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 "Galactic Chronicles: The Quest for Nova Prime" 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 12-13: 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 1-7
        a. Description/discussion
        b. Pseudocode
        c. Running time complexity
        d. The program code (related algorithm implementation) and snapshots of input/output.
    3. Conclusion – Part 8 (Be creative!) – No marks
    4. Group contract and progress reporting using FILA form.
    5. References.

Galactic Chronicles: The Quest for Nova Prime

Part 1: The Asteroid Labyrinth

The Aetherion shimmered into realspace with a soft pulse of blue light, emerging at the edge of the Kepler-729 Asteroid Belt—a massive celestial scrapyard that wrapped around the orbit of a dead star like a metal serpent. Captain Elara stood on the bridge, eyes fixed on the expanding wall of rocky debris that filled the main viewport.

"We're five parsecs off course," mumbled Navigator Korrin, tapping furiously on the nav console. "The last hyperskip destabilised our trajectory. We're too deep in the belt."

A deep rumble shook the ship. Outside, asteroid fragments spun chaotically, some the size of pebbles, others as massive as mountains. Traditional navigation was impossible—radar returns were saturated, and the system's obstacle-mapping AI was overloaded with data points. The ship needed to identify a safe path across a thousand kilometres of asteroid clusters, each zone with varying asteroid densities and movement vectors.

"Can we plot a route manually?" asked Elara.

Korrin shook his head. "Too many variables. We'll burn out trying to process all of it at once."

Eleanor, the ship's systems analyst, stepped forward. "What if we don't analyse the entire field at once? She activated the sector grid. The visual turned into a vast checkerboard of space that visualised the asteroid field (Figure 1). Eleanor continued: "We need to analyse each sector, check the density of asteroids. If it's above the safe threshold, discard it. Otherwise, we explore its sub-sectors."

The captain nodded. "Like searching for a corridor through a jungle, cutting away dense underbrush until we find a trail."

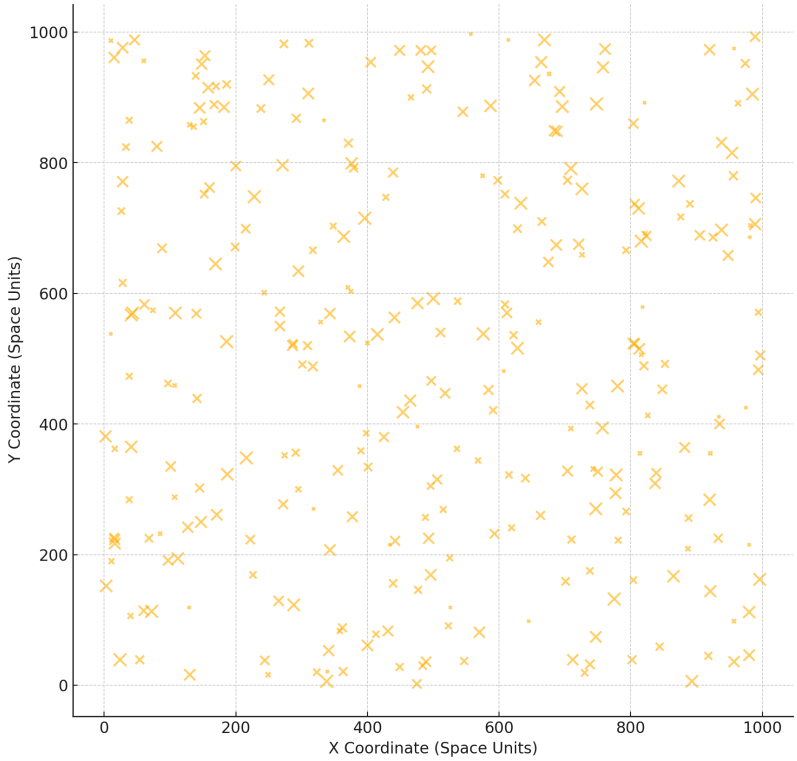

Figure 1: The asteroid field

Dataset: Asteroid_Field_Data.csv

Part 2: Market of Moira

After safely navigating through the asteroid field, the Aetherion touched down on the bustling trade moon of Moira, a former mining colony turned interstellar marketplace nestled in the shadow of the gas giant Verdanis. Here, under the shimmering auroras of ion storms, time is currency, and prices dance like flame.

