Homework 1

Mengxiang Jiang
CSEN 5303 Foundations of Computer Science

September 1, 2022

Problem 1. Describe an algorithm that takes as input a list of n integers and produces as output the largest difference obtained by subtracting an integer in the list from the one following it.

Algorithm A. Find largest difference in an integer list a with n elements

```
function LargestDifference(a: arrayInt) : integer;
    var
        max_dif, i, dif : integer;
    begin
        max_dif := INT_MIN;
        for i:=0 to n - 2 do
            begin
                dif := a[i + 1] - a[i];
                if max_dif < dif then max_dif := dif;
            end;
        return max_dif;
    end;
```

Write its corresponding program using your favorite programming language.

```python
import math

def find_largest_dif(a):
    n = len(a)
    max_dif = -math.inf
    for i in range(n - 1):
        dif = a[i + 1] - a[i]
        if dif > max_dif:
            max_dif = dif
    return max_dif
```

Listing 1: Largest Difference

Problem 2. Describe an algorithm that takes as input a list of n integers in non-decreasing order and produces the list of all values that occur more than once.

Algorithm B. Find duplicate integers in a non decreasing integer list a with n elements

```
function Duplicates(a: arrayInt) : stackInt;
    var
        i : integer;
        dup : boolean;
        result : stackInt;
    begin
        dup := false;
        result := new stackInt;
        for i:=0 to n - 2 do
            begin
                if dup then
                    begin
                        if a[i] <> a[i + 1] then dup = false;
                    end;
                else
                    begin
                        if a[i] = a[i + 1] then
                        begin
                            dup = true;
                            result.push(a[i]);
                        end;
                    end;
            end;
        return result;
    end;
```

Write its corresponding program using your favorite programming language.

```python
def find_duplicates(a):
    n = len(a)
    result = list()
    dup = False
    for i in range(n - 1):
        if dup:
            if a[i] != a[i + 1]:
                dup = False
        else:
            if a[i] == a[i + 1]:
                dup = True
                result.append(a[i])
    return result
```

Listing 2: Duplicate Integers

Problem 3. Describe an algorithm that takes as input a list of n integers and finds the total number of negative integers in the list.

Algorithm C. Find number of negative integers in an integer list a with n elements

```
function CountNegatives(a: arrayInt) : integer;
    var
        i, negs : integer;
    begin
        negs := 0;
        for i:=0 to n - 1 do
            if a[i] < 0 then negs := negs + 1;
        return negs;
    end;
```

Write its corresponding program using your favorite programming language.

```python
def count_negatives(il):
    n = len(il)
    negs = 0
    for i in range(n):
        if il[i] < 0:
            negs += 1
    return negs
```

Listing 3: Count Negatives