University of Victoria

Examinations April 2003

SENG 265 S01 – Introduction to Software Engineering

To be answered in booklets.

Duration: 3 hours
Instructor: Michael Zastre

Students must count the number of pages in this examination paper before beginning to write, and report any discrepancy immediately to the invigilator.

This question paper has 6 pages, including this cover page.

- This is a closed-book, closed-notes exam.
- Ensure all cellular phones are switched off.
- *When the invigilator indicates that the exam has ended, all students must immediately hand in their papers. If an invigilator determines that students are comparing answers before handing in their papers, then these students may be penalized by receiving a failing grade for the course.*

1. Perl [20 marks]

Consider the following Perl code (the line numbers are for your reference):

```
 1 #!/usr/bin/perl

 2 sub A {
 3         @in = ("3", "1", "4", "1", "5", "9", "2",
 4                "6", "5", "3", "5", "8", "9", "7",
 5                "9", "3", "2", "3", "8", "4", "6",
 6                "2", "6", "4");
 7         print "line 1: ", $#in, "\n";
 8 }

 9 sub B {
10         my $i;
11         foreach $i (@in) {
12                 $var1{$i} = $var1{$i} + 1;
13         }
14         my @k = keys (%var1);
15         my $m = @k;
16         print "line 2: ", $m, "\n";
17 }

18 sub C {
19         my $i;
20         my $p = 0;
21         foreach $i (@in) {
22                 $var2{$i} = $var2{$i} . "$p ";
23                 $p++;
24         }
25         my @k = keys (%var2);
26         my $m = $#k + 1;
27         print "line 3: $p $m\n";
28 }

29 sub D {
30         my @k1 = sort (keys (%var1));
31         my @k2 = sort (keys (%var2));
32         print "line 4";
33         for my $i1 (@k1) {
34                 print ":", $var1{$i1};
35         }
36         print "\n";
37         for my $i2 (@k2) {
38                 print $i2, ": (", $var2{$i2}, ")\n";
39         }
40 }

41 my @in = (); my %var1; my %var2;
42 A(); B(); C(); D();
```

(a) Ignoring the bang path (line 1), what is the first line executed by this script?

(b) List all lines where the keyword "my" is used beside a non-scalar variable.

(c) What is the output of this script? (There are no syntax errors.)

2. Perl [15 marks]

A text file contains a sequence of x, y coordinates. These represent the endpoints of line segments (i.e, for example 2, the first line segment is from [3,5] to [10,3], the next segment is from [10, 3] to [2, 1]).

Example 1:

```
0 0
0 5
5 5
5 0
0 0
```

Example 2:

```
3 5
10 3
2 1
```

Every such file contains information for at least one line segment. You may *not* assume a maximum number of such line segments.

(a) Write a perl function to compute the straight line distance between a pair of coordinates, i.e.:

$$dist = \sqrt{(y1 - y2)^2 + (x1 - x2)^2}$$

The exponentiation operator in perl is represented by "**". You can obtain a square root of a number by taking it to the power of 0.5.

(b) Write a perl script that uses the function from (a) to print the distance covered by all segments in a text file – assume all input is from stdin. Some marks will be given for the quality of your solution. (The value printed for example 1 would be 20; that for example 2 would be 15.526.)

3. Software Engineering: Concepts [10 marks]

A software project has been estimated to take 12 months with three programmers. Milestone A will be achieved 3 months from the start, Milestone B at 6 months from the start, Milestone C at 9 months, and Milestone D at 12 months (completion).

(a) How many programmer-months are required to complete this project?

(b) Work begins with three programmers. However, Milestone A is achieved 3 months later than expected. How many programmer-months have been spent so far, and how many programmer-months remain in the project if the original estimates are correct for the remaining milestones?

(c) The project leader decides that the remaining milestones are as inaccurately estimated as Milestone A. However, the leader wants to keep to the schedule, and decided to throw more programmers at the project. If Milestone D is still to be achieved from 12 months of project start, how many programmers must be added?

(d) Why is it inadvisable to add more programmers to a team as suggested in (c)?

(e) What options does the project leader really have? List your answers in point form.

4. CVS [10 marks]

(a) What is a "conflict", and how is it solved?

(b) What is the difference between "init" and "import"?

(c) What do `$Id$` and `$Log$` represent in a source-code file?

(d) What does it mean to "add a file to CVS control"?

5. C programming [15 marks]

Consider the following C code (the line numbers are for your reference):

```
 1 #include <stdio.h>

 2 int j = 0;
 3 int k = 1;
 4 int *pk = &k;
 5 float r = 1.0;

 6 int A(int m)
 7 {
 8         int s;

 9         s = m * m + 2;
10         r = r + (2.0 * m);
11         return s;
12 }

13 void B (int *s)
14 {
15         *pk = 3;
16         pk = s;
17         k = 10;
18 }

19 int *C (float t, int *pa, int *pb)
20 {
21         if ( t > 25.0 ) {
22                 return pa;
23         } else {
24                 return pb;
25         }
26 }

27 int main(void)
28 {
29         int *p;

30         k = A(10);
31         printf ("%d\n", k);
32         p = C(r, pk, &j);
33         *p = 314;
34         B(p);
35         printf ("%d %d %d %f\n", j, k, *pk, r);
36         return 0;
37 }
```

(a) Prepare a table with a row for each executed line and a column for each global variable (ensure rows and columns are labeled). For example, the top of the table would look like:

line	j	k	pk	r
30	0	1	(address of k)	1.0

(b) What is the output of this program? There are no syntax errors.

6. C programming [20 marks]

Consider an array of random integers:

```
int[] arr = { 25, 20, 94, 42, 39, 38, 23, 53, 53, 86, 96,
       31, 73, 65, 5, 45, 80, 65, 81, 82, 0 };
```

The final "0" indicates that there are no more numbers to follow in the array.

Write a C function accepting such an array as a parameter and returning:

- the minimum value
- the maximum value
- the average value
- the median value
- the number of elements in the array

More precisely, these values must be returned in a dynamically-allocated structure, and this structure is to be of your own design. You must provide all code for the function and for the structure declaration. Some marks will be given for the quality of your solution.

7. Testing & Debugging [10 marks]

(a) Give three examples of "boundary conditions".

(b) What is the difference between testing and debugging?

(c) When would you choose black-box testing over white-box testing?

(d) A fellow student has called you to ask for help debugging their "flinker" (Linker version 4). On some input files, it segfaults at the seventh line; on other files, every third or fourth line has a missing symbol. Suggest a strategy for finding the bug – write your answer in the form of numbered points.

END