Comp Sci 1MD3
Mid-Term II 2004

Dr. Jacques Carette

Name: ______________________________

Student No.: ____________________________

Duration : 50 minutes

- This midterm contains 18 questions on 4 pages
- This midterm will be marked out of 50. There are 60 total marks available.
- Answer the question in the space provided.
- Do not separate the pages.
- Make sure that you do not get stuck on one question; use your time wisely.

1. All of the following questions are true/false and worth 1 point each. *[3]*

   (a) It is possible to have a C function return a function pointer as a return value.

   (b) XSL is a programming language.

   (c) It is possible to implement a linked-list of bounded length using an array.

2. Show how the array below would be arranged in main memory when stored in row major order. *[3]*

5	3	7
4	2	8
1	9	6

3. Which of the following datastructures has the drawback of "creeping forward" in memory during normal use ? *[1]*

   (a) an array

   (b) a queue

   (c) a circular stack

   (d) a doubly linked list

4. Which of the following methods to resolve collisions in a hash table result in primary clustering? *[2]*

   (a) double hashing

   (b) extend buckets with a linked list

   (c) put the elements in the next available slot

   (d) put the elements in the next available slot, looking at slots $(h(k) + i^2) \bmod m$

5. Given a hash table of size m where collisions resolution is done via linked list, what does the statement "this hash table currently has a load factor of 3" mean? *[2]*

   (a) only three more elements can be stored in the hash table

   (b) all the linked lists have length 3

   (c) there are 3 elements stored in the hash table

   (d) there are $3m$ elements in the table

6. The structure definition

   ```
   struct foo {
       int i;
       struct foo *a;
       struct foo *b;
   }
   ```

   can be natural for implementing two different datastructures. Which are they? *[2]*

   (a) a doubly linked list and a linked list

   (b) a queue and a stack

   (c) a queue and a doubly linked list

   (d) a doubly linked list and a tree

7. Give the general solution of the following recurrence equation *[6]*

   $$t(n) = 4 * t(n-1) + 5 * t(n-2).$$

   Also, give the complete solution when given that $t(0) = 6, t(1) = 18$.

8. What is the difference between a declarative statement and an imperative statement (in languages like C and Pascal)? *[2]*

9. Rewrite the print() function in the following code to print a tree of characters, stored alphabetically, in reverse order. *[3]*

```
#include <stdbool.h>
#include <stdlib.h>
#include <stdio.h>

/* use char as datatype */
typedef char datatype;

/* useful short-hand */
#define empty_tree (tree *)NULL

/* actual definition of a binary tree type */
typedef struct tree {
    datatype data;
    struct tree *left;
    struct tree *right;
} tree;

void print(tree *t) {
    if (t!=empty_tree) {
        print1(t->left);
        printf("%c ", t->data);
        print1(t->right);
    }
}
```

10. Derive a recurrence for the running time of the *print1* function of the previous question. *[3]*

11. Rewrite the following for loop to use a while loop instead. *[4]*

```
for(i=0,j=0; i < 20 && j < 100; j+=i, i++) {
    j--;
}
```

12. The table below represents the contents of some cells in a computer's main memory along with the address of each cell represented. Note that some of the cells contain letters of the alphabet, and each such cell is followed by an empty cell. Place addresses in these empty cells so that each cell containing a letter together with the following cell form an entry in a linked list in which the letters appear in alphabetical order. (Use zero for the NULL pointer.) What address should the head pointer contain? *[4]*

Address	Contents
11	C
12	
13	G
14	
15	E
16	
17	B
18	
19	U
20	
21	F
22	

13. Give an clear example of a complete automated *test case* (in any programming language). Make sure to properly label every part of the test case. *[4]*

14. Give one programming language frequently used for *server side* scripting for web applications, and another frequently used for *client side* scripting. *[2]*

15. Give an example of a web protocol other than http. *[2]*

16. In the *Extreme Programming* model of software development, several novel ideas are used. Name and describe 2. *[4]*

17. Consider the following Javascript program embedded in a web page. Describe what the resulting web page would look like. *[3]*

```
<html>
<body>
<script language="JavaScript">
    name = "Jacques"
    constr = "Under Construction"
    document.write("<h1>"+name+"'s home page</h1>")
    col = '0000ff'
    p = "<font face=Arial color="+col+">"
    document.write(p+constr)
</script>
</body>
</html>
```

18. BONUS: The print() function below prints a tree of characters. Rewrite it so that it does not use recursion (at all), nor does it use any dynamically allocated data (like a stack or a queue). Hint for one particular solution: you may assume that all pointers are aligned on 2-byte boundaries.*[10]*

```
#include <stdbool.h>
#include <stdlib.h>
#include <stdio.h>

/* use char as datatype */
typedef char datatype;

/* useful short-hand */
#define empty_tree (tree *)NULL

/* actual definition of a binary tree type */
typedef struct tree {
    datatype data;
    struct tree *left;
    struct tree *right;
} tree;

void print(tree *t) {
    if (t!=empty_tree) {
        print1(t->left);
        printf("%c ", t->data);
        print1(t->right);
    }
}
```

END TEST