End Semester Examination – Semester IV

CSPE41 – Software Engineering

16 May 2024 | 2022 CSE

Marks: 90 | Duration: 3 hours | Instructor: C. Oswald

Note: Read the questions carefully. Your *logic* is more important than the answer.
Present your content as per the marks given. Marks are indicated in a bracket near the question.

0. Mention the grade you expect in this course + 2 lines justification. (0 m)

Design Phase (CO2)

1. a. Welcome to 'Vantara' meaning 'Star of the Forest', one of the largest Animal Rescue Centres in the world located at **Jamnagar, Gujarat, India**. It is a comprehensive rehabilitation center, designed to recreate a natural and nurturing environment akin to the lush habitats from which the rescued animals hail. The grand conservation center includes state-of-the-art healthcare facilities, hospitals, research centers, and academic institutions. Since its inception, the initiative has successfully saved more than 200 elephants and a variety of reptiles and birds, including critical species such as rhinos, leopards, and crocodiles. The Elephant Hospital center has nutritionists, and pathologists, who work tirelessly to ensure the well-being of elephants, offering treatments such as hydrotherapy pools, a large elephant jacuzzi, and even multani-mitti massages. The facilities offer ICU, MRI scan, endoscopy, dental scalers, lithotripsy, dialysis, and cutting-edge technology for live video conferences during surgical procedures.
The administrators of Vantara are in need of a software (product) to efficiently plan and schedule the logistics for the treatment of an animal in such a way that time and resources are utilized effectively. You may creatively assume the necessary information required for a good design of the software.
To start with the development of the software, draw a UseCase diagram and a Class Diagram and be sure to label all associations with appropriate multiplicities. (3 + 5 m)

b. State True or False. If true, Justify in one line. If false, write the true statement. *Marks shall be given only if the true statement is justified/true statement is written for false statement.* (9 m)

i. Coupling in software design should be low and Cohesion should be high.
ii. A baseline is a time/phase in the software development (usually a project milestone) after which any changes must be formalized.
iii. "Classes that change together belong together" is Common Closure Principle.
iv. In an Interface design, if the distance from the starting point to the target is 5 cms and the width of the target along the axis of motion is 3.5 cms, then the Index of difficulty is 1.279.
v. People pay too much attention to bugs and not enough on flaws.
vi. Modules that perform many unrelated functions are called "segregated" components.
vii. Any single entry, single exit program segment that has all statement on some path from the entry to the exit can be specified using only sequencing and iteration.
viii. Abbreviation of WYSIWYG: What You See Is What You Give.
ix. Tom Demarco said: Even if you can't measure the quality of a software, you can still manage it.

SDLC and Requirements Engineering (CO1)

2. a. On a true incident for the problem given below, for which Amazon.com, Inc., found that a non-technical solution was much more effective than a technical solution. Give a technical and a non-technical solution for the same. (4 m)
Problem: Filling boxes ("picking") was too slow.

b. **TrIchyFest** is a famous Annual Technical convention of the Engineering Institutes of Tamil Nadu, held in Trichy every year. Since its first edition in 1986, it has gone through several major changes regarding its structure, length and location, but the tickets have always been sold in a traditional way: through two events agencies. The organizers decided to completely modernize the tickets selling system and created the following concept. From this year on, the tickets will be sold in three distinct ways: traditionally, i.e. by the two events agencies, in electronic format directly on the festival website, and through Aha! railway company. All parties will have access to the same unique tickets database of the new system, to avoid double selling. A partnership with the Aha! railway company needs to be set up, such that Aha! can sell combi-tickets including both the convention admission fee and the train ride to the convention venue at reduced price, from anywhere in TamilNadu. This way, more tech. fans would have easier and cheaper access to TrIchyFest. Moreover, the system will have to be extended to support not only Tamil, but also English, Hindi and Telugu. Since tickets will also be sold online, SecurePayment Inc. will be contracted to provide and ensure the security of the online payment service. The TrIchyFest event manager will take care and negotiate all these details with the involved

parties. Additionally, upon arrival at the convention venue, each participant has to self-check in at a touch screen terminal, which scans the barcodes on his/her ticket and issues a bracelet with an electronic chip. This can be used to load money, such that whenever (s)he wants to purchase snacks or beverages, (s)he does not have to use cash any more, thus reducing waiting times. This measure was initiated by the program manager and will be deployed by WristSolutions Inc. Lastly, according to the state laws, the way the payment transactions are performed has to be audited by an external company at the end of the convention, since this is a public event, where the municipality of Trichy is also involved - allowing free use of the public space. For this business problem:

i) Identify all the stakeholders in this software development process. (4 m)
ii) Mention one goal, one functional requirement and two non-functional requirements. (max. 3 lines each) (4 m)

Software Quality Metrics (CO3)

3. a. Estimate the effort E required to write the following C function using Halstead's Software Science. Analyze the asymptotic time complexity of your algorithm (max. 5 lines). State the assumptions you make, in a clear way. (6 m + 2 m)

