2023 EXAMINATIONS

Lancaster University

Part II

COMPUTING AND COMMUNICATIONS – On-line Assessment [2.5 Hours]

SCC.306 INTERNET APPLICATIONS ENGINEERING

---

*Candidates are asked to answer **THREE** questions from **FOUR**; each question is worth a total of 25 marks.*

Lancaster University

Question 1

1.a. When considering the security of a website what broad classes of threat actors could be considered defending against and which of those threat actors are appropriate to defend against?

[3 Marks]

1.b. You have been recently employed by an organisation called ask.com who performs representative surveys of views held by people in different countries. They have tasked yourself to investigate the security of their website at http://ask.com.

i. What security issues exist because parts of their website are loaded over HTTP.

[3 Marks]

ii. When using HTTPS it is found that a large number of weak TLS 1.2 cipher suites are in use. Explain the security issue that exists when using weak cipher suites. Explain why a website that needs to have a broad international reach may choose to continue supporting weak cipher suites and what trade-off ask.com is making.

[3 Marks]

1.c. ask.com are currently considering a redesign of their survey interface presented to users. Sketch the structure of a **single page** of a website that presents questions to users and asks for their responses. You should include **three** main pieces of functionality on this page and indicate where this functionality is located on the webpage. Describe the interface and what steps you will take to ensure that it is enabling for different accessibility requirements.

[7 Marks]

1.d.

i. Considering that you are doing a visual redesign which may entail backend changes, what is **one action** you could take to ensure that you have not introduced new vulnerabilities by changing the website's implementation?

[1 Mark]

ii. Present an argument as to why this is a suitable action to take.

[2 Marks]

Question 1 continues on next page…

Question 1 continued.

1.e. ask.com have decided that approaches to ensure the security of their website are too expensive and will not be proceeding with these changes. You are aware of a vulnerability that means sensitive information on participants is accessible publicly on their website. Due to the cost to fix the issue, ask.com has chosen to not address it.

i. If you chose to blow the whistle are you protected under UK law and if so which law?

[2 Marks]

ii. Considering that your employer does not plan to address the security vulnerability identified. What **two** possible risks are there in disclosing the existence of the vulnerability?

[2 Marks]

iii. What action could you take to deter the organisation from their choice to not address the issue? What is the intended outcome from the action you take?

[2 Marks]

[Total 25 Marks]

Lancaster University

Question 2

2.a. Explain the difference between performance and scalability. Use the different metrics to quantify performance and scalability of web sites to highlight the differences.

[5 Marks]

2.b. Over the next decade there will be a large increase of connected vehicles on roads. These vehicles will need internet-connected services to scale to meet the demand of this eventually large number of vehicles.

i. Explain the difference between scaling via monolithic and microservice architectures and identify which could be more appropriate for this scenario.

[3 Marks]

ii. As there are currently not many connected vehicles in use, there is no immediate need for service to accommodate a large number of vehicles. Draw a diagram of a scalable backend infrastructure of microservices for connected vehicles reporting and receiving reports of incidents on roads. You may assume that there is an API via which vehicles can subscribe to notifications and receive updates of incidents. Focus on functional aspects of the system and via what protocols or mechanisms they will interact.

[5 Marks]

iii. Explain how you have employed **four** of the principles of cloud architecture in your solution to question 2.b.ii.

[4 Marks]

2.c. Due to this service being used to deliver a safety feature for connected vehicles it is important that the system is implemented correctly.

Using the natural language tests that the Cypress framework provides, write a test that checks 1) given vehicles that are subscribed to notifications, 2) when an incident occurs on a road, 3) then subscribed vehicles are notified of the incident.

You should not specify implementations for natural language strings. You should explain which elements in a natural language string are variables and the intent of each clause in the test case.

[8 Marks]

[Total 25 Marks]

Question 3

When developers design and create internet web-based applications they need to consider designs and implementation that can optimise a website's performance to networked clients and provide a good user experience.

3.a. One of the parameters that impact on performance and a good user experience is latency. Latency is a measure of the time delay experienced by resources requested from webservers before the content can be displayed in the browser.

List the main factors that contribute to latency when fetching content from a Webserver?

