Lessons Learned In 18641 Project 1

Unit 1.

1. What does containment mean for Java class?

Containment for Java means one class could have the field composed by other class. For example, in the class OptionSet, there is a set of Option object. Containment is a relationship between different class, which can be thought that one class has many class as components, and this one class contain these classes.

2. What does encapsulation mean for Java class?

Encapsulation is an approach to design the model with modularity and abstraction. We set the data field or method to private and if you want to change some of them, you may use getter-setter method. This is used to hide the complexity of this class component, and prevent changing these data or method from outside directly. For example, in Automobile, we set OptionSet field as private, and in OptionSet, we set Option as private.

3. What is the benefit of using inner class

Inner class is benefit for organize the project. For example, the Option class are inner class in the OptionSet class, so Automobile do not have to know how to access an option, but just call the OptionSet to handle the work. It make the work more concise and conceal the detail of implementation of option from outside.

4. What are some ways to analyze data (presented in requirements) to design Objects?

There are some ways to analyze data to design object:

The first is to transform all the requirement data to the most specific and operable ones. In this project, for example, Automobile is the what we want to operate, but it is too large and general, so I specify it into option set according to the operation requirement. Then the option set can have lots of options and option has its own properties, name and price, so I continue specify it to two classes : option set and option. Now the object is most specific for Automobile and cannot be divide any more, so we have designed three class here.

The second is to design object by its function. In this project, we have to set up an IO function for input/output data and serialization, so we designed the util package with FileIO class. In this way we design class by its specific function.

To design object, we also have to consider about their data field and method. At first, we have separate objects by their most specific data and function. Then we have to decide the visibility of these data, and then the method in this object. Due to the fact that most method in object is to operate data in this object, so the visibility of some method is not only based on your desire, but also on the visibility for your designed data. For example, in Automobile class, Optionset and Option are protected, so the method manipulate these data are protected in Automobile class.

5. What strategies can be used to design core classes, for future requirements, so that they are reusable, extensible and easily modifiable?

Modularity is the first concern for future use. If you want to modify the way you print one Option, modify from Automobile class may result in mess because your Automobile may have more contained objects and data than just an Option. The

smart we to do is to have a independent class act as an Option and contained it in Automobile. Then the you could change how you print it in its own class, but the call method from Automobile could remain unchanged.

Write public get-set, update and delete method for your private data field once you create one such data field. Then if you extend and reuse this class, all data field should be get outside is easy to obtain.

Cover all possible input is a effective way to reuse and extend this class. For example, if you want to access an Optionset in Automobile Optionset array, you may want to use index, or name in string. If you handle all this input in Automobile class, then outside Automobile class you could manipulate this data field at your convenience.

6. What are good conventions for making a Java class readable?

Give a package name and import needed source file to your class, because it is a good behavior for viewing the project organization and compile.

Declaring all the instance variables in order and at first of your class body, which in case you forget something and help other people know what data you could operate in this class without confusion. Furthermore, put each declaration in one line and then you could add comment here for noticing the use of this method.

Name your variable in detail and specific, name unchageble variable in all capital name and name your method in a “to-do” style, like in Automobile, I used method like “toUpdateOptionSetName()”, which is clear what they are going to do.

Put declaration only at the beginning of blocks. Do not wait to declare it until your first use because its sudden declaration and use may be confusing, and you may overlook its scope.

Do not code a line exceed 80 characters, it is too long to read.

Give a comment before your method, write its input and return in this comment will extremely enhance the reading and understanding for reader, and your coding and debug process.

Last, and the most important, keep constant with your format. Do not change your own convention in a project. A sudden change will confuse whoever read your code, including yourself.

7. What are the advantages and disadvantages of reading data from sources such as text files or databases in a single pass and not use intermediary buffering?

Reading from text file in a single pass is easy, which is the only advantage from my mind. This is an unsafe approach to read data because you do not know how large space you should have to handle the data. If you use a string to save a extremely large input file, you could meet buffer overflow exception during process.

