

Multimedia Systems Theoretical Q&A

- 1. At a high level, it is possible to identify two main challenges when designing interactive systems: performance and usability. How can this duality be efficiently addressed?**

In order to promote interactivity, both performance and usability should be targeted. The system needs to be effective so that the users can appropriately and efficiently interact with the system, i.e, the system will receive in due time the required input from the user (performance). Yet, this process should be as natural as possible, which is accomplished through the use of human-like communication methods such as speech or gestures. Also the interaction should adapt to individual users, taking in consideration it's limitations or preferences (usability).

- 2. What are the phases of an iterative process design?**

The iterative process design has 3 phases: Design, Implementation and evaluation.

- 3. Indicate one of the major factors to be considered in an iterative design process toward obtaining good results.**

The major factor is the number of iterations. High number of iterations have better chances of delivering apps that meet user's expectations

- 4. What are the steps that should be taken when adopting an iterative design process?**

The iterative design process is composed by several iterations, where the accuracy and correctness increases in each one. The first iteration should be a low fidelity prototype (LFP) and it's advised to test more than one LFP, in order to test different alternatives in parallel and the better ones move to higher iterations.

- 5. Compare in terms of advantages and disadvantages, two techniques for conducting a user analysis**

The goal of user analysis is to know the users, i.e, their problems and requirements, their preferences and expectations and their limitations and constraints. To do so, there are three distinct methods: Observation, Interviews and Questionnaires.

Observation consists on a real environment where a user uses the app while observed. The user is encouraged to think aloud, providing insights about the user rationality behind the usage of the app.

Interviews can be structured, non structured or semi-structured. The first one has a specific interview plan, is more efficient, yet needs preparation. The second method consists on an open talk with the user, which can be inefficient. The third type, has a plan of questions planned, yet, as the interview progress, starts being an open talk. It is more balanced and often the more appropriated.

Questionnaires are a list of questions in the form of multiple choice or rating, to which the participants reply individually. It's useful to obtain information about the viewpoints, values, behaviour and intentions of the participants. In a quantitative approach, closed questions should be used, as there is no subjectivity associated with them, To get a qualitative approach, open-ended questions should be used.

- 6. When performing a task analysis during the iterative design process, is it always possible to conduct it in the same way?**

No. When developing an app, we encounter two scenarios: the app is an improvement of an already existing product or the app is disruptive. In the first case, it's possible to observe how the users interact with the already existing app and try to mimic its actions. On the second scenario, we have to take a different approach since the goal of the application are not yet covered by another app.

7. List and briefly explain two techniques for performing task analysis.

Task analysis involves breaking down the application's functionality into a series of tasks that users need to perform in order to achieve their goals. There are two methods to accomplish this process:

Contextual Inquiry combines interviewing and observation in the user's actual work environment, discussing the actual work products. Implies a strong collaboration between the designer and the user and the designer need to ask concrete questions that involve action from the user's part. The user show the how and explain while the designer watches, questions and registers. Its a master-apprentice methodology.

Participatory Design assumes the user is always right regarding any problem he has with the interface. He presents his difficulties and the designer presents alternative designs to solve the problem.

8. When adopting the “participatory design approach” for task analysis, should the statement “the user is always right” be always followed?

No, only when the user has a problem with the interface.

9. Explain briefly what is “cognitive friction” and how it can be avoided or minimised.

Cognitive friction occurs when a user is confronted with an interface that appears to be intuitive, yet the results are unexpected. This happens when the developed model is not in accordance with the mental model of the user. To minimise this we must adapt a model that corresponds to the mental model of the user, with intuitive procedure that match expectations. The new model should not be confused with something that already exists somewhere else.

10. Is it correct to state that the conceptual model is the first version of the GUI?

No, a conceptual model is an abstract representation of the software's functionality, while a GUI (graphical user interface) is the physical manifestation of that functionality

11. When developing prototypes, how can the amount of effort invested and time be minimised?

To minimise the effort invested and time in developing prototypes and prioritise creating low-fidelity prototypes initially. The feedback give from the users and stakeholder is easier to implement as the phase of the project. This way, if there is something that needs changing, is less costly to do it in earlier phases of the project.

12. List the types of prototypes that can be developed and indicate some pros and cons of each one.

There are four types of prototypes:

Horizontal: Completed interface with no actions implemented. Allows the user to test the interface, yet we get no feedback on the functionality of the app.

Vertical: Limited interface, with actions implemented. We don't get to test neither all action or interface yet we get a complete feedback on what was tested.

Low Fidelity: Artistic representation with many missing details. Good for early prototyping, yet very incomplete.

High Fidelity: Very similar to the final project. Hard to implement, yet represents a good version of the final project.

