

CS 736 Software Performance Engineering Fall 2010 Midterm Exam

This is a take home exam. By writing your name and student ID and signing in the box below you acknowledge that you will not seek help nor discuss the exam with anyone until after the exam due date on Thursday, October 21, 2010 (hard copy, at the beginning of the class). Late exams will not be accepted. All answers must be either typed or written clearly and neatly. Include your name and page number (e.g., Page 1 of 5) on each page.

Student name	
Student ID	
Student signature	

1	a	/15
	b	/20
	c	/5
	d	/10
2	a	/25
	b	/5
	c	/5
3		/5
		/10
4		/10
Total		/110

1. An e-commerce site FunFallBreakTravel.com offers to users an ability to book complete vacation packages: plane/train/bus tickets, hotels, car rental, excursions, etc. Service providers (airlines, bus companies, hotel chains, etc) are providing Web services to query their offerings and perform reservations. Credit card companies are also providing services to guarantee payments made by consumers. The problem 1 is focused on *Booking vacation package scenario*. Only the user in this scenario is a human being. The travel agent service, airline, hotel and payment services are machines.

The user accesses the travel agent service of FunFallBreakTravel.com through a Web browser. He/she is presented with a form to fill in order to provide the travel agent service with details about dates of his/her travel, the destination and preferences such as non-stop flights, narrowed search to a preferred airline, and showing only refundable fares. The user submits the information to the service in order to get a list of flights corresponding to his/her schedule. The travel agent service finds a list of airlines and then for each airline requests a list of flights accommodating the user request. The travel agent service presents the results of the queries to the user, with the flights sorted by there criteria: the lowest price, departure time, and shortest flight time. The user chooses a preferred flight and communicates his/her choice for the flight. The user is offered an option to select sits. The travel agent service requests the chosen airline to put the flight on hold. The airline returns a confirmation number with an expiry date.

Then, the travel agent service finds a list of hotels. For each hotel found the travel agent service requests accommodation options for the period and builds a list of options for the user. The travel agent service presents the results of the queries to the user letting him choose the best option, along with the payment options offered. The user chooses a hotel option. The travel agent service contacts a bank for payment authorization. If the payment service doesn't confirm the validity of the user's payment option, the user should be presented with an error. Otherwise, the bank authorizes the transaction and the travel agent service books the hotel and confirms the flight, using the payment authorization from the bank. The service provides the user with various confirmation numbers and wishes the user a good fall break vacation.

- a) Write a scenario for *Booking vacation package* and develop a UML sequence diagram for this scenario. (15 points)
- b) Draw the software execution graph for *Booking vacation package* scenario. Assign software resource requirements for each step in the software execution graph. Assuming the values for the computer resource requirements given in the tables below, estimate the total elapsed time. (20 points)

Devices	CPU	Disk	Delay	Network
Quantity	1	1	1	1
Service units	KInstr	Physical I/O	Unit	Message

Work unit	20	0	0	0
DB	500	2	0	0
Delay	0	0	1	0
Message	10	0	0	1

Service time	0.0001	0.02	1	0.01
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- c) What is the appropriate type of system execution model? Explain your answer. Based on the results from the software execution model identify the bottleneck device and estimate the maximum throughput. (5 points)
- d) Solve the system execution model. (10 points)
2. A DB server receives request from 50 clients. Each request to the DB server requires that 5 records be read on average from the server's single disk. The average read time per record is 9 msec. Each DB request requires 15 msec of CPU to be processed. This system is modeled as a closed queuing network with think time $Z=0$. Consider the following modifications:
- More indexes are built into the database to reduce the average number of reads per access from 5 to 2.5.
 - The disk is replaced by 60% faster disk, that is, the average service time drops to 5.63 msec.
 - The CPU is replaced by twice as fast CPU, that is, the service demand at the CPU drops to 7.5 msec.
- a) For the original system and for modifications i, ii, iii, i+ii, and i+iii compute and draw the optimistic bounds on the throughput. Identify the bottleneck device in each case. (25 points)
- b) Compare the results (original system, modifications i, ii, iii, i+ii, and i+iii) and discuss the cost effectiveness of each modification. (5 points)
- c) Discuss the usefulness of analyzing system execution models (represented by either open or closed queuing networks) based on bounds? (5 points)

3. Prediction of software performance metrics based on analytical models consists of two steps: (1) software execution model and (2) system execution model.
 - a) Describe the advantages of having two distinct steps. (5 points)
 - b) Assume that the software execution model shows that the software performance objectives are met. However, when the corresponding system execution model is solved it appears that the software does not satisfy the performance objectives. Why? What are the appropriate steps that could be taken to resolve this problem? Explain your answer. (10 points)

4. Explain how software performance engineering activities can be used during software development in the early life cycle. What are the advantages of early life cycle (specification and design) assessment versus late life cycle (implementation and testing) assessments? What are the drawbacks? (10 points)