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 teammates.

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 presentations.

Objective:

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

Project Scope:

To meet the project requirement, you will need to:

- ✓ Form a work team of 5-6 members.
- ✓ Elect a team leader, write a contract item and sign using the group contract.
- ✓ Identify clear roles and responsibilities, distribute and coordinate various tasks appropriately, and able to operate as a high-performing team. You must indicate 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 "The Mystery of Marshall Mansion" below. For each part problem, record the possible approach to the problem on the ICT-INOV Platform (Brainstorm) and come out with one solution.

(PART 2) Discover, Define and Ideate

For each part problem, describe the algorithm, write the pseudocode, and discuss the limitations or possible modifications for the solution. Record your discussion on the ICT-INOV Platform (Level 1).

(PART 3) Prototype and Evaluation

For each part problem, code a computer program using Python according to the pseudocode defined in Part 2 to solve the given problems. State the running time complexity for the program. Place the link to your code on the ICT-INOV Platform (Level 2).

Week 14: The student must do a 30-minute presentation and demonstration of the program. Each group is required to give feedback on the other groups. Place the link to your evaluation form on the ICT-INOV Platform (Level 3).

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

- Source code: Python files
- Report Content:
    1. Introduction.
    2. The solutions to Part 1-8
        a. Description/discussion
        b. Pseudocode
        c. Running time complexity
        d. The program code (related algorithm implementation) and snapshots of input/output.
    3. Conclusion – Part 9
    4. Group contract and progress reporting using FILA form.
    5. References.

The Mystery of Marshall Mansion Murder

Last Christmas, I was invited to the Marshall Mansion by Lashram Rivers, a friend I had met a few months before at another friend's wedding party, for a private dinner since I just moved into the city and had no one to celebrate Thanksgiving with.

Rivers was adopted by Mr Phillip Marshall, the mansion's owner, when he was 8 years old. Mr Marshall is a wealthy businessman who runs several manufacturing factories all over the US, and Rivers helps manages the business for Marshall.

Close families and friends attended the dinner. Mr Marshall's children, Jones and Jenna Marshall, his brother and sister, Peter and Penelope Marshall, his uncle Will Marshall and several other close friends of the family; around 15 people were eating at the large dining table that night.

The dinner was wonderful, with plenty of food to eat. But suddenly, in the middle of the desert, Mr Marshall gasped and fell off his chair. Everyone was panicking, and I ran to Mr Marshall to see what could be done. A few minutes later, while waiting for the ambulance, Mr Marshall was not breathing anymore.

Part 1: Who poisoned Marshall?

A few moments before Mr Marshall passed away, he whispered, "I know who did this". As a detective who works for the Police department in this city, I realised this was not an accident; instead, someone had murdered Mr Marshall.

After the mansion was closed for investigation and everyone had left, I started looking for clues. The mansion was a big building with many rooms over a huge land and a lake, and I managed to get a layout of the building (Figure 1) and the surrounding areas (Figure 2). The main building must have some clues, so I will search all the rooms.

