Small (first) assignment

Common requirements for the assignments

The documentation should include

- the description of the exercise (copied from here)
- the class diagram (designed using Umbrello, draw.io, plantUML, etc.)

The code should include

- javadoc comments for each class and method (except getters and setters)
- unit tests for each of the important methods (not getters or setters)

All of the assignments require just two classes

1 Alchemist & Potions

An alchemist manages a collection of magical potions, each with its own unique properties. Every potion has a name, an effect type (such as healing, poison, or stamina boost), a potency level that determines its strength, a rarity classification (common, rare, or legendary), and an expiration status which indicates whether the potion is still usable or expired (potions are given usable or expired, you don't need to model them expiring).

The alchemist needs to find and organize potions efficiently. Some of their tasks include searching for the strongest potion by identifying the one with the highest potency level. Alchemists also regularly check how many healing potions they have in stock, as these are commonly used in their craft. Additionally, the alchemist might want to find out which rare or legendary potions are available in their collection.

Beyond inventory management, the alchemist can brew new potions by combining multiple potions of a similar type to create a stronger version, where

- effect type is the effect type that occurs most often in ingredient potions
- potency level is the average of the potency of the ingredient potions added to the maximum potency level among them
- rarity classification is legendary
- if one of the ingredient potions is expired then the new potion is also going to be expired

Occasionally, the alchemist must ensure that expired potions are removed from the inventory. Alchemists also keep track of how many potions they have used and created over time.

2 Spy & Gadgets

A spy must carry out secret missions and relies on a set of gadgets, each with unique properties. Every gadget has a function type (surveillance, hacking, offensive, or escape), a battery life that determines how long it can operate, a stealth rating showing how well the gadget avoids detection, and a usage limit that affects how many times it can be used before it becomes unusable.

Some gadgets have additional properties, such as being rechargeable or single use. The spy must choose and use gadgets wisely depending on the mission at hand. Some tasks might require selecting the stealthiest gadget of a given type to avoid detection, while others need locating gadgets with the longest battery life for extended operations. The spy may also need to check how many gadgets of a function type are still operational, as using broken or depleted gadgets could compromise a mission.

When activated, gadgets may be compromised due to overuse, malfunction, or detection by enemy forces (the latter two randomly happens, each with a preset probability). The spy can remove non-functional gadgets from their inventory. Gadgets may also be restored (repaired or recharged), allowing the spy to restore them for future use. The spy keeps records of the total number of times they used gadgets and failures due to equipment malfunctions to improve planning for future assignments.

3 Captain & Ships

A captain is responsible for managing a fleet of ships, each with unique attributes that determine its suitability for different voyages. Every ship has a name, a maximum speed, a cargo capacity for transporting goods, a sailing range that determines how far it can travel before refueling, and a durability rating that decreases over time. Some ships are optimized for long-distance voyages, while others are built for speed and maneuverability.

The captain must carefully select which ship to use depending on the mission. Some voyages require the fastest ship to outrun potential threats, while others need a ship with the highest cargo capacity for trade or resource collection.

These ships can be sent onto missions, which have a name, a distance, and a value they bring (you don't need to create a class for missions). During missions, the durability of ships decreases depending on the length of the voyage. The captain must schedule maintenance checks where the ships with low durability are selected and repaired. Ships can eventually become not operational if their durability rating reaches zero due to repeated wear and tear.

If a ship becomes not operational it should be retired from the fleet. During voyages, unexpected events may impact a ship's durability (with a preset probability), requiring fast decision-making to prevent costly losses (with a preset probability). The captain also tracks voyage history (which ship was sent on which mission, identified by the name of the mission), total distance traveled, and the overall value that each ship has contributed to the fleet. By analyzing this information, they can plan future fleet expansions and ensure only the most reliable ships are used for critical missions.

4 Sculptor & Sculptures

A sculptor manages a collection of sculptures, each with unique artistic characteristics and physical attributes. Every sculpture has a title, an artistic style (such as classical, modernist, or abstract), a material (marble, bronze, wood, etc.), a market value, a weight, and a sold status (boolean), which indicates whether the sculpture is still available for exhibitions or has already been sold. Some sculptures are small and delicate, suitable for gallery exhibitions, while others are large and monumental, designed for public spaces or architectural installations.

