BS-CSE Program Outcomes Assessment Test (POCAT) (Sample Test)

Background: POCAT was created in order to help assess the degree to which BS-CSE majors achieve the various program outcomes of the BS-CSE program. Information about the performance of individual students on POCAT will not be collected or used in any way. Please do not write your name anywhere on this test. Note that each test paper has a unique code assigned to it that appears at the top right of this page. When results of the test are posted (in a few weeks), they will be organized by this code. If you want to know how you did on the test, you will have to remember the code that appeared on your test. If you forget your code, there is no way to later determine your score on the test.

The test: The topics that the questions in the test are based on are from the required high-level courses (CSE 541, 560, 601, 625, 655, 660, 670, 675, 680). But they are not the typical questions you might find in, say, the final exams of those courses. Instead, they are more conceptual and are intended to see how well students understand key concepts from across the curriculum and apply them in appropriate situations.

There are 16 questions on the test. Each is a multiple-choice question. Each question has, as one possible answer, something along the lines of “I have no idea”. You should choose that if you really don’t have any idea how to answer the question; if, on the other hand, you are not sure of the answer but can make an informed guess, please do so. There are a couple of additional questions at the end that ask for your opinions about this test.

Further details about this test and how it will help us assess the program and improve it appear in a set of web pages that can be accessed by following the Exit Test-link that appears in the BS-CSE page of the department’s on-line Undergraduate Program Brochure.
1. Consider the statement, “The ACM Code of Ethics and Professional Conduct imposes a set of legally binding requirements on BS-CSE graduates working for an agency of the US Government.”
   Is this statement:
   (a) True;
   (b) False;
   (c) I am not sure;
   (d) I have never heard of the ACM Code.

2. *Lex* and *yacc* are Unix tools that are useful for:
   (a) Producing a compiler.
   (b) Extracting the original program from a parse tree.
   (c) Decompiling an object file.
   (d) I have never heard of these tools.

3. Which of the following best describes the term “acceptance testing”?
   (a) Testing phase that typically catches all errors in interfaces between modules.
   (b) Testing a program with no regard for its internal code.
   (c) The final testing performed by the customer to determine if the software meets the customer’s specifications.
   (d) I have no idea.

4. According to design-by-contract principles, which party is responsible for making sure that an operation’s precondition is satisfied at the time of a call to the operation?
   (a) The *client* of the operation;
   (b) The *implementer* of the operation;
   (c) *Both* the client and the implementer;
   (d) *Neither* the client nor the implementer;
   (e) I do not know what design-by-contract is.

5. Consider the language $L = \{0^n0^n|n \geq 0\}$. This language is:
   (a) Regular;
   (b) Context-free;
   (c) Both regular and context-free;
   (d) None of the above;
   (e) I have no idea.
6. Consider the language of all *correct* .html (.xhtml?) pages. That is, these pages must not only be well-formatted, but the *links* in these pages must also be correct, i.e., they must lead to pages that exist and are accessible; but those pages that you link to do not themselves have to be correct in this sense, that is, they may contain bogus links. Suppose someone wrote a grammar for this language. Would this grammar be:
   (a) Regular;
   (b) Context-free;
   (c) Context-sensitive;
   (d) None of the above;
   (e) This question makes no sense!
   (f) I have no idea.

7. Suppose $L_1$ and $L_2$ are two otherwise similar programming languages but $L_1$ provides facilities for *data abstraction* and $L_2$ does not. Suppose also that $L_1$ and $L_2$ are implemented in similar ways. Given this, would you then in general expect programs written in $L_1$ to run:
   (a) Faster than equivalent programs written in $L_2$;
   (b) Slower than equivalent programs written in $L_2$;
   (c) *At about the same speed* as equivalent programs written in $L_2$;
   (d) Not predictable;
   (e) I have no idea.

8. Suppose you are told that a given programming language $L$ provides garbage collection. Would you expect the *parameter passing mechanism* of $L$ to be:
   (a) *Call-by-value*;
   (b) *Call-by-reference*;
   (c) There is no connection between these two aspects of a language;
   (d) I have no idea.

