Exercise Session 1

Requirements

A possible scenario

- The municipality of Milano is telling you the following:
  - "We take a long time to make decisions about granting permission to build residential buildings in the city, and we want to develop a piece of software that helps us reduce this amount of time."
- From where do we start from?

We can start inverviewing stakeholders and create scenarios

- "Could you please describe a scenario of usage for the system?"
  - Expert 1: When someone submits a residential building construction request I receive it and I evaluate the following aspects:
    - The area where it is going to be constructed is of the right type (there are three types of areas: residential, industrial, and agricultural)
    - The area can host the new building. Each area has associated an occupation percentage and this percentage should never exceed 80%.
    - For every new building, the constructor must guarantee that the building will occupy 80% of the whole area while 20% will be organized and maintained as a park under the financial and organizational responsibility of the constructor and the building owners.

We can start inverviewing stakeholders and create scenarios

- Continues with Expert 1 description
- The new building must respect the characteristics of the area. Each area can include buildings with a minimum and maximum number of floors, having specific characteristics in terms of external colors and used materials.
- The company proposing the construction must be financially solid, and one of the authorized banks must guarantee it will support the project.
- All top-level managers in the company and the person in charge of the specific project should have no criminal record.
- The decision-making process cannot be fully automated because, in some cases, decisions are based on subjective and difficult-to-predict elements.

We can start inverviewing stakeholders and create scenarios

- Continues with Expert 1 description
  - For instance, the ”Bosco Verticale” skyscraper was built a few years ago.
  - In that case, the constructor proposed to use 100% of the available surface for the building, but it also proposed to create green areas vertically and fully integrated with the building itself

We can start inverviewing stakeholders and create scenarios

- The city manager says:
  - Building companies are upset because we take too much time to give permission.
  - We have great technicians; our authorization for the "Bosco Verticale" is an example.
  - However, they spend too much time on clerical work and do not have time to focus on the critical aspects of the process.

We can start inverviewing stakeholders and create scenarios

- A citizen committee says:
  - We do not want Artificial Intelligence to make decisions for our city!
  - The decision on whether to grant building permissions should be human-based; it cannot be delegated to a machine.

