**COM526 Introduction to AI**

**AE1 Portfolio Report**

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**Introduction**

COM456 Introduction to AI Portfolio Assignment is an opportunity to put what is learnt into action through a collection of activities, making use of skills gained along the way such as critical thinking and problem solving. The portfolio will be covering different topics completed from week one of the module through to week 5, it will also highlight the different aspects learnt in class such as **theory**, **AI concepts**, **design of algorithms**, and **completing simple problems using AI techniques**. Each week will be slightly different ranging from pictures used to demonstrate understanding to diagrams sourced or created, or simply a worded explanation sourced from reliable resources. Each week will be systematically documented in such a way that will allow anyone to open it at any time and find what it is they are looking for.

# **WEEK 1 ACTIVITIES**

## 1) Define in your own words the following terms in relation to AI and intelligent agents:

1. Turing test: A test developed by Alan Turning to define intelligence. The test involves three parties on computer, a human, and the interrogator, to pass the computer must fool the interrogator in thinking that it is a human. The Turing test on a basic level would essentially tests if the computer is able to perform these four “skills” as stated in (Russell & Norvig, 2016)

Natural Language Processing

Knowledge Representation

Automated Reasoning

Machine Learning

b) Rational act: For an Agent, acting rationally is the process of using given knowledge and facts to move forward reaching either the best outcome or best expected outcome based on one’s goals.(Russell & Norvig, 2016)

c) Agent: An agent is something that can produce an effect through actions, computer agents execute actions to achieve results such as operate autonomously, perceive their environment, persist over a prolonged time period, adapt, and pursue defined goals.(Russell & Norvig, 2016)

d) Agent function: The function of an agent is to act for the user or other program to complete a pre-defined goal.(Russell & Norvig, 2016)

e) Environment: The environment for an agent would be anything that the agent is able to perceive through sensors. Environment is the task provided before a given agent, environments come in all types, some are more difficult for agents than others.

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This is best shown in a figure taken from “**Artificial Intelligence: A Modern Approach**”

(Russell & Norvig, 2016)

f) Percept: The inputs received by the agent through sensors from ones surrounding environment.(Russell & Norvig, 2016)

g) Action: after a solution is found the execution phase will commence in which the agent will make use of its solution to help guide its actions. An agent’s actions are generally not just one single action if the environment is known but instead a map. (Russell & Norvig, 2016)

## 2) General AI vs Narrow AI

Some computer algorithms are capable of mimicking human intelligence, to reason and solve problems on their own, and to apply previously acquired knowledge on completely new types of problems.

Which category or domain do these algorithms fall into? Choose A or B below and explain your choice in a paragraph.

A. Artificial Narrow Intelligence (Narrow AI)

B. Artificial General Intelligence (General AI)

**Option B (General AI)**: I have chosen option B (General AI), as general AI can solve multiple types of problems (even ones it has never seen before) whether it’s with previously acquired knowledge or newly provided information. Narrow AI on the other hand is specific to its field, as stated in the question if a narrow AI agent were to be given a new type of problem to what it is used to it would not be able to solve it.(Monett, et al., 2020)(Wang, 2019)

# **WEEK 2 ACTIVITIES**

## Machine Learning, a sub-field of AI, can be achieved using different approaches. Describe the concept of

Base Example: A Child (toddler) meets a kitten for the first time. The child doesn’t know what it is called and there are three different ways the child could learn the name of this animal. This example I read from “Artificial intelligence for marketing: practical applications”

1. **Unsupervised learning and provide one example**: Unsupervised learning is when a machine is given a cluster of data that has not been classified or labelled in anyway by humans to analyse and find patterns or data groupings without any human intervention. Applications of these could be exploiting data, cross selling strategies, image recognition. If we make use of the base example, we can use Unsupervised learning for the child to learn the name of the animal. With Unsupervised learning the child will have to be alone to figure things out by itself, it may not get the correct answers, but it will learn more and more about the thing it is trying to figure out (such as cats will meow and dogs will bark).(Russell & Norvig, 2016)
2. **Supervised learning and provide one example:** Supervised learning is a (machine learning) task in which the machine is given training data which has been labelled for a specific output and the algorithm will have to analyse and learn the patterns that lead the input data to the desired output so that it will be able to yield similar/same results when given a data set it has never seen before. If we make use of the base example, we can use Supervised learning to teach the child the name of the kitten. Simply point to it repeating a few dozen times the word “kitty”. Supervised learning would be you Pointing at the kitten and calling it a “kitty” (given the child a labelled example).(Russell & Norvig, 2016)
3. **Reinforcement learning and provide one example:** Reinforcement Learning is essentially a system to allow the machine to self-learn, it works by giving “rewards” for doing correct things and “punishments” for doing the incorrect things which trains the robot or machine to know what to do as it wants to achieve “rewards”. If we make use of the base example, we can use Reinforcement learning to teach the child the name of the kitten. Simply correct the child when they mistake the kitten for something other than what it is and praise the child when they get the name correct.(Russell & Norvig, 2016)

