

# Patterns and Programming for Software Development

**PROBLEM SCENARIOS.** The assignment is in three parts.

## **[32 marks] Part A – Pattern-Oriented Design of Object-Oriented Software (using GoF patterns)**

1. [8 marks] A forum is a website that provides the following functionality: i) start a conversation thread, ii) comment (post a message) on a specific conversation thread, iii) register to a specific conversation thread to get updates by each time someone posts a message.

Question: How would you implement such a system using *Composite and Observer design patterns*? Draw the UML class diagrams for the solution, with explanation – you do not have to provide details of all methods in the classes, but describe the classes you would have and key methods based on the design patterns.

2. [8 marks] Suppose you should design an application, which takes a text file and applies a number of filters on it. For example, starting with a paragraph of text, the system will feed it through a *filter to remove common words* such as “and”, “the”, “a” and so on. And then the result is then fed into another *filter to remove all short words* (less than 5 characters long say), and then into a *spell-checker* to remove misspelled words, and finally into a *count-word filter* that counts the number of words in its input text. Four filters are mentioned here, each taking a paragraph of text as input and producing some output (e.g., another chunk of text or some numbers). The application should allow the user to configure different sequences of filters (as long as the output of one can match the input of another) linking filters into a set of objects which serve to process information – somewhat analogous to a production line where a car (in the making) is passed along a chain of stations, each station performing a different (if any) operation on the car.

Question: How would you implement such a system based on *one or more design patterns*? Identify one or more design patterns you would use. Then, draw the UML class diagrams for the solution, with explanation – you do not have to provide details of all methods in the classes, but describe the classes you would have and key methods based on the design pattern(s) you use. You are free to use descriptive names for the classes.

3. [8 marks] Consider an application which needs to be ported to different operating systems and to different hardware. There are parts of the application, e.g., to access sensor and GPS data, that are dependent on the hardware and operating system the application is running on and other parts of the application which are independent of the hardware and operating system the application is running on.

Question: How would you implement such a system based on *one or more design patterns*? Identify one or more design patterns you would use. Then, draw the UML class diagrams for the solution, with explanation, stating assumptions and naming components in your own way for illustration – you do not have to provide details of all methods in the classes, but describe the classes you would have and key methods based on the design pattern(s) you use.

4. [8 marks] For mobile application development, a key idea is event-driven programming. Many mobile platforms utilise such mechanisms, such as Android and iOS. Often, the event-driven programming model manifests itself in different forms using different terminology. Consider two programming constructs for event-driven programming in the Android platform (which is in Java): Listeners (e.g., UI listeners, see

<http://developer.android.com/guide/topics/ui/ui-events.html>) which is also used in Java in general (see <https://docs.oracle.com/javase/tutorial/uiswing/events/intro.html>), and Broadcast Receivers (see <http://developer.android.com/reference/android/content/BroadcastReceiver.html>).

- (i) Listeners and Broadcast Receivers are implementations of a GoF design pattern. Which GoF design pattern do Listeners and Broadcast Receivers implement? Explain how the Listeners and Broadcast Receivers implement this GoF design pattern (You can give code examples for illustration and draw class diagrams.)
- (ii) Describe in detail two coding examples of how this design pattern is also used in iOS programming, sketching the code (but you do not need to implement).

[Hint: you do not need to know everything about Android but only to read particular documentation about it, the parts linked to above.]

### **[38 marks] Part B – Swift Programming of Pattern-Oriented Design of Object-Oriented Software (using GoF patterns)**

In the labs, you looked at examples of design patterns implemented in Java. The following Website has examples of GoF design patterns implemented in Swift: <https://github.com/ochococo/Design-Patterns-In-Swift> (a .zip containing a playground with all the code can be downloaded from as well).

1. [28=4x7 marks] Translate the following lab Java examples (as used in labs and as given originally in LMS) into Swift in a playground or inside an iOS app (when submitting the assignment, save and submit the playground and/or corresponding iOS app); you can add additional test code to ensure they work (where a user interface is used in test code, e.g., in TestMemento.java (in the Memento Example) you might need to implement the example as an iOS app with a user interface, since UI elements might not work interactively in playground):
  - i. adapterpattern.zip (used in lab 1)
  - ii. observerpattern.zip (used in lab 1)
  - iii. VisitorExample.zip (used in lab 2)
  - iv. MementoExample.zip (used in lab 2)
2. [10 marks] Translate the following lab Java example into Swift code that runs as a Single View iOS app (when submitting the assignment, save and submit the entire Xcode project):  
FlyweightExampleSolution.zip (used in lab 2)

Conduct experiments to examine the performance with and without (creating new objects each time) using flyweight (as in the labs) of creating a large number of the objects (rectangles), on a simulator and on a real iOS device (iPad or iPhone). Write a report (1-2 pages) on the experiments made in order to show how much improvement the flyweight pattern conveys for large numbers of rectangles (e.g., 10000, 500000, 1000000, 1500000, 2000000, and more). [Note: you will need to investigate how to do timings in Swift. You can draw graphs of run-time versus the number of rectangles/objects with and without using flyweight. The graphs need not be part of the app.]

### **[30 marks] Part C – iCloud iOS app development using Swift**

1. [20 marks] Implement an app that allows a user to make simple drawings (lines and shapes, etc) and to store them locally on the device and on iCloud. The app should allow

the user to decide if the drawing made should be saved or not saved, and if it is to be saved, the user should be able to enter a short textual description to accompany the saved drawing and to say whether the drawing should be saved on the iCloud server or just locally. The app should also allow the user to view a list of saved drawings (and their descriptions) and to retrieve and display the drawings (retrieved from iCloud and/or locally). State any assumptions you make – if underspecified, you are free to make design decisions as necessary.

(when submitting the assignment, provide a simple design document of the storyboard, brief explanation, and submit the entire Xcode project).

2. [10 marks] Extend the app above to allow the user to take photos and save them on the iCloud server, not just drawings, and to view photos previously taken using the app. [Note: you will need to investigate how to take photos and save photos in Swift/iOS.]
3. [10 marks, for a possible total of 110/100] BONUS – SHOULD ONLY BE ATTEMPTED AFTER ALL THE ABOVE HAVE BEEN DONE AND IF YOU ARE FAMILIAR WITH PHP OR SOME OTHER WEB SERVER TECHNOLOGY. Create an app to allow uploading of geotagged photos and videos to a Web server, in addition to the iCloud server. The app should allow the user to take photos/video clips of an event, get the location (GPS coordinates) of where the photo/video was taken, and upload them to a Web server with a short textual description. The app should also allow the user to download and view photos/videos from the Webserver [Hint: you can use the REST API approach using a simple HTTP protocol, but will need to investigate how to do this in the iOS platform and in Swift, and how to capture and save videos, and how to get location information in Swift, etc. You are free to use any third-part Web hosting service or use the La Trobe servers such as latcs5 and latcs6, etc]

**END OF ASSIGNMENT**