

# EE4371: Assignment 3a - Stacks, Recursion

August 18, 2019

This assignment is in two parts. Submit a C file for each.

1. Read Chapter 3 of Tanenbaum
2. Read Chapter 2 of Aho, Hopcroft and Ullman
3. Consider the knapsack problem in Aho:

Given a set of objects with weights  $\{w_i\}_{i=0}^{N-1}$ , we need to select a subset of these objects so that their total weight is exactly  $W$ .  $W$  and  $w_i$  are positive integers, and  $N$  is given.

- (a) Following the pseudocode below from Aho, write the C code to implement this problem.

```
Boolean knapsack(int W, int i) {
    if W==0
        return True
    else if W<0 or i>=N
        return False
    else if knapsack(W-w[i], i+1)
        print w[i]
        return True
    else
        return knapsack(W, i+1)
    end
}
```

- (a) Use a static scalar integer, count, to accumulate the number of times knapsack is called.
- (b) Write a main program that randomly generates  $10^4$   $N$  (uniform in 1 to 20),  $W$  (uniform in 0 to  $N^2/2$ ) and the  $w_i$  values (uniformly random in 0 to  $N$ ). For each such set, determine the number of times knapsack was called. Write out a table as follows:

$N$	Min	Max
1	1	1
...	...	...
20	?	?

- (c) In the report, include the output of Min and Max vs  $N$  shown above. Determine the scaling (is it logarithmic, polynomial (if so order), or exponential (exponent?)) Can you justify the scaling?