COMPUTER SCIENCE TRIPOS Part II – 2021 – Paper 9

11 Mobile and Sensor Systems (rkh23)

(a) Contrast the measurement of biosignals from conventional medical devices with those from smartphone and wearable device sensors. [5 marks]

(b) A researcher wishes to screen users for the hand tremor symptom via a smartphone app. They recruit a cohort of people with diagnosed tremor and a control cohort about which nothing is known. The researcher has a smartphone that collects data from its sensors. They give it to each participant and ask them to hold it as still as they can while sitting. The researcher then uses the data captured to develop a tremor classifier that has sensitivity 0.97 and specificity 0.99.

   (i) Why is getting a high specificity a particular priority for a smartphone-based screening app? [4 marks]

   (ii) Explain why the prevalence of the disease must also be taken into account in deciding whether to deploy this app, illustrating your answer by considering tremor prevalences of 0.1% and 5%. [3 marks]

   (iii) The smartphone app is deployed. It asks users to test their tremor monthly at home, when sitting and trying to hold their phone still. Why might the screening be less effective than expected from the collected data? [3 marks]

   (iv) The researcher changes the app to do background tremor screening. The app now constantly monitors for the user holding the phone appropriately. When it observes this it captures sensor data and applies the tremor classifier. Discuss the advantages and disadvantages of this approach compared to the previous approach. [5 marks]