CS 446 - Final
Friday Dec 15, 2000
7:00-10:00 pm

Name: _____

ID Number: _____

Signature: _____

Instructions:

- Please make sure you have 15 pages including this page
- No Aids permitted
- Read all the questions first
- Answers should be clear and brief. Please use good grammar and spelling
- Good Luck

Question	Maximum	Mark Received
Q1 - Ownership Architecture	**40**	
Q2 - Tools and Processes	**10**	
Q3 - Web Applications & Evolution	**15**	
Q4 - C Style Includes Using Tarski	**25**	
Q5 - Patterns and Architecture Styles	**20**	
Q6 - Software Metrics	**10**	
Q7 - Use of Design Patterns	**20**	
Total	**140**	

1. **[40 Marks] Ownership Architecture**

a) Define ownership architecture. [5]

b) Describe the benefits of having an ownership architecture for a software system. [8]

c) Present a diagram of the conceptual architecture of your SX4-OAM system. Highlight the deviation between your conceptual and concrete architecture. (Do not forget to use a legend to explain your diagrammatic conventions) [10]

d) In terms of Garlan & Shaw's list of architectural styles, which of them most closely describes the style of your architecture. Explain. [5]

e) Present a diagram of the ownership architecture of your SX4-OAM system. Does the ownership architecture aid in explaining the deviation between your conceptual and concrete architecture. [5]

f) Given a software system, how can you derive its ownership architecture. Which method did Bowman and Holt use to derive the ownership architecture of Linux and why? [7]

2. **[10 Marks] Tools and Processes**
Describe processes or a set of tools, perhaps based on those provided by PBS, which could be used to enforce the following:

a) All source files in the software system follow the same coding style.
b) Conceptual and concrete architecture of the software system don't diverge.

If using tools, give enough detail so that it is clear how these tools would be constructed and how they would be used in practice.

3. **[15 Marks] Web Applications & Evolution**

a) List three of the challenges that web applications present to traditional software engineering techniques. [6]

b) How did Godfery characterize the growth of the Linux kernel? To what did he attribute the well-managed growth of the Linux kernel? [9]

4. **[25 points] C Style Includes Using Tarski Algebra**

You are given the following:
H: the set of all the .h (header) files in a software system.
C: the set of all the .c (implementation) files in a software system.
I: all the include relation in a software system. For example, if a file f1 includes a file f2 then the relation I contains <f1,f2>. An implementation file can include another implementation file or a header file. Also a header file can include another header file or an implementation file.

a) Given a header file named {f1.h} give a Tarski expression that returns all the .c (implementation) files that include it. [5]

b) Give a Tarski expression that returns all the header files that include other header files. [5]

c) Give a Tarski expression that finds all the header files that are included by more than one implementation file. (Note: An expression is required; do not use counting) [5]

d) Give a Tarski expression that outputs all the files in any cycle. For example if F1 includes F2 and F2 includes F1, your expression should output F1and F2. [5]

e) Give a Tarski expression that finds all the header files that are not included directly or indirectly by any source file. [5]

5. **[20 Marks] Design Patterns and Architecture Styles**

If you use diagrams to clearly explain your solution, then do not forget to give a legend for your diagrammatic notations.

a) After the successful release of SX4-OAM version 1.0, the marketing department has relayed to the architecture team the need of customers to run SX4-OAM on multiple platforms (Windows and Mac are the main platforms requested by customers with many other platforms expected in future releases). What modifications of your current architecture are needed to ensure the new requirement? [5]

b) In addition, customers expressed the need to have more control over their billing logic. They need to be able to load different billing modules developed in house instead of using the built-in billing module. What modifications are needed to your billing subsystem design to enable the support of customer specific billing logic? Are there any design patterns that you should attempt to use? [5]

c) You joined a new company working on the development of the control system for the Waterloo subway system. You are assigned the design of the scheduling subsystem. The scheduling subsystem is responsible for scheduling the subway trains to avoid collision. The scheduling subsystem must be accurate, redundant and support the experimentation with new scheduling algorithms without affecting the current running system. Which design pattern would you employ? Also describe how to use your proposed design to safely introduce and experiment with new scheduling algorithms. [10]

6. **[10 Marks] Software Metrics**

A newly appointed team lead who just joined the company ordered a code freeze as soon as he learnt that the McCabe cyclomatic complexity of many modules in the software system is above 500 and the code size of the system is over 10 MLOC. He argues that the code freeze is to review the code and prevent the software system from decaying. Is his decision justifiable or does he need more data? Discuss.

7. **[20 Marks] Use of Design Patterns**
In this question, you are asked to provide the design of a simple program

You are to design a Universal File Reader. The UFR should be able to read, print, and convert to text any file. A configuration file is used to store the mappings between a file extension and the appropriate commands to read, print and convert to text. For example, the configuration file would contain lines like the following:

```
.ps       ghostview      lpr            pstotext
.gif      xv             printpic       none
```

("none" means that there is no application that can perform the required operation)

At the command line the user types:
"`ufr -t operation_type file_name`"

`operation_type:`	can be "read", "print", or "text"
`file_name:`	is the name of the file to process. If a directory is given instead of a simple file name the whole directory should be processed.

Use a UML class diagram to describe the design of your system. Make sure you show the different objects and highlight the different design patterns used in your design. For every design pattern used, detail all the participants.

You will be marked based on the correct and clear use of design patterns and the correctness of your design. **Do not write any code**