PROJECT BRIEF (WIA2005 - Algorithm Analysis and Design)

University/Programme/Course: University of Malaya/Bachelor of Computer Science/Algorithm Analysis and Design

Year: 2nd year / 4th semester

Pedagogical Approach: Project-based Learning and Design Thinking.

Learning Outcome:

Experience analysing and designing algorithms for problem solving with other team mates.

a. Utilise the chosen tools

b. Apply algorithms to solve the given problems

c. Execute the computer program while explaining the relation between steps in algorithms with the behaviour/output of the computer program.

d. Analyse the complexity main algorithms that solve the given problem.

e. Function effectively as a team member.

f. Communicate effectively through reports and presentation.

Objective:

This project requires you and your team mates to analyse, design, and code a computer program using Python and the chosen tools to solve the given problems.

Project Scope:

To meet the project requirement, you will need to:

- ✓ Form a work team of 5-6 members.
- ✓ Elect a team representative, write contract item and sign using the group contract.
- ✓ Identify clear roles and responsibilities, distributing and coordinating various tasks appropriately, and able to operate as a high performing team. You must clearly communicate how you have worked as a team.
- ✓ Analyse, design, and code a computer program using Python and the chosen tools to solve the given problems as the following:-

Project Instructions:

(PART 1) Understand

Brainstorm the ideas with the group based on how to solve the problem given in the story of "Adventures of Algo Jones" below. For each part problem, discuss and record the possible approaches to the problem.

(PART 2) Discover, Define and Ideate

For each part problem, describe the algorithm, write the pseudocode, state the running time complexity and discuss the advantages and limitations, or possible modification for the possible solutions. Select the best solution and justify your choice.

(PART 3) Prototype and Evaluation

For each part problem, code a code a computer program using Python according to the selected best solution's pseudocode define in Part 2 to solve the given problems.

Week 11-12: The student must do a 30-minute presentation and demonstration of program.

Report Submission:
Week 14: One final submission to the Teams.

- Source code: Python files (Recommended: Use Google Collab)
- Report Content:
    1. Introduction.
    2. Solution to Part 1-6
        a. Description/discussion
        b. Pseudocode
        c. Running time complexity
        d. The program code (related algorithm implementation) and snapshots of input/output.
    3. Conclusion – Part 7 (Be creative!)
    4. Group contract and progress reporting using FILA form.
    5. References.

The Adventure of Algo Jones

Part 1: Finding the Golden Statue of Bastet

Algo Jones is an archaeologist, who goes around the world looking for missing treasures. His latest project brought him to Egypt, to look for the Golden Statue of Bastet, said to be hidden in a chest in one of the chambers in the Pyramid of Khufu. The pyramid contains many chambers and the floor plan (marked with grid numbers), look like the following (Figure 1). Entrance is located in chamber 1.

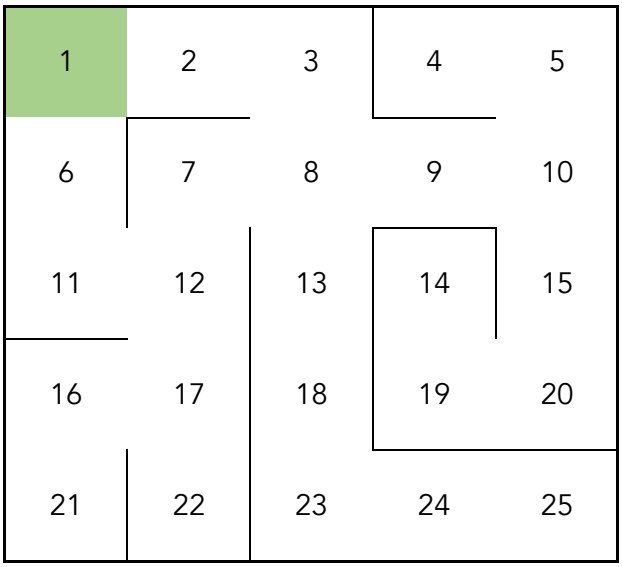


Figure 1: Floor plan of chambers in the Pyramid of Khufu

Problem:
How to search all the chambers without missing any areas?