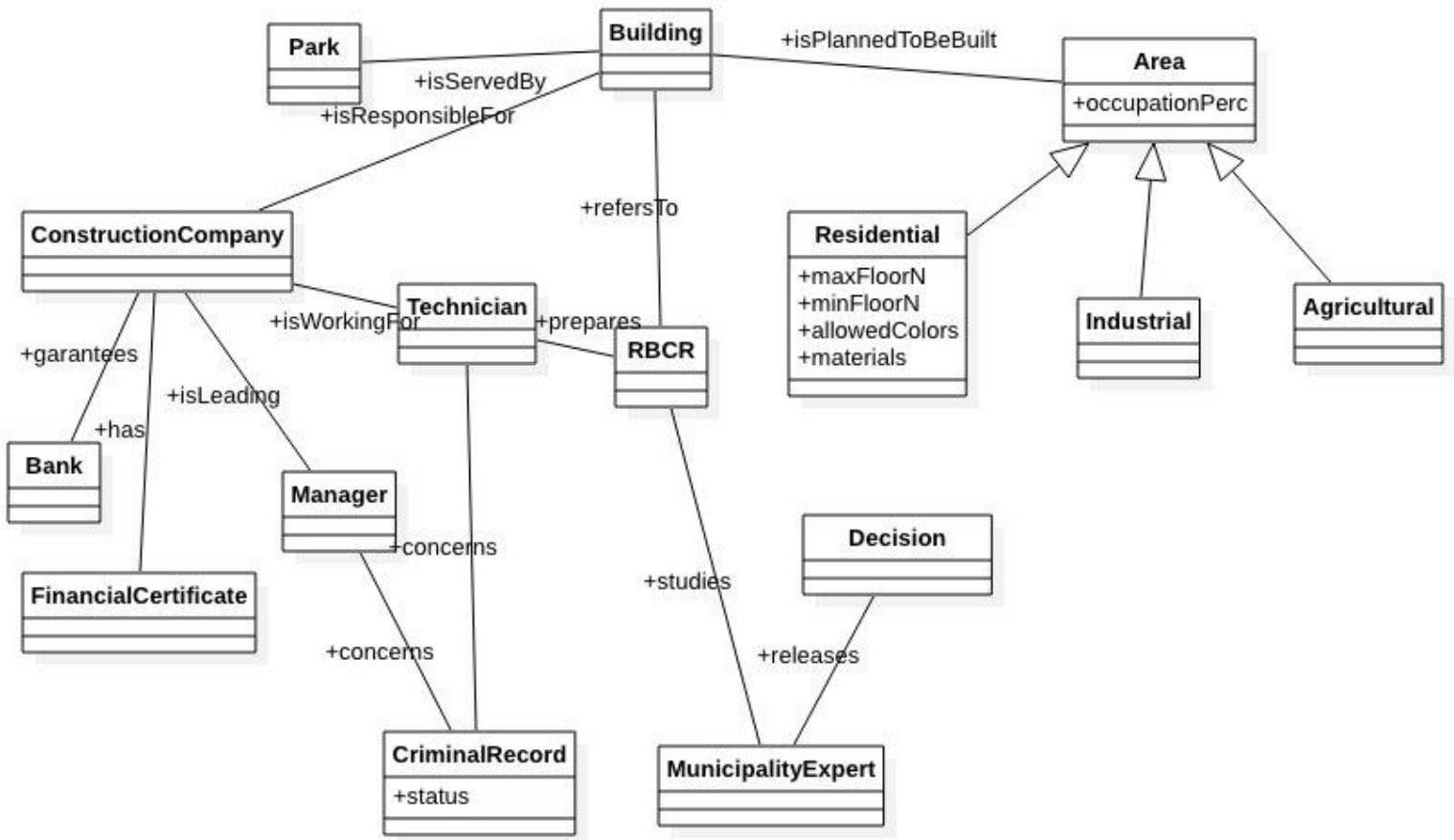
Next steps

- Clarify terminology
- Define system boundaries
- Define phenomena
- Define use cases
- Define requirements and domain assumptions
- Finalize RASD

System boundaries

- **The area where it is going to be constructed is of the right type** (there are three types of areas, residential, industrial, agricultural)
- The area can host the new building. Each area has associated an **occupation percentage**. This percentage should never exceed 80%.
- For every new building, the constructor must guarantee that the building will occupy 80% of the whole area while 20% will be organized and maintained as a park under the financial and organizational responsibility of the constructor and the build owners -> **maybe better to leave this to humans**
- *The new building must respect the characteristics of the area. Each area can include buildings with a minimum and maximum number of floors, having specific characteristics in terms of external colors and used materials*
  - **The software could check the minimum and maximum number of floors constraint. Then it could check whether colors and materials are aligned and if not ask the human operator**
- *The company proposing the construction must be financially solid and one of the authorized banks must guarantee that they will support the project*
  - **We can define basic checks done by the software and leave the final decision to the human operator**
- **All top-level managers in the company and the person in charge of the specific project should have no criminal record**

