Homework #4

CSE 7350

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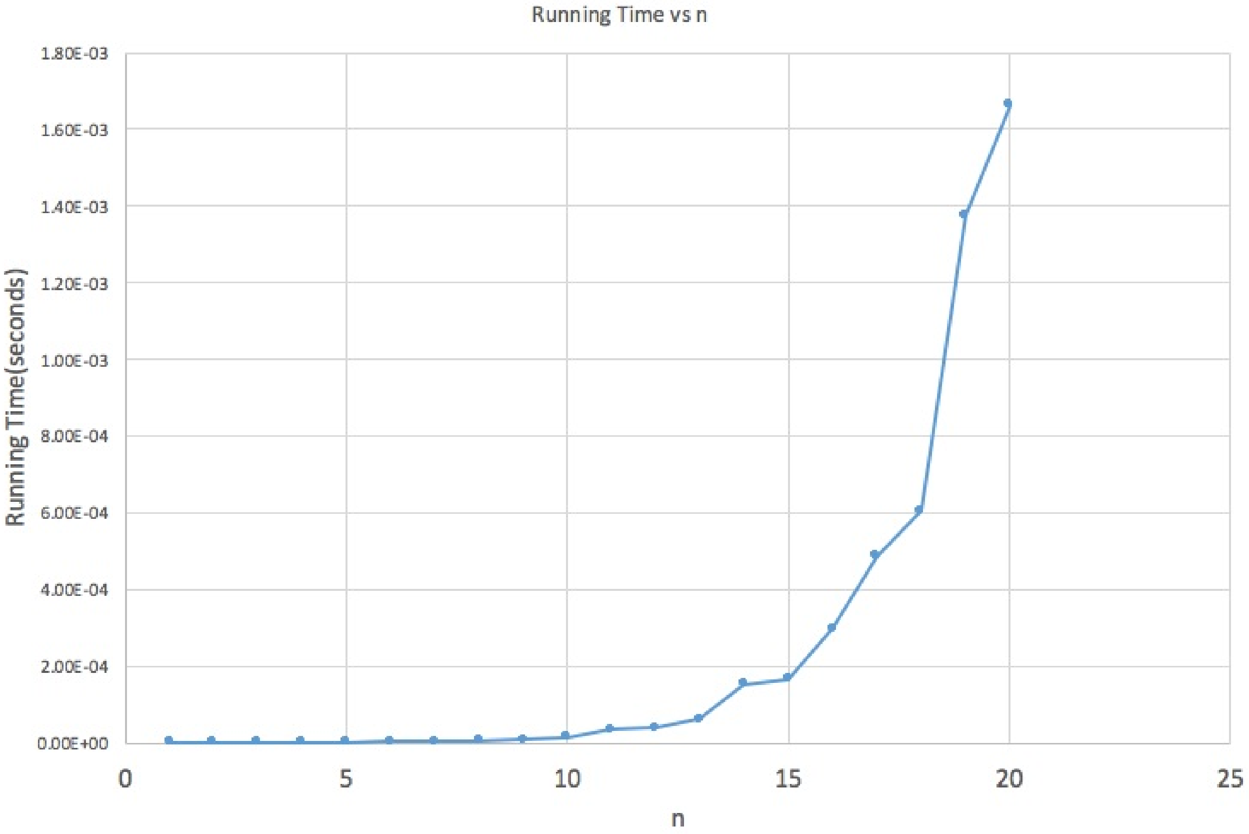
1. Recursive Fibonacci

```
def fib_rec(n)
  n <= 