

ICS 52: Introduction to Software Engineering

Fall 2001

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Assignment 2: Architecture and Module Design

Version 2.0

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Due: Monday, 5th November 2001(beginning of Discussion)

SUMMARY

The Requirements Document and Acceptance Test Plan that you submitted for the last assignment was received and reviewed by your Customer. The Customer decided, for unknown reasons, to ignore your document, change focus somewhat, and work with another Requirements Engineer. Somewhat reluctantly you have since successfully negotiated a contract to proceed on the basis of the new Requirements Specification, which is included in this document. Note that there are likely some significant differences between the negotiated specifications and the original one you submitted, in form as well as in content.

Do not base your design on the requirements specification that you created for assignment 1; only designs based on this new official requirements specification will be graded.

In this Design Assignment, you are going to construct a software architecture and define module interfaces for the part of the **CONGO BACKOFFICE** known as the **ORDER FULFILLMENT PROCESS**. The input to this process is the **Order Record** which is the output of the **ORDER RECORD DEVELOPMENT PROCESS** (see Assignment 1).

STRUCTURE

The combination of the architecture and the module design is the deliverable for assignment 2. The printed copy of your document that you turn in for credit should include:

- A title page using a 20 point font with the following text centered vertically and horizontally

Congo.com Architecture and Module Design
First_name Last_name
{Last four digits of your student ID}

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- Page numbers on each page (at the bottom of the page)
- Font used for the document should be similar to Times New Roman (or any of the Times family).
- Major section headings in 18 point, other subsection headings in 16 point, and body text in 12 point.
- Stapled once in the upper left hand corner, no binders, no plastic covers.

The deliverable should adhere to the following structure:

- **Table of contents**
- **Introduction**, which provides a brief overview of the system from the point of view of the system architect.
- **Architecture**, which (a) explains the main architectural style used by the system, (b) why this style was chosen, (c) presents the high-level architecture, and (d) discusses the rationale for the architecture.
- **Component design**, which precisely describes each component in your design. As needed, each component should be further broken down into sub-components (modules). Each module, at whatever level, must be described in this section. Four aspects of each module must be described:
 - **The purpose of the module:** State the generic purpose of the module. Specify which part of the requirements document it addresses, if this is appropriate. (Appropriate items to address here include such topics as: What secret does this module hide? Does the module represent an abstract data type?)
 - **The provided interface:** Define the provided interface by listing all its methods with descriptive names. The definition includes the names of the methods, their parameters, and their return types. Provide a short commentary describing each of the methods (i.e. what it does).
 - **The required interface:** Define the required interface by listing all its modules/methods. Note that every one of the modules/methods listed should be described elsewhere in this document, either as part of the design which you are creating or else as an externally provided service.
 - **Constraints on the module:** E.g., performance constraints, platform requirements, and so on. Only include this part if necessary.

Each module should be described on a separate page.

- **COMPRISES diagram**, which presents, in one diagram, the hierarchical breakdown of the **CONGO BACKOFFICE** architecture into its modules and sub-modules.
- **USES diagram**, which in one diagram relates all *elementary* modules according to the USES relation. Each module is labeled with a number indicating its level in the USES hierarchy. Required interfaces of each of the modules are connected to the provided interfaces of the other

modules. Note that every part of an interface that is *required* should be *provided* by one of the interfaces to which that required interface is connected.

- **Integration Test Plan** which describes the test plan for the system after all the modules have been integrated.

GRADING

The architecture and module interface design should be clear, easy to understand, easy to implement, easy to change. A design "that just works" but is not consistent with the design principles presented in class will not get full credit. Apply the software engineering principles introduced in the lectures and found in the textbook.

The grading of this assignment will be broken down as follows:

- 5% for architectural style used and reason
- 30% for the quality of the architecture and its rationale (i.e. consistency with design principles discussed in class)
- 10% for COMPRISES Diagram and USES Diagram
- 40% for Module Specifications
- 15% for Integration Test Plan

The assignment counts 18% toward your final grade for the course.

