American University of Beirut

الجامعة الأميركية في بيروت

CMPS 363 Final Exam

February 02, 2006

Student Name: _____   Student ID:_____

Signature: _____   Section: __1__

- *There are **twelve** pages, including this one. The test is out of 100 marks, and the value of each question is provided. Please use this information to manage your time effectively.*
- *Your handwriting should be neat and readable **or I will not mark the answer!***
-

Question 1: _____/20	
Question 2: _____/10	
Question 3: _____/20	
Question 4: _____/05	
Question 5: _____/10	
Question 6: _____/20	
Question 7: _____/15	
Total: _____/100	

Question 1: General Questions [20 marks]

A) What are design patterns? How are they different from frameworks? Give an example **[4 marks]**

B) I am building a Word Processor and need to support unlimited undo of actions. What design pattern might I use to assist me in designing a good solution? **[3 marks]**

C) I am building a graphical user interface framework and need to subclass the window abstraction and the window implementation. What design pattern could I use? provide UML **[3 marks]**

D) I am limited to only one database connection. What design pattern helps me limit the number of objects I can create? Provide UML **[3 marks]**

E) I want to have several objects that "watch" another object and take action when the object changes. What design pattern will help? provide UML **[3 marks]**

F) It is said that patterns define a vocabulary among designers. Discuss in the context of your individual projects. **[4 marks]**

Question 2 Design Patterns [10 marks]

A) Subsystems in our application does not need to know, how the object has to be created, it should also allow you to hide the concrete implementation and dynamic object configuration. Discuss using examples. Provide UML. **[5 marks]**

B) Global variables are problematic in OOD. What are the potential problems? And what design patterns can be helpful to resolve these problems. Give an example + code. Provide UML **[5 marks]**

Question 3 Design Decisions [20 marks]

A) It is said that designs are often loaded with overprivileged class inheritance, where much of the functionalities exist. Show an example, and provide UML **[4 marks]**

B) Use composition (via an example) to resolve the above problem. Provide UML **[4 marks]**

C) Design for interface not for implementation. Discuss, and give a OO (PHP) example. Provide UML. **[4 marks]**

D) It is said that object creation and destruction has a great effect on running/modification of the code. Discuss. **[4 marks]**

E) Tight coupling implies that when a change occur somewhere in a system, it often necessitates many changes elsewhere in that system. You can give an OO PHP example that is related to data-bases. **[4 marks]**

Question 4 Architectural Styles [8 marks]

```php
if (!in_array ($_GET['page'], array('index', 'products', 'contact', 'about'))) {
    $page = 'index';
} else {
    $page = $_GET['page'];
}

$driver = false;

switch ($page)
{
    case 'products':
        if (isset ($_GET['cat'])) {
            include 'classes/products.php';
            $driver = new ProductCategory($_GET['cat']);
        }
        break;

    case 'contact':
        include 'classes/contact.php';
        $driver = new Contact();
        break;

    case 'about':
        include 'classes/about.php';
        $driver = new About();
        break;

    case 'index':
    default:
        include 'classes/index.php';
        $driver = new Mainpage();
        break;
}

if ($driver) {
    $driver->display();
} else {
    die ('Something is really messed up!');
}
```
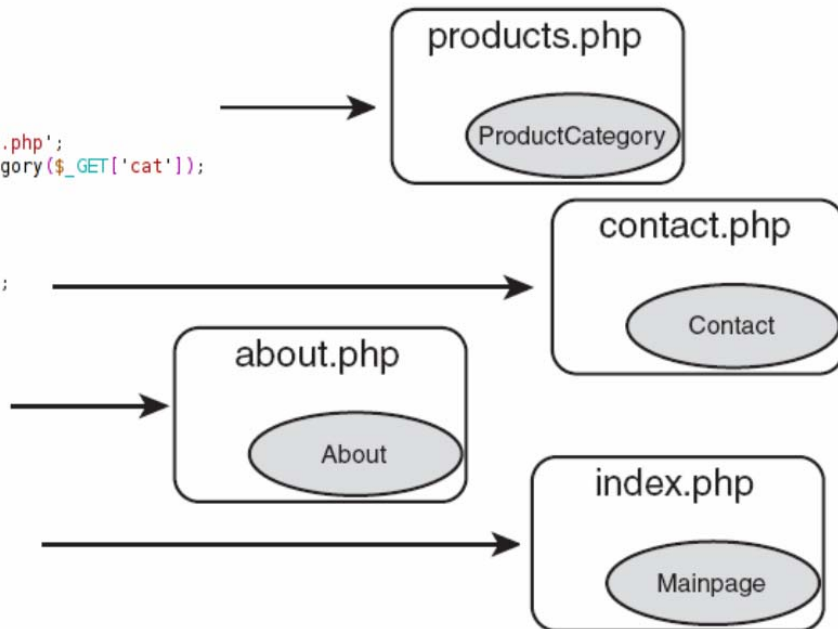
products.php → ProductCategory