13. Explain the benefits of developing storyboards when prototyping mm applications.

Storyboards help the developer to identify task that he needs to include in the prototype and also select come objects that he'll need to implement in order to complete each use case. Besides that, also helps you identify usability issues and to communicate ideas to the investors.

14. How many persons should be involved when carrying out tests with prototypes? What are their roles?

There should be at least three people involved with the following roles:

Facilitator: Explains the interface and conducts the test.

Computer: Knows the program and simulates answers without giving explanations.

Observer: Annotates reactions and recommendations.

15. Indicate the benefits of using UML to describe software multimedia applications.

UML enables to describe the software and systems. Its a well established system with formal rules, therefore universal and anyone can understand.

16. Both functional and operational requirements may be defined for multimedia software systems. Explain the difference and indicate which ones are relevant for the UML tools.

Functional and operation requirements address different characteristics of a system:

Functional: Describe what the system is supposed to do. Describes the features and functions. They can be represented in use case diagrams, user stories or data flow diagrams.

Operational: Describe how the system works and how it is implemented. Address topics like infrastructure, performance and security. Can be represented in sequence diagrams, state diagrams or class diagrams.

17. What is the biggest challenge for multimedia streaming services in best-effort networks?

Best-effort networks do not guarantee any Quality of Service. Their main challenge is the variation in the delay - Jitter. They can't predict congestion nor available bandwidth.

18. Define “joint optimisation” in the context of streaming in best-effort networks.

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19. What are the factors that contribute the most to degrade the quality of experience in video streaming applications?

Delay, jitter, erros and losses.

20. What are the classes of mechanisms that can be implemented by the application to minimise the occurrence of transmission errors?

Error correction, error detection and error resilient coding (as MP3).

21. Would you say that errors and losses are likely to have the same perceptual impact regardless of the type of algorithm used for compressing video? For instance, all intra versus predictive video encoding schemes.

No, in intra encoding each frame is coded individually, therefore there is no propagation of error. In predictive encoding, the frame are coded based on the previous frames, therefore an error on a frame will propagate to the next frames.

22. How can errors propagate in a video sequence?

If the coding is predictive, the errors will propagate to the next frames.

23. HAS defined a new paradigm to address bandwidth congestion variability in relation to traditional steaming. Please explain this new paradigm.

In HTTP Adaptive Streaming (HAS), instead of being the network to accommodate the requirements of the application, is the application that accommodates to the availability of the network.

24. What are the goals of HAS?

The goals of HAS is to allow dynamic adaptation of the multimedia presentation according to the network various parameters. Also enables of the same content among several sources to support scalability, error resilience, bandwidth congestion.

25. What are the principles on which HAS is based?

HAS generates multiple variations of the content and divides them into fragments them into segments and assigns to the client the freedom of independently download rearrange and decode such segments.

26. When building the different quality/bit rate versions in a HAS server, what are the constraints that need to be observed so that it is possible to switch between versions at the segment level?

27. Explain how live streaming is supported in HAS protocols.

The server encodes multiple versions of the multimedia presentations, divides them into segments and creates playlists that list the segments for each version of the video. The master playlist lists the available versions of the video and the URIs of their associated media playlists. While the media playlist lists the URIs of the segments for a specific version of the video.

To play a HLS stream, the client first obtains the master playlist from the server and then obtains and plays each media file in the playlist

28. Explain briefly the steps taken by a HAS client to start playing a movie.

Second paragraph of the last question.

29. Explain briefly the operations that need to be performed on the server side by a HAS service.

First paragraph of the last question.

30. What is the goal of the ABR algorithm in a HAS client?

The goal of ABR, Adaptive Bit Rate, is to select the optimal bit rate for the current network conditions and user preferences. This ensures that the video is played smoothly and without buffering, while also maximising the quality of experience (QoE) for the user.

31. What is the main challenge for HAS in live streaming services?

Handling sudden changes in network conditions.

32. Explain briefly the solution implemented in the HAS protocols to minimise latency in live streaming.

Each media segment is fragmented into smaller chunks. Each chunk can be delivered as soon as it is available and a player can start rendering a segment right after its first chunk is received. The latency is thus reduced from the segment level to a chunk level causing the minimum latency to reduce from one complete segment period to one chunk period (from 10 seconds to a few hundred milliseconds).

33. Does the solutions developed for low-latency HAS allow to reduce the switching latency?

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34. Is it correct to say that in HAS, a good QoE is ensured as long as the playout continuity is ensured?

No, because HAS doesn't ensure factors such as video quality, resolution, and latency. Even though it cause minimise them, if the network is too week, there nothing the algorithm can do to ensure a user satisfaction.

35. Explain why ABR algorithms in low-latency HAS have more stringent requirements.

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