Captain Elara, Engineer Dax, and Analyst Eleanor entered the Grand Bazaar—rows and rows of bioluminescent stalls, mechanical hawkers, and vendors shouting prices in a dozen languages. They must secure rare upgrade modules for the ship's damaged hull and AI core. But there was a catch.

"Market resets in 20 minutes," said Eleanor, checking her wristpad. "Every price on this planet recalibrates with the next solar flare. And flares hit every cycle."

Dax eyed the sprawling list of available items on the holographic stall panel. It flickered rapidly as new data streamed in—hundreds of items with fluctuating prices based on current galactic trends, seller mood metrics, and Moiran weather anomalies.

"We need modules compatible with the ship's core, under 800 credits, with a durability rating above 85," Dax said.

“But the list isn’t even sorted,” Eleanor said, frustrated. “And there are over 300 items, all jumbled together. If we don’t prioritize and act fast, we’ll miss the flare window.”

Captain Elara looked over. “Can the system handle this in time?”

“Only if I implement something faster than what this old vendor interface uses,” Eleanor muttered, pulling up her toolkit. As the first flare burst across the sky, lighting up the marketplace in electric blue, Eleanor’s program began slicing through the data with precision while the team narrowed their choices.

Dataset: Moira_Market_Items.csv

Part 3: The Stowaway Protocol

Twelve hours after departing Moira, the Aetherion cruised through the black void of the Nevrion Expanse. The crew was finally at ease—until the red security alert pierced the silence.

“Unregistered biometrics detected,” the ship’s AI, OBERON, intoned. “Presence unauthorised. Vital signs suggest one additional entity on board.”

The bridge plunged into tension. Across the ship, there were hundreds of storage compartments, air ducts, maintenance tubes, and crawl spaces. Manually searching each one would take days—time they didn’t have, with a plasma storm approaching in five hours.

“We need to identify the stowaway before they sabotage us,” Elara said. “But we can’t search everything blindly.”

Eleanor’s eyes lit up. “What if we don’t search everything? What if we search intelligently and randomly, based on likelihood?”

She pulled up crew movement logs, oxygen consumption anomalies, and heat map fluctuations from thermal sensors.

“Let’s find a way so that we select compartments based on likelihood,” Eleanor proposed. “And if we model the expected success of each attempt, we can maximise our chances.”

Captain Elara nodded. “Find a way to model the expected number of trials until success as well,” she added.

Dataset: Compartment_Sensor_Data.csv

Part 4: The Broken Stargate

The stowaway was finally detained and will be handed over to the authorities at the next stop. The Aetherion continued its mission and emerged from slipspace into the heart of the Orion Transit Web, a forgotten superstructure of ancient Stargates built by a long-lost civilisation. This network once allowed near-instantaneous travel across light years, but now, only fragments remain functional.

"Multiple Stargates detected," OBERON announced. "Power signatures fluctuating. Network integrity: 43%."

Eleanor studied the gate map. Dozens of gates blinked red — offline, unstable, or corrupted. Only a few safe passageways remained, many of them long and winding. They needed to reach Nova Node Theta-5, the final working gate that could hurl them toward Nova Prime. But the path was far from obvious.

"Some of these routes may look short, but if a gate fails mid-jump, we're lost," Dax muttered.

Elara frowned. "We need a route that minimises travel time and avoids instability."

Eleanor interfaced with the ancient system, mapping the gates into a graph. The weights included travel time, instability risk, and energy costs. With time running out and energy reserves limited, only one route could be attempted.

She initiated OBERON's navigation protocol ----

Dataset: Stargate_Data.csv

Part 5: AI Override

The crew's relief after escaping the broken Stargate was short-lived.

"Warning," OBERON announced in a garbled voice. "Core Integrity… compromised. Executing… random override."

Suddenly, lights flickered. Gravity wavered. Systems across the Aetherion began activating and deactivating without reason—doors sealed, engines hiccupped, life support cycled on and off.

