**Q1. Consider a person who mostly stays at home and occasionally gets out. The person has a smartwatch in his possession. The smartwatch has access to GPS data. The GPS is sampled every 3 seconds. The watch has to communicate with the smartphone to receive calls. If the connection between the smart watch and the phone is not good then calls get dropped. Whenever the smart watch observes that the person has moved 5m from his home position the watch bumps up the radio power to ensure good call reception. At low power the call drop rate is 0.2 indoors, i.e., 2 out of 10 calls are dropped however at high power the call drop rate is 0.01 indoors. Whenever the person is outside, the call drop rate increases by 10% with respect to indoor call drop rate. From the GPS data the smart watch has developed a mobility model of the person. Every 1 second, the probability that the person is inside the house i.e., P(x < 5m) = 0.7. Consider that the smartwatch is initially in a low power mode. Calls arrive at the rate of 1 call per second.**

**What is the worst case expected call drop rate for a 6 second period? (5 points)**

**What is the best case expected number of call drops for a 6 second period? (5 points)**

**2. We are in the age of semi-autonomous cars, where the driver is in control most of the time, but during critical scenarios when the system understands that the driver is incapable of taking actions, the car takes over the decision making. In such a system, consider a brain mobile interface application that assists drivers in a freeway by monitoring their drowsiness. The driver wears a Neurosky headset that senses brain signals (EEG) at 500 Hz. Each brain data point is a 32 bit floating point number. The brain signal is collected by a smartphone and sent to a server, where complex machine learning algorithms are employed to determine the drowsiness level of the driver. In addition, the car is equipped with sensors on the wheel and 360 camera, which are again interfaced with the smartphone of the individual. The data rate from the sensors is 2 kbps, while that from the camera is 200 kbps. Using such data the driver assist system also attempts to predict impending accidents. If the driver is detected to be drowsy and an impending accident is predicted, the driver assist system should react with some actuation, either automatic braking or steering. The driver assist system only has 3 seconds to decide after collecting 5 seconds worth of data. There are two options for performing all the related computation: a) use a datacenter, and b) use a fog server such as a laptop with internet connectivity that is travelling with the driver. The datacenter upload speed is 1 Mbps, while that of the fog server is 3 Mbps. However, computation speed of the datacenter is 750 kbps, i.e., it can finish the computation on 250 kb of data in 1 second, on the other hand the fog server has a computational speed of 400 kbps.**

**Which server should be used by the driver assist system and why? (10 points)**

**3. Consider three smartphone applications each consuming data at the rate of 6kbps, 10 kbps, and 4 kbps respectively. Given full CPU bandwidth app A finishes in 10s, app B in 20s, and app C in 15s. The maximum speed of the smartphone processor is 15 kbps, i.e., it can compute on 15 kb of data and give results in one second. Find out the when will each app finish execution. (5 points)**

**Q4: Consider a Mobile Computing student who does not bother to come to class often. But when he does bother he uses his Bluetooth headphone to connect to his smartphone and he listens to music (or some other stuff). In the spirit of Mobile Computing the student develops an app which automatically connects to Bluetooth when he comes to class at 4:30 pm Mondays and Wednesdays. But since he does not come to class often so there are many occasions where he does not have his Bluetooth with him at home (or wherever) during class times and when he tries to listen to music (or stuff) the phone automatically connects to Bluetooth. The student then has to manually intervene, which is annoying. Below is a log of his attendance**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **T** | **T** | **T** | **F** | **T** | **F** | **T** | **F** | **F** | **F** |
| **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **F** | **T** | **T** | **F** | **T** | **F** | **T** | **F** | **F** | **T** |

**Model the attendance of the student using a Markov chain. Consider two states attendance = T and attendance = F. Write the state diagram of the Markov chain. (5 points)**

**On an average how many times out of 100 does the student gets annoyed with the Bluetooth connection operation? (5 points extra credit)**

**Q5. Consider a mobile phone user who is moving back and forth between two fixed cells. Consider that there are n location registrars. A registration area based architecture will divide the entire area into n subareas. While a tree based replication architecture with n location registrars will have the area divided into p different subareas where p is the total number of leaf nodes. (8 points)**

**a) Which architecture will have the least best case update cost and Why? (2 points)**

**b) Which architecture has the highest worst case update cost and why? (2 points)**

**c) Which architecture has the least best case search cost and why? (2 points)**

**d) Which architecture has the highest worst case search cost and why? (2 points)**