## Types of Problems Solved Using Artificial Intelligence

**Different Artificial Intelligence algorithms can be used to solve a category of problems. Differentiate between classification, regression and clustering problems and name some algorithms that can be used to solve each type of problem.**

**Classification**: Predictive problem in which it would predict the class label for any given example data

**Regression**: Predictive model in which it would predict a relationship between two variables

**Clustering**: Predictive model which divides the data into groups (clusters), It will split data in a specific way that the points within single clusters will become very similar and points in different clusters will be very different (groups unlabelled data)

Classification is a predictive model which attempts to apply class labels on given example data for example an email (in Gmail) can be labelled as one of three “Primary”, “Promotions”, “Updates”. Regression on the other hand is a predictive model which will generate a continuous quantity, it will predict a discrete value in an integer while classification predictive model is a probability for a class label.

Clustering is like Classification in a way that it groups the given example data, but it differs here as it groups them into unlabelled clusters (groups) and ensures that each point/item in the cluster are very similar and the points in other clusters are different. Clustering uses unsupervised learning to function. (Sterne, 2017)

## Classify the problems below as classification or regression.

**Regression**

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Graphical user interface, text, application

Description automatically generated**Classification**

Graphical user interface, text, application

Description automatically generated**Classification**

Graphical user interface, text, application

Description automatically generated**Regression**

**Classification**

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**Classification**

**Graphical user interface, text, application

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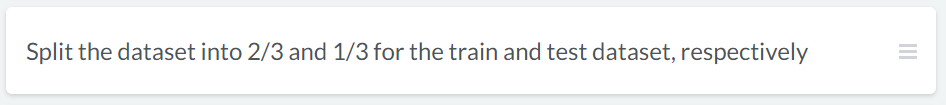
(Sterne, 2017)

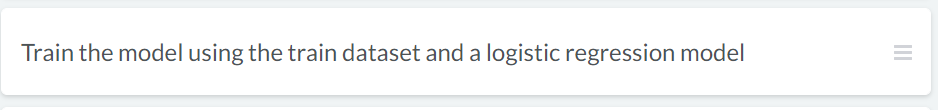
## Steps for building a model

**Correctly order the tasks.**

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## Explain in your own words what is Robotic Process Automation. What are the major differences between RPA and Macros?

**RPA (Robotic Process Automation):** This is a software process in which you get an automated specialised computer program using rule-based software to perform tasks that are extremely repetitive, this is used to improve the quality of business. (Newman & Blanchard, 2019)

**Differences between RPA and Macros:**

Macros compared to RPA have a limited range on what they can automate as it is difficult to connect them with other products that what they are built with (outside Microsoft Office).

Macros require a certain level of programming knowledge to create in contrast to RPA requiring almost nothing to use.

RPA can obtain knowledge over time from their procedures while Macros are unable to as they only perform quick simple tasks (programmed by you likely).

(Newman & Blanchard, 2019)

# **WEEK 3 ACTIVITIES**

## What are search algorithms and why are they important in the field of AI? Provide some examples where they could be beneficial.

Search algorithms are a sequence of instructions given to the program to help it efficiently find whatever it is the programmer/user wants. Search algorithms in AI is the method of going from the starting state to the goal state and creating a solution after its done.

When agents are built to act rationally, they are more than likely making use of a kind of search algorithm in the background to create a solution for their problem. Search algorithms are so crucial to allow AI to make decisions especially when there are many outcomes such as in games.(Russell & Norvig, 2016)

## Watch the video A\* Search Algorithm on YouTube:

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**(Screenshot of video)**

1. **In a short paragraph, describe what A\* (star) search means (try to use terms such as nodes, goal, cost (least distance, shortest time) and heuristics).**

A\* algorithm is a path finding algorithm which consists of Nodes, Edges (weighted and unweighted), and a (open) set. It follows the algorithm F(n) (addition of G and H) = G(n) (being the current shortest distance) + H(n) (being the estimate of distance to end) and “n” is the previous node, with this formula the algorithm takes into consideration all the variables (including cost) to find the best path from the starting node and work its way to the end node.

(GeeksforGeeks, 2017)

1. **Find the best path for the following problem.**

You need to find the shortest path between S and G by performing the A\* Algorithm on the following figure. You should follow the same approach as in the video or lecture notes and show your calculations/diagrams. Explicitly write down the queue at each step.