"What's happening?" Elara shouted.

Dax stared at the diagnostics. "The AI core took a hit during the last jump. It's activating non-critical subsystems at random, drawing power away from essential ones."

“We need to restore control,” Eleanor said, opening the emergency override panel. “We can’t shut down everything at once—it’s too risky. But we can prioritize system recovery strategically.”

She accessed the manual override interface. Dozens of systems flashed red—each with:

- A power requirement
- A restoration time
- A criticality score (how important the system is to survival)

“Our power reserve is limited,” Eleanor continued. “We’ll need to select a combination of systems to restore that gives us the highest total criticality score without exceeding power or time limits. Currently, we are at 20% power and 10 minutes before we lost all control of the ship!”

OBERON’s override cycle restarted. They had one chance to input the override sequence before the core rebooted completely.

Dataset: AI_Override_System_Data.csv

Part 6: The Ores Negotiation

After narrowly restoring control of the Aetherion, the crew arrived in orbit above Diplos, a diplomatic nexus moon shared by several galactic factions. Aetherion, in addition to executing an exploration mission, carries valuable ores used by warships to reinforce their hulls against light damage as part of its role as a peacekeeping agent. Each faction had warships or shuttles waiting to dock at the ship’s only available transfer port.

OBERON projected the current queue:

“Docking requests received from 25 vessels. And we can only be here for 15 hours only due to solar turbulence.”

Each vessel requested a specific docking time window with start and end times. Some required longer windows, and others overlapped with multiple requests.

Captain Elara sighed. “We don’t have time to argue. If we approve the wrong sequence, we’ll lose trust — or worse, start a skirmish.”

Eleanor stepped in. “Let’s prioritise ships that don’t conflict. We can accommodate the maximum number of ships without overlap if we’re smart.”

Dax added, “Or maybe we should prioritise certain factions to gain strategic trust.”
“You’re both right,” Elara said. “We need to maximise docking approvals, and optionally give weight to high-priority factions.”

OBERON began simulating the schedule.

Dataset: Docking_Requests_Dataset.csv

Part 7: Echoes of the Ancients

Once the transfer of the ores was completed, the Aetherion coasted into the orbit of Nova Theta-5. Suddenly, a faint transmission crackled through the ancient comms channel—something no one had heard in over a millennium.

It wasn't a voice, but a stream of encoded pulses, repeating in rhythmic patterns.
"This signal's being broadcast from that derelict satellite," Eleanor said, pointing to a ruined probe rotating silently near the edge of the dark moon.

She decrypted the first layer of the signal. It revealed what looked like garbled text (Figure 2):

```
QrydSulphFrruglqdwhv:Vhfwru-7Doskd &$&_*_!QrydSulph
Frruglqdwhv:Vhfwru-7Doskd&$&_*_!QrydSulphFrruglqdw
hv:Vhfwru-7-Doskd&$&_*_!QrydSulphFrruglqdwhv:Vhfwru
-7-Doskd&$&_*_!QrydSulphFrruglqdwhv:Vhfwru-7Doskd&
$&_*_!QrydSulphFrruglqdwhv:Vhfwru-7-Doskd
```

Figure 2: Decrypted signal data

Elara leaned in. "What does it mean?"

"I think it's a message hidden," Eleanor replied. "We need to match sequences, filter signal from static, and decode what's embedded."

"Whoever left this message… they wanted it to be found—but not too easily," Eleanor whispered.

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. Most possible and suitable solution has been considered and discussed.	Almost all algorithms and the usage of tools are presented, execute without error and output appears to be accurate. Some possible and suitable solution has been considered.	Most algorithms and the usage of tools are presented, without error but output appears to be less accurate. Possible solution has been considered without any alternative.	The usage of tools are presented, execute with minor/major error, resolve with hard-codes, output appears to be accurate. Solution are less suitable.
Part 1 Problem (5%)				
Part 2 Problem (5%)				
Part 3 Problem (5%)				
Part 4 Problem (5%)				
Part 5 Problem (5%)				
Part 6 Problem (5%)				
Part 7 Problem (5%)				
(Total scoring for part 1-7 /35) * 30%	**/30%**			