The sculptor frequently organizes and selects sculptures for different pur-

poses. When preparing for an exhibition, they may need to find the most valuable (unsold) sculpture, ensuring that their most prestigious pieces receive the most attention. Sometimes, customers require the heaviest unsold sculpture, while certain exhibitions or client requests may demand sculptures made from a specific material to match a particular theme.

Beyond exhibitions, the sculptor also oversees sales and inventory management. Tracking the sale of each sculpture helps the sculptor keep a record of how many pieces have been sold and at what price. Additionally, keeping an eye on which artistic styles are gaining popularity allows them to decide what type of sculptures to create in the future (this is done by counting the number of sold sculptures of a given style). Over time, sculptor may choose to retire sculptures, ensuring that their collection remains relevant and only the finest pieces are actively displayed or sold.

5 Library & Publications

A library manages a collection of publications, each with unique attributes and availability status. Each publication has a title, an author, a genre (such as fiction, history, or science), a publication year, and a copy count indicating how many copies are currently available for borrowing. Some books are widely requested and need frequent restocking, while others remain in the archive for research purposes.

Books may also become damaged over time due to frequent borrowing, mishandling, or general wear. Every publication has a condition level that decreases each time it is borrowed. If the condition level drops below 20, the book is considered damaged and is permanently removed from circulation.

Visitors to the library may have different interests when searching for publications. Some may look for the most borrowed book, while others search for a book by a particular author or browse books within a specific genre (here, all of these books need to be collected and presented to the visitor). The library ensures that its inventory is well-organized so that all visitors can find the books they need.

To maintain a well-managed collection, the library keeps track of borrowing trends, ensuring that more copies are ordered from frequently borrowed books when they become unavailable. Additionally, the system tracks the total number of books borrowed and the number of books retired due to damage. This helps librarians make informed decisions about future acquisitions and stock management. The library also keeps statistics on reading trends and the most popular genres to help guide future book recommendations.

6 Video Game Rental Store

A video game rental store manages a collection of video games, each with distinct attributes that determine its availability and demand. Every game has a title, a genre (such as action, puzzle, or simulation), an age rating that indicates suitability for players, a popularity score based on previous rentals, a damaged status indicating whether the game is still functional, a rental price per hour, and a total rent count that tracks how many times the game has been rented. Each game also has an availability status showing whether it is currently rented or in stock.

Customers visiting the store may have different preferences when selecting a game. Some may look for the most popular game based on past rentals, while others may search for a game within a particular genre or browse games suitable for their age group. The store must efficiently manage game availability to ensure that customers can find the games they want.

Games become damaged. Every time a game is rented, its total rent count increases, and with repeated use, it may sustain wear and tear. A game is considered damaged and permanently removed from circulation if it has been rented more than 20 times, marking it as too worn out for further use.

The store also enforces a rental pricing system. Each game has a fixed price per hour, and rental costs are calculated based on the total hours rented. Late returns result in an additional fine, which is calculated as twice the hourly rental rate for each overdue hour.

To maintain an organized rental system, the store tracks the number of games rented, their due dates, and applies late fees if they are returned past the deadline. Additionally, the system keeps records of the total revenue from rentals, ensuring that the store can analyze which genres and titles are most profitable. Over time, games that are damaged are removed from circulation. By keeping detailed records of rental statistics, customer preferences, and game performance, the store ensures that only high-demand and properly functioning games remain available for rent, creating a better player experience.

7 Parking Lot & Parking Spots

A parking lot manages a collection of parking spots, each available for short-term or long-term parking. Every parking spot has a spot number, a vehicle size limit (compact, standard, or large), an availability status indicating

whether it is occupied or vacant, and an hourly parking rate.

Drivers looking for parking spots may have different requirements. Some may need a large spot for a truck or SUV, while others may prioritize the cheapest available spot. Customers may also seek long-term parking arrangements for extended stays. If a vehicle is parked for more than 10 days, a 50% discount applies for every extra hour beyond the 10-day period to encourage long-term rentals.

