[**Closed book/notes/calculator**] Show all of your work clearly in the space provided or on the additional page at the end of the exam. If the additional page is used, clearly identify to which exam question it is related. Be sure to **read each problem carefully**. You should do all six problems. Note that the exam is double sided.

1. (15 points) What is the purpose of studying software design patterns? How are they useful? Give at least two distinct advantages of pattern analysis.

2. (15 points) A client needs to access different substructures of a software project without having to interact directly with them. The project contains multiple concrete realizations of an abstract class. The implementation requires the ability to choose at runtime which concrete realization to use **and** be able switch to a different concrete realization without recompiling or even restarting the application.

Of the patterns covered so far, which is the most appropriate pattern to apply to this situation. Justify your answer.

3. (10 points) Briefly describe the purpose of creational patterns.

4. (20 points) Over an eight year period, the company you work for has written a framework using a particular class library. The framework is used as a foundation for all application development at your company. Unfortunately, QuickBuck.com, the company that wrote the class library, has now gone out of business without fixing three significant defects in their class library. Your boss has decided to buy a new class library from SluggishGreenback.com that provides the same functionality. As expected, many of the classes have different interfaces. Even though you don't have access to the source code for either of the class libraries, your boss has put you in charge integrating the class library into your company's existing framework.

Select the most appropriate design pattern to use to address the problem. Justify your answer.

5. The textbook asserts that the composite pattern can be used in the financial domain, where a portfolio aggregates individual assets.

For example, an individual's portfolio may contain his/her stock portfolio and bond portfolio. The stock portfolio may in turn contain a tech stock portfolio (which contains various individual tech stocks), energy stock portfolio and various other individual stocks.

(a) (25 points) Show appropriate class diagrams and enough code fragments to illustrate your use of the pattern.

(b) (15 points) Write a sample driver program that shows how the composite pattern can be used to make calculating an individual's "worth" easy.

Additional work area for any problem. Clearly identify to which problem the work on this page is related.

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