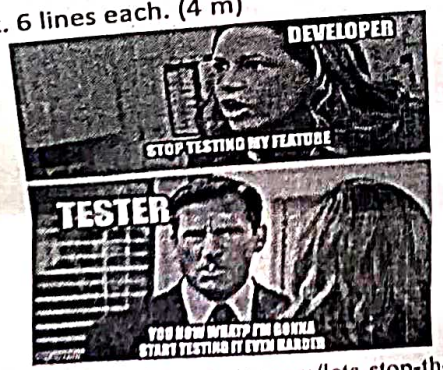
```
Void swap (int a[ ], int i)
{
int temp;
temp = a[i];
a[I] = a[I+1];
a[i+1] = temp;
}
```

b. Computer Cyclomatic Complexity (V(G)) of the below code. What is the ideal range for V(G))? (5 m)

```
statement1
If expression1
            statement2
else
            statement3
statement4
do
            statement5
while expression2
statement6
```

Software Testing (CO4)

4. a. Look at the following pictures and comment on the moral it speaks, based on the concepts discussed in the lectures max. 6 lines each. (4 m)



courtesy: https://dev-tester.com/lets-stop-the-developer-vs-tester-feud/

"I started a new job!"

300 likes,
40 comments
5,200 impressions

"I'm starting my own business"

2 likes
1 comment
10 impressions

https://thefounderspress.com/top-startup-memes/

b. Consider the following code (Euclid's GCD) below.

```
int f1(int a, int b) {
    while (a != b) {
        if (a>b) then
            a=a-b;
        else b=b-a;
    } return a;     }
```

i) Generate the number of linearly independent paths and a test case for each. (6 m)
ii) Generate a test case for statement coverage. (4 m) Set of cases
iii) Generate a test case for branch coverage. (2 m)

c. The Triangle problem accepts three integers (a, b and c) as its input, each of which are taken to be sides of a triangle. The values of these inputs are used to determine the type of the triangle (Equilateral, Isosceles, Scalene or not a triangle). For the inputs to be declared as being a triangle they must satisfy the six conditions: C1. $1 \le a \le 200$. C2. $1 \le b \le 200$. C3. $1 \le c \le 200$. C4. $a < b + c$. C5. $b < a + c$. C6. $c < a + b$.
Otherwise this is declared not to be a triangle. The type of the triangle, provided the conditions are met, is determined as follows: 1. If all three sides are equal, the output is Equilateral. 2. If exactly one pair of sides is equal, the output is Isosceles. 3. If no pair of sides is equal, the output is Scalene. Use Standard Boundary Value Analysis to develop all possible test cases for the above problem. (6 m)

d. You have been asked to test a method called catWhiteSpace in a "Sentence" that, within the sentence, replaces sequences of blank characters with a single blank character. Identify at least 2 testing partitions for this example and derive a set of tests for the cat WhiteSpace method. (2 m)
You may consider the input sentence: *Attitude is more important than marks.*

Software Project Management, Project Scheduling and Mixed Bag (CO5)

5. a. A company needs to develop a strategy for software product development for which it has a choice of two programming languages L1 and L2. The number of lines of code (LOC) developed using L2 is estimated to be twice the LOC developed with LI. The product will have to be maintained for five years. Various parameters for the company are given in the table below.

Parameter	Language L1	Language L2
Man years needed for development	LOC/10000	LOC/10000
Development cost per man year	Rs. 10,00,000	Rs. 7,50,000
Maintenance time	5 years	5 years
Cost of maintenance per year	Rs. 1,00,000	Rs. 50,000

Total cost of the project includes cost of development and maintenance. What is the LOC for L1 for which the cost of the project using L1 is equal to the cost of the project using L2? (4 m)

b. For the Software Engineering course project you worked as a team, identify at least 10 tasks related to the Software Development Life Cycle(SDLC). Develop a Gantt chart(Timeline chart) along with the progress of each task. (4 m)
Create a Task Network using the Gantt chart developed and identify the critical path. (4 m)

c. i. A computer system has an exponential failure density function function $f(t) = (1/4589)e^{-(t/4589)}$ where $t>=0$. What is the probability that the system will fail after the warranty (seven months or 5100 hours) and before the end of the first year (1 year or 8760 hours)? (2 m)
ii. Over the course of two months, a software firm suffers 4 virus attacks. The first event took 30 minutes to minimize, the second 31 minutes, the third 40 minutes and the fourth 56 minutes. What is the monthly MTBF? (2 m)

d. Differentiate the following terms concisely in a **maximum of 3 lines** for each term. (4 *2 = 8 m)
i. Software Engineering vs. Software Development
ii. Requirements vs. Specification
iii. Alpha Testing vs. Beta Testing
iv. Validation and Verification

Bonus Question:

e. Which development process is most suitable for a particular software project depends on the characteristics of the project. (max. 5 lines each) (4 m)
i. Give one project characteristic that would make a plan-driven development process (a waterfall-like process) more appropriate than an agile development process.
ii. Give one project characteristic that would make an agile development process more appropriate than a plan-driven development process.

Be Good, Do Good