Furthermore, some wrapper class is immutable and read from a single pass is waste of time and space. For example, if you read in a file by line and save it in a string, every time you save it, you will get a new string concatenating the new input and saved string, and throw the last saved string in string pool where garbage collector can never reach. Then you call the concatenation method of string which search the end of the stored string is another waste of time. With a buffer, you do not have to worry about these issues.

8. What is the advantage of using Serialization?

The advantage of Serialization is that you could save an Object in disk and make it persistence. When you want to restore an Object or go back from some change, this

will give you a lot of help. Furthermore, serialization is key feature for network communication because it network frame and disk can only read data in bit. Serialization makes object in bit and it could be transferred and restored in other end.

9. What issues can occur, when using Serialization with Inner classes?

Inner class is non-static nested class, and serialization of inner class is error prone. There are some issues for serialize inner class. First, serializing an inner class declared in a non-static context that contains implicit non-transient references to enclosing class instances results in serialization of its associated outer class instance.

Second, synthetic fields generated by Java compilers to implement inner classes are implementation dependent and may vary between compilers; differences in such fields can disrupt compatibility as well as result in conflicting default serialVersionUID values. The names assigned to local and anonymous inner classes are also implementation dependent and may differ between compilers.

Furthermore, because inner classes cannot declare static members other than compile-time constant fields, they cannot use the serialPersistentFields mechanism to designate serializable fields.

Lastly, because inner classes associated with outer instances do not have zero-argument constructors (constructors of such inner classes implicitly accept the enclosing instance as a prepended parameter), they cannot implement Externalizable. The Externalizable interface requires the implementing object to manually save and restore its state using the writeExternal() and readExternal() methods. These are the issues for serialization of inner class.

10. Where can inheritance be used in object relationship?

Inheritance happens when you get an “has-a” relationship where one class could be an abstraction of other class. For example, Automobile could be an abstraction of SportsCar, where SportsCar inherit some feature of Automobile.

11. Where can polymorphism be used in object relationship?

Polymorphism is used where you have many specific class of a superclass. For example, you could have Animal super class, and you could also have Cat, Dog or Bird subclasses. An animal class could be instantiated by any of these sub-classes.

12. How can you design objects, which are self-contained and independent?

Self-contained means one object should have data field and method to operate these data. And this call of method is independent from each objects. From my perspective, I firstly separate required data in the most specific status, where no data could be split. Then I group this data by meaning or function in class with no overlap. Then add method for each class to manipulate their own data.

Unit 2

13. What role(s) does an interface play in building an API?

API is abbreviation of Application Program Interface, which is a set of function that user could use without knowing how does it work. Java interface is like a combination of method and play the role like window from user to the inside of program. For example, interface allows multi-inheritance for class, and in this

project, BuildAuto class implement UpdateAuto, CreateAuto and FixAuto interface, which enable BuildAuto to inherit multiple set of methods. These interface required the BuildAuto class must implement their inside method, and this method would be used from outside user, as known as the Driver. Driver outside is ensured by the interfaces that all method it would use are implemented inside the program, but Driver do not have to know how actually methods work inside the program, which do User a convenient.

14. What is the best way to create a framework, for exposing a complex product, in a simple way and at the same time making your implementation extensible.

Using interface. With the help of interface, you could design different interface to limit the scope of method for an object, and when you instantiate a method within interface, this instance will only have limit access to all methods, and this help simplify the work of simple instance.

In another perspective, this will help make your work extensible. If you want to add specific method for specific user, you could just add an interface with this method, and make instance limit within the new interface for this user, without knowing other methods for the class who implement this interface.

In this project, we made a BuildAuto to implement all the methods. Every time we add a new method, like UpdateAuto or CreateAuto, we just let BuildAuto implement these interface in detail. But if we want to use a specific method , like create a new auto, we can instantiate like CreateAuto ca = new BuildAuto(), and instance “ca” will only have access to CreateAuto’s method, and its method scope was limited in CreateAuto.

15. What is the advantage of exposing methods using different interfaces?

For object-oriented design, interface help organize functions of different class part. And it is simple to use and extensible. When use interface, we could also limit the scope of object. Like instantiate a CreateAuto instance, CreateAuto ca = new BuildAuto(), the “ca” will only have method limited in CreateAuto, it cannot update or edit car. This will help a lot to distinguish the class function and access range.

