

DAT321/DIT847:

Software Quality

Welcome to the examination for the *Software Quality* course. Each question has a number of points assigned shown in the square brackets. When the question is broken down into smaller sub-questions the part of the points for that specific sub-questions are also shown as following:

1. [10 pts].
 - a. [2 pts]
 - b. [8 pts]

The percentage of points and the corresponding grade is presented below (100 points in total):

% of points	DAT321	DIT847
[0, 50%)	U	U
[50%, 65%)	3	G
[65%, 85%)	4	G
[85%, 100%]	5	VG

Instructions about how to submit this exam are found in the Assignments section of Canvas (under the Written Exam Submission page). You must submit a PDF file with your answers. Make sure that you label your answers with the question numbers so we can identify which question your answer is referring to. You can choose any editor to write your answers.

Important: You must write clear, readable, understandable and unambiguous answers. An advice is to refer to the provided software product context used in this exam.

The questions in this exam refer to the **ISO 25010:2011** that categorises internal and external software quality attributes into eight characteristics.

Questions about the exam contact:

Francisco Gomes, tel. 031 772 69 51, francisco.gomes@cse.gu.se

The exam review will be done via Zoom scheduled for:

Date: 2020-11-20 between 09:00 – 10:30.

Zoom Link: <https://chalmers.zoom.us/j/63042185246>

Password: 646191

The questions in this exam are related to the context below. Note that you must justify your answers with i) the theory and terminology from software quality and ii) their connections to the elements in this context (e.g., teams, product, processes, architecture, customers, etc.).

You are hired by an online gaming company called OnGame-Co that creates one of the most popular **competitive online games** with millions of users. The software product for this exam is a real-time action game where several players (i.e., the end-users of the software) work together to beat the opposing team. Examples of similar games are League of Legends, Overwatch, Smite, etc.

Features, business and customers:

In order to engage the community of players, OnGame-Co also developed a launcher platform where players first need to login to access the game. Before starting the actual game (i.e., game lobby), players can hang out, chat with other online players, add friends to play together, and even buy merchandise (t-shirts, accessories, toys) related to the game. To buy merchandise, players provide their credit card information to perform monetary transactions.

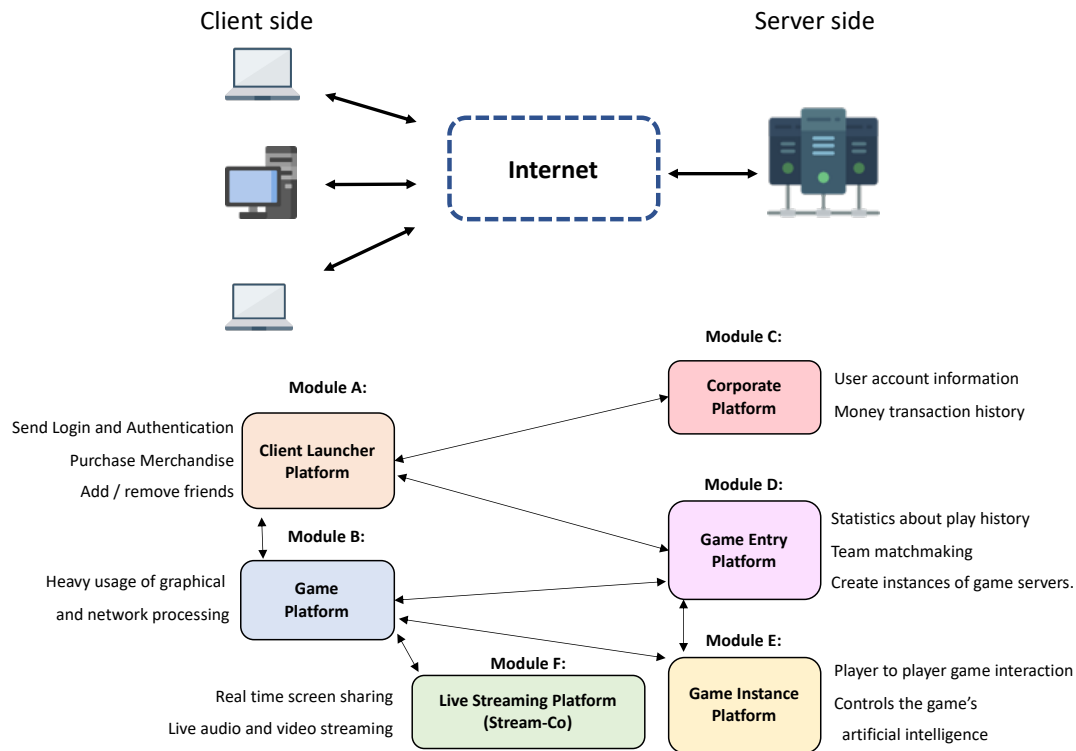
To ensure fairness in their matches, the game platform can create random teams of players with similar gameplay statistics (e.g., choice of characters, level of experience, user profile). This matchmaking feature is an important feature since different team composition is used by the Artificial Intelligence software of the game to adapt the game difficulty to match the player's experience level.