Clarify terminology



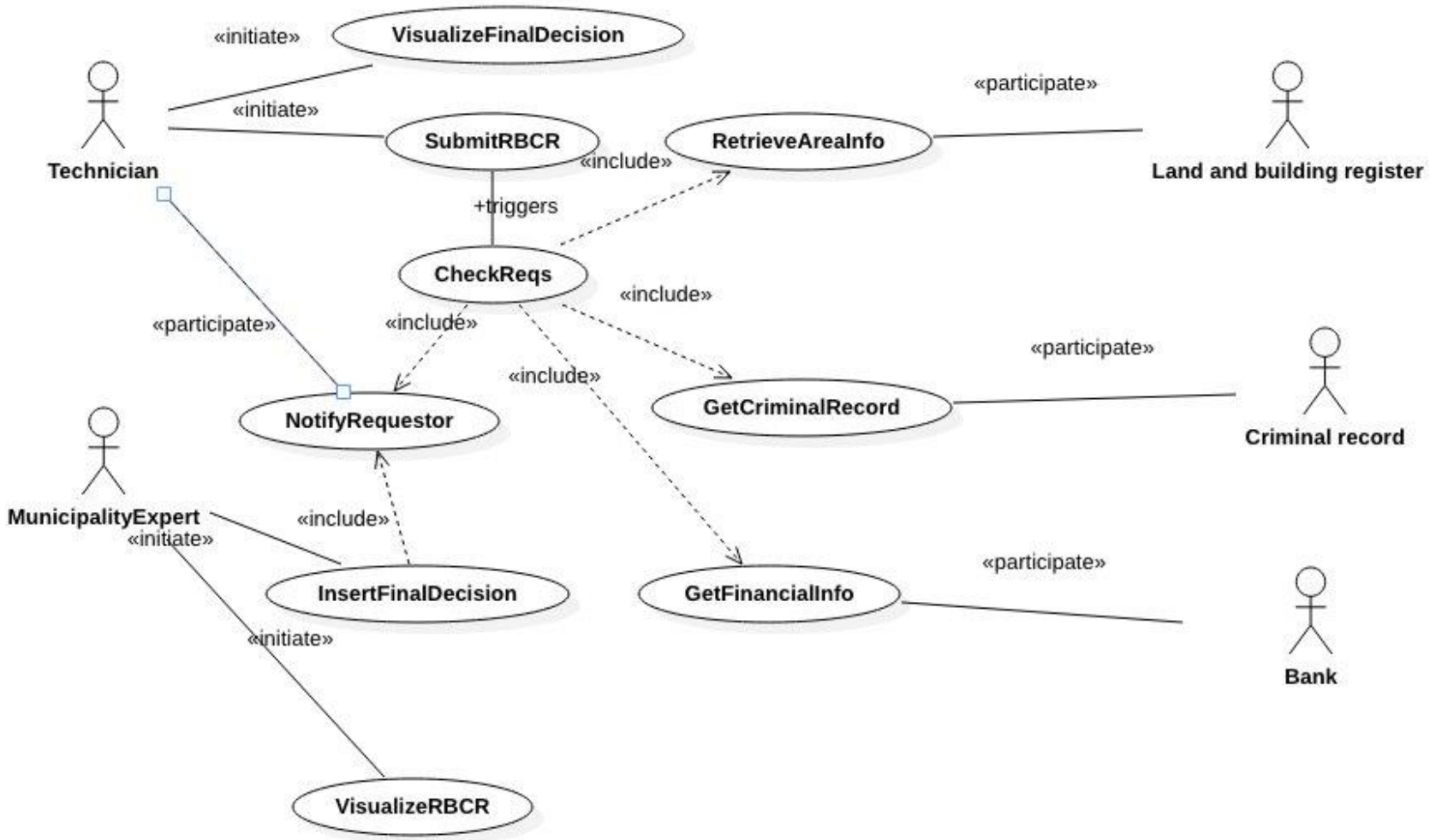
Phenomena

- The company runs the feasibility study (world, not shared)
- The company submits the building request (shared, world-controlled)
- The machine acknowledges the submission
- The machine retrieves the info about the area (shared, machine-controlled) from the **land and building register**
- The machine checks that the area type, occupation percentage and min-max number of floors is ok (machine-only)
- The machine contacts the **criminal record** to check if proponents do not have any record (shared, machine-controlled)

Phenomena

- The machine contacts the **bank** to acquire information about proponents (shared, machine-controlled)
- The machine checks whether the financial risk is acceptable (machine-only)
- The machine informs the operator about the new request (shared, machine-controlled)
- The operator consults the documentation in the system (shared, world-controlled)
- The operator have meetings with colleagues and proponents (world-only)
- The operator inserts in the system the final decision (shared, world-controlled)