[4 Marks]

3.b. When analysing request from a Website, it is often important to view the timing of requests in relation to one another displayed by a waterfall when inspecting network activity. Further, it is possible too to view the timing breakdown of each phase in a request. Using the following three runs of network activity screen-shots taken from the Lancaster University Website: www.lancaster.ac.uk **shown in Figure 3.1 below**, explain the significance in time required for a given request relative to the total time for the following phases:

- Queueing
- DNS lookup
- Initial connection
- Waiting (TTFB)
- Content Download

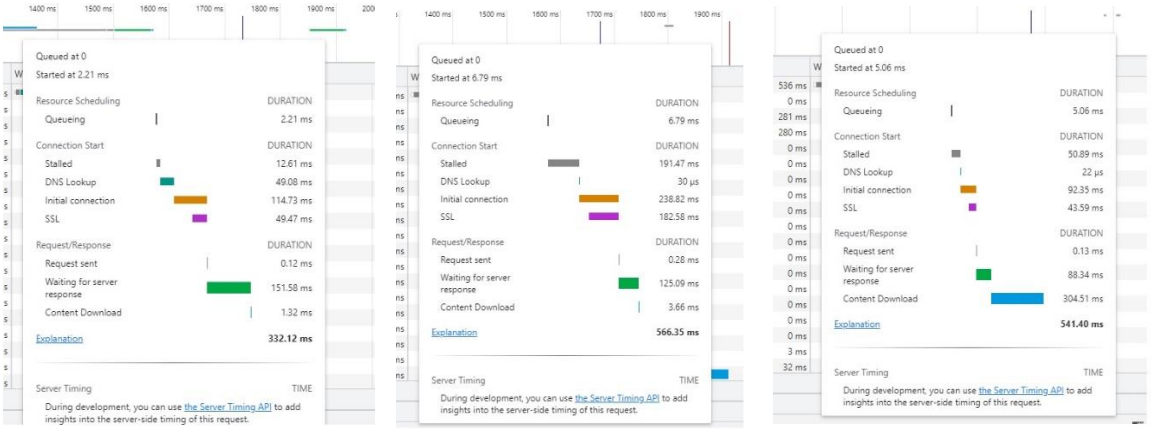

Figure 3.1: Time breakdown phases of three consecutive runs of www.lancaster.ac.uk main page

[9 Marks]

Question 3 continues on next page…

Question 3 continued.

3.c. You are the product owner for a website serving multimedia content to users. This website has been designed to be highly scalable in order to ensure fast delivery to users.

i. The current webservers supporting this system have been configured to deliver resources using HTTP/1.1.
Explain the advantages, connection wise, provided by HTTP/1.1 over older HTTP application layer protocols.

[6 Marks]

ii. In order to further optimize its Web-based applications and improve performance, the organisation has decided to adopt the HTTP/2 protocol.
What advantages would this version of HTTP provide to support the company's webservers over previous HTTP versions?

[3 Marks]

iii. What are the limitations of HTTP/2 and how are they addressed by potential solutions proposed by future versions such as HTTP/3.

[3 Marks]

[Total 25 Marks]

Lancaster University

Question 4

This question focusses on Web design layouts, Web performance and the utilisation of user-centric metrics to optimise performance and the user experience.

4.a. Intrinsic Web Design is a new way of building layouts for the web. Compare this approach to Responsive Web Design. Include in your answer the example of how a set of content items are displayed on a landing page, each of different sizes. Consider in your answer different screen widths.

[6 Marks]

4.b. What **four** observations could be made about a website with good performance? Provide **three** reasons explaining why web performance matters.

[7 Marks]

4.c. Largest Contentful Paint (LCP), First Input Delay (FID), and Cumulative Layout Shift (CLS) are three important user-centric metrics when viewing a webpage. Describe what is being measured for each metric and any associated score values that are recommended to provide a good user experience.

[3 Marks]

4.d. For Largest Contentful Paint (LCP), explain how this metric could be negatively impacted?

[2 Marks]

4.e. For First Input Delay (FID) and Cumulative Layout Shift (CLS), explain the methods used to measure both metrics.

[2 Marks]

4.f. What actions could a web developer take to improve all three metrics: LCP, FID and CLS? in order to provide a good user experience?

[5 Marks]

[Total 25 Marks]

---End of Paper---