

University of Nevada, Las Vegas Computer Science 477/677 Spring 2021

Assignment 3: Due Thursday February 25, 2021 11:59 pm

Name: _____

You are permitted to work in groups, get help from others, read books, and use the internet. Turn in the completed assignment on Canvas, using instructions given to you by the grader, Mr. Nicholas Heerdt, by 11:59 PM February 25.

1. Work Problem 2.4 on page 71 of your textbook.
2. Work Problem 2.16 on page 73 of your textbook.
3. Work Problem 2.20 on page 74 of your textbook.
4. (Demonstration only) Walk through the steps of heapsort for the array WIORGBNCVQ. Show the array after each exchange. Here is my answer. (Find my error, if any!)

123456789a Hexadecimal indices of the array implementation of max-heap.

WIORGBNCVQ Initial array.

WIORQBNCVG Bubbledown(G).

WIOVQBNCRG Bubbledown(R).

WVOIQBNCRG Bubbledown(I).

WVORQBNCIG Bubbledown(I). Max-heap order, End Heapify.

GVORQBNCIW W swapped to final position.

VGORQBNCIW Bubbledown(G).

VROGQBNCIW Bubbledown(G).

VROIQBNCGW Bubbledown(G). Max-heap order restored. End Phase 1.

GROIQBNCVW V swapped to final position.

RGOIQBNCVW Bubbledown(G).

RQOIGBNCVW Bubbledown(G). Max-heap order restored. End Phase 2.

CQOIGBNRVW R swapped to final position.

QCOIGBNRVW Bubbledown(C).

QIOCGBNRVW Bubbledown(C). Max-heap order restored. End Phase 3.

NIOCGBQRVW Q swapped to final position.

OINCGBQRVW Bubbledown(N). Max-heap order restored. End Phase 4.

BINCGOQRVW O swapped to final position.

NIBCGOQRVW Bubbledown(B). Max-heap order restored. End Phase 5.

GIBCNOQRVW N swapped to final position.

IGBCNOQRVW Bubbledown(G). Max-heap order restored. End Phase 6.

CGBINOQRVW I swapped to final position.

GCBINOQRVW Bubbledown(C). Max-heap order restored. End Phase 7.

BCGINOQRVW G swapped to final position.

CBGINOQRVW Bubbledown(B). Max-heap order restored. End Phase 8.

BCGINOQRVW C swapped to final position. End phase 9. Sorted.

5. Walk through the steps of heapsort for the array UBRYPQSVFMTX. Show the array after each exchange. I'll help you get started:

123456789abc Hexadecimal indices of the array implementation of max-heap.
UBRYPQSVFMTX Initial array.

6. The following function computes the product of two positive integers. Verify that that $p + cd = ab$ is a loop invariant for this code, and use the loop invariant to show that `product(a,b)` returns $a*b$.

```
int product(int a, int b)
{
    assert (a > 0 and b > 0);
    int c = a;
    int d = b;
    int p = 0;
    while(d > 0)
    {
        if(d % 2) p = p+c;
        c = c+c;
        d = d/2;
    }
    return p;
}
```

7. The following function computes x^b for a real number x and a positive integer b . What is its loop invariant?

```
float power(float x, int b)
{
    float y = x;
    int d = b;
    float z = 1.0;
    while(d > 0)
    {
        if(d % 2) z = z*y;
        y = y*y;
        d = d/2;
    }
    return z;
}
```