School of Computer Science

COMP20010: Data Structures and Algorithms I
Semester I

Exercises: Recursion
On: 16/11/2018
Due: ...

Q1: _____ **(20points)**

Draw the recursion trace for $ReverseArray(A, 0, 6)$ where $A = \{12, 5, 19, 6, 11, 3, 9, 34, 2, 1, 15\}$.

```
1: function ReverseArray (A, i, j)
2:     Input: An array A and non-negative integer indices i and j
3:     Output: Reversal of elements in A starting at i and ending at j
4:     if i < j then
5:         swap A[i] and A[j]
6:         ReverseArray(A, i + 1, j − 1)
7:     end if
8:     return
9: end function
```

Q2: _____ **(20points)**

Using the binary recursive version of Fibonacci, write out the recursive trace of the function for the 5th fibonacci number: `Fibonacci(5)`

Q3: _____ **(20points)**

Consider the following function:

```
1: function Foo (x)
2:     Input: integer x
3:     print x%10
4:     if (x/10) ≠ 0 then
5:         Foo(x/10)
6:     end if
7:     print x%10
8: end function
```

i. What does the function `Foo` do? [10]

ii. What is the output of `Foo(2468)`? [10]

Q4: _____ **(20points)**

Write the psuedocode for a recursive function which prints the elements of a linked list *in reverse*?

Q5: _____ **(20points)**

Write the psuedo code for a fully recursive function (no loops) which removes the node at position k?

Q6: _____ **(20points)**

Write the psuedocode for a fully recursive function which copies a linked list?

Q7: _____ **(20points)**

Write the pseudocode for a *recursive* function `SumOfDigits` which computes the sum of the digits in a number. The function `SumOfDigits(121) = 4` and `SumOfDigits(54321)=15`.

Q8: _____ **(30points)**

Following the link to the outline of the Towers of Hanoi problem, solve the following problems:

i. Write an iterative Java implementation of the Towers of Hanoi problem for any n (use a Scanner to read n from the console)? At each move your code should print `n -> peg_from -> peg_to` eg: [10]

```
1 -> A -> B
2 -> A -> C
1 -> B -> C
3 -> A -> B
```

ii. Write a recursive Java implementation of the Towers of Hanoi problem for any n (use a Scanner to read n from the console)? [10]

iii. How many moves are required to solve the problem with 3 pegs and n disks? [10]