contact.php → Contact

about.php → About

index.php → Mainpage

Discuss the above design style and state its advantages and disadvantages.

Question 5 Object creation [7 marks]

Aside from inheritance, and its partner, polymorphism, we can find other situations where objects are involved in some kind of interaction. Definitely, one concept that rapidly comes to my mind is that of aggregation. Generally speaking, aggregation occurs when one object uses the functionality of another object to satisfy its own purposes. Having two objects A and B, if our object B simply "passes away" when object A dies, then we say that object B composes to A.

Explain these two concepts with examples, and show potential design effect on testing.

Question 6 MVC Framework [20 marks]

In contrast to software engineering, which relies on relatively well established development approaches, there is a lack of a proven methodology that guides Web engineers in building reliable and effective Web-based systems. Currently, Web engineering lacks process models, architectures, suitable techniques and methods, quality assurance, and a systematic approach to the development process. As a result, Web engineering is still struggling to establish itself as a reliable engineering discipline. The cost of poor reliability and effectiveness has serious consequences for

the acceptability of the systems. One of the main reasons for the low acceptance of Web-based applications is the large gap between design models and the implementation model of the Web. It is therefore not surprising that Web engineering education still focuses on technologies, rather than on critical skills that facilitate engineers to solve real-world problems effectively.

A) Discuss the theoretical aspect behind MVC, and show how the MVC paradigm can help to bridge the gap between design and implementation. **[10 marks]**

B) When a request requires common actions $A' = \{a_1, a_2,..., a_n\}$ from view v_i to view v_j where $A' \in A$ the set of all possible actions in a Web engineering system S, and $\{v_i, v_j\}$ is a subset of $V = \{v_1, v_2,..., v_n\} \in S$, certain disadvantages can be expected when coding S. Discuss how the MVC framework can help to reduce these disadvantages. **[10 marks]**

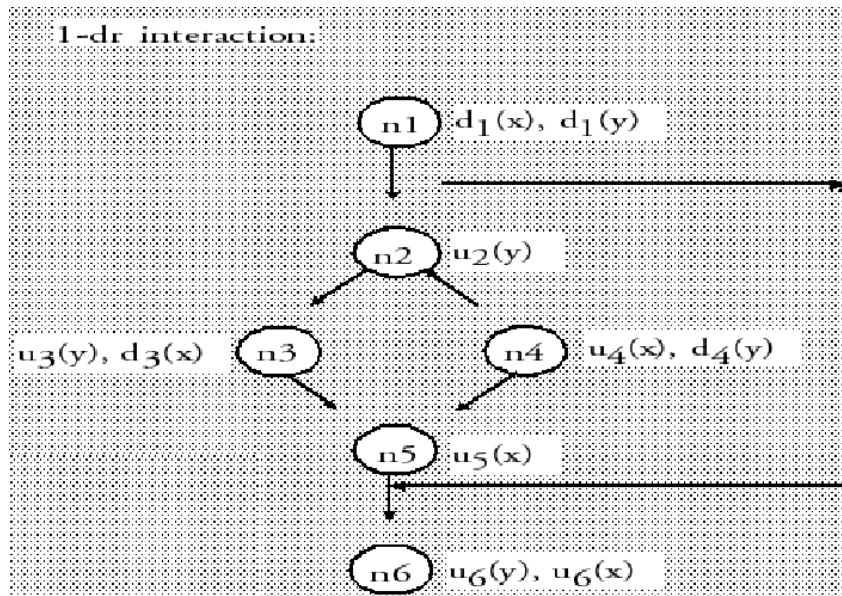# Question 7 Software Testing (Dataflow flavors) [15 marks]

