

A18877

NO CALCULATOR PERMITTED IN THIS EX-
AMINATION

THE UNIVERSITY OF BIRMINGHAM

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06 17423

Systems Programming in C/C++

May 2007 1½ hours

[Answer questions 1–3 and one of questions 4 and 5]

Turn Over

Questions 1–3 are compulsory.

1. (a) Explain what's meant by "In C/C++, arguments to functions are passed by value". [5%]
- (b) Explain how passing arguments on the commandline to a C-program works. [6%]
- (c) The program `fault` (see Appendix 1) should store the commandline arguments, which are supposed to be integers, in a list and print them out. However, it does not compile due to various errors. The output of the compiler is

```
cc -Wall -Werror -o fault fault.c
fault.c: In function 'addElement':
fault.c:13: warning: suggest parentheses around assignment used
        as truth value
fault.c:17: error: structure has no member named 'element'
fault.c:19: error: incompatible types in return
fault.c: In function 'main':
fault.c:31: warning: passing arg 1 of 'addElement' makes integer from
        pointer without a cast
fault.c:31: warning: passing arg 2 of 'addElement' from incompatible
        pointer type
fault.c:31: error: incompatible types in assignment
fault.c:37: error: structure has no member named 'element'
fault.c:38: error: request for member 'next' in something not a
        structure or union
```

Correct the errors in the program. If your solution contains modification of a line, write down the number of the line you want to modify and the corrected line. If your solution contains addition of a line, write down the number of the line after which you want to add a line of code, and write down the additional line. If your solutions contains deletion of a line, write down the number of the line you want to delete.

Hint: the function `atoi` converts a string to an integer without error checking.

[16%]

2. (a) Why is it important to prevent memory leaks in systems programming? [5%]
- (b) Why is buffer overflow so dangerous? [5%]
- (c) What does "segmentation fault" mean? Which (erroneous) code typically produces it? [6%]
- (d) The program `memory` (see Appendix 2) should print the words occurring in each line, where words are separated by spaces. It compiles correctly but does not work because all code which handles memory allocation is missing. However, the program is correct otherwise. Add code which ensures that memory is handled correctly. Your code should also ensure that no memory leak occurs.

If your solution contains modification of a line, write down the number of the line you want to modify and the corrected line. If your solution contains addition of a line, write down the number of the line after which you want to add a line of code, and write down the additional line. If your solutions contains deletion of a line, write down the number of the line you want to delete. [18%]

- (e) Write a C++-class definition for the list-structure used in the file `memory.c` and write code for the method `printList` in the file `memory.c`. [8%]
3. (a) What is a dependency in Makefile, and how do you specify a dependency in a Makefile? [6%]
- (b) The enclosed Makefile (see Appendix 3) is supposed to be used for compiling and installing two programs `insert` and `delete` from two source files from the source files `insert.c` and `delete.c`. Both files use the include file `trees.h`, and `insert.c` uses in addition the file `strings.h`.
- (i) Is the Makefile suitable for this purpose? If not, correct it. [5%]
- (ii) Which commands are executed by running the corrected Makefile with the listing here?
- ```
-rwxr-xr-x 1 exr root 1310 Feb 21 10:38 delete.c
-rwxr-xr-x 1 exr root 5901 Feb 21 10:42 insert
-rwxr-xr-x 1 exr root 1626 Feb 21 10:38 insert.c
-rwxr-xr-x 1 exr root 1490 Feb 21 10:43 strings.h
-rwxr-xr-x 1 exr root 1326 Feb 21 10:40 trees.h
```
- [5%]

**Answer one of the following two questions.**

4. (a) What is the effect of a segmentation fault in a kernel program?. [5%]
- (b) What is a system call? How is it used in a program? [5%]
- (c) What is a race condition in the kernel? How can it arise? [5%]
5. (a) What is a vector as defined in the standard library in C++? [5%]
- (b) What is a virtual class? What is used for? [5%]
- (c) How do you pass functions as parameters in C/C++? [5%]