Part 2: Cracking the chest lock code

Algo Jones finally found the chest in chamber marked 14 in the floor plan. The chest contains a lock that requires a 3-digit number combination (Figure 2).

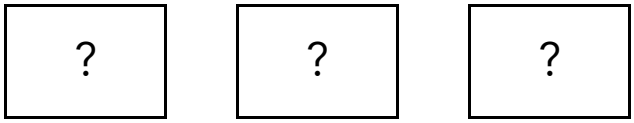


Figure 2: 3-digit number combination for the lock

Problem:
What are the possible number combination for the lock?

Part 3: Choosing the treasures

Algo Jones have 120 possible 3-digit lock combination to try, but fortunately, he manages to open the lock on his 20th try. He found several treasure items in the chest and a couple of letters. He was carrying a bag but he knows he could not fit all of the treasures in his bag which can only carry up to 10kg, but he must choose the most precious one first and come back for the rest later. After evaluating all the items, he came out with an assessment list for all the items (Table 1).

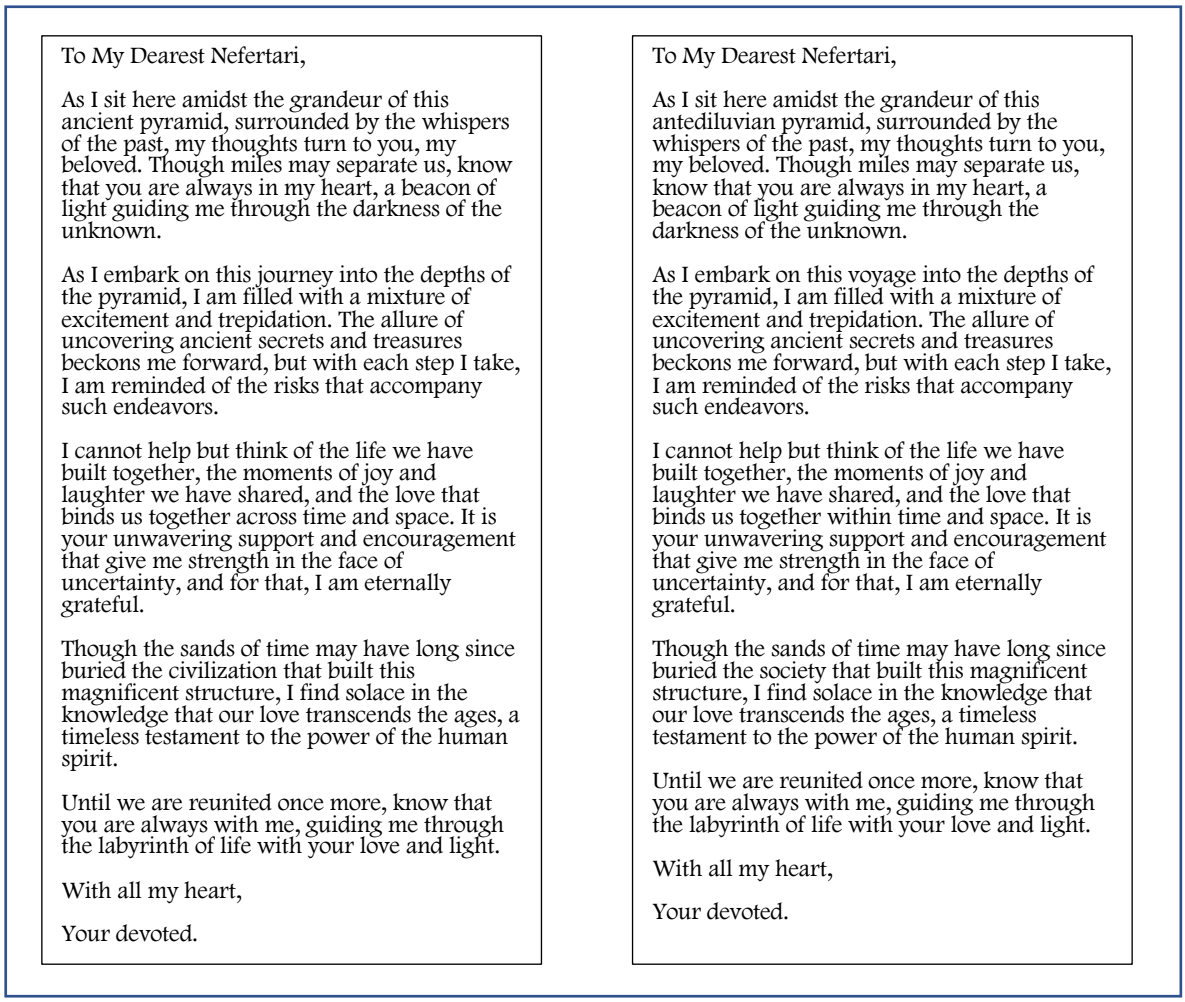
Items	Description	Value	Weight
Sceptre of Eternal Power	A jewelled sceptre adorned with rare gems, said to grant its wielder unimaginable power and authority over life and death. Legends claim it was used by the ancient pharaohs to command the forces of nature and control the destiny of nations.	Priceless	5kg
The Eye of Horus Pendant	A golden pendant in the shape of the Eye of Horus, crafted with intricate hieroglyphics and encrusted with precious stones. It is rumoured to possess protective powers, granting its wearer visions of the future and safeguarding them from harm.	$2 Million	0.5kg
The Ankh of Immortality	A shimmering ankh symbol made of pure silver, believed to hold the secret to eternal life. According to myth, those who possess it can defy death itself and enjoy everlasting youth and vitality.	$5 Million	1.5kg
The Scarab Amulet of Fortune	An ancient scarab amulet carved from jade, with iridescent wings and inscribed with ancient symbols. Legend has it that it brings incredible luck to its owner, ensuring prosperity, success, and protection from evil spirits.	$1.5 Million	0.2kg
The Golden Mask of Osiris	A magnificent mask crafted from solid gold, depicting the god Osiris with eyes encrusted with sparkling gemstones. It is said to hold the wisdom of the gods and bestow unparalleled insight and enlightenment upon those who wear it.	$10 Million	2kg
The Crown of the Pharaohs	A majestic crown adorned with rare jewels and precious metals, symbolizing the divine authority of the pharaohs. It is said to confer upon its wearer the wisdom of the gods and the right to rule over the lands of Egypt with absolute power and sovereignty.	$15 Million	3kg
The Emerald Scarab of Transformation	A large emerald scarab beetle statue with wings outstretched, believed to hold the power of metamorphosis. According to legend, it can grant its possessor the ability to shape-shift into any creature they desire, transcending the limitations of mortal form.	$3 Million	2kg