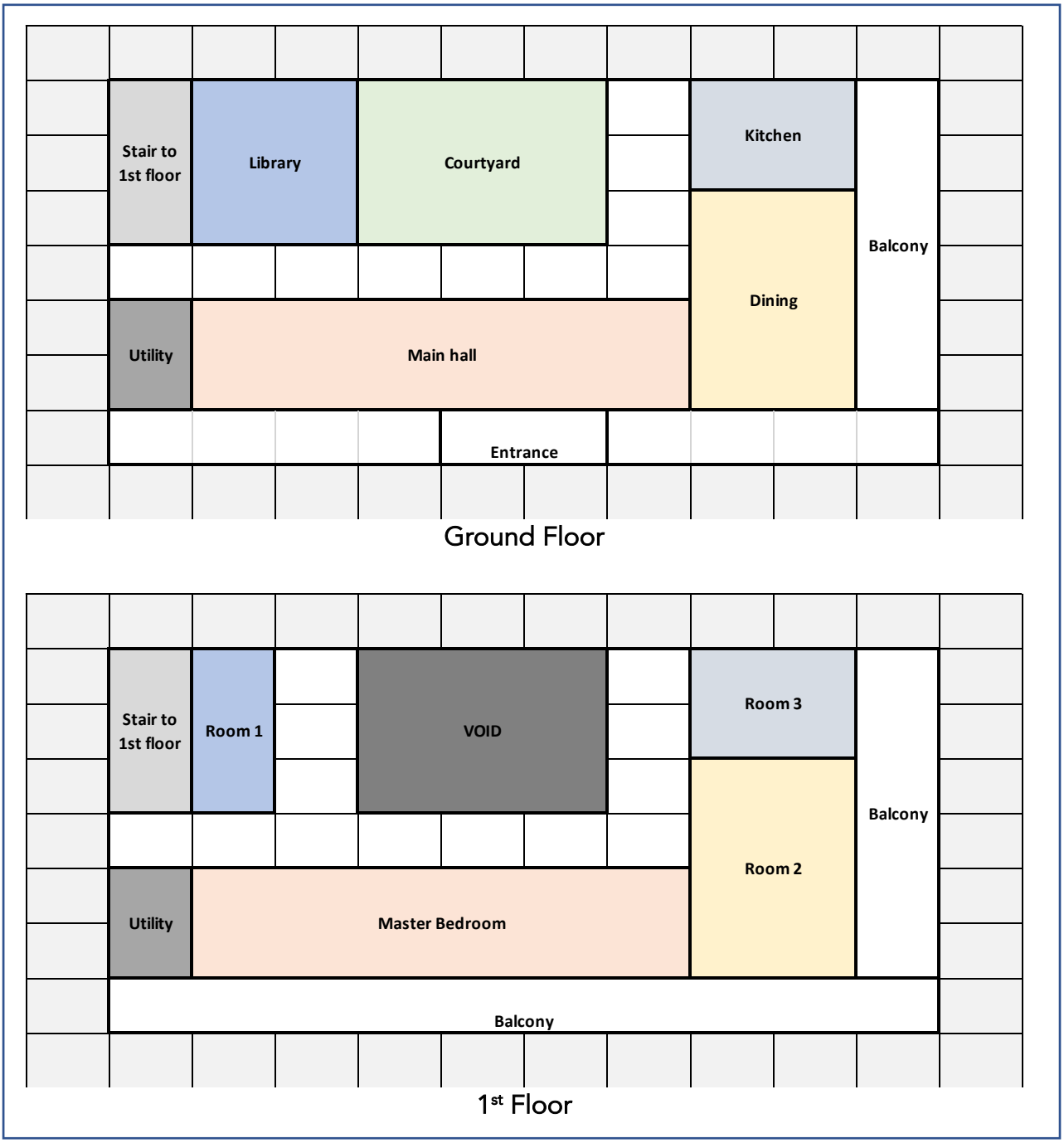

Figure 1: Floor plan of the main building (with grid markings around the building)

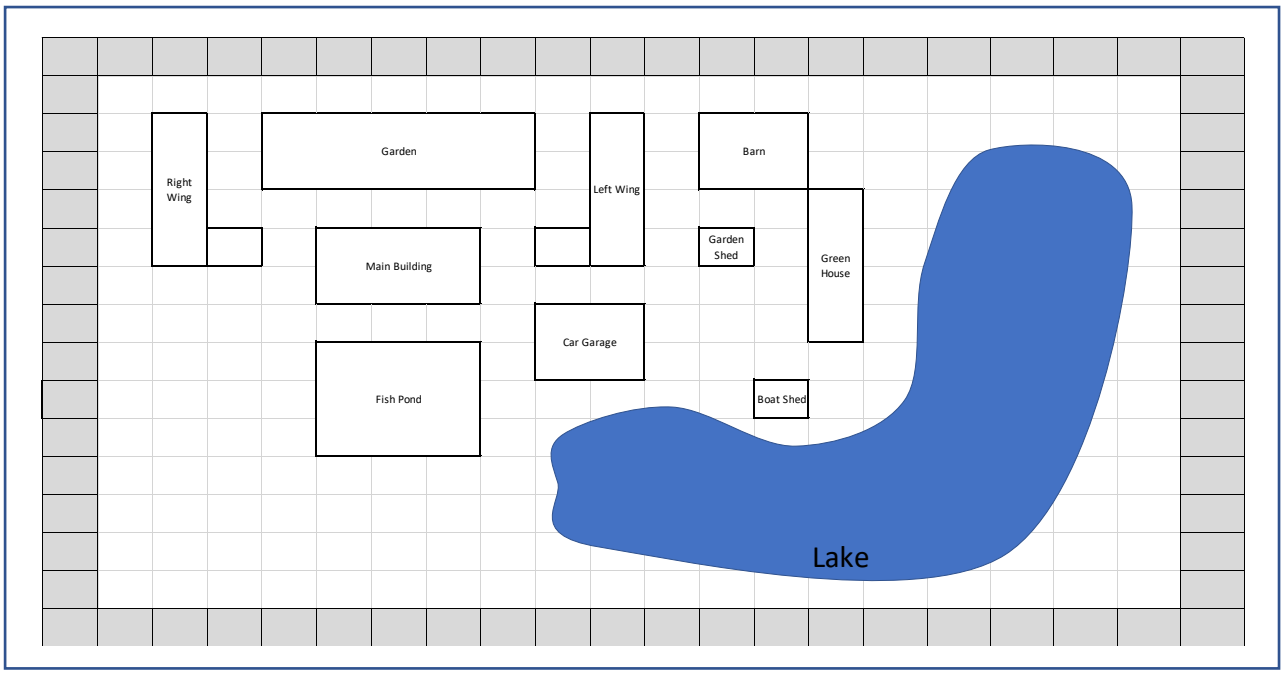

Figure 2: Marshall Mansion Overall Property Layout (with grid markings around the property)

Problem:

How to search all the rooms in the building without missing any?

Part 2: Cracking the chest lock code.