16. How to hide codes in abstract class?

In this project, we build an abstract class ProxyAutomobile, where all method buildAuto should implement are implemented here, and buildAuto just extends this abstract class and hide all the method from external because all its method are implemented in the internal abstract class ProxyAutomobile.

17. Is there any advantage of creating an abstract class, which contains interface method implementations only?

There are several advantages of doing this. The first is for this project, this implementation distinguish internal and external usage. The abstract class ProxyAutomobile is in the internal it can access to internal class, buildAuto is external and cannot access internal class, so the extends relationship from buildAuto and ProxyAutomobile is like bridge for communication.

The second is that abstract class cannot be instantiated, so it promise no internal instance is built because no internal object instance is needed in this project.

The third reason is that, when one external class extends internal abstract class, it could extend its method for external use, and it is easy for external user to use both external method and internal method together.

18. What is the advantage of LinkedHashMap over HashMap?

LinkedHashMap and HashMap all support key-value pair insertion and search. They all support constant time insert and search. But the HashMap class do not have order, while LinkedHashMap keeps an order of time for when you insert this object. This is very effective for insert time based iteration in this data structure.

19. How to log the exception?

In this project, I learned the concept of log exception. For a single run project or program, it seems useless, but for a non-stop server or project, this is extremely useful for test and debug. To log the time of exception , I use “Timestamp ts = new Timestamp(date.getTime())” to save the computer time as time stamp and write it in the log file.

20. How can you create a software architecture, which addresses the needs of exception handling and
recovery?

Based on this project, to handle and recovery exception in the software architecture, I have to consider all the possible exception that could happen at runtime. Then build a package with all exception enumeration and a independent class with corresponding fix method.

21. What is the advantage of exposing fix methods for exception management?

By exposing fix methods for exception management instead of using default exception handling method, you could define how to handle the exception. Like if you input a wrong name of file or Automobile, with the default exception management, you could have a print stack trace with null pointer exception, but

with exposing fix method, you could define how to deal with this situation, like input another time or just input a backup file.

22. Why did we have to make the Automobile object static in ProxyAutomobile class?

To share it between objects. You will not be able to update, as the Automobile object in ProxyAutomobile is not declared as a “static” Object, because when you create an instance for BuildAuto (child of ProxyAutomobile), a new Automobile object will be created in the class if it is not static. So this requires variable Automobiles in ProxyAutomobile be static so that it can be shared between objects.

23. What is the advantage of adding choice variable in OptionSet class?

The choice variable is used for further extension of project. We have to deal with different type of client. Some clients are from enterprise and just want to upload model’s all information, some clients are customer and they want to configure a car model and see the price. So the choice is used for customer to configure a car and see the price of their configuration.

24. What measures had to be implemented to expose the choice property in Auto class?

Designed for the customer, there are 3 methods that should be implemented. The first is read, you have to give client all options they could choose. The second is select. Customer could select one option as their choice. The last is update, with which customers could update their choice when they had chosen one.

25. What is enumeration used for?

In Java, enumeration can be used as class, and each name-value pair is static in this class. Each name has a unique number behind, and it helps you use name to represent integer number and avoid magic number issues.

Unit 3

26. What is the best way to setup multithreading in an Enterprise Class application?

To set up multithreading, the best way is to limit the scope of multithreading method for object to be operated, because multithreading is really time-consuming. In this project, I put the method to be multithreading in an independent class and synchronize the access to object for operation, which enable multithreading and do not harm the efficiency of program.

27. What is race condition for multi-threading program?

For multi-thread program, all threads for one process are sharing the context, so race between threads may happen. Like two different thread may want to change the same Automobiles optionset name, but to different names. This will bring in race conditions and corrupt the data for this object.

28. What is producer-consumer problem? How to handle it?

This is a classic thread problem for thread programming. For example, there is a shelf for product. Producer is responsible for putting product onto the shelf, consumer is responsible for getting product from the shelf. However, consumer is not guaranteed that there are products on shelf, and if the shelf is empty, consumer's get method may lead to something wrong. To handle this situation, we have to set a flag to indicate if there is product on shelf, and once there is product on shelf, producer could use notify method to notify client they can get product. If the shelf is empty, producer must stop the get method from consumer.