To ensure efficient operations, the parking lot tracks active parking reservations, monitors occupancy rates, and calculates total revenue from parking fees. The system allows customers to search for available spots based on size and price restrictions, helping them quickly find a suitable space.

The parking lot also manages overstay penalties for vehicles that exceed their reserved time. If a driver does not remove their vehicle before the rental period expires, a penalty fee equal to twice the hourly rate per extra hour applies until the car is removed.

8 Astronomical Observatory & Celestial Bodies

An astronomical observatory is responsible for monitoring and studying a vast collection of celestial bodies, each with its own characteristics. Every celestial body has a name, a category (such as planet, star, comet, asteroid, or moon), a visibility score (ranging from 0 to 100) that indicates how frequently it can be observed from Earth, a risk status that determines whether it poses a potential threat, an orbit type that can be stable, elliptical, or irregular, and a last observed year representing the last recorded observation of the celestial body.

Time tracking is managed through a global observatory year counter, which advances each time observations are updated. Every celestial body has a last observed year, and when the current observatory year increases, celestial changes are processed accordingly.

Celestial bodies experience changes over time. If a celestial body has an elliptical or irregular orbit, its visibility score decreases by 5 points every year due to distance changes or cosmic interference. If a celestial body's visibility score drops below 20 for three consecutive years, it becomes obsolete and is removed from active observation. It is recommended to keep track of previous visibility scores of a celestial body in a list in the object.

Some celestial bodies are also classified as risky based on their characteristics. A celestial body is considered risky if its orbit is irregular and its visibility score decreases for five consecutive years. Risky celestial bodies,

such as asteroids or comets with unstable orbits, must be tracked carefully to ensure they do not pose potential threats to Earth.

Astronomers working at the observatory must regularly observe celestial activity. Their tasks include identifying the most visible celestial body, detecting and collecting bodies that are risky, finding the most visible risky body, and calculating the average visibility across all bodies.

9 Treasure Hunter & Artifacts

A treasure hunter explores ancient ruins, lost temples, and forgotten sites, collecting artifacts with unique historical significance. Each artifact has a historical value (an integer), a rarity level (common, rare, legendary), and an origin that indicates where it was found. However, not all artifacts are authentic—some may turn out to be fake upon closer inspection.

Artifacts can be revealed as fakes if they meet specific criteria during authenticity verification. An artifact is determined to be fake if:

- It has an unrealistically high historical value for its rarity level (for example, a "common" artifact with an abnormally high value).
- It is a duplicate of another artifact already in the collection (having the same name, rarity, and origin).

The treasure hunter must efficiently find and organize artifacts. Some of their key tasks include identifying the most valuable artifact, counting how many artifacts originate from a specific location, and selecting (collecting) fake artifacts using the authenticity verification rules. If an artifact is found to be fake, it is removed from the collection.

Over time, the treasure hunter keeps track of their discoveries, recording the total number of artifacts collected, the number of fakes removed from the collection, and the highest-value artifact they have ever found. These insights help them improve future expeditions, refine their expertise in identifying truly valuable finds, and ensure that only the most significant artifacts are preserved for historical study.

10 Mechanic & Car Parts

A mechanic manages an inventory of car parts (list of CarPart objects). Each car part has a price (int) and durability (int). The parts in the inventory can include various types, such as engines, tires, and brakes.

The mechanic needs to find the best replacement parts for customers. For instance, when a customer needs a new tire, the mechanic looks for a tire with the highest durability. Similarly, when the customer needs an engine replacement, the mechanic looks for the engine with the highest durability. The mechanic should be able to retrieve the part with the highest durability of a specific type (like tire, engine, or brake).

Additionally, the mechanic should be able to count how many parts of a given type are in the inventory. They can also look for the cheapest part of a given type if cost is a priority. They can also calculate the total value of their inventory, and the total value of a type (like tires). The mechanic manages the inventory using a list, and they should be able to add new parts to it and search for parts based on specific needs, such as finding the part with the highest durability or the lowest price.