I was looking in the library; there were stacks of books on the table and hundreds of books on the shelves around the room. Apparently, Mr Marshall does a lot of reading and spends much time in this room. I found an old safe on one of the shelves, and after close inspection, it requires a 3-digit number combination to open it (Figure 2). I look around for the code, but I guess I must figure out how to crack this safe.

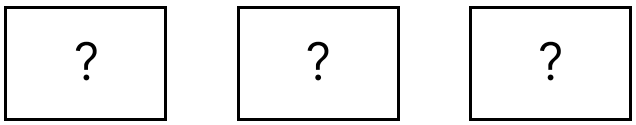

Figure 3: 3-digit number combination for the old safe

Problem:

What is the possible number combination for the lock?

Part 3: Same but not identical.

I was finally able to open the safe. Inside there are several documents, but at the very top, two letters look the same, or so I thought, since after a closer look, they are not identical (Figure 3).

Dear Annabel,

I hope you're doing fine. Are you excited about the summer break? Thank you for your last letter. It's always lovely to hear about what's going on back home.

I'm writing to you to invite you to come to visit me during the holidays. If the weather is terrible, we could go to the art and history museums. We could even spend the day at the park, or walk around the state fair. We could go to that café you like or take a day trip on the boat.

It would be great to spend a few weeks with you here in the city. We'd have a lot of fun! I know how much you love the city.

Let me know your thoughts. If you decide to come, we can start making plans for what we'll do while you're here.

I hope to hear from you soon, and I hope to see you soon.

With best wishes,

Phillip

Dear Annabel,

I hope you're doing great. Are you excited about the winter break? Thank you for your last letter. It's always lovely to hear about what's going on back home.

I'm writing to you to invite you to come to visit me during the holidays. If the weather is terrible, we could go to the art and history museums. We could even spend the day at the park, or walk around the state fair. We could go to that café you like or take a night trip on the boat.

It would be great to spend a few weeks with you here in the city. We'd have a lot of fun time! I know how much you love the city.

Let me know your thoughts. If you decide to come, we can start making plans for what we'll do while you're here.

I hope to hear from you soon, and I hope to see you soon.

With best wishes,

Phillip

Figure 4: The two letters from the safe.

Problem:

What are the different words from the two letters?

Part 4: Find that book.

The different words found between the two letters sounded like a book title. I look around the library, there are hundreds of books here, but thankfully they are sorted alphabetically.

Problem:
How to find the book quickly?

Part 5: Secret message.

I finally found the book. Between the pages, I found a piece of paper containing, what looks like, a secret message (Figure 4).

Ymfy ujwxts nx htrnsl ktw rj! Nk dtz knsi ymnx styj, qttp fwtzsi rd uwtujwyd. Mnsy: N anxnyji ymj fwjf bnym rd ywtqqjd kwtr ymj lfwijs xmji. - 5

Figure 5: The piece of paper found between the pages.

Problem:
How to decode the secret message?

Part 6: Find the next clue.

I went to the shed. True enough, there is a trolley and several other items. The trolley can carry at most 30kg of items. And the items in the shed are as follows (Table 1):

Item	Weight
A sack of corn for the chicken at the barn.	12kg
A hoe for the green house.	5kg
An oil tank filled with fuel for the boat at lake.	10kg
Four pieces of tyres for the car in the garage.	16kg

Table 1: Items in the garden shed and their weight.

I thought Mr Marshall must have visited the area based on his trolley capacity to carry these items. The next clue must be there.

Problem:
Find out which item was carried on the trolley.

Part 7: Almost there!

Based on the items carried, I visited all the areas. I found another secret message (Figure 5) in a bottle in one of the areas!

Figure 6: The secret message.

Although it didn't make sense initially, I realised each line was a word with jumbled letters.

Problem:
What is the secret message?

Part 8: Murder suspect.

So, from the last message, I know the murderer must have a strong motive. Is it money? Or something else?

I list each family member's characteristics, relationship with Mr Marshall, and net worth below (Table 2).

Name	Relationship	Character	Net worth ($)
Jones Marshall	Son	Always rude to people especially his father.	1Mil
Jenna Marshall	Daughter	The quiet one in the family.	700K
Peter Marshall	Brother	Animal lover.	50K
Penelope Marshall	Sister	Playful despite of her old age.	500K
Will Marshall	Uncle	Retired army officer	10K

Table 2: Mr Marshall's family members, characteristics, and wealth.

The murderer must be one of them. But who?

Problem:
Who has the most significant motive to be the suspect in this murder?

Part 9:

Decide how the story ends. Have fun with it!

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.	Some algorithms and the usage of tools are presented, execute with minor/major error, resolve with hard-codes, output appears to be accurate.
Algorithm to resolve Part 1 Problem				
Algorithm to resolve Part 2 Problem				
Algorithm to resolve Part 3 Problem				
Algorithm to resolve Part 4 Problem				
Algorithm to resolve Part 5 Problem				
Algorithm to resolve Part 6 Problem				
Algorithm to resolve Part 7 Problem				
Algorithm to resolve Part 8 Problem				
(Total scoring for part 1-8 /40) * 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 1-5 x 1% (5%)				