A) Does the sequence of definitions <n1, n2, n4>, <n1, n2, n3, n4>, and <n1, n2, n3, n2, n3, n4> in the following graph form an ordered context coverage with respect to x, y and z. Explain. **[5 marks]**

Ordered Context Coverage
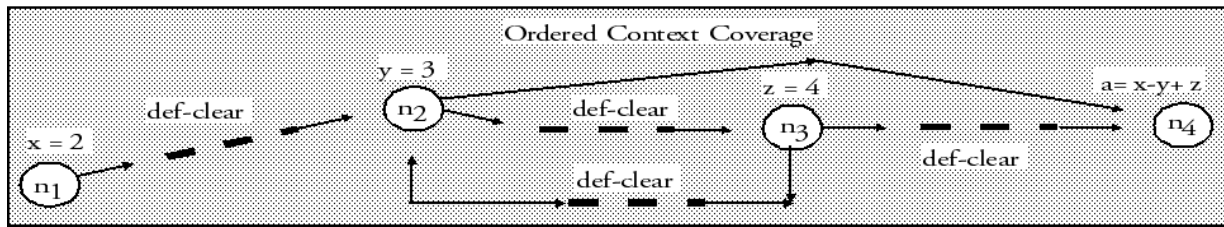
B) A proposed a family of test adequacy criteria called the *required k-tuples*, where *k* is a natural number > 1. The required k-tuples require that a path set $P = \{p_1, p_2, ..., p_n\}$ covers chains of alternating definitions and uses, or definition-reference interactions called *k-dr* interactions (k > 1). An example of a k-dr interactions is depicted in the Figure below. In n_1, there is a definition of a variable x_1, that us used to define variable x_2 in n_2 such that $x_1 \in n_1$ reaches n_2 via path p_1. Therefore, the information assigned to variable $x_1 \in n_1$ is propagated to variable $x_2 \in n_2$. This information is further propagated to another variable, say, $x_3 \in n_3$ such that $x_2 \in n_2$ reaches n_3 via path p_2. This information propagation process continues until it reaches n_k. Thus, the set of paths $\{p_1, p_2, ..., p_{k-1}\}$ form a k-dr interactions. The required k-tuples requires some subpath propagating each
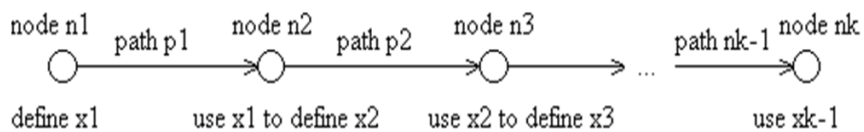
k-dr interaction such that (1) if the last use is a predicate the propagation should consider both outcome (true and false), and (2) if the first definition or the last use is in a loop, the propagation should consider either a minimal or some larger number of loop iterations. The required k-tuple coverage criterion, or k-dr interaction chain coverage criterion, then requires that all feasible k-dr-interaction chains should be tested. Calculate the 1-dr interaction and its satisfying paths for the following CFG. **[5 marks]**

1-dr interaction:

n1 $d_1(x)$, $d_1(y)$

n2 $u_2(y)$

$u_3(y)$, $d_3(x)$ n3   n4 $u_4(x)$, $d_4(y)$

n5 $u_5(x)$

n6 $u_6(y)$, $u_6(x)$

C) How applicable is this family of applicable criteria to Visual Dataflow Languages. Explain. **[5 marks]**.