Note:

- **Do not work in teams to complete this assignment**
- **No late assignments will be accepted**

REQUIREMENTS SPECIFICATION FOR THE "ORDER FULFILLMENT PROCESS"

1. Application Context

The Congo.com backoffice supports numerous functions: accounting, personnel, payroll, publications (marketing), legal matters, and so on. To a great extent Congo.com's philosophy is to contract out as many services as possible, in order to be a true "e-commerce" company. Thus the company seeks to have no warehouses, engage in no shipping activities, issue no physical mail, and so on. For this design and development project you are tasked with supporting the order fulfillment process (OFP); ie. once a complete order record has been developed, either through interactions over the web or by telephone as described in the previous assignment, the order must be processed such that the customer receives the books ordered, the company receives payment, the publishers are paid for their services, and so on. Since Congo.com does not have any warehouses, the purchase process works by having Congo.com place an order for the books the customer ordered with the set of publishers involved. Congo.com then issues requests to the selected shipping companies to pick up the books from the publishers and deliver them directly to the consumer. All the publishers that Congo.com works with, therefore, are responsible for the warehousing of the books as well as packaging and labeling them for handing over to the shipper.

2. Functional Requirements

2.1 INPUT: A file of order records, hereinafter referred to as the Order Input File (OIF) and a file of publisher information referred to as the Publisher Input File (PIF).

An Order Record is created when the **ORDER RECORD DEVELOPMENT PROCESS** is successfully completed. The order record information is then stored in a file. At periodic intervals, usually once an hour, the file is submitted to the OFP. The **SampleOrderRecordFile.txt**, as shown in section 6 below, provides the details of what information is contained in an order, and the format in which information is provided. Examples of two order records are also shown.

The input files are guaranteed to adhere to the format described in Section 6; no additional error checking is required.

2.2 ACTIONS:

Fulfilling an order consists of the following activities:

1. Obtaining the order record from the OIF.
2. Maintaining contact with the customer, by first confirming the order with the customer, by sending an email with the following information
 - a. Order_Record_Number
 - b. Name of the customer
 - c. Address of the customer
 - d. Email address of the customer
 - e. A list of books purchased
(with "Book_Title", "Book_Author", "Book_Price")

- f. Name of the shipping company
- g. Mode of Shipment
- h. Cost of shipping
- i. The total bill (Total_Cost) that he will be charged (sum of "Book_Price" for all books purchased + Cost of shipping)
- j. Type of Credit Card
- k. The last 4 digits of the Credit Card Number.

After the order has been shipped, send a final email to the customer with the following information

- a. Email address of the customer
- b. Order_Record_Number
- c. Name of the shipping company
- d. Mode of shipment
- e. Tracking Numbers for all the shipments

3. Place the order with the publishers by providing the following details

- a. Book_Title
- b. Book_Author
- c. Number of copies purchased
- d. Order_Record_Number
- e. Name of the customer

Each publisher returns a unique Publisher_Tracking_Number to the Congo BackOffice which is used by the shipper when it contacts the publisher to collect the shipment.

Congo.com facilitates the purchase of books from the following publishers

- a. Addison Wesley
- b. Penguin
- c. Random House
- d. O'Reilly
- e. Kluwer
- f. Prentice Hall
- g. Harvard Business School Press
- h. Lawrence Erlbaum Associates
- i. PWS Publishing Company

Note that in order to support the above activity, you will first need to find out the "Publisher of the book" from the **Publisher Input File (PIF)** using the "Book_Title" and "Book_Author". The **SamplePublisherFile.txt**, as shown in section 6 below, provides the details of what information is contained in the Publisher Input File, and the format in which the information is provided.

4. Contract with the selected shipper to pick up the books from the various publishers involved (separate shipments per publisher) so that the books are delivered to the customer.

Following is the list of shippers and their modes of shipment that Congo.com has a tie-up with

- a. FEDEX
 - 1. FEDEX 2Day
 - 2. FEDEX first overnight
 - 3. FEDEX Standard overnight

- b. UPS
 - 1. UPS Ground
 - 2. UPS Next Day Air
 - 3. UPS Second Day Air

Send the shipper the following information

- a. Order_Record_Number
- b. Name of the customer
- c. Address of the customer
- d. A list of publishers of the books purchased (a list of "Publisher of the book" and the corresponding "Publisher_Tracking_Number" of each publisher)
- e. Mode of shipment

The shipper returns a set of Tracking Numbers (one for each shipment) which is used by the customer to find out the status of his shipments. Then, it collects the book/s from the concerned publishers and ships them to the customer.

- 5. Handle the billing process. This consists of

- a. Charging the customer's credit card**

The customer is charged only after all the Tracking Numbers have been obtained from the shipper. Congo.com deals only with VISA and MASTERCARD credit card companies (which means that it accepts only VISA and MASTERCARD credit card information from customers).