Use cases


«initiate»
VisualizeFinalDecision
«initiate»
«participate»
Technician
SubmitRBCR
«include»
RetrieveAreaInfo
Land and building register
+triggers
CheckReqs
«include»
«participate»
«include»
«participate»
«include»
NotifyRequestor
GetCriminalRecord
Criminal record
MunicipalityExpert
«include»
«initiate»
«participate»
InsertFinalDecision
GetFinancialInfo
Bank
«initiate»
VisualizeRBCR

Requirements

- R1: the system shall allow technicians from construction companies to submit a RBCR
- R2: the system shall move the RBCR in the pre-processing stage
- R3: the system shall contact the land and building register to gather information about the area indicated in a RBCR
- R4: the system shall check whether the area is a residential one and reject the RBCR if not
- R5: the system shall compute the area occupation percentage
- R6: the system shall check whether the number of floors, colors and materials in the RBCR are compliant with the area requirements

Requirements

- R7: the system shall contact the Criminal record to acquire information about the technician submitting the RBCR and all top managers in the construction company
- R8: if Criminal record is not empty, the system shall reject the RBCR
- R9: the system shall contact the Bank to acquire information about the construction company
- R10: the system shall add financial information about the construction company in the RBCR
- R11: the system shall add occupation percentage in the RBCR
- R12: the system shall note in the RBCR if number of floors, colors or materials are not aligned with the requirements in the area

Requirements

- R13: after receiving all needed inputs from land and building registry, criminal record and bank, the system shall move the RBCR in the processing state and inform the municipality expert
- R14: the system shall allow the municipality expert to visualize a RBCR
- R15: the system shall allow the municipality expert to insert his/her decision
- R16: upon insertion of decision, either in the pre-processing or in the processing phase, the system shall notify the requestor
- R17: the system shall allow the technician to visualize the final decision when available

Domain assumptions

- DA1: Land and buiding registry, criminal record and bank provide accurate and precise information
- DA2: Information required to land and buiding registry, criminal record and bank is supposed to be immediately available when it is requested
- DA3: Municipality expert finalizes the decision in 10 days from the time the RBCR is moved to the processing state

Exercise 2: PaasPopCoin

- The private security and event organisation company “HSG” from The Netherlands wants to build an application---PaasPopCoin---that handles the coin emission and transactions in the scope of a medium-size music festival they are organizing. The goal of the system is to allow festival-goers and operators to spend an allotted amount of money in relative safety and without the need to bring wallets and other assets around the event. The software in question needs to handle at least three scenarios:
    1. Emission of coins in exchange of money through appropriate cashier desks and Automated Teller Machines (ATMs).
    2. Cash-back, that is, exchange of coins with cash in the same locations (we assume that people at the festival may be willing to receive back the money corresponding to the coins they have not used).
    3. Tracking of coin expenditure transactions at the various festival shops.
- In the scope of the above scenarios, there are several special conditions to be considered.

PaasPopCoin (2)

- First, in the scope of coin emissions, there exist four classes of coin “buyers”, namely: (a) VIPs (e.g., event artists, shop-owners) who receive a 30% discount on the coins they buy; (b) event organisation people (e.g., security guards, event managers) who receive a 50% discount; (c) event ticket holders class A, who receive a 20% discount; (d) finally, regular ticket holders who receive no discount. When buying coins, users first need to authenticate themselves by inserting their own ID card in the ATM or by giving it to the cashier; this allows the system to determine the class to which each coin buyer belongs. After authentication, buyers get the coins upon inserting into the ATM or giving to the cashier the corresponding amount of money.
- Second, also in the context of cash-back, users need to authenticate with their ID card to make sure the appropriate amount of money is given back, considering their role and privileges.
- Third, during the event, every shop clerk keeps track through the PaasPopCoin system of the sales of products and the coins received.
- PaasPopCoin relies on a third-party analytics service to periodically check whether the festival is earning money or not (cost-benefit analysis). Such check is performed with respect to costs of products being sold during the event, as well as the overhead to cover all event organisation and management expenses. Note that reasoning and evaluating these aspects is beyond the scope of the exercise.

