FIT3036 COMPUTER SCIENCE PROJECT

Computers Doing IQ Tests, and Pick the ‘Odd One Out’

Project Workbook

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Week 1 Journal

I got introduced to 4 projects to choose for the whole semester. I am interested in project1 which is the design of keyboards and other interfaces for user with reduced capacity. Started thinking several ideas or solution about the projects including:

- Increase the usability and functionality of sticky keys
- Create a program to predict the word based on the first 2 or 3 letters typed
- Install the definition for each special character that can be typed without holding the shift
- Install additional functionality in keyboard if particular mode is turned on, for example a shortcut to frequently used word in several key like "[" represent "the", and the mode can be switched on and off easily.

In addition, I decided to use Python programming language for the program implementation. Started researching what the advantageous and disadvantageous of python in terms of this project requirements and scope. Comparing the supported library and modules with other programming languages to help implement the keyboard support program. The other optional programming language are Java and C++.

Week 2 Journal

After thinking and comparing the project options for the whole week, I decided to choose Project3 about computer program solves IQ test more interesting. Hence, I decided to start researching about the topic and find possibilities that an AI can do to solve IQ test.

The results of gathering requirements are as follow:

- Create an AI program that actually able to read IQ question, understand it, and solve it
- However, an algorithm to solve questions related to picture is really complex. Hence, I discard the idea to solve picture questions

During the tutorial, I also told to start researching for the topic alongside to practice to get the references format correctly. Hence, I start to find some journal articles and thesis writing about Artificial Intelligence in general and the types of IQ questions that typically can be found in IQ test.

I also have decided to use APA 6th edition as my reference format with the help of EndNoteX8 tool.

The results of references I found are:

- Information about the type of IQ question from IQ tests book

Week 3 Journal

This week, I read the references given in the project introduction about Computer program capable of passing IQ test in conference proceedings and computer models solving intelligence test problem journal article.

Based on these references, I added some program requirements that I want to implement in the program. These additional requirements are:

- The program can solve IQ questions for several types. The types includes insert missing numbers and letters (sequences), and directions.

The problem solving techniques for missing numbers sequences is quite straightforward and simple just like mentioned in the computer program capable passing IQ references. The method consist of trying all functions into the sequence until it got the function right. Assuming that the question is not hard for human to solve, the program can handle most of the question covering all common mathematical sequence function.

The technique for direction is using x and y axis distance. First the program need to distinguish the distance for each direction in the question. Then the program would update the current position of x and y axis for each direction. Finally, after the last direction, the distance can be calculated by using Pythagoras function.

Furthermore, I tried to search more effective way to solve number sequences by using more complicated function with the result of faster, more accurate, and heuristic calculation. The results of my research includes:

- Applying programming to solve number series problems writing
- Spatial IQ test for AI thesis

The results of my research did not satisfy my expectation. I am thinking that in order to successfully predict the next number of the sequence accurately for all type of sequences without hardcoding each function to check, I should find a technique to predict the function of the visible sequence. I tried searching several research such as non-linear regression, and Taylor series. However, I did not find any results to get the formula that I need. Therefore, I will put the normal technique as my main requirement for the project plan. Nonetheless, I can use some of the techniques and formula in the references I searched to help with my algorithm concept.

I also start to make a target and milestone to start the project specification from next week and finish the project specification by the mid semester break.

Week 4 Journal

Based on my further research for the project, I have discovered the simplicity of directions algorithm regarding directions question in IQ tests. The breakthrough is referred in the references listed in the project guide under the name of Computer Program Capable of Passing IQ Test. The solution is to represent the x-axis and y-axis of the directions and update the axis every direction is entered. Finally after the final directions is updated, the distance can be calculated by simple trigonometry function. Hence, I have decided to put the directions problem into the main requirements.