9. This question is in the context of databases. Consider relations $R$ and $S$ of cardinalities $m$ and $n$ respectively. What is the cardinality of the cross join of $R$ and $S$?
   (a) Maximum of $m$ and $n$;
   (b) Minimum of $m$ and $n$;
   (c) $mn$;
   (d) $m + n$;
   (e) None of the above;
   (f) I have no idea.

10. Assume a relation $\text{Students}(\text{SSN}, \text{Gender})$ with 50 records. Consider the following query:
    
    ```sql
    select Gender, count(*)
    from Students
    group by Gender
    ```
    
    How many records will the outcome of this query contain?
    (a) 1 or 2;
    (b) 50;
    (c) 100;
    (d) Impossible to tell from the given information;
    (e) I have no idea.
11. Consider how data is transferred between disks and main memory. The primary reason that this transfer is handled by **direct memory access** (DMA) is that:
   (a) Disks contain far more storage than main memory, and DMA is used to account for the difference in address lengths;
   (b) Disk storage is organized into tracks that the DMA subsystem makes sure are the same size as memory pages;
   (c) Disk transfers using DMA can be overlapped with computations done by the CPU, which improves system performance;
   (d) I have no idea.

12. Consider the following performance measurements for a program:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Computer A</th>
<th>Computer B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction count</td>
<td>10 billion</td>
<td>8 billion</td>
</tr>
<tr>
<td>Clock rate</td>
<td>4 GHz</td>
<td>4 GHz</td>
</tr>
<tr>
<td>CPI</td>
<td>1.0</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Based on this data, you can conclude that:
   (a) Computer A is faster and has the higher MIPS rating;
   (b) B is faster and has the higher MIPS rating;
   (c) A is faster but B has the higher MIPS rating;
   (d) B is faster but A has the higher MIPS rating;
   (e) I have no idea.

13. Consider a computer system with a paged virtual memory. Let the page size be 512 bytes. The main memory consists of 64 pages (stop laughing!). The virtual address space consists of 256 pages. How many bits are needed for a **logical** address if the machine is byte-addressable?
   (a) 8;
   (b) 9;
   (c) 10;
   (d) 12;
   (e) 17;
   (f) I have no idea.

14. $P_0, P_1, P_2, P_3, P_4$ are processes. You are given the following information:

<table>
<thead>
<tr>
<th>Process</th>
<th>Arrival Time</th>
<th>CPU Burst</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_0$</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>$P_1$</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>$P_2$</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>$P_3$</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>$P_4$</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

In what order will these processes be run using **shortest job first** scheduling algorithm?
   (a) $P_1 P_2 P_0 P_3 P_4$;
   (b) $P_0 P_1 P_2 P_3 P_4$;
   (c) $P_1 P_2 P_3 P_4 P_0$;
   (d) $P_3 P_1 P_2 P_4 P_0$;
   (e) None of the above;
   (f) I have no idea.
15. The following recurrence relation was derived based on a worst-case analysis of some algorithm:

\[ T(n) = T\left(\frac{n}{2}\right) + cn \]

Based on only this information, which statement best describes the running time of the algorithm?

(a) \( O(n \lg n) \);
(b) \( \Theta(n \lg n) \);
(c) \( O(n) \);
(d) \( \Theta(n) \);
(e) \( O(n^2) \);
(f) I have no idea.

16. You are writing an application. You need a data structure that will allow you to insert new elements. In addition, you must sometimes remove the maximum element and other times simply report the value of the maximum element. The client wants the program to be as efficient as possible. Which of the following data structures should you use in your design?

(a) Hash table;
(b) Heap;
(c) Sorted linked list;
(d) Unsorted linked list;
(e) Array;
(f) I have no idea.

17. The remaining questions are about this test. First, think about the length (not the difficulty, just the length) of the test. Would you say that it was:

(a) Too long;
(b) Too short;
(c) Just right!

18. In terms of difficulty of the test, would you say this test was:

(a) Too difficult;
(b) Too easy;
(c) Just right!

