Graduate Assessment Test (Sample)

CS201-203

1. Fibonacci sequence is defined by a recurrence relation. The series is: 0,1,1,2,3,5,8,13,... Write a complete recursive method/function that returns the fibonacci sequence element for a particular index;

```
int  fibonacci(index)
{
```

2. Draw a BST (Binary Search Tree) with the following integer values: 60,55,45,57,59,100,67,107,101.

Give the sequence of the nodes visited by preorder, postorder and inorder traversal algorithms.

3. Give a suitable class definition of a node in BST.

Write a search method/function that determines if the element is present in the BST.

CS312 Assessment Test

1. Consider that $T(n) = 2T(n/2) + f(n)$; where $f(n)= n^2$. Find a theta notation for T(n)

2. Derive the time complexity (in theta notation) for the number of times the statement x=x+1 is executed

```
j=n
while (j>=1) {
        for i=1 to j
                x= x+1;
        j=j/2
}
```

3. Express the recurrence relation for the Fibonacci sequence (problem #1).

What is the solution in “O” notation.

CS386 Assessment Test

1. Give the Regular Expression that describes the set of Strings over (0,1) where every 0 is always followed by a 1

Draw a nondeterministic finite automaton (may use null transitions)

2. Consider the following grammar:

<S> → a<S>b<S> | a<S>b<S>c<S> | d

Give two distinct derivations on the string: adbadbdcd (Show steps)

Based on two distinct derivations, how do you classify this grammar.

3. Using the Chomsky hierarchy of formal languages, (i) name the types of language and (ii) the corresponding automata that accepts the language

$L = \{0^n 1 0^m 1^* \mid m > n$ where m,n are positive integers$\}$

Object Oriented Programming Assessment Test (CS202/CS203)

`GeometricObject` class is defined as below:

```
public abstract class GeometricObject
{
   private java.util.Date dateCreated;

   public GeometricObject() {
         dateCreated = new java.util.Date();
   }

   public java.util.Date getDateCreated() {
         return dateCreated;
   }

   public String toString() {
         return "Created on " + dateCreated;
   }

   public abstract double getSurface();

   public abstract double getVolume();
}
```

Design and implement Sphere and Cylinder classes that extend GeometricObject:

Each class should contain the following methods:

- A no-argument constructor that creates a default object.
- A constructor that creates an object with the specified data fields (i.e. ‘radius’ for a Sphere and ‘radius’ and ‘height’ for a Cylinder).
- Accessor(get) methods for each data field.
- A method named getSurface( ) that returns the surface area of the object.
  - Surface Area of a Sphere = 4*PI*(radius^2)
  - Surface Area of a Cylinder = 2*PI*radius*height
- A method named getVolume( ) that returns the volume of the object.
  - Volume of a Sphere = 4/3*PI*(radius^3)
  - Volume of a Cylinder = PI*(radius^2)*height
- A method named toString( ) that returns a string description of the object. The description should contain the name of the shape and its data fields. For example, the toString( ) method for a Cube should return: “Sphere: radius = 6”

The following test program creates 5 different geometric objects and stores them in an array type of GeometricObject.

Complete the following test program such that it

- computes surface area and volume of each object
- sorts the array based on its surface area in descending order
- outputs a description of the shape using toString( ) method
- and outputs the data field (i.e. radius for a sphere), surface area and volume of the object in the sorted order

```
public class GeometricObjectTest
{
      public static void main(String[] args) {

            GeometricObject objArray[] = {
                        new Sphere(5),
                        new Cylinder(3,2.5),
                        new Sphere(6.3),
                        new Sphere(2.7),
                        new Cylinder(2.1,1.7)
                        };


            // compute their surface area and volume

            // sort them in descending order based on its surface area

            // display their shape description using toString( ) method

            // display their data field (i.e. radius for a sphere),
            // surface area and volume
      }
}
```

Web programming Assessment Test (CS320)

Complete the following application using any technology. JSP is preferable as its competency is expected for CS520. However, you can implement this application using any other technology for which you need to bring your own laptop.

[Introduction]
A local ACM Student Chapter has accumulated a sizable collection of technical books over the last few years. Most of the books are about topics such as software development, networking, and program languages, which would interest many students and faculty. However, due to the lack of a proper distribution mechanism, the books are just collecting dust now on the shelves in the ACM office. To rectify this situation, the ACM chapter has chosen a member to be the librarian to manage these books. To make the life of the librarian a little easier, you are going to develop an online book reservation system, using, of course, JSP without scripting elements. With this system, students and faculty can browse and reserve the books that they are interested in online, and later pick up the physical copies of the books at the ACM office. The system also helps the librarian to keep track of the books in the collection.