Table 1: List of items in the chest including the weight and value

Problem:
Which items should he carry out in his bag first?

Part 4: The love letter

Once he have put all of the selected items in his bag, he went to look at the two letters in the chest. He picked up the letters (Figure 3) and there it was written:



To My Dearest Nefertari,

As I sit here amidst the grandeur of this ancient pyramid, surrounded by the whispers of the past, my thoughts turn to you, my beloved. Though miles may separate us, know that you are always in my heart, a beacon of light guiding me through the darkness of the unknown.

As I embark on this journey into the depths of the pyramid, I am filled with a mixture of excitement and trepidation. The allure of uncovering ancient secrets and treasures beckons me forward, but with each step I take, I am reminded of the risks that accompany such endeavors.

I cannot help but think of the life we have built together, the moments of joy and laughter we have shared, and the love that binds us together across time and space. It is your unwavering support and encouragement that give me strength in the face of uncertainty, and for that, I am eternally grateful.

Though the sands of time may have long since buried the civilization that built this magnificent structure, I find solace in the knowledge that our love transcends the ages, a timeless testament to the power of the human spirit.

Until we are reunited once more, know that you are always with me, guiding me through the labyrinth of life with your love and light.

With all my heart,

Your devoted.

To My Dearest Nefertari,

As I sit here amidst the grandeur of this antediluvian pyramid, surrounded by the whispers of the past, my thoughts turn to you, my beloved. Though miles may separate us, know that you are always in my heart, a beacon of light guiding me through the darkness of the unknown.

As I embark on this voyage into the depths of the pyramid, I am filled with a mixture of excitement and trepidation. The allure of uncovering ancient secrets and treasures beckons me forward, but with each step I take, I am reminded of the risks that accompany such endeavors.