29. What is deadlock for the thread programming?

Deadlock is the situation, where two thread's run are based on each other, like thread A is based on the output "1" of thread B to produce an "2", but B's output "1" is based on A's output "2". With this situation, no thread could approach and this will last forever. In program we should keep an eye on this situation and never let it happen.

30. For multi threaded program, what does synchronized modifier used for?

To set synchronized modifier for methods in class, when this class is instantiated, only one thread from multiple thread have the right to access these methods, and other threads will wait for this thread. When you set an object synchronized, only one thread could access to this object at one time. The synchronized modifier is a simple and effective way to avoid thread collision.

31. What strategy is used for synchronizing, so you end up with a scalable application?

Limit the scope of synchronising method as mush as possible. For scalable application, I build an independent class to hold all multithreading method and synchronizing thread with locking the Automobile object in Fleet class.

32. What implementation strategy can be used for creating a race condition for testing Multithreading?

Use two thread to access the same object in one run of program, if you do not lock the method or the object two threads are operating, you will see the race condition. However, for example, if you set one Automobile object locked for one thread, where two threads want to change its properties, you could see no race condition this time.

33. How does Synchronization work in JVM? What are the performance consequences of synchronizing?

Synchronization in JVM means lock the method for one object or lock the object itself for one thread at a time. Synchronisation will slow down the performance, because only one object could access the synchronized object or method, but it will solve the race condition problem for multi thread.

34. Why should not synchronize every method in class?

Only one thread could access the synchronized method, and if one thread access one synchronized method, other synchronized method is locked for any other thread to avoid race condition.This will slow down the program if you synchronize

the thread-irrelevant method because it has no relationship to race but thread access it have to wait for another thread.

Unit 4

35. How to read in a ".Properties" file?

Read in .Properties file is more convenient than read in .txt file because it save your time for parsing the file. In .Properties file , everything is saved as "Name=Value". And when we want to use it, we could just use load method to load all the "Name=Value" pair into instance object, and using a uniform method to read in the name and value.

36. What is socket?

Socket is an abstraction of a "Communication link" between machines and over some network. In this
project, user and server are communicating through this socket.

37. How to identify a socket when you want to communicate?

The two important part is hostname and port. Hostname can be parsed as a string, or IP address. Port is like the function ID of a socket, which is tied to a specific usage of a socket.

38. What is often used for socket IO?

For socket communication , InputStream and OutputStream is mostly used. The streams returned from socket rely on TCP's error correction and flow control.

39. How to transfer .txt file through socket?

To write the transfer file, we have to use socket object stream. We have to set up a buffer object and save moderate amount of data in this buffer, and transfer it with buffer stream attached to an object stream, and send or receive with buffer.

40. What is the blocking feature of ServerSocket?

When using ServerSockets, the call to "accept" causes the program to wait until the method returns. This blocking call can cause a program to hang. If other operations must take place, we need some ways of placing the accept class in its own thread.

41. What is protocol? How to write protocol program?

For this socket programming unit, protocol is not irrelevant to physical layer, but only the agreement between server and client about the sequence of dialog and how to handle each request.

To write protocol program, I think order is the first thing to consider. What is the order of input and output, when the input and output will occur is considered before programming. In this program I marked all the specific communication with comment and make sure request and response are corresponded exactly between client and server.

42. How could one server handle several client?

We could make the server iterative and never stop. To implement this server, we have to make a non-stop server class, and make the detailed handle session method in an independent thread class. For this project, I make the Server client run in a while(true), and once it accept the request from client, it put the socket into a new DefaultSocketServer thread to handle the session. So one client could get their own thread and make request and get response.

43. How to keep a client thread non-stop working if you want? And how to stop this client?

For client, I use a two layer while(true) structure. In the outer while(true), it is always waiting for your input, and inner while(true) could jump to the specific handle method. If handle method run into some exceptions that cannot be handled, the inner while(true) will be break, but the outer while(true) is keep going to handle input request.

