Instructions

There are 15 short questions, each of 3 marks, and 2 programming questions each of 15 marks. Write the short answers in a single text file along with the corresponding question number, and upload it in the Google Form. Also, upload the code in the designated places as a zip files.

Short Questions

1. Consider a function that needs to access the /proc filesystem of an Android device. A developer decides to write it in native code. On a freshly purchased smartphone, would it function? Justify.

No, it would not function properly – 1.5 mark
Access to /proc filesystem is disabled / rooting of phone needed to access – 1.5 mark (2nd part only accepted if the first part is right)

2. Assume that a visually challenged user wants to use their fingerprint to utilize additional gestures. Which feature of Android can be utilized to enable this? Does this need to be coded using native code?

Need to use Accessibility Service – 1.5 mark
Native code not needed – 1.5 mark (2nd part only accepted if the first part is right)

3. Consider an IoT device that is released into the market with the same default password. Is this setting fine, or is it likely to lead to some problem? If it could lead to some problem, then what could be the problem?

Could lead to problems – 1 mark
Easily break into large number of such devices by attackers – 2 marks (2nd part only accepted if the first part is right)

4. Consider a function that is likely to lead to high energy and time consumption. How would an offloading framework deal with it, and what is the systems technique that it would use to do so?

Offloading function would try to run the function on the cloud – 1.5 mark
Utilize remote procedure call – 1.5 mark (2nd part only accepted if the first part is right)

5. Suppose two apps within Android decide to use FIFOs/named pipes to communicate with each other. Is this possible, and if so, write a short code to explain how to do it. If not possible, then explain which feature of Android stops it from doing it.

Not possible to use FIFO for communication across apps – 1.5 mark
Security / Sandboxing prevents it – 1.5 mark

6. Is it possible to set up an Android device with a different bootloader, while retaining the warranty on it? Why or why not?

Different bootloader voids warranty – 1.5 mark
Because Android devices add a signature to the bootloader – 1.5 mark

7. GPS provides a best accuracy of 1 meter today. Is it still possible for LocationService to give better accuracy than 1 meter? If so, using which function and how?

Possible to get higher accuracy – 1 mark
Using fused location / combining with other sensors like gyroscope – 2 marks

8. Suppose you run SensorManager when the app is in the background. Does this create any extra problems, and if so, what is it?

Higher power consumption – 1.5 marks
Sensors will be used throughout – 1.5 marks

9. Assume that you want to use native code from Java (not necessarily using Android). How is it possible for the Java code to know the existence of the C functions? Is there any specific code snippet used for this purpose?

The C functions must be compiled into a library – 1
Then, the java needs to use loadLibrary(<library_name>) – 1
Each function must be declared using native – 1 (give mark for each individual component)

10. Suppose you are using a companion app to communicate with your smartphone. What is the most likely network technology that is being used? What are the problems an alternative technology could have created?

Bluetooth – 1.5 marks
Alternative network technologies like WiFi consume more power/energy – 1.5 marks

11. Suppose a user runs an app, which attempts to read a file that it is not allowed to. The user then changes the ownership of the file to itself, and tries to provide the required permissions. Is this likely to work? Why or why not?

This is unlikely to work – 1 mark
In Android, users cannot change the ownership, as file ownership is by apps – 2 marks

12. Assume that a user wants to use machine learning to predict the words that they use, but does not want to send each typed key to the cloud. Assuming that a smartphone does not have the compute capability to train the model, is there any technique to enable this facility? If it is possible, then you must name the technique.

Possible using federated learning – 3 marks

13. Consider a case in crowdsensing where a particular device decides to send malicious information. Is this usually considered a possibility in crowdsensing, and how are such problems analytically modeled?

Possible – 1 mark
Modeled as Byzantine faults / randomly gives incorrect outputs – 2 marks

14. Consider an app that has to run multiple neural networks, some with high accuracy and others where high accuracy is less required, but quick results are essential. The smartphone has an offloading framework, as well as NPUs and the usual CPU. Where should the neural networks be executed to satisfy the requirements?

High accuracy – Offloading framework – 1.5 marks
Low accuracy – NPU – 1.5 marks

15. Assume that you have two smartphones in your pocket. You are measuring the number of steps taken using each of them. Each of them can give slightly different results. How would you identify the number of steps using the least amount of estimation error?

Using weighted sum of the two results / sensor fusion – 3 marks

Programming Questions

1. Write a program to hard-code two matrices of dimension 3x3 and compute its product in **native mode**.

- Declaration of native function and loading native library in Kotlin / Java – 5 marks
- Writing of C function that (i) accepts the matrices as input, and sends a matrix as output. Check whether conversion of the matrix for sending into the function is valid – 5 marks
- Checking if three loops are used to compute the matrix product in C code – 5 marks

2. Write a program that shows the exact entry and exit routes to take if you want to go from our campus to Lotus Temple.

- Check whether any location/mapping/geofencing service is used (possible that one uses some sort of template function too) – 5 marks
- Check that the user activity can show a list of directions – 5 marks
- In addition, check that the Kotlin/Java function iterates over the list – 5 marks

Assigned

Programming 1 – Najiya
Programming 2 – Rohit, Vedant
Questions 1-3 – Abhishek
Questions 4-6 – Amey
Questions 7-9 – Aryaman
Questions 10-11 – Atishay
Questions 12-13 – Shraman
Questions 14-15 – Vedant

Final Examination Question Paper

Shraman, Vedant, Najiya – Midterm
Najiya, Rohit, Vedant – Finals
Makeup – Atishay