Send the concerned credit card company the following information

- a. Name of the customer
- b. Address of the customer
- c. Name of the company charging the customer (which is Congo.com itself)
- d. Credit Card Number
- e. Total Cost

- b. Paying the publishers the cost of the book/s**

For each book in the order, acquire the "Publisher_Book_Price" from the corresponding publisher. For this send the "Publisher of the book" the following information

- a. Book_Title
- b. Book_Author

The publisher returns the "Publisher_Book_Price" of that book. Then, pay the "Publisher of the book" the "Publisher_Book_Price".

- c. Paying the shipper the shipping charges**

Pay the shipper the "Cost of shipping" which is the sum of all shipment costs.

- d. Estimating profits and losses**

After processing every 100 order records send an email to the Financial Manager informing him of the profits and losses incurred. Specifically, send the following information

- a. The email address of the Financial Manager ("fm@congo.com")
- b. The number of books sold.
- c. The sum over all the books of the difference in the Congo.com price of each book ("Book_Price") and the publishing price of the same book ("Publisher_book_price")

The **CONGO BACKOFFICE** repeats the above set of steps for every order record in the **ORDER RECORD DATABASE**.

2.3 External Module Interfaces

As described below in Section 5 the interface specifications for the email facility, publishers, shippers and the credit card companies have not yet been received.

3. ENVIRONMENTAL REQUIREMENTS

Programming Language - Java , JDK 1.2.2

Operating System - Windows NT, Windows 95, 98, 2000, Unix

Browsers - Customers should be able to use the following browsers

- a. Internet Explorer 5.01 and higher,
- b. Netscape Communicator 4.76 and higher

4. SUBSETS & SUPERSETS

4.1. SUBSETS

1. Congo.com accepts only VISA and MASTERCARD credit cards.
2. Congo.com does not allow the cancellation of an order.
3. It offers limited shipping options for e.g. no FEDEX Priority Overnight shipping.
4. A customer can only purchase 1 quantity of a book at a time.

4.2. SUPERSETS

1. In the future Congo.com will also allow purchases with AMEX and DISCOVER cards.
2. Congo.com in the future will allow the cancellation of an order within 10 hours of creating the order.
3. There will be new modes of shipment which will be added to the existing list of shippers. These are
 - a. UPS 3 Day Select
 - b. FEDEX Ground and Home Delivery
 - c. FEDEX Priority Overnight

4. More than one book of the same type can be bought by the customer at the same time.
5. As Congo.com expands customers will be able to buy more books from Congo.com. This means that Congo.com will have to tie-up with more publishers.

5. EXPECTED CHANGES & FUNDAMENTAL ASSUMPTIONS

- None of the publishers that Congo.com works with have yet provided interfaces to their order processing systems. While these interfaces may come along later you will have to create a generic interface for your initial use and testing. However these external interfaces could be supplied at any moment, at which time you will have to accommodate them.
- Similarly to the case of the publishers, none of the shippers with whom Congo.com contracts have provided their specific order interface specifications. Handle this situation as well.
- It is assumed that during the Order Record Development Process an order record is created only if the publisher has the book in stock. However, in the future the Order Fulfillment Process will handle it. This will involve Congo.com contacting the concerned publisher to find out whether the book is in stock. The publisher will look up an internal stock inventory and inform Congo.com whether the order can be met.
- Congo.com assumes that the shipper returns the Tracking Number/s when the shipments have been shipped.
- Currently it is assumed that Congo.com will only serve customers from USA and Canada. However the top-level management of the company is going to meet soon to decide whether Congo.com should support international customers. So this is highly likely to change.
- Since Congo.com serves only domestic customers it only provides domestic shipping facilities. So if Congo.com decides to serve international customers it will need to have international shipping options/facilities.
- The software for Congo.com will be built in Java using Java 2 Platform Standard Edition (JDK) 1.2.2. In the near future it is very likely that there will be a change to JDK 1.3.1 version for implementation.

6. DEFINITIONS AND REFERENCE DOCUMENTS

6.1 Definitions

- **Address of the customer** (*four fixed length strings: 30 characters, 20 characters, 15 characters, and 10 characters*)
 - The first string contains the Apartment Number and the Street Address
 - The second string contains the Name of the City
 - The third string contains the Name of the State
 - The fourth string contains the Zip Code