In its simplest form, the online book reservation system consists of a Login page, a User page, a Librarian page, and a backend database.

[Database]

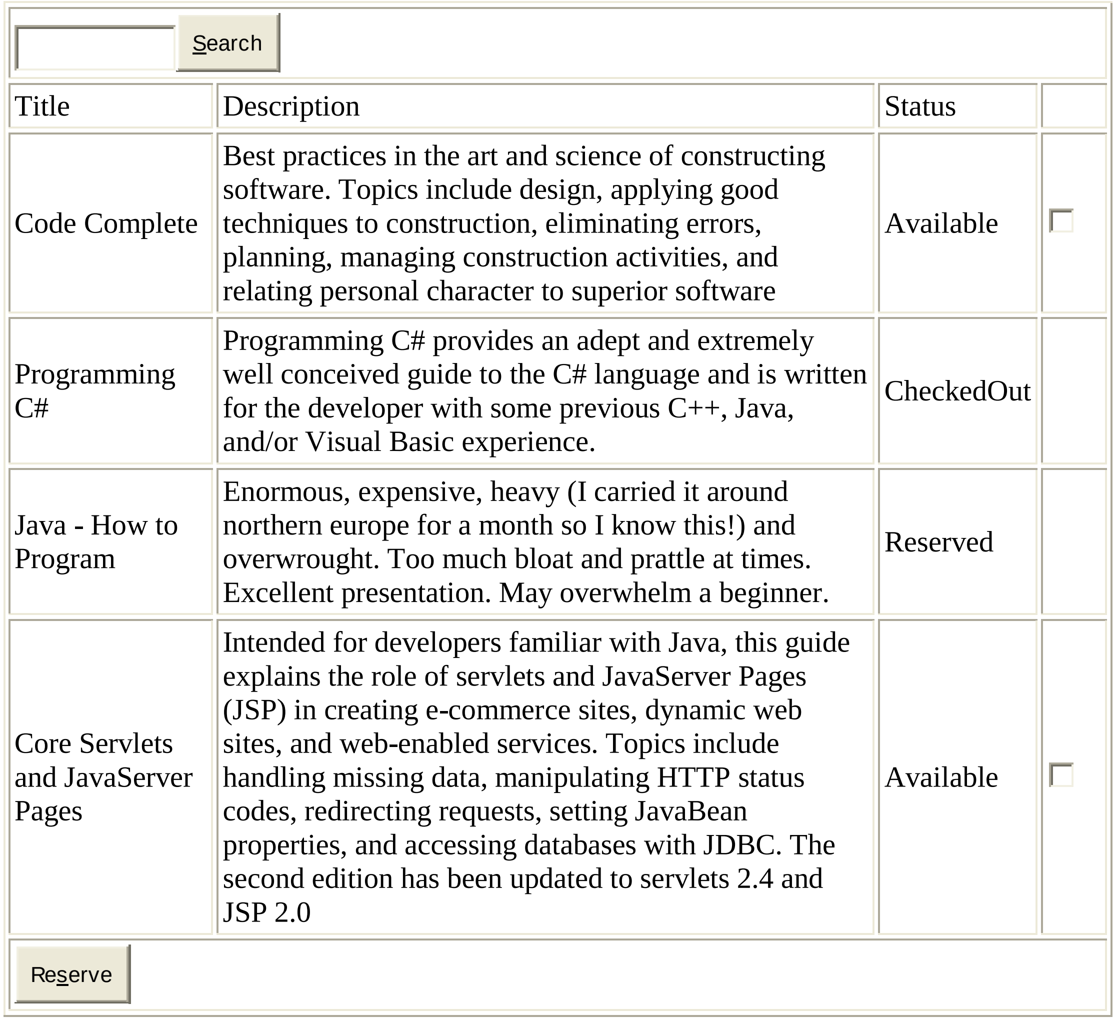
The backend database contains the following information:
The title and description of each book.
The username and password of each user, and whether the user is a librarian or not.
The status of each book, which could be Available, Reserved, or CheckedOut. And for the books that have been reserved (or checked out), the database also keeps track the user who reserved (or checked out) the book.
For this part of the exam, you need to turn in a library.sql file which include the statements to create all the tables in the database, and the statements to populate the tables so that there are at least four books in the database, and each table has at least two records.

