SOFTWARE METRICS

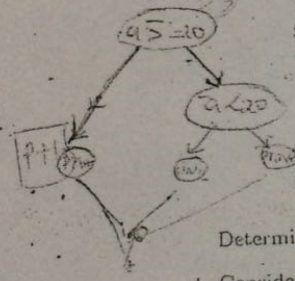
SECTION A: Answer ALL questions in this section

1. Define the following terms as relates to software metrics:
   (a) Software Availability (1 mark)
   (b) Predicate node (1 mark)
   (c) Valid measure (1 mark)
   (d) Software metric (1 mark)
   (e) Quantification (2 marks)

2. External attributes are often difficult to measure. However, measurement can still be achieved by making use of internal measures. Briefly explain what makes this kind of measurement valid. (3 marks)

3. A program's complexity can be measured by the cyclomatic number of the program flowgraph. Consider the following snippet of code:

```
#include <stdio.h>
main()
{
int a ;
scanf ("%d", &a);
if ( a >= 10 )
   if ( a < 20 )
      printf ("10 < a< 20 %d\n" , a);
   else
      printf ("a >= 20    %d\n" , a);
else
      printf ("a <= 10    %d\n" , a);
}
```



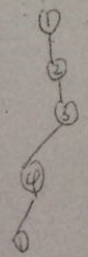
Determine the cyclomatic complexity v(G) of the snippet (3 marks)

4. Consider the following statement below and explain whether it is meaningful or not (2 marks)

   A semantic error takes twice as long to fix as a syntactic error

5. There are techniques that can be used to investigate the properties of software, related [illegible] techniques

   (a) Briefly [illegible] consider in choosing a



MAKERERE UNIVERISTY
COLLEGE OF COMPUTING AND INFORMATION SCIENCES
BSE3104: SOFTWARE METRICS
TEST 1
Answer all questions
Time: 1 Hour

1) a) With examples, distinguish between *measure*, *measurement* and a *metric*.
   b) If you measure temperature only, what does that tell you? Does temperature alone provide enough information for a decision to be taken?
   c) External attributes are often difficult to measure. However, measurement can still be achieved by making use of internal measures. Briefly explain what makes this kind of measurement valid.

2) a) Formally, what do we mean when we say that a statement about measurement is meaningful?
   b) Discuss the meaningfulness of the following statements:
      i) The average size of a JAVA code is about twice that of a similar PYTHON Code
      ii) Codding took as long as requirement analysis
      iii) Of the two Ada program analysis tools recommended in the Ada coding standard, tool A achieved a higher average usability rating than tool B." For this example, program usability was rated on a four-point scale:
      4: can be used by a non-programmer
      3: requires some knowledge of Ada
      2: usable only by someone with at least five years' Ada programming experience
      1: totally unusable

3) Jack Holdings Uganda limited is a leading producer of ladies clothes in Uganda. Currently, the company is undertaking a software development project that can help increase the profit margins of their product. The project is expected to be accomplished with in a period of 2 years. You are the project manager for Global IT Solutions, a company contracted to undertake the project. However, Global IT Solutions is facing a number of challenges. For instance, due to competition pressure from the market and need for the system to be used in a major trade show in town, the client would like the system to be completed four months before the initially agreed period of the project. This has led to increased pressure to you as the project manager because of the tight deadlines and a change within the schedule that has been introduced in the project. However, despite all negotiations made, the client still insists that the project has got to be accomplished before the major trade show.

   a) Explain three reasons why software measurement is necessary in this case
   b) Identify the elements that are required for measurement to take place
   c) You as the project manager have to decide upon the release time of the final product. Construct a Goal Question Metric (GQM) tree related to this goal. Include at least three questions for the goal and 2 metrics for each question.
   d) Assuming the project is successfully completed, you would like to collect data on the effort involved (budget, personnel), the number of errors investigated and the project duration. What investigative technique(s) would you recommend be used to capture these aspects? Give a reason why.
   e) State one possible hypothesis that would guide the investigation and clearly state the variables.

ii. Construct a flow graph that represents the chart (5 marks)

iii. Determine the complexity of the program code by identifying the independent paths(3 marks)

3. One of the reasons for software measurement is to allow for meaningful analysis to be made with the deductions of measurement. However, there are different analyses that can be made and measurement scales help us to understand which analyses are appropriate.

(a) What is a measurement scale? (2 marks)

(b) i. Identify any two major measurement scales (2 marks)

ii. For the identified measurement scales, state atleast two characteristics of each (4 marks)

iii. Give a suitable software related example for each of the scales above, with appropriate measures, M. (6 marks)

iv. Using your examples in (b)iii. above, choose another suitable measure M' and illustrate the admissible transformation for that scale type between M and M' (6 marks)

4. The management of Tuskys supermarket would like to create a system that does the general inventory management of stock that comes into and goes out of the supermarket. The managers would particularly like the system to track trends and give reports of the most bought items, and for certain seasons (e.g., Christmas, new year, back-to-school, etc), can recommend what products to stock up on. The system should also keep track of goods that are about to expire and alert the store managers accordingly. Your firm, Developers Integrated, is selected to create the system. Software measurement is to be a part of this project.

(a) Explain any three reasons why measurement would be necessary for a project like this (6 marks)

(b) Measurement is dependent on personnel involved.

i. Identify two personnel that would be interested in software measurement on this project (2 marks)

ii. For each personnel identified, state three examples of the kind of measurement information they would need (6 marks).

iii. Briefly explain three techniques you might use to assess this software product's success (6 marks)

5. Lines of Code (LOC) can be used to measure software size, however there are factors that influence the definition of LOC

(a) List and briefly explain three of these factors (6 marks)

(b) List 2 advantages of using LOC to measure software size (5 marks)

(c) Size-oriented metrics are used to measure the software process.

SECTION A: Answer ALL questions in this section

1. Differentiate between the following terms: (2 marks each)
   (a) Error and Defect
   (b) Measurement and Calculation
   (c) Fan-in and Fan-out measures
   (d) Feature point and function point
   (e) Ratio scale and interval scale

2. Identify two limitations of using the Cyclomatic Complexity metric for determining the testability of a program (2 marks)

3. For software measurement,
   (a) Define a measurement scale (2 marks)
   (b) Rate the following with an appropriate measurement scale (1 mark each)
      i. Computer Programmers classified as novice, programmer, lead programmer, and team leader
      ii. Automobiles with values of Ford, Toyota, Chrysler
      iii. Velocity relative to Makerere, CIT Block B
      iv. Temperature measured on a Fahrenheit or Centigrade scale
   (c) Identify two direct and two indirect measures of the product (4 marks)

4. Software reliability is an important element of the quality of a program, determined by failure-free operation of the program.
   (a) Identify three main causes of software failure (3 marks)
   (b) Given a probability density function that is uniform over [0, 100], give the expression for the survival function, and compute the expected value within the given interval (4 marks)

5. Effective software measurement is useful for assessment and process improvement. Identify the different process levels, stating a characteristic of each. (6 marks)

6. Consider the following snippet of code:

```
i = j + 1;
{
int a = 1, b = 1;
i = a + b + i;
```

% Conformance to ~~Sft~~ dev. Standards.

(a) Define the term quality (2 marks)

(b) Suggest three distinct points of view that you would use to assess quality of the product, stating one characteristic of each (6 marks)

(c) Suppose you decide to use the ISO 9126 standard quality model to guide quality assessment,

i. Outline the factors you would consider (6 marks)

ii. Specify two ways in which you would use the ISO 9126 standard quality model and the factors identified above to actually monitor the product's quality. (4 marks)

(d) Which two quality measures would you recommend for use? (4 marks)

5. You are about to begin a large project that uses new tools, techniques and languages for developing the software for a telephone switching system for a client company. You are interested in knowing if the new tools, techniques and languages should become company standards if the product is a success.

(a) Identify three techniques you would use to assess the software product's success (3 marks) - Surveys, Case studies & Formal experiments

(b) Describe the considerations you would make in designing the assessment exercise (6 marks)

(c) You are interested to collect data that will help you determine appropriate measures, metrics, and indicators.

i. Using suitable examples, differentiate between a measure, metric and indicator that would apply to this project (6 marks)

ii. State three reasons why it would be necessary for you to collect metrics (3 marks)

iii. What two issues would you have to overcome that arise from metrics? (2 marks)

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