OnGame-Co also has a partnership with another company named Stream-Co that provides a streaming platform so that players can do live streaming of their gameplay. Examples of similar platforms are Twitch or Youtube. Note that OnGame-Co does not develop the streaming platform, but must ensure that its game platform can communicate with the platform developed by Stream-Co.

Design and architecture:

The software product uses a typical Client-server architecture (Figure 1), and players play live using an Internet connection. The game is composed of different modules deployed in different parts of this architecture. Each module's responsibilities are listed below; they are connected to the features of the system listed above. These modules exchange information and also depend on each other for the game to properly function.

Modules A and B are deployed in the client side of the architecture, whereas Modules C, D and E are deployed in the server side of the architecture. Module F is its own platform developed and deployed by Stream-Co. Our only responsibility to it is to make sure the streaming interfaces can communicate with our gaming interfaces to ensure communication between platforms.



Development process and teams:

There are three teams in OnGame-Co. Team X is a team of 50 engineers composed into smaller teams of roughly equal size that work with the server side of the game (Modules C, D and E). Team Y is composed of 30 engineers working in the client side of the game evenly split between Modules A and B. Finally, Team Z is a small team of 4 engineers responsible for creating and maintaining the communication with Stream-Co (Module F).

The three teams are mainly composed of a mix of both junior and senior engineers (developers, testers, architects, managers, UX and game designers) that have used agile methods before. Each team has their own isolated development environment using version control. However, only Team X is doing continuous integration, such that teams Y and Z do not have the necessary tool chain (i.e., automation tools and servers) installed in their development environments.

Software Product – Future plans:

OnGame-Co is aiming to create a **new game** that runs on different hardware platforms including laptops, mobile phones and tablets. This new game is also independent from the existing game. Still, OnGame-Co aims to reuse Modules C and D of their current architecture to save time and costs with software development. Moreover, OnGame-Co aims to create two new teams:

- Team M: Responsible for developing the new client-side Module G for this new game;
- Team T: A small team composed of 5 test engineers whose sole responsibility is to plan, implement and manage all testing strategies for all games developed by OnGame-Co;

1. [30 pts] Using the context above, answer the following questions:
 - a. [15 pts] Choose three software product quality's characteristics, **and, for each**, provide examples of why they are relevant to the software product at OnGame-Co. You can use the features listed in Figure 1 as sources for your examples.
 - b. [15 pts] Choose **one of the features** from the modules in Figure 1 and explain how we can evaluate **the quality of the chosen feature** from three different perspectives, namely, (i) an Internal Quality perspective, (ii) an External quality perspective, and (iii) a Quality in Use perspective.
2. [15 pts] OnGame-Co wants to foster sustainability in ICT. Using the Sustainability Awareness Framework, you must (i) choose or suggest **two features** to the game and explain the (ii) immediate, (iii) enabling and (iv) structural effects of those features. You must also indicate the **corresponding dimension** in which those effects occur.

For this question you are free to choose to modify an existing feature (from Figure 1) or create a new feature. We refer to feature as a functionality in our software product. Make sure to clearly distinguish between the immediate, enabling and structural effects in your answer.

3. [30 pts] Considering the decision to migrate all teams to Continuous Integration and the specific composition of Team T (dedication to testing), answer the following questions:
 - a. [10 pts] Choose two different levels of testing. Considering any of the features in Figure 1, provide at least two examples of test cases for each level of testing chosen.
 - b. [10 pts] OnGame-Co decided to migrate all its teams to develop using Continuous Integration. List **two activities** you would do or teach to the teams before introducing CI. Justify why those activities would be relevant to introduce CI in OnGame-Co
 - c. [10 pts] Introducing CI will affect all teams in OnGame-Co. Particularly for the role of Team T in the development process, list one advantage and one disadvantage that CI will bring. Note that Team T is a team dedicated to testing, so your advantage and disadvantage **must** be connected to software testing.

4. [15 pts] Considering internal quality measures and quality attributes, answer the following questions:
- a. [10 pts] An analysis of the technical debt revealed that all modules need refactoring and have the same debt, such that restoring the maintainability of each module would take 10 days. You only have resources to choose three modules to reduce this technical debt. **Which modules** would you choose and **why**?
 - b. [5 pts] You were asked to design a two-dimensional chart (x-axis and y-axis) to visualise the internal quality of the different modules in Figure 1. Which two quality measures would you show in this chart? Which quality attributes would be easier to understand using your proposed visualisation?
5. [10 pts] Every workday, the Continuous Integration pipeline merges all code commits and automatically builds a version of the game. Those commits vary in size (Lines of Code – LOC) and in which module was modified.

In order to properly plan for the upcoming weeks of development, OnGame-Co wants to predict whether a given build of your CI will fail or not based on the size of the commit made and which module was modified. You are able to collect data from the past six months of modifications to the modules (example of the dataset shown below):

Build status	Size of Commit (LOC)	Module
Successful	120	Module A
Failed	150	Module B
Failed	200	Module A
Successful	85	Module C
Successful	50	Module F
Failed	350	Module D
...		

Write down the *mathematical model definition* for this prediction using *any* variable names and priors of your choice. State the ontological and epistemological reasons for your likelihood. Remember to clearly state and justify the choices and assumptions regarding your model.