I have also been thinking to solve the odd one out with automated algorithm or heuristic algorithm. However, no concrete solution that can solve the problem successfully come up. There are indeed some plausible algorithm and solution that might solve the problem in general but the cost of time and effort to apply it into programming sense is too abstract or complicated. The solutions can be explained as follows:

- Categorizing words so that the program can see the differences between words fast. However, the complications are the development of category of English words is too diverse and too taxing to develop the whole database of category. Moreover, there are some English words that might too abstract to categorize it in one category only. For example, mercury might refer to chemical substance and planet name. Father can be considered in family category as well as organic, human category as well. This problem might overlap with each other and have a possibility of cases which the program has a hard time to solve a tricky questions.
- The reinforcement learning of artificial intelligence is a solution with completeness in its solution. In other words, the machine learning can solve pretty much all the questions if the program has learned most of the English words. However, the technique or algorithm to solve the odd one out problem have not yet discovered. The problem is the algorithm might be too complicated for this project to be completed in limited time.

No progress of project specification and code have been made this week.

Future Plans:

Start to create the project specifications based on the results of the research these past weeks. Determined the scope of the project, thinking the outline design of the program, and generate the scheduled time for the project.

Week 5 Journal

Progress Made:

I have started to do the project specification. This week I have finished the introduction, functional and non-functional requirements in the project specification. I also decided to use missing numbers and letters sequences, directions, and odd one out for the main requirements of the program.

Note:

Reviewing the methodologies I have researched past weeks and choose the suitable method to be implemented for the project. In the end, I choose the reinforcement learning techniques for the odd one out problem. I have been analyzing and testing theoretically for the reinforcement learning to be worked out under the odd one out problem. The result was quite promising in terms handling odd one out problem under several constraints and scope limitations such as handling English words only, and must be given a feedback to the machine in order for it to learn the words. In other words, the limitations is the machine must know every right answers of the questions in its learning process.

The simple pattern prediction for number sequences by using a lot of references from mathematical functions will be used in solving number sequences problem. Additionally, simple algorithm of updating x and y axis will be used to solve the direction problem as well. Hence, these three method of algorithm will be used as the project scope and main requirements in project specifications.

Future Plans:

The plans for next week is to finish the project specification as much as possible before the week 6 starts. Hence, I need to make most of my progress in mid semester break. The remaining parts of project specification that needs to be finished by the start of week 6 are expected to be at least the requirements, scope and time plan, schedule, risk table, and software design.

Week 6 Journal

Progress Made:

By the end of the Thursday, I have completed the project specification for computer solving IQ test project. In the end, my final decision for the project specifications would be using number sequences, letter sequences, direction, and odd one out problems. In addition, the final program would have a simple GUI and able to recognize the questions type by parsing the questions words. An executable program will be made as well as part of the requirement if possible.

Note:

Take consideration about the software architecture design pattern for the program to make the software flexible, extendable, and have a good dependency. Model-View-Controller (MVC) design pattern is a basic design pattern that can be use in the program to allow the program flexibility by separating model, view, and controller into separate classes. Adapter pattern can also be used to solve problem of generalizing the data from different classes in this case is the agent class.

Future Work:

Start to design the program architecture both on paper and practice. Research the additional external library that would be required for the project requirement such as the GUI and external libraries related to the algorithm processing. Start to implementing the program main requirements, the first plan is to implement the number sequences problem. In addition, experimenting the odd one out methodologies in practice with small test case to prove the algorithm completeness and validity.

Week 7 Journal

Progress Made:

The implementation of number sequences problem is started and can handle several simple pattern recognition. The result of experimenting the feasibility of odd one out techniques stated in project specifications show a good results. Hence, I am keeping the odd one out problem requirements for this project.

The design pattern that is decided to be implemented in the program is model and view pattern but without controller as the current requirement of the program does not need to have a lot of user interaction and interface elements.

Note:

Discuss about test plan in detail at tutorial. The ideal test plan should at least include unit test plan and system test plan. In addition, make sure to include enough test cases for both boundary and unique cases with just reasonable amount of test cases.

Reminding the preparation for the presentation regarding the preparedness and technical difficulties during the presentation day.

Future Plans:

Resuming the implementation of number agent which handles the number sequences questions. Right now it can only handle some simple sequence of number such as fibonnaci, multiplication and addition. The plan is to implement more sophisticated algorithm to solve more complex sequences. Currently the sequences cases in plan includes the power sequence, prime numbers, and unique different additions sequence.