First Question

- With reference to the Jackson-Zave distinction between the world and the machine, identify the relevant world phenomena for PaasPopCoin, including the ones shared with the machine, providing a short description if necessary. For shared phenomena specify whether they are controlled by the world or the machine. Focus on phenomena that are relevant to describe the requirements of the system.

Possible world-only phenomena

- User buys Class A ticket
- User buys regular ticket
- VIP is contracted for event
- Event organization is started and contractors registered
- Event starts
- User gives money to cashier (to be converted in coins)
- User gives coins to cashier (to be converted in money)
- User gives ID card to cashier
- User buys some product at festival
- The external analytics service checks the success of an event

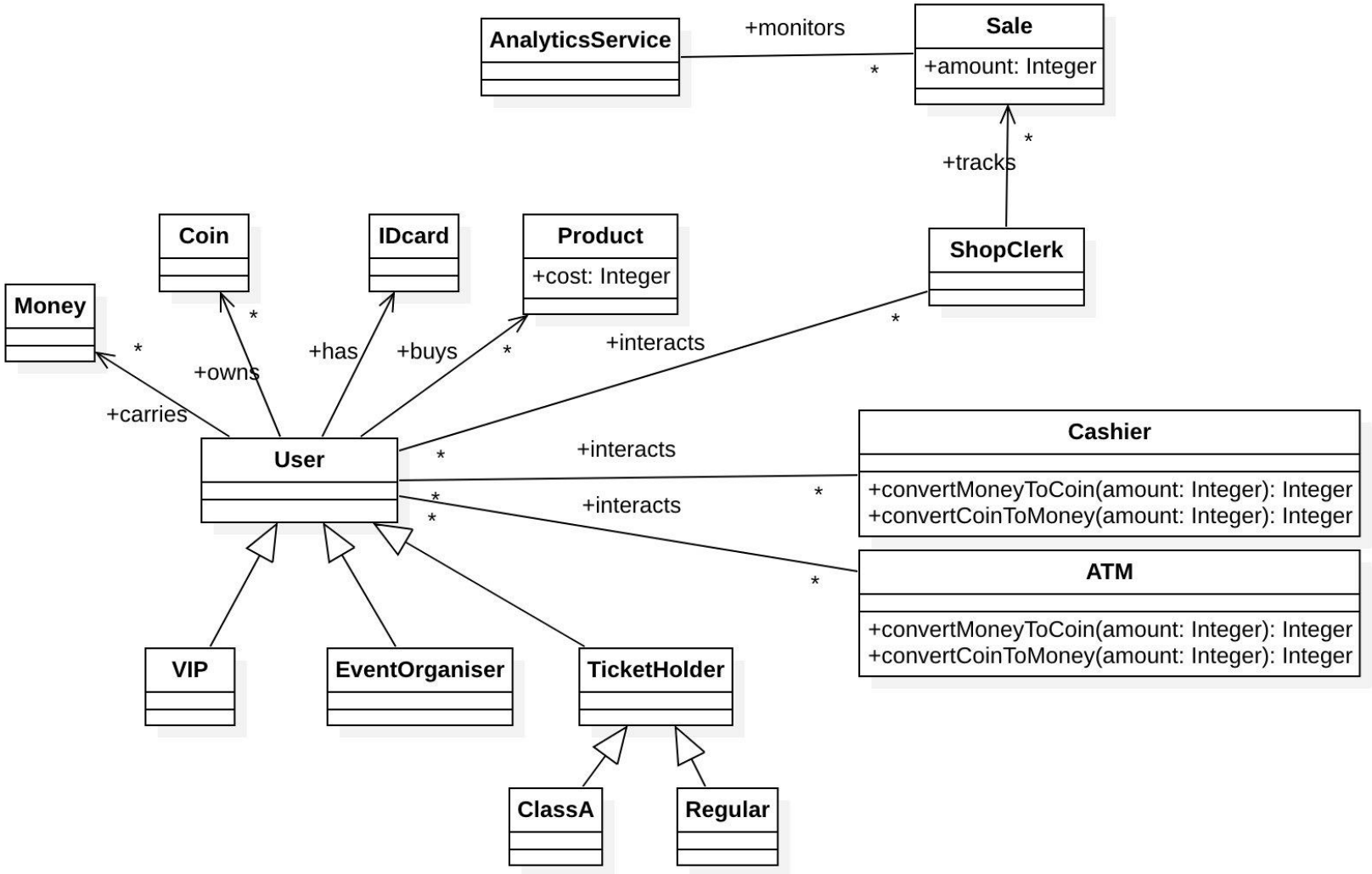
Possible shared phenomena

- World-controlled
  - User inserts money into an ATM machine
  - ID Card is inserted into ATM
  - User inserts coins into an ATM
  - Cashier inserts in the system an ID card number
  - Cashier inserts in the system the amount of money handed by a certain user
  - Cashier inserts in the system the amount of coins returned by a certain user
  - Store clerk inputs in system the amount of coins spent by user in shop
- Machine-controlled
  - The system enables coin emission after checking ID card and inserted amount of money
  - The system enables cash-back after checking ID card and inserted number of coins
  - The system sends data about purchases to the external analytics service

Second Question

- Describe through a UML Class Diagram the main elements of the PaasPopCoin domain.

