

Calculators may be used in this examination provided they are not capable of being used to store alphabetical information other than hexadecimal numbers

UNIVERSITY OF BIRMINGHAM

School of Computer Science

Operating Systems and Systems Programming

Mock Exam December 2024

Time allowed: 2 hours

[Answer all questions]

Question 1

- (a) What is the difference between call-by-value and call by-reference? **[4 marks]**
- (b) Give two possible consequences of an access beyond the boundaries of an array in a C program. **[4 marks]**
- (c) Consider the following code:

```

1  #define BUFFERLENGTH 80
2  struct entry_t {
3      int entry_id;
4      char title[BUFFERLENGTH];
5  };
6  struct list_t {
7      struct entry_t entry;
8      struct list_t *next;
9  };
10
11 struct list_t *addElem(struct list_t *allItems, int newID,
12     char *newTitle) {
13     struct list_t *prevItem, *currentItem;
14     struct list_t newItem;
15
16     strcpy(newItem.entry.title, newTitle);
17     newItem.entry.entry_id = newID;
18     currentItem = allItems;
19     while(currentItem->entry.entry_id < newID) {
20         prevItem = currentItem;
21     }
22     prevItem->next = &newItem;
23     return allItems;
24 }
25 void deleteAllItems (struct list_t *items) {
26     while(items != NULL) {
27         free(items);
28         items = items->next;
29     }
30 }

```

The intention is that the function addElem has a list allItems, a title ID newID and a title newTitle as arguments and adds a new element consisting of the ID

and the title to the list. You may assume that the list is ordered by the title ID when the function is called. You may assume that `newTitle` points to a properly null-terminated string of arbitrary length. The list which is returned by `addElem` should also be ordered by title ID.

The function `deleteAllItems` should delete the list and all titles stored in the list. This code compiles correctly, but does not work as intended. List the errors (including memory management) and provide corrections. Do not list or provide corrections for concurrency errors.

Hint: The `strcpy(char *dest, const char *src)` function copies the string pointed to by `src`, including the terminating null byte (`'\0'`), to the buffer pointed to by `dest`. It does not do any memory allocation or checks. The function `strlen` returns the length of a string excluding the terminating null byte (`'\0'`). **[12 marks]**

Question 2

- (a) What is a context switch? Why is it important for the operating system to minimise the number of context switches? **[4 marks]**
- (b) A multi-user system used to work well, with low response times and good throughput. Now many users use a package for automatic program verification, and as a result the response time is high, and throughput low. How would you distinguish between overloaded CPU, thrashing and overused disk as a possible reason? **[4 marks]**
- (c) A webserver for an e-commerce shop is serving several kinds of requests. The first kind consists of rendering large images, which is computationally expensive and can happen in the background. The second kind is a preview of the list of items for sale, which needs to be fast. These preview requests are computationally inexpensive but use lots of I/O. The third kind are purchase requests which are computationally inexpensive and use a moderate amount of I/O. Assume the system is highly loaded.
- (i) Describe the effects of using each of FCFS, Round Robin and priority scheduling strategy in this scenario. **[9 marks]**
- (ii) Which of the three scheduling strategies mentioned in part (i) would you choose for this scenario? Justify your answer. **[3 marks]**

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Do not complete the attendance slip, fill in the front of the answer book or turn over the question paper until you are told to do so

Important Reminders

- Coats/outwear should be placed in the designated area.
- Unauthorised materials (e.g. notes or Tippex) must be placed in the designated area.
- Check that you do not have any unauthorised materials with you (e.g. in your pockets, pencil case).
- Mobile phones and smart watches must be switched off and placed in the designated area or under your desk. They must not be left on your person or in your pockets.
- You are not permitted to use a mobile phone as a clock. If you have difficulty seeing a clock, please alert an Invigilator.
- You are not permitted to have writing on your hand, arm or other body part.
- Check that you do not have writing on your hand, arm or other body part – if you do, you must inform an Invigilator immediately
- Alert an Invigilator immediately if you find any unauthorised item upon you during the examination.

Any students found with non-permitted items upon their person during the examination, or who fail to comply with Examination rules may be subject to Student Conduct procedures.