Name: _____ **100 points total**

CS 2123 Homework 5 Fall 2019

Assignment is due at 11:59pm on December 5. Submit a digital copy of the assignment on Harvey as a SINGLE PDF file. The easiest way to scan your work is to use an app on your phone that saves a single PDF (e.g., the Google Drive app for Android phones (see
https://support.google.com/drive/answer/3145835?co=GENIE.Platform%3DAndroid&oco=1) or apps such as Scanner Pro. You can see a list of choices here: https://www.pcmag.com/roundup/349681/the-best-mobile-scanning-apps

NOTE: As a reminder, students who worked in pairs on HW4 must work with a different partner on HW5.

You may submit a lateness coupon request BEFORE the assignment is due by sending an email to cs2123f19@googlegroups.com with Subject "CS2123 Lateness Coupon". All other late work will receive a 10 percentage point deduction per day (including weekends), No late work is accepted beyond two days after the assignment is due.

Q2 (12)	_____
Q3 (30)	_____
Q4 (30)	_____
Q5 (24)	_____
Q6 (4)	_____
Total (100)	_____

Q1. (12 points)
Consider the following code.

```
def two_pow(i):
    if i == 0: return 1
    return two_pow(i-1)+two_pow(i-1)
```

a. What is the running time if no memoization is used?

b. What is the running time if memoization is used?

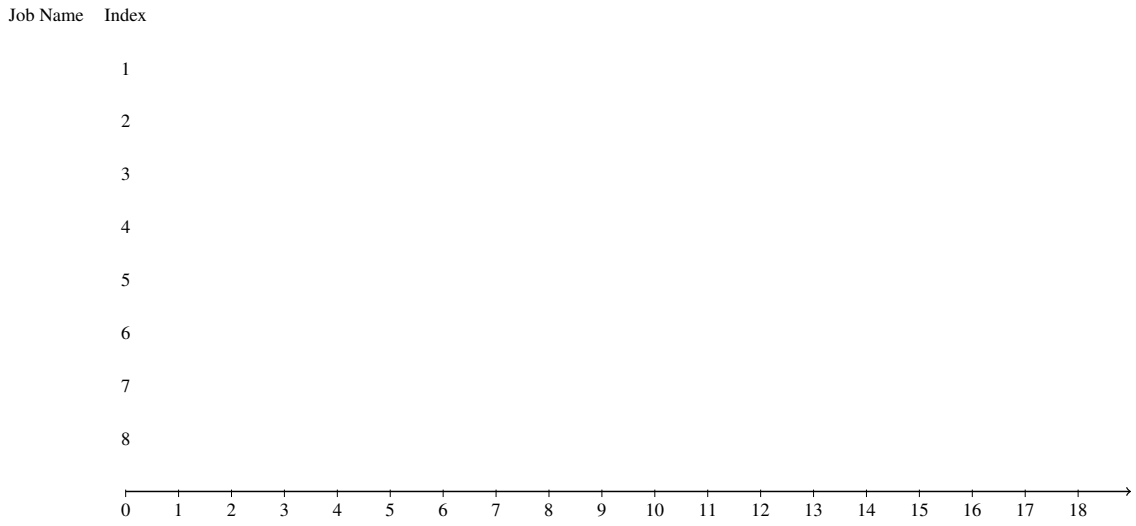
Q2. (30 points)

Consider the following 8 jobs:

Job name	Start time	End time	Job weight
A	7	11	4
B	4	14	6
C	15	17	2
D	10	16	5
E	3	8	3
F	6	12	5
G	1	5	2
H	9	13	3

Solve this weighted interval scheduling problem using a dynamic programming approach.

a. Draw the jobs on the following axis in the correct order. Label the job name next to the corresponding index.



b. Fill out the following table.

Job name	Index j	Weight v_j	$p(j)$	$v_j + M[p(j)]$	$M[j-1]$	$M[j]$
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					

c. What is the total weight of the optimal job selection?

Q3. (30 points)
Calculate the edit distance between the two strings “coral” and “koraal” (the Dutch word for coral).

a. Complete the edit-distance table, including arrows to indicate which operation took place.

C	_	k	o	r	a	a	l
_							
c							
o							
r							
a							
l							

b. Based on the table, what is the minimum number of steps to transform “coral” into “koraal”?

c. Explain precisely the sequence of steps (including the operation and character affected) required to turn the string “coral” into “koraal”.

d. Do you think edit distance would be useful when designing automated language translation software such as Google Translate? Why or why not?

Q4. (24 points)
Consider the following 4 objects:

Object index i	Value v_i	Weight w_i
1	2	1
2	4	2
3	9	4
4	12	5

Solve the knapsack problem for knapsack weights up to 7 using a dynamic programming approach.

a . Fill in the table of $OPT(i, w)$, defined as:

$$OPT(i,w) = \begin{cases} 0 & \text{if} i = 0 \\ OPT(i-1,w) & \text{if} w_i > w \\ \max(OPT(i-1,w), v_i + OPT(i-1, w-w_i)) & \text{otherwise} \end{cases}$$

Each row represents the subset of items $1, \ldots, i$, and each column represents the total knapsack weight limit w.

	0	1	2	3	4	5	6	7
$\{\}$								
$\{1\}$								
$\{1,2\}$								
$\{1,2,3\}$								
$\{1,2,3,4\}$								

b. What is the optimum value of the knapsack with weight capacity 7?

c What is the set of objects in the optimal knapsack with weight capacity 7?

Q5. (4 points) How long (in hours) did you spend on this assignment?