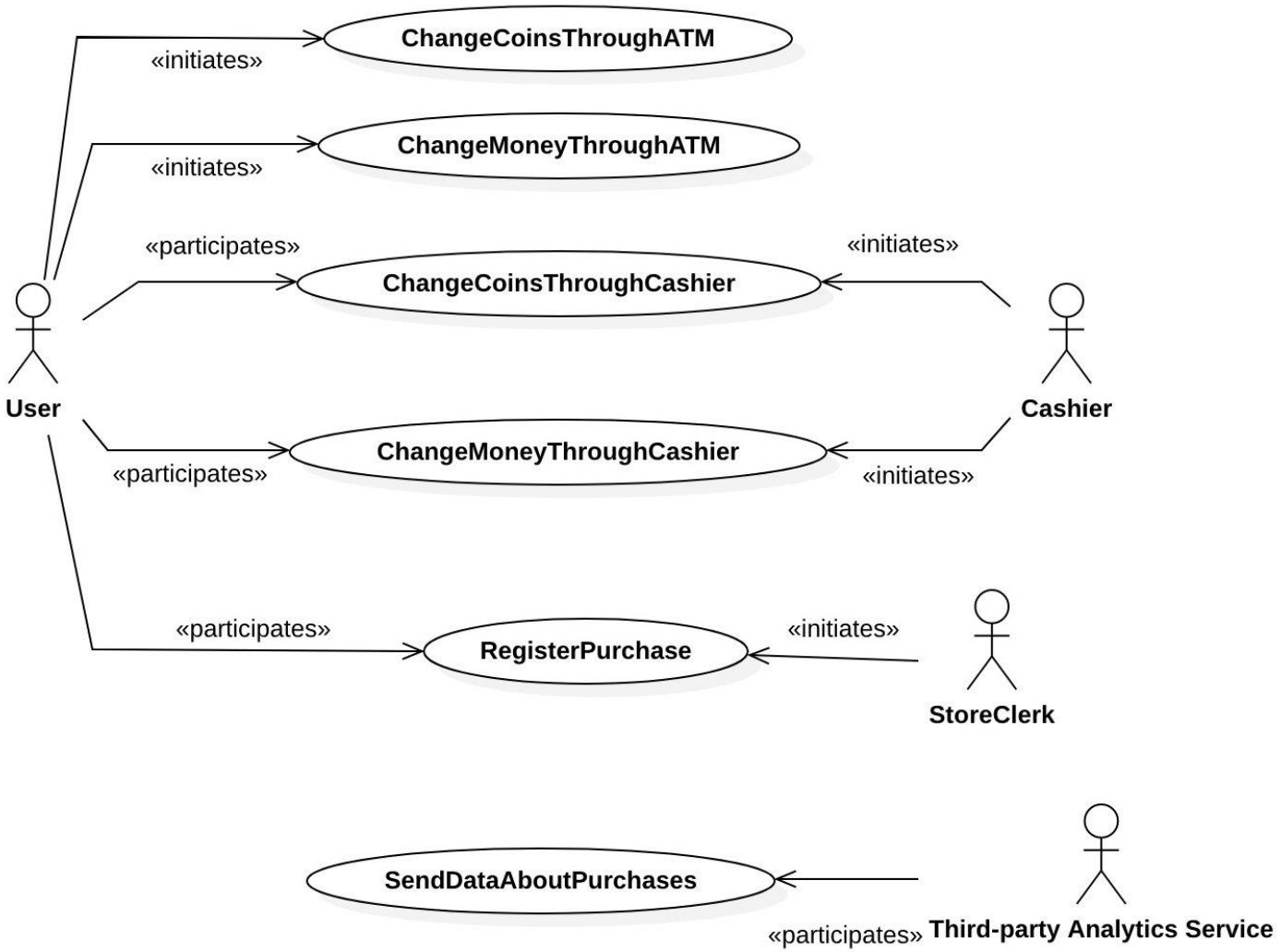
Class Diagram



Third Question

- Define a UML Use Case Diagram describing the relevant actors and use cases for PaasPopCoin.
  - You can provide a brief explanation of the Use Case Diagram, especially if the names of the use cases are not self-explanatory.

Use Case Diagram



Exercise 3: Milk vending machine

- A milk vending machine accepts 3 types of coins: 25¢ (cents), 50¢, and 1$. It accepts coins only in ascending order, for example, after inserting a 50¢ coin, it can only accept 50¢ or 1$ coins and it cannot accept 25¢ coins until the process is restarted by asking for the remaining change.
- Every time the amount of money in the machine reaches (or surpasses) 1$, it produces a bottle of milk, subtracts 1$ from the amount of money that is in the machine, and leaves the rest in the machine.

Exercise 3: Milk vending machine

- At any time, the user can ask for the money still in the machine (and not used to buy a bottle of milk) to be returned (this can occur even if there is no money remaining in the machine); the effect of this is that the process is restarted, so smaller coins can be introduced again.