- **Book_Author** (*max 120 chars*)
The name of the authors of the book; each author separated by a semicolon.
- **Book_Price** (*max 6 chars*)
Congo.com's book price.
- **Book_Title** (*max 120 chars*)
The title of the book.
- **Cost of shipping** (*max 6 chars*)
The total amount charged by the shipping company for delivering all the shipments to the customer. It is the sum of all shipment costs.
- **Credit Card Number** (*16 digit unsigned integer*)
The 16-digit customer's credit card number.
- **Customer's Phone Number** (*fixed 10 chars*)
The phone number of the customer which includes the area code.
- **Email address of the customer** (*max 60 chars*)
Congo.com sends email to the customer at the email address specified during the Order Fulfillment Process.
- **Entry_Number** (*8 digit unsigned integer*)
A unique number identifying each book entry in the Publisher Input File (PIF).
- **Mode of shipment** (*max 20 chars*)
The mode of delivery for example, UPS Ground, FEDEX overnight etc.
- **Name of the customer** (*a character string of maximum length 30*)
The name of the customer includes the first name and the last name.
- **Name of the shipping company** (*max 20 chars*)
Name of the shipper, for example, USP or FEDEX
- **Number of books purchased** (*a 5 digit unsigned integer*)
The number of books in an order record.
- **Number of copies purchased** (*a 5 digit unsigned integer*)
The number of copies of the same book purchased.
- **Order_Record_Number** (*a 16 digit unsigned integer*)
Used for Congo.com's internal tracking of an order. Guaranteed to be unique for each order.
- **Order Input File**
The Order Input File (OIF) contains a set of order records created by the Order Record Development Process.

- **Publisher_book_price** (*max 6 chars*)
The publishing company's price of the book. This is different from Congo.com's Book_Price. The difference between these book prices is used to calculate the profits earned by Congo.com.
- **Publisher_Tracking_Number** (*a 16 digit unsigned integer*)
Returned by the publisher to Congo BackOffice. This number is then given by Congo BackOffice to the shipper who contacts the publisher using this number.
- **Publisher Input File**
The Publisher Input File (PIF) contains a list of all the books and the corresponding names of the publishers.
- **Publisher of the book** (*max 50 chars*)
Name of the publishing company for example, Addison Wesley
- **Total Cost** (*max 6 chars*)
The total charge incurred by the customer. This is the sum of the Book_Price for all the books and the Cost of shipping.
- **Tracking Number** (*a 16 digit unsigned integer*)
Used by the customer for tracking the shipment. Guaranteed to be unique for each shipment.
- **Type of Credit Card** (*max 15 chars*)
For example, VISA or MASTERCARD.

6.2 Reference Documents

- **SampleOrderRecordFile.txt**
This file contains the format of the Order Record and two sample Order Records.
- <http://www.ups.com>
This is the UPS web site and lists all the UPS shipment delivery options
- <http://www.fedex.com>
This is the FEDEX web site and lists all the FEDEX shipment delivery options

SampleOrderRecordFile.txt

Format of the Order Record

Each line of the file is terminated by a CR/LF

```
*****
#%Order_Record_Number
Name of the customer
Address of the customer
Email address of the customer
Customer's Phone Number
Number of books purchased
```

// List of books purchased (each entry separated by "#;#". End of entry // indicated by "#;#" or by the size of the field)
Book_Title #;# Book_Author #;# Book_Price

...
...

Name of the shipping company
Mode of shipment
Cost of shipping
Type of Credit Card (VISA/MASTERCARD)
Credit Card Number

*****SAMPLE ORDER RECORDS*****

#%6578234523456578
Robert Fisher
229 Berkeley, Irvine, CA - 92612
rfisher@hotmail.com
9495091234
2
Software Engineering#;#Ian Sommerville#;#100.00
Human-Computer Interaction#;#Jenny Preece#;#75.00
FEDEX
FEDEX 2Day
15.00
MASTERCARD
1234567891234567

#%4395873287324395
Tim Anthony
2346 Hayden Blvd, Boston, MA - 02116
anthonytim2000@yahoo.com
6033292343
1
Culture of the Internet#;#Sara Kiesler#;#50.00
UPS
UPS Ground
4.35
VISA
7654234598653457

eof [*eof indicates End of File*]

SamplePublisherFile.txt

Format of each entry

Each line of the file is terminated by a CR/LF

```
*****
#%Entry_Number
// List of books (each entry separated by "#;#". End of entry
indicated // by "#;#" or by the size of the field)
Book_Title #;# Book_Author #;# Publisher of the book

*****SAMPLE ENTRIES*****

#%56781234
Software Engineering#;#Ian Sommerville#;#Addison Wesley

#%67891235
Human-Computer Interaction#;#Jenny Preece#;#Addison Wesley

#%65432345
Culture of the Internet#;#Sara Kiesler#;#Lawrence Erlbaum Associates

#%87652349
Using C++ An Introduction to Programming#;#Julien Hennefeld;Charles
Burchard#;#PWS Publishing Company

**eof  [**eof indicates End of File]

*****
```