I cannot help but think of the life we have built together, the moments of joy and laughter we have shared, and the love that binds us together within time and space. It is your unwavering support and encouragement that give me strength in the face of uncertainty, and for that, I am eternally grateful.

Though the sands of time may have long since buried the society that built this magnificent structure, I find solace in the knowledge that our love transcends the ages, a timeless testament to the power of the human spirit.

Until we are reunited once more, know that you are always with me, guiding me through the labyrinth of life with your love and light.

With all my heart,

Your devoted.

Figure 3: The two letters found in the chest

The two letters looked similar but he notices some of the words are different between the two letters.

Problem:
What are the different words from the two letters?

Part 5: The secret message

The different words found in one of the letter sounded like an ancient book title that Algo Jones have seen in the library back in Harvard University. He straight away plan his travel to visit the library. Once there he found the book and straight away open to read them. At first

glance, nothing seems out of the ordinary apart from the usual writings on ancient civilisation, but at the end of the book, Algo Jones found a string of strange characters (Figure 4).

```
Wkh vwdwxh lv exuulhg xqghu d wuhh pdunhg zlwk a rq
                Foxvwhu Lvodqg- 3
```

Figure 4: The characters found in the book

He knew it must have mean something. He needs to decode them.

Problem:
What is the secret message from the book?

Part 6: The final search of the Golden Statue of Bastet

The message forces Algo Jones to find a ship so that he can travel to Cluster Island. The island is made of 5 separate islands with different land condition and wild animals. The condition are as follows (Table 2):

Island location	Land condition	Wild animals
North	Swamp area	Full of wild animals
South	Mountains and caves	Some wild animals
East	Thick woods and a lake	Full of wild animals
West	Sandy flat land	Small but poisonous animals
Middle	Inhabited with villages and agriculture area	No wild animals

Table 2: The 5 islands of Cluster Island's land condition and wild animals

As much as Algo Jones wanted to find the Golden Statue of Bastet, he must consider where to look for it safely. He needs to determine which island he should search without endangering himself.

Problem:
Which island(s) should he search?

Part 7:

Decide how the story ends.

Assessment Rubrics

Table 1: Assessment criteria for soft skill (Individual Assessment)

		Partially meets	Meets	Exceeds	Exemplary
Skill level	**Score Description**	**1**	**2**	**3-4**	**5**
CS1 (KIM) **Presentation (2%)**	The ability to present ideas clearly, effectively and confidently, in both oral, written forms Oral Parameters: • delivery, • projection (pace, volume, enunciation) • appearance (attire and demeanor)	Either one parameter is acceptable.	All parameters are acceptable.	Some parameters are exceptional.	All parameters are exceptional.
TS4 **FILA form (3%)**	**The ability to contribute towards:** • **planning,** • **coordination** **of the team's efforts** **- Peer evaluation**	Student is able to contribute towards any one task	Student is able to feasibly contribute towards both tasks.	Student is able to contribute towards both tasks well.	Student is consistently able to contribute towards both tasks excellently.

Table 2: Assessment criteria for algorithms in solving the given problems (Group Assessment)

Criteria	**Scoring**			
Accuracy / Content Knowledge	**5**	**4**	**3**	**2-1**
	All algorithms and the usage of tools are presented, execute without error and output appears to be accurate. Improvements are considered.	Almost all algorithms and the usage of tools are presented, execute without error and output appears to be accurate.	Most algorithms and the usage of tools are presented, without error but output appears to be less accurate.	The usage of tools are presented, execute with minor/major error, resolve with hard-codes, output appears to be accurate.
Part 1 Problem (5%)				
Part 2 Problem (5%)				
Part 3 Problem (5%)				
Part 4 Problem (5%)				
Part 5 Problem (5%)				
Part 6 Problem (5%)				
(Total scoring for part 1-6 /30) * 25%	**/25%**			
Discussions of solutions	**5**	**4**	**3**	**2-1**
	Most possible and suitable solution has been considered and discussed.	Some possible and suitable solution has been considered.	Possible solution has been considered without any alternative.	Solution are less suitable.
Problem Part 1-6				
(Total scoring for part 1-6 /6) * 5%	**/5%**			