Birla Institute of Technology & Science, Pilani
Department of Computer Science and Information Systems
First Semester 2017-2018

Comprehensive Examination

Course No.   : CS G541
Course Title   : Pervasive Computing
Nature of Exam   : Closed Book
Marks   : 20
Duration   : 60 minutes
Date of Exam   : 07/12/2017

No. of Pages   = 1
No. of Questions = 5

Note:

1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

Q.1.   Justify using a suitable example whether the following statement is correct or not.
       "Human Centered Design relies primarily on carefully calculated assumptions."

[3]

Q.2.   Define Visual Analytics as a transformation $F : S \rightarrow I$ where F is a concatenation of functions, S is the input data set and I is the output of the process, also called Insight.

[4]

Q.3.   Discuss the various types of Location Acquisition mechanisms in spatially aware context-aware based systems.

[3]

Q.4.   Explain Goal-based Intelligent System with a suitable diagram. Give an example of such a system.

[4+2=6]

Q.5.   Briefly describe the different types of social graphs used for analysis in Online Social Networks.

[4]

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Comprehensive Examination

Course No.   : CS G541
Course Title   : Pervasive Computing
Nature of Exam   : Open Book
Marks   : 40
Duration   : 120 minutes
Date of Exam   : 07/12/2017

No. of Pages   = 5
No. of Questions = 5

Note:

4. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
5. All parts of a question should be answered consecutively.
6. Assumptions made if any, should be stated clearly at the beginning of your answer.
7. No computers/mobile phones/gadgets of any kind/loose sheets are allowed.

Q.6.   Justify with proper explanations whether the following statements are true or false.
        (Note: Merely writing true or false without proper justification will not fetch any mark)

   a) Intermittent remote-resource access is favored only when the network is partitioned or congested.
   b) Cold Start is the main problem in content filtering based recommender and referral systems.
   c) Client-side Service Discovery is more transparent than Server-side Service Discovery in terms of the service discovery logic.
   d) Funneling effect related to energy consumption in Wireless Sensor Networks occurs for nodes located closer to the source of event detection.
   e) Manual mode of service selection during Dynamic Service Discovery should never be preferred over Automatic mode of service selection.
   f) Partial Order Planning mostly generates lesser states as compared to Hierarchical Task Analysis.
   g) Distributed Operating System requires more transparency with respect to the user as compared to Network Operating System.

h) Care-of-Address is a permanent IP address for a mobile node as issued in the Foreign Network so that any communication directed towards the home address can be re-directed by the Home Agent to the Foreign Network using a process called Tunneling.

i) A higher read range is never advantageous for RFID tags.

j) Context awareness can always be added to an application by incorporating sensors.

[10 X 2=20]

Q.7. Consider a Cognitive Radio Network (we denote it by CRN) having one set of Primary Users (PUs), one set of Secondary Users (SUs) implementing real-time VoIP communication and another set of Secondary Users (SUs) executing non real-time DATA transmissions. The PUs are the licensed users in the network and have absolute priority over accessing idle channels. SUs can only access channels when PUs are idle or absent. The VoIP SUs sense channel status and on finding channels idle start VoIP transmissions. As this SU operates in the first tier, we call such a VoIP SU as SUtier1. Moreover, as VoIP has on-off periods, utilizing the silence suppression mechanism, the DATA SUs can further transmit in the idle periods of VoIP SUs. As DATA SU operates in tier 2, we call the DATA SU as SUtier2. It is to be noted that on PU arrival, all SUs have to preempt their channels. Moreover, DATA SUs can only operate in the silence (off) periods of VoIP SUs. Thus the user priority in the CRN is of the order PU>SUtier1>SUtier2 where PU has the highest priority and SUtier2 has the lowest priority in terms of accessing an idle channel.