If you want to stop this client, I set up a condition in the outer while, if you input "0", the outer while(true) will be break and it will jump to the closeSession method after handleSession method.

Unit 5

44. What is the difference between JSP and Java Servlet?

Java servlet is compiled Java class essentially. It is pre-compiled and once they were triggered by the web page, it runs the compiled program and print the output

as HTML. JSP is a essentially an HTML page, but it could use multi-language, including Java, to handle input and dynamic generate page content.

45. What is Tomcat?

Apache Tomcat, often referred to as Tomcat, is an open-source web server and servlet container developed by the Apache Software Foundation (ASF). Tomcat implements several Java EE specifications including Java Servlet, JavaServer Pages (JSP), Java EL, and WebSocket, and provides a "pure Java" HTTP web server environment for Java code to run in.

46. What is Web Container?

Web container, or Servlet container, is the component of a web server that interacts with Java servlets. A web container is responsible for managing the lifecycle of servlets, mapping a URL to a particular servlet and ensuring that the URL requester has the correct access rights.

A web container handles requests for servlets, JavaServer Pages (JSP) files, and other types of files that include server-side code. The Web container creates servlet instances, loads and unloads servlets, creates and manages request and response objects, and performs other servlet management tasks.

A web container implements the web component contract of the Java EE architecture, specifying a runtime environment for web components that includes security, concurrency, lifecycle management, transaction, deployment, and other services.

47. How to write Java code in servlet to display a web page.

In Java servlet class, you must display the web page based on the response. When you handling doGet() or doPost() method, you have use their response input, and

use response.getWriter() to get the output for writing the web page. At last, you could use out.println() method to write the formatted web page, like HTML language.

48. What is HTML and CSS.

HyperText Markup Language, commonly referred to as HTML, is the standard markup language used to create web pages.It is written in the form of HTML elements consisting of tags enclosed in angle brackets. Web browsers can read HTML files and render them into visible or audible web pages. Browsers do not display the HTML tags and scripts, but use them to interpret the content of the page. HTML describes the structure of a website semantically along with cues for presentation, making it a markup language, rather than a programming language.

Cascading Style Sheets (CSS) is a style sheet language used for describing the look and formatting of a document written in a markup language.

49. How to transfer information from client using HTML Form?

When you using HTML form, like SELECT with OPTION, you could give each OPTION a name and value.
Then you should define the form ACTION to the destination page and METHOD to get. Then when you SUBMIT the form with INPUT, you transfer the whole form to the destination page.

50. How to transfer object from servlet to JSP?

Use interface HTTPsession. Write session.setAttribute(“objectname”, object) and the page you directed to could start a session to receive the object with “object name”, like session.getAttribute(“objectname”);

51. How to jump between web pages?

Set ACTION mark for some buttons and write ACTION = “destination page url” to jump from one page to another.

Unit 6

52. What is Normalization Theory?
Normalization theory involves relations, attributes and dependency of attributes upon one another. With normalization, you can minimize redundant and inconsistent data and avoid update anomalies.

53. What is primary key and foreign key?
A primary key is a field in a table which uniquely identifies each row/record in a database table. Primary keys must contain unique values. A primary key column cannot have NULL values. A table can have only one primary key, which may consist of single or multiple fields.

A foreign key is a column (or columns) that references a column (most often the primary key) of another table. The purpose of the foreign key is to ensure referential integrity of the data. In other words, only values that are supposed to appear in the database are permitted.

54. What are three rules of Normalization

First Normal Form : First normal form (1NF) says that arrays or other repeating fields should not be used.

Second Normal Form : For a table to qualify for second normal form, it should be in first normal form (1NF) and all of the data in the table must be dependent on the value of the primary key.

Third Normal Form : For a table to qualify for third normal form, it must be in 2NF, 1NF and each of columns in that table except those used as keys, must not be interdependent.

55. What are steps to design relational models?

There are two steps for designing a relational models:

The first step in designing a database application is gathering requirements. This would include functional requirements, data requirements, performance requirements.

The second step is developing a logical data model.
A logical data model is representation of the data elements used by an enterprise and relationships between those data elements. One of the most common methods for developing a logical model is entity relationship modeling.