Week 8 Journal

Progress Made:

The implementation of number sequences has progressed smoothly without problem. The pattern recognition has increased with more complicated pattern such as power sequences, prime number, and unique sequences. The odd one out agent is implemented in the program as well. The program has successfully solve a sample IQ test given that the agent has learned the IQ test hundreds of times. In addition, the program can also solve country names in the world based on continents category. The country questions is randomly generated based on the category.

Note:

Discussion in tutorial is about reminding the references completeness regarding about the penalties in project specification and project report.

Latex program is recommended for preparing the project report especially in references part. I will take consideration and research about Latex later on to be used in final report.

Future Plans:

In order for further testing, the plan of creating other categories of countries other than continents should be made. The reason is to test the integrity and algorithm completeness of reinforcement learning when the program undertake different similar categories which can be tricky questions. Generate and research more sample test cases for odd one out program in order for the program to learn more category. The next plan of the sample test cases to learn is about animals but not necessarily to be a complete sample cases. Reasonable amount of common animals name is enough.

Week 9 Journal

Progress Made:

The testing of odd one out problem learning country names with different categories has proved the algorithm completeness. The program has undertaken the learning of both continent and region category. Then, the program show the satisfying results from questions of both category as well. The idea creation of new sample test cases is abandoned to prevent the risk of time overrun since generating the new sample test cases of animals and its category needs a significant effort and time.

Note:

Starting to take a preparation and note about the presentation plan and slides. Since I choose the week 11 as my first preference, I need to take a note and make sure that the program is at least executables and has a proper GUI before the presentation day. Most importantly, I need to speed up the testing process of the program, especially the odd one out problem with boundary testing because I am planning to use the problem for my demonstration.

Future Plans:

Start to implement the direction agent.

Perfect the questions recognition algorithm based on current state of the program.

Further testing of odd one out agent and researching new arithmetic and geometric sequences

Week 10 Journal

Progress Made:

Presentation of the project is done.

The program has completed a proper basic GUI and odd one out agent has undergone most of the testing process. The agent for questions parser or recognition is also been perfected up to the point the program can recognize most of the common questions pattern.

Note:

Since I have finish and tested most of my program functionality and main requirements. I will try to limit the new implementation of feature into the program to prevent the risk of time overrun or unfinished implementation. Therefore, generating plans of testing in order to fix the performance and the bug of the program along might be the last iteration of the project.

Future Plans:

Revise the test plan created from the project specification and generate the detailed test plan and test report of the program. Unit testing, system testing, and interface testing would be the main content of the test report.

Starting the final report of the project by outlining the important content of the report and plan the report structure and the content needed for the project.

Week 11 Journal

Progress Made:

Unfortunately, no significant progress has been made up to this point. Due to other assignments and works, there is no progress in both final report, and testing report. The only completed progress are the idea of how the testing will be done and the abstract section of the final report.

Future Plans:

Creation of detailed timetable for creating final report and testing report in addition with testing stage of the program. The timetable should prevent any time overrun of the final submission deadline. Therefore, the timetable plan needs to be finished by at least 8 hours before the deadline.

Creation of custom class as a testing tool to test the both unit and system functionality in the testing stage is considered to be important. Therefore, the next plan would be an implementation of testing class to test the odd one out agent behavior and efficiency under large inputs.

Week 12 Journal

Progress Made

Final report has progressed smoothly according to plan. The progress completed are the introduction, background, and the methodology part of the final report. In addition, the test report is also completed for both unit testing and system testing.

The program has undergone several additional testing due to the discovery of bugs and error during the testing phase when creating the test report. However, the program known bugs and error has been completely fixed.

The custom testing class successfully implemented and tested with odd one out agent. The statistics and results of the test also been collected but the experimental statistics is not used yet for analyzing the machine characteristics.

Note:

There are several days left before the due date of the final submission. Hence, the rest of the unfinished reports and in code documentation needs to be finished before the due date. Ideally, all the reports and code need to be finished 8 hours before the deadline according to the plan.