IIT Kharagpur
Dept. of Computer science and Engineering
Smartphone Computing and applications (CS60009)
End semester examination

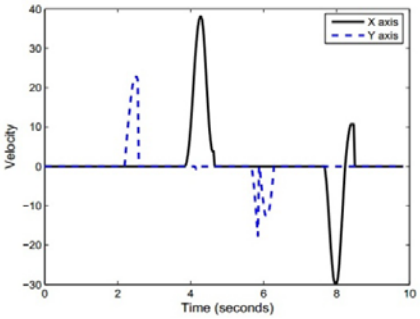
Time-3hrs

1. Suppose, we need to transfer 3 frames in 6 slots. As the channel conditions are constantly changing, the energy required to transfer a frame in a slot is not a constant. The energies required to transfer a frame at each of the 6 slots are the following: slot 1=1000 mJ, slot 2=1500 mJ, slot 3=700mJ slot 4=500mJ, slot 5=2000mJ and slot 6=110mJ. The tail time (time during which Radio-card is ON after sending a frame) is half of the slot time and Tail Energy is 600 mJ.

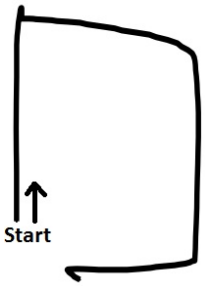
Using the dynamic programming algorithm proposed in the "BARTENDR" system OR otherwise (Hint: there are 20 options), schedule the frames in the optimal slots to minimize the total energy.
(Assume that NO in between tail energy is lost if two frames are scheduled consecutively)

(6+2)

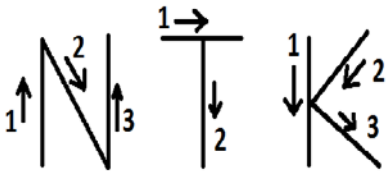
2.



(A)



(B)



(C)

i) If (A) is the accelerometer readings for X and Y axes while drawing (B) in air. Find the accelerometer readings (X & Y axes) for writing "NTK" in air according to the stroke directions specified in (C). (3)

ii) Suppose, a word is detected by "Phone Point Pen" (P3) as "ITILL" and according to the P3 aware spelling checker the closest matches are "HILL" and "STILL". Find the edit distances of these two words from "ITILL" and which one do you think should be the correct choice as the corrected word? (2)

3. i) Suppose, a car c_1 is using the "Carsafe" app and there is another car c_2 in front of it. In the picture taken by the camera, the pixel heights of c_1's front-most point is 10 units and c_2's rear-most point is 25 units. The focal length of the rear camera and the Smartphone mounting height are 50 units and 2000 units respectively. Now, if c_1's front-most point is actually at 2500

units horizontal distance from the camera, what is the actual horizontal distance between the camera and c_2's rear-most point? (7)

ii) State 3 ambiguities the “RiskRanker” has to deal with while doing first order medium risk analysis? (3)

iii) What are the needs of checking "unsafe Dalvik code loading" module in the second order risk analysis and how is the checking done? (1+1)

iv) Suppose there is a commercial IEEE 802.11 radio (WiFi) operating in two states–a normal ’active’ mode and a Power Save Mode(PSM), P_a=950 mW is the power needed in active state and P_i=250mW is the power needed in the Power Saving Mode (PSM). Lower bound on the minimal idle time Th_{idle} = 100ms. Mode-switching energy E_{switch} = 14 µJoule.

For sending a data of size 10 MB at a sample frequency of 100 samples/second with sample size 1KB over a 100KBps channel, how much energy will be spent? (3)

v) Android makes use of a virtual machine as its runtime environment in order to run the APK files that constitute an Android application. State one advantage of this approach? (2)

4. Consider message anonymization using personalized location k-anonymity model. The system consists of a message perturbation engine which anonymizes the messages. Let a message m be defined as

<u_id,{x,y},k,{d_x,d_y},C>(ignore the time dimension).