[Login]

A user must login to reserve books online. The Login page validates the username and password provided by a user against the information stored in the database. If the authentication is successful, the Login page redirects the user to the User page or the Librarian page based on whether the user is a librarian or not.

[User]

The User page allows a user to browse, search, and reserve books, as shown below:



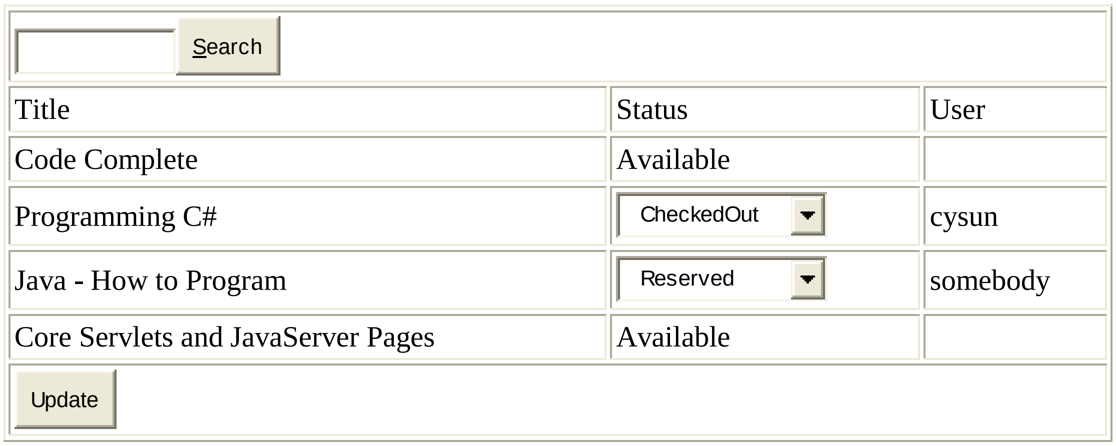
Title	Description	Status	
Code Complete	Best practices in the art and science of constructing software. Topics include design, applying good techniques to construction, eliminating errors, planning, managing construction activities, and relating personal character to superior software	Available	☐
Programming C#	Programming C# provides an adept and extremely well conceived guide to the C# language and is written for the developer with some previous C++, Java, and/or Visual Basic experience.	CheckedOut	
Java - How to Program	Enormous, expensive, heavy (I carried it around northern europe for a month so I know this!) and overwrought. Too much bloat and prattle at times. Excellent presentation. May overwhelm a beginner.	Reserved	
Core Servlets and JavaServer Pages	Intended for developers familiar with Java, this guide explains the role of servlets and JavaServer Pages (JSP) in creating e-commerce sites, dynamic web sites, and web-enabled services. Topics include handling missing data, manipulating HTTP status codes, redirecting requests, setting JavaBean properties, and accessing databases with JDBC. The second edition has been updated to servlets 2.4 and JSP 2.0	Available	☐

By default the page displays all the books in the database. A user may use the keyword search feature to limit the display to only the books whose title or description contains the keyword.

A user can reserve the books which are currently available. However, the total number of books which are reserved or checked out by the same user cannot be more than 2. For example, a user may reserve at most two books, and if he or she has already reserved or checked out one book, then the user can reserve only one more book. If the reservation fails due to the violation of this rule, an error message should be displayed, and if the reservation succeeds, the status of the reserved books should be changed from Available to Reserved.

[Librarian]

The Librarian page allows a librarian to view and update the status of the books through drop-down lists, as shown below:



Title	Status	User
Code Complete	Available	
Programming C#	CheckedOut ▾	cysun
Java - How to Program	Reserved ▾	somebody
Core Servlets and JavaServer Pages	Available	

Note that the Librarian page is designed to allow only three kinds of status updates:
from CheckedOut to Available
from Reserved to CheckedOut
from Reserved to Available
And similar to the User page, the Librarian page also has a keyword search feature, which can be used to limit the display to only the books whose title or description contains the keyword.
[Grading Criteria]
Database (20pt)
Login
basic username and password validation (10pt)
redirect based on user type (10pt)
User
search (15pt)
display (including proper display of the checkboxes) (20pt)
reservation (25pt)
Librarian
search (10pt)
display (including proper display of the drop-down lists) (20pt)
update (30pt)
final.html is missing or doesn't have the link to your application on the CS server (-10pt)
Only features working correctly on the CS server will receive full credit. Partial credit will be given at my discretion.
The total of the final is 100pt. Anything above 100 is considered extra credit.