### Name:\_\_\_\_\_\_\_\_\_\_\_\_\_

**Fundamentals of Software Engineering**

# Exam II

The purpose of this question is to assess your software design skills. Please answer the exam questions to the best your abilities. **If something is not clear to you then make whatever reasonable assumptions you see appropriate.** It is extremely important that your answers are clear and concise.

**The Business Problem**

A Retailer, like Wal-Mart, operates a number of local retail stores in the Boston area. The local stores sell products to end customers. In addition to supporting the local stores the retailer operates a warehouse for the ordering and delivery of products to the local stores. The warehouse is located in the New England region. The warehouse receives orders from local stores and ships back products if the requested products -in the requested quantity- is available in the warehouse. When inventory is low the local store must order products by preparing and submitting requests to the warehouse for processing.

The warehouse is an organization is a unit of the Retailer and does business with a number of suppliers. When the warehouse receives an order from one of the local stores it is usually for multiple products from all kinds of approved suppliers. Such suppliers are manufacturers or distributors of other manufacturers’ products. The warehouse staff receives orders (“Retailer Order”) from the local stores and then they do the following: 1) check if there are enough products in the warehouse inventory; 2a) if yes then they deliver the products to the local store; 2b) If not then they turn around and prepare one or more “Supplier Orders” to the suppliers. Suppliers receive orders for products, fulfill the orders, and then deliver the products ordered to the warehouse. The warehouse in turn delivers the product to the local stored as requested. In certain situations the warehouse orders more than the amount originally requested by the local stores.

The warehouse maintains a master order list of all the orders coming in from the local stores. The warehouse maintains another master order list of all the orders issued by the warehouse to the suppliers. The above description is what you refer to as the Retailer’s Inventory Management Process.

The current inventory management process for this Retailer is manual, paper-based, and prone to errors, delays, etc. The Retailer is facing financial pressures and would like to improve efficiency and reduce cost. An Inventory management expert recommended that they focus on automating the inventory management process. More specifically, all orders to the warehouse as well as orders to the suppliers must be filed and monitored electronically. All suppliers are already enabled through electronic ordering capabilities and ready to accept electronically submitted orders.

On the Local Store side a user must be able to perform the following functions

1. Fills the order specifying all the products that they need, suppliers of these products, and quantities, amount other pieces of information that might be important such as priority.
2. Check the status of their orders and expected arrival time.

On the warehouse side, user must be able to perform the following functions:

1. Review the orders coming from the local stores
2. Based on the orders coming from Local Stores, prepare orders to the suppliers. The warehouse user generates a minimum number of orders to suppliers, i.e. a single supplier order from the warehouse includes product items from multiple Local Stores. See the tables below for an example.

The following is the business model for the Retailer:

Warehouse

Local Stores

Suppliers

The following are the orders coming to the warehouse from the local stores:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Order Id | Store | Quantity | product | supplier |
| 1 | Best Buy Framingham | 50 | HP Printer 110 | HP |
|  |  | 20 | Epson Scanner 11 | Epson |
| 2 | Best Buy  Burlington | 7 | Toshiba Sat Notebook | Toshiba |
|  |  | 12 | HP Printer Color laser | HP |
|  |  | 200 | Epson DeskJet printers | Epson |
|  |  | 70 | HP Printer 110 | HP |
| 3 | Best Buy  Braintree | 30 | Toshiba Sat Notebook | Toshiba |
|  |  | 100 | HP Printer 110 | HP |

The following are the orders going out to suppliers:

|  |  |  |  |
| --- | --- | --- | --- |
| Oder Id | Supplier | Quantity | Product |
| 101 | HP | 220 | HP Printer 110 |
|  |  | 12 | HP Printer Color laser |
| 102 | Epson | 20 | Epson Scanner 11 |
|  |  | 200 | Epson DeskJet printers |
| 103 | Toshiba | 37 | Toshiba Sat Notebook |
|  |  | … |  |

**Retailer Order**

**Retailer**

**Warehouse**

**Master Order List**

Consider the following model that describes how retailer orders are mapped to supplier orders. Notice a supplier order is a combination of order items from even different retailers.

**Supplier Order**

**Order Item**

**Supplier Master Order List**

**Product**

**Supplier**

**Questions**

1. How would you use inheritance to simplify the model described above? Remember the purpose of inheritance. Use one simplification to show how inheritance works in java by defining a class and subclass relationships.
2. In the above model, there are multiple entities involved but they are all part of a single partnership led by one company. What additional concepts you need to introduce to unify your model so it corresponds to a single application. Show all the classes and relationships you must introduce.
3. Suppose the retailer wants to know the status of an order. Since retailer orders are converted to supplier orders one has to go beyond the retailer order to find out the status of an item. What methods and attributes are needed and on which classes to find the status of an order. No java code is needed here.

1. Suppose the Retail wants to eliminate the warehouse, as a physical entity, completely and have the local stores order directly from suppliers. Suppliers ship directly to Local Stores. Define an object model describing this way of doing business (no warehouse). Key here is how the object model (design) will change because of the change in the business model.
2. Suppose corporate headquarters of Walmart wants to know their top 10 local stores (a retailer is a Wal-Mart local store). Assume their best stores are those who have the highest sales volume (order totals). Review your design and explain if your design can generate this type of information and how? If not then explain why not and how to extend your design to support this.
3. [Advanced] To reduce the number of supplier orders going out consider the following procedure: retailer orders arrive into some order processing queue. Once a day the retailer orders waiting in the queue are processed by converting them to a minimum number of supplier orders. In other words, a single supplier order will include all supplier products requested by any number of local stores. Design an algorithm that show how the orders waiting in the queue will be converted to the least number of supplier orders before they are routed to suppliers. You must use your object model from question 3 to do this.