S: Start

G: Goal

A picture containing clock

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Table

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**Best path: ACG**

**Total cost: 4**

# **WEEK 4 ACTIVITIES**

## Explain the difference in a short paragraph between

1. **Uninformed and Informed search algorithms (provide some examples)**
   1. Uninformed Search Algorithms are algorithms that have not been provided with any pre-defined information of any sort about the problem (apart from its definition), these algorithms can generally solve any solvable problem but may struggle and be much less efficient. Informed Search Algorithms are efficient as they are given some guidance helping them reach the solutions. (Russell & Norvig, 2016)
   2. Uninformed Search Algorithms: Depth First Search, Breadth-First Search(Russell & Norvig, 2016)
   3. Informed Search Algorithms: Greedy Search, A\* Search, Graph Search(Russell & Norvig, 2016)

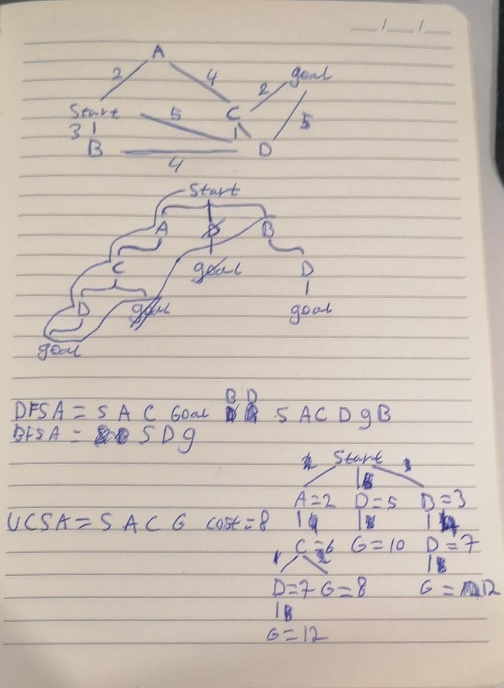
1. **TREE-SEARCH and GRAPH-SEARCH**

Compared to Tree Search, Graph Search will allow for a state to occur once in the whole graph (each state is unique). In a graph there is more than one path or move sequence that can be utilised to get from one state to another, compared to Tree Search which only allows for one path between vertices, additionally moves made in a graph search can also be undone, due to this Tree Search is unable to have more than a singular path to the **goal**, instead, the path to the **goal** state is much clearer although it may appear more than once in the whole tree.

Finally, graphs, unlike trees, contain both vertices and edges, both are used to help reach the **goal** state, and because of this, there are two types of graphs, **directed** and **undirected** which influence how we reach the **goal** state.

## For each of the following search strategies, work out the path returned by the search algorithm on the graph shown below.

1. Depth-first search algorithm.
2. Breadth-first search algorithm.
3. Uniform cost search algorithm.



Diagram, schematic

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Answers (Solution returned):

1. Depth-first search> Solution is \_\_\_Start, A, C, D, Goal, B\_
2. Breadth-first search> Solution is \_\_\_Start, D, Goal\_
3. Uniform cost search> Solution is \_\_\_Start, A, C, Goal - Cost = 8\_

# **WEEK 5 ACTIVITIES**

## Describe redundant paths in TREE-SEARCH and explain how we can avoid them?

Redundant paths are what is known as loops in the Search Tree, loops occur when the tree visits a node that ends up visiting itself later down the path causing it to repeat.

## One strategy to solve Constraint Satisfaction Problems is the backtracking approach. Describe its main steps in a few lines.

Backtracking search is an uninformed algorithm utilised to solve CSPs. Backtracking picks one variable at a time and assigns it and then continues down the tree considering only values which do not conflict with the previously assigned variables. If the search reaches a dead end or a conflict it will backtrack up until it finds a variable that can have its value changed. If it goes all the way up to the start (root) this means No solution.(Russell & Norvig, 2016)

## Consider the following scenario

**The classes are:**

1. Class 1 - Programming: meets from 8:00-9:00am

2. Class 2 - Artificial Intelligence: meets from 8:30-9:30am

3. Class 3 – Machine Learning: meets from 9:00-10:00am

4. Class 4 - Computer Vision: meets from 9:00-10:00am

**The professors are:**

1. Professor A, who is qualified to teach Classes 1 and 2.

2. Professor B, who is qualified to teach Classes 3 and 4.

3. Professor C, who is qualified to teach Classes 1, 3, and 4.

|  |  |  |
| --- | --- | --- |
| Variables | Domains | Binary Constraints |
| C1 | {A, C} | C1 ≠ C2 |
| C2 | {A} | C2 ≠ C1 |
| C3 | {B, C} | C3 ≠ C4 |
| C4 | {B, C} | C4 ≠ C3 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C1 | C2 | C3 | C4 |
| Initial | {A, C} | {A} | {B, C} | {B, C} |
| C1 as C | C | {A} | {B, C} | {B, C} |
| C2 as A | C | A | {B, C} | {B, C} |
| C3 as B | C | A | B | {B, C} |
| C4 as C | **C** | **A** | **B** | **C** |
|  | **Answer above** | | | |

## Read on “Responsible AI” practices and write a short paragraph to explain why developing a framework is important.

Developing a framework for responsible AI is important as it gives researchers, developers or anyone involved a clear picture of what a functional competent AI will look like that also is responsible and can be trusted. AI have many responsibilities that need to be followed for instance legal responsibilities which requires the AI to perform in a manner that aligns with government and law. Developing a framework can also be used in aiding discussions for AI ethics, for instance it could give the people an opportunity of intervening in the systems allowing them to contest their results to clearly define a line of accountability and responsibility. (Neff, 2020) (Cheng, Varshney, & Liu , 2021)

**Total Words in Document: 1950**

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