

INTRODUCTION TO SCIENTIFIC AND ENGINEERING COMPUTATION

2017-2018 SPRING MIDTERM 2

90 minutes

Apr 24, 2018

Id	Full Name	Signature

Q1	Q2	Q3	Total
/ 30	/ 35	/ 35	/ 100

No questions are allowed. Answer the questions to the best of your understanding. If you need to make extra assumptions, state them clearly. Make sure that all your answers are sufficiently explained. WHEN YOU ARE ASKED TO WRITE A FUNCTION, ONLY WRITE THAT FUNCTION, NOT A WHOLE PROGRAM.

1. Answer the following questions regarding equality of arrays.

- (a) Write a function

```
bool equals(int a[], int a_size, int b[], int b_size)
```

that checks whether two arrays have the same elements in the same order.

(b) Assume that you have the following function that sorts a given array:

```
void sort(int x[], int x_size)
```

Using this `sort` function and the `equals` function from (a), write a function that checks whether two arrays have the same elements but not necessarily in the same order. You are NOT asked to write the `sort` function, and you can use the described `equals` function even if you haven't answered part (a).

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2. We want to write a program that will rotate a string to the right. In this operation, all characters are moved one position to the right and the last character becomes the first character of the result. For example, if you rotate the string “hello” 1 character to the right, you get the string “ohell”. If you rotate “hello” 3 characters to the right, you get “llohe”.
 - (a) Write a function `rotate_right` that takes two strings (`dst` and `src`), and an integer (`n`) as parameters, rotates `src` right by `n` characters as described above and stores the result in `dst`. You can assume that `n` is a non-negative integer, you don’t have to check its value.

- (b) Write the function `main` that will get a string to rotate and the rotation amount from the user, calls the `rotate_right` function to do the rotation operation and prints the result. You can assume that the user will type a string without spaces and a non-negative integer.

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3. Consider the program given below. In the first part, the program wants to create a dynamic array and fill it with some initial values. In the second part, it wants to copy that array into another dynamic array.

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

#define N_NUMS 10

int main()
{
    int* nums = (int*) malloc(N_NUMS * sizeof(int));
    int* p = nums;
    *p = 2;
    for (int i = 1; i < N_NUMS; i++) {
        p++;
        *p = *(p - 1) + 3;
    }
    free(p);
    int* nums_copy = (int*) malloc(N_NUMS * sizeof(int));
    for (int i = 0; i < N_NUMS; i++) {
        nums_copy[i] = nums[i];
    }
    free(nums);
    return EXIT_SUCCESS;
}
```

- (a) After the first `for` loop, what will be the contents of the `nums` array? Explain your answer.

(b) Does this program have a “dangling pointer” problem? If yes, how would you fix it? Explain your answers.

(c) Does this program have a “memory leak” problem? If yes, how would you fix it? Explain your answers.