In order to model such a network, we use Markov Chains to determine the blocking and dropping probabilities. Let the steady state probability for every such state be denoted by P (**i,j,k,l,m**) where

- **i** = total number of active PUs transmitting in CRN

- **j** = total number of active SUtier1 in CRN, that has been admitted to the CRN

- **k** = total number of active SUtier2 in CRN, that has been accepted by SUtier1

- **l** = current "status" of SUtier1, and

- **m** = current "status" of SUtier2

The "status" conditions for **l** and **m** are defined as follows.

Status Value	Meaning	Definition
0	Transmission Mode	SU has obtained access to a channel and is successfully transmitting.
	Null Mode	SU is not performing any transmission, handoff, blocking or dropping functions.
1	Handoff Mode	On PU arrival, the SU is performing spectrum handoff to another channel considering that an idle channel is available in the system. SU transmission is suspended temporarily during the handoff process.
2	Dropping Mode	SU transmission is suspended permanently as PU has arrived in the current channel and there are no idle channels available in CRN.
3	Blocking Mode	The incoming SU is not allowed to gain access to any channel for initiating transmission as there is no idle channel left in CRN.

For example: State (1,2,0,0,0) indicates a CRN having one PU in transmission mode and two SUtier1 in transmission mode. There is no SUtier2.

Another example: State (0,2,2,0,0) indicates a CRN having two SUtier1 and two SUtier2, all of which are in transmission mode. There is no PU.

Based on this CRN model, answer the following questions.

a) For $j = k$, when l has value 2, m also assumes the value 2. However, for $j \neq k$, m can also have the value 2 even when l has value 0. – Explain the reason behind this phenomenon.

[3]

b) Let us further add two more cases.

Case 1: It denotes the scenario when only SUtier1 performs spectrum handoff to a different channel when PU arrives in the current channel. SUtier2 cannot perform spectrum handoff and is therefore dropped.

Case 2: It denotes the scenario where SUtier2 also has the spectrum handoff capability and follows SUtier1 to the alternative channel without getting dropped.

Based on these two cases, complete the following table.

PU Arrival Status	Case 1: Handoff by SUtier1 only		Case 2: Handoff by both SUtier1 and SUtier2	
	Value of (l,m)	Justify the answer	Value of (l,m)	Justify the answer
PU arrives at a channel occupied by both SUtier1 and SUtier2. There are idle channels available in CRN.	?	?	?	?
PU arrives at a channel that is used by SUtier1 only. There are idle channels available in CRN.	?	?	?	?
PU occupies the channel not used by both SUtier1 and SUtier2.	?	?	?	?

[6]

c) In another modification to this setup, SUtier2 is totally excluded from the CRN. This means that CRN now comprises of only PU and SUtier1 where SUtier1 is executing VoIP calls. In such a network, a policy is proposed where some of the channels are reserved for exclusive use by PUs only; SUtier1 can only access the unreserved channels whereas PUs can also access the unreserved channels but only after completely occupying their designated list of reserved channels.

Explain in detail how such a system may prove advantageous to SUtier1 specifically in terms of its real-time VoIP communication.

[2]

Q.8. Draw a suitable diagram illustrating the process of Agreement based Grid Scheduling approach.

[4]

Q.9. Consider a resource allocation problem where resources need to be allocated to the Application. The size of the Application Repository is R=30 Units. There are 4 resources whose configuration in terms of size and value are listed below.

Item	A	B	C	D
Value	50	140	60	60
Size	5	20	10	12

The value of the system is determined after allocating resources efficiently. Using greedy approach, formulate this problem as a Fractional Knapsack problem and find the Maximum Value that can be obtained after incorporating the resources within the Capacity R.

[3]

Q.10. In the Game of Life operational mode, consider a 3 X 3 board having 9 cells where all the four corner cells exhibit alive states. Using the rules for life, death and stasis, determine the fate of the center cell in the grid.

Hint: Consider 4 possibilities.

Possibility 1: If it is alive, it dies.
Possibility 2: If it is dead, it goes alive.
Possibility 3: If it is alive, it stays alive.
Possibility 4: If it is dead, it stays dead.

Justify your selection of the possibility/possibilities with respect to the center cell in the grid using proper explanations.

[2]

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