport/movement. Since there can be multiple submarines and predicates for submarines apply to separate submarines, typing a submarine would be beneficial. A submarine has a water location at all times, so I made a predicate for a submarine and its location. The submarine can have a pilot and a crew on board, and there is one cargo space on a submarine that is either used up by a kit (false), or is empty (true). Finally, a submarine has a shield that can be active or not.
- For the Command Centre and Research Bases:
  - A few actions can be performed at either a Command Centre or a Research Base. To keep the domain simple, I typed a base, and made sub-types of a command centre and research base. Each base has a location. This is predicated with arguments to define the base (a Command Centre or one of the Research Bases).
- For the Personnel:
  - Personnel is typed to be a pilot or crew. The crew have sub-types of scientists and engineers. A pilot and a crew have specific locations that remain untyped, as it can be a submarine or a base. An argument to specify which pilot/crew we are talking about is present.
- Scanning related predicates:
  - A location can be Subsea Surveyed or Research Scanned. Subsea Surveys mark a location surveyed and a construction zone. The 'no construction in a marine protected location' rule is upheld by assuring the marine protected predicate is false in certain actions. Research Scans mark a location as scanned and produce research. The research can be located on a submarine or a base (which is typed as a research base); These conditions are separated by two predicates. A predicate for research of a location being analysed is present as well.
- Kits:
  - A kit can either be a Structure Kit or a Cable Kit. Since some actions apply to both kits, I created a canopy type, 'kit', with the above as sub-types. Like research, a kit can either be in the submarine or a command centre. However, since there is only one Command Centre, if the kit is located in the command centre, then there is only need to know which kit we are talking about, so that predicate only has an argument for kit. Structure kits are unavailable after use, so a predicate to define a kit as used was necessary.
- Generators and Cables:
  - Generator's and Cable's locations are needed to be able to construct one another and a research base. So a predicated confirming if a generator or cable is on location is needed
- Different Stuff:
  - Some actions require two different objects of the same type. For example, two different submarines, two different kits and two different research bases. A predicate to define the difference between two of each of these objects is made so that an action that requires two submarines is not defined as completed with submarine 1 in both places.
- Additional:
  - Two additional predicates are defined to confirm whether the krakens are confused, which is true when a sonar array is switched on. These do not have any arguments since they could be seen as "worldly" predicates.

The actions that can be performed by the agent are listed as below:

- A submarine can move normally through the water if there is a pilot on board, and the locations of travel are not kraken housing.
- If they are kraken housing then the submarine requires a shield, or for the kraken to be confused.
- All personnel start in the Command Centre and need to be present on a submarine, or need to be moved between bases. This is defined using four different actions:
  - Moving a pilot to a base from a submarine, and a submarine from a base
  - Moving a crew member to a base from a submarine and to a submarine from a base
- The shield on a submarine can be activated and deactivated.
- A submarine can perform a subsea survey
- A submarine can perform a research scan if they have a scientist on board
- A kit can be loaded onto a submarine from a command centre by an engineer
- A kit can be unloaded from a submarine on a command centre by an engineer.
- A generator can be constructed if there is an engineer and structure kit on board. It cannot be built on a marine protected location, and the location needs to have been subsea surveyed.
- A cable can be installed with the same conditions as the construction of a generator, except a cable kit rather than a structure kit.
- A research base can be constructed with the same conditions as the construction of a generator, however, two separate submarines are needed, with engineers and structure kits in both subs.  
Another condition
- Research on a location collected from a research scan can be sent to a research base.
- The research can be analysed provided there is a scientist situated in the research base.
- A sonar array can be activated if there are two research bases constructed in the world.

# Problems

I created 4 problems that each make use of every action defined in the domain. They are all based off a 3x3 grid with different configurations. There is at least 1 kraken house and 1 marine protected area in each problem. The Command Centre is pre-defined in the initial block of the problem, and all submarines, personnel and kits are located in the Command Centre/on its location.

## Problem 1

3

2

1

Deep Kraken	Shallow	Land	1
Deep	Command Centre	Land	2
Deep	Marine Protected	Land	3

Problem

3

2

1

Deep Kraken	Shallow Generator	Land	1
Deep Research Base	Cable Shallow Command Centre	Cable Land	2
Deep	Shallow Marine Protected	Land	3

Goal

**Goal:** Generator at (2,1) & Cable at (2,2) and (3,2) & Research Base at (3,2).

## Problem 2

3

2

1

Deep Kraken	Deep	Shallow Command Centre	1
Shallow	Shallow	Land	2
Deep	Shallow Marine Protected	Shallow	3

Problem

3

2

1

Deep Kraken	Deep	Shallow Command Centre	1
Shallow Cable	Shallow Generator	Land	2
Deep Research Base	Cable Shallow Marine Protected	Shallow Research	3

Goal

**Goal:** Generator at (2,2) & Cable at (3,2) and (3,3) & Research Base at (3,3) & Location Researched (2,3) & Research Analysed

## Problem 3

3

2

1

Deep Kraken	Shallow Command Centre	Land	1
Deep Kraken	Deep	Shallow	2
Deep	Deep Marine Protected	Deep	3

Problem

3

2

1

Deep Kraken	Shallow Command Centre	Land	1
Deep Kraken	Deep Research Base	Cable Shallow Generator	2
Deep	Deep Marine Protected	Deep Cable Research Base	3

Goal

**Goal:** Generator at (1,2) & Cable at (2,2) and (1,3) & Research Base at (2,2) and (1,3) & Sonar Activated & Submarine 3 at Location (3,2) & NOT Submarine 3 Shield Activated

Problem 4

	3	2	1	
	Deep	Deep	Shallow	
	Marine Protected	Kraken	Command Centre	1
	Deep	Deep Cable	Land	2
	Deep	Deep	Shallow Cable	3
		Kraken		

**Goal:** Submarine 2 at Location (3,1) & NOT Submarine 2 Shield Activated