- The vending machine also accepts fidelity cards. When the user inserts a fidelity card, he/she can buy a bottle of milk for 75¢ instead than 1$. Thus, if the machine receives the fidelity card and the current amount of money is equal to or surpasses 75¢, it produces the bottle of milk, subtracts 75¢ from the amount of money that is in the machine, and leaves the rest in the machine.

The task

- Referring to the Jackson-Zave distinction between the world and the machine, identify world, machine and shared phenomena. For these last ones specify which part (world or machine) is controlling them

Phenomenon	Shared	Who controls it
User wants to buy some milk	N	W
User inserts a coin in the machine	Y	W
The machine compares the inserted coin with the last received one	N	M
The machine rejects the inserted coin	Y	M
The machine accepts the inserted coin	Y	M
User inserts a fidelity card	Y	W
The machine checks and accepts the fidelity card	Y	M
The machine sees that amount needed to buy a bottle of milk is reached	N	M
The machine delivers the bottle of milk	Y	M
The machine updates the current amount of money	Y	M
The user goes home with the milk	N	W
The user wants to receive the money back	N	W
The user asks for the money back	Y	W
The machine delivers the amount of money to the user	Y	M
The machine resets the money count	N	M
The operator sets the current number of bottles in the machine	Y	W
A milk sensor signals the milk in the machine is finishing	Y	W
The machine decreases the counter of the current number of bottles	N	M