(u_id - user id, {x,y}- location coordinates, k - anonymity level, {d_x,d_y} - spatial tolerances, C - content)

Consider four messages m_1, m_2, m_3 and m_4 are present in the system.

m_1 = <1,{4,5},2,{3,4},C1>, m_2 = <2,{2,6},3,{4,4},C2>, m_3 = <3,{8,10},2,{2,2},C3>,

m_4 = <4,{5,7},3,{5,5},C4>

a) Draw the constraint box for each message.

b) Which set of messages can be anonymized together?

c) If such a set exists then find the extent of the spatial cloaking box. (4+2+2)

5. Consider the distance matrix given below. Each entry (i,j) in the matrix represent the distance between i and j . The graph is undirected. Considering the least-action-trip-planning algorithm and the start vertex s=p_1, determine the order in which the vertices are visited and also the total distance covered. Assume the distance function to be d^{-a} where the value of a is infinite. (5)

	p_1	p_2	p_3	p_4	p_5	p_6	p_7	p_8
p_1	-	6	5	8	∞	∞	∞	∞
p_2	6	-	4	7	5	∞	8	∞
p_3	5	4	-	∞	7	6	8	∞
p_4	8	7	∞	-	∞	5	∞	8
p_5	∞	5	7	∞	-	5	∞	7
p_6	∞	∞	6	5	5	-	∞	6
p_7	∞	8	8	∞	∞	∞	-	9
p_8	∞	∞	∞	8	7	6	9	-

6. (a) The automatic tagging system TagSense makes an assumption that the people in the picture roughly face the camera and hence the direction of their compasses will be complementary to the camera's facing direction. Thus by analyzing this, TagSense expects to tell who all are in the picture. The challenge is that the user and her phone may not be facing the same direction. It needs to calculate the angle between the user's facing direction and her camera. If the camera angle is 60^o and the compass angle is 45^o, calculate the angle between user's facing direction and her camera.

(b) Suppose the users x_1, x_2, x_3, x_4, x_5, y_1, y_2, y_3, y_4, y_5, z_1, z_2 went to a place x_1, x_2, x_3, y_1, y_3, y_4 and z_1 were pictured together in a photo. TagSense tagged x_1, x_2, x_3, y_2, y_3, y_5, z_1 and z_2 in the photo. What is the precision and recall of TagSense in this case?

(3+1+1)

7. (a) A node wants to download 2000 kB of data and is willing to incur a cost of 1000 units. The system allows collaborative download and there are 6 other nodes in the system who have sent their bid and their WWAN speeds. They are specified in the table given below. The initiator node will recruit 3 collaborators. If the initiator uses threshold-based group selection criteria then which of the above 6 will be selected as collaborators by the initiator.

	bid	WWAN speed
Node_1	0.4 units/kB	12.5 kB/sec
Node_2	0.8 units/kB	20 kB/sec
Node_3	0.3 units/kB	10 kB/sec
Node_4	0.4 units/kB	2 kB/sec

Node_5	0.2 units/kB	5 kB/sec
Node_6	0.1 units/kB	1 kB/sec

The file is divided into 8 chunks of equal size. Once the 3 collaborators are selected they will download parts of the file for the initiator. If the "work-queue algorithm" is followed then how much cost will be incurred by the initiator for downloading the whole file. (3+5)

(b) Consider an initiator willing to download a file of size F and is willing to incur a cost of C. Each collaborator i downloads a chunk of size x_i with bandwidth B_i where N is the number of distinct I-am-Alive (the number of bidding collaborators) messages received by the initiator. Pose the group selection criteria as an optimization problem. (4)

8. (a) Outline of the architecture and components of MoodScope mobile application to infer mood of a user. Clearly show how the cloud infrastructure can significantly reduce the overhead of the Smartphone device.

(b) In principle, Moodscope application collects a lot of user specific data through various channels. This may essentially explode the feature table. Propose a simple greedy algorithm to reduce the size of the feature table.

(c) Personalized mood model exhibits better performance in terms of accuracy. Point out the major limitation of this model. In this light, propose a hybrid model which performs a trade-off between accuracy and training data. Compare the accuracy of both the systems with respect to the training data (show a schematic plot).

(3+3+4)