19. Would you like to know how you did on this test in comparison with others who took the test?:

(a) Yes, I would love to know how I did!
(b) No way, leave me alone!
(c) I am not sure.

20. In an earlier version of the test, students were asked to include their names on the test. In the longer term, do you think the test should be anonymous? Some students might feel better if it were anonymous but we would then not be able to do some types of interesting statistical analysis on the results (see next page). Assuming that we use the names only for statistical analysis and no information about individual student performance is retained after the analysis is complete, do you think:

(a) The test should be anonymous;
(b) Students should have the option of providing their names;
(c) Students should be asked to provide the names;
(d) I am not sure.
Details

Why this test?: As you may know, the BS-CSE program is accredited by the Engineering Accreditation Commission (EAC) and by the Computing Accreditation Commission (CAC), both of ABET, Inc. Recently, EAC and, to a lesser extent, CAC have increased their expectations regarding assessment of the degree to which students achieve the outcomes of the program by the time of their graduation. Until recently, it was sufficient for a program to use such mechanisms as our exit survey (which all BS-CSE majors are required to complete before graduation) to assess this; but with the recent changes in EAC policy, we are also required to have direct assessment of this. Direct assessment essentially means that we have to evaluate the degree to which the various outcomes of the program are achieved by the time of graduation based on actual performance by students on tasks (such as answering specific technical questions, their work on specific projects etc.) related to the various outcomes. The program is then required to use the results of this assessments to identify any weaknesses in the program and make suitable changes.

How?: Note first that the outcomes specified by EAC can be classified into three separate groups. The first group deals with technical skills; an example of this is: an ability to apply knowledge of mathematics, science, and engineering. The second group deals with soft skills, specifically those dealing with effective communication, team-working, and lifelong learning. The third group is related to general education issues, for example, a knowledge of contemporary issues. After extensive discussions in the Undergraduate Studies Committee (UGSC), we decided upon a two-pronged approach to satisfying the direct assessment requirement. With respect to the outcomes related to the soft skills, we will rely on student performance in various activities in each of the capstone courses to assess the degree to which the outcomes related to effective communication, team-working, and lifelong learning are achieved. The capstone course instructors will do this assessment and report the results to UGSC. Students in the capstone courses will not notice any difference except that all capstone courses will use uniform rubrics to evaluate these activities.

This test is being used to assess the outcomes related to the technical skills. For example, question 14 deals with the outcome that reads, ability to design and conduct experiments, as well as to analyze and interpret data; question 1 deals with the outcome that reads, an understanding of professional and ethical responsibility; etc. Thus the results of this test and of the assessment described in the last paragraph in the capstone courses will allow UGSC to get a good idea of the degree to which outcomes in these two groups are achieved. If, for example, it turns out that relatively few students are able to answer question correctly, then we know we have a problem in a particular course (which one?). Hence, based on analysis of these results, we expect to identify possible changes in the program to improve it in various ways. Note, by the way, that for now we are not considering outcomes in the group related to general education.

All BS-CSE majors will be required, as a graduation requirement, to complete this test; anyone who takes this pilot version of the test will be considered to have met this requirement. The performance in the test won’t affect the grades of individual students in any courses, nor will any records be maintained of how individual students performed in the test. Some simple statistical analysis may be performed, for example, to see whether factors such as which particular section of a course a student takes, or the order in which a student takes two specific courses (neither of which is currently a prerequisite of the other), has any effect on the student’s performance in questions dealing with particular areas. But once this is completed, the information about individual students’ performance in the test will be destroyed. The goal is to assess the program, not the students; in particular to assess the effectiveness of the program in ensuring that students achieve the various outcomes by the time of their graduation. The test will be offered once a quarter, probably on a weeknight early in the quarter. We hope this test and the standardized assessment in the capstone courses as described above, will help us not only meet the accreditation requirements with respect to direct assessment but also help identify specific opportunities for improving the program. If you have any comments, ideas, or suggestions, please email neelam@cse or peg@cse. And thanks for taking this test!