



Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin

Ollscoil Átha Cliath | The University of Dublin

Faculty of Engineering, Mathematics and Science

School of Computer Science and Statistics

Senior Freshman Integrated Computer Science
Senior Freshman Computer Science Joint Honours

Michaelmas Term 2021

Systems Programming

10th December 2021

Take Home Exam

14.00 – 19.00

Dr David Gregg

Instructions to Candidates:

- ☐ Answer 1 out of the 2 questions
- ☐ All questions are marked out of 100
- ☐ All program code should be commented, indented and use good programming style
- ☐ Answers to the questions should be completed by completing corresponding assignments that can be found on the CSU22014 Blackboard page.

Materials permitted for this examination:

Question 2

1. A queue is a data structure where values are inserted at one end the queue and removed from the other, in a first-in-first-out order. A doubly-ended queue is a variant of a queue where values can be pushed or popped from either end of the queue. Write a C abstract data type (ADT) called *deque* that represents a doubly-ended queue of strings. You should support the following functions:

- a) // create a new empty deque

```
struct deque * new_deque();
```

[25 marks]
- b) // push a string to the front of the deque

```
void push_front_deque(struct deque * this, char * str);
```

[12 marks]
- c) // pop a string from the front of the deque

```
char * pop_front_deque(struct deque * this);
```

[12 marks]
- d) // push a string to the back of the deque

```
void push_back_deque(struct deque * this, char * str);
```

[12 marks]
- e) // pop a value from the back of the deque

```
char * pop_back_deque(struct deque * this);
```

[12 marks]
- f) // free the memory being used by a deque

```
void free_deque(struct deque * this);
```

[12 marks]
- g) // return a string from the deque at position "index", where the item at
// the front of the deque has index 0, and subsequent items are numbered
// successively. if there are fewer than index+1 items in the deque,
// return a string containing the value "ERROR"

```
char * item_at_deque(struct deque * this, int index);
```

[15 marks]

This is an online exam, so students will be given C language source files in which to write their solution, and test cases that they can use to test their code.

Students may find it helpful to draw sketches of their deque data structure. Please feel free to upload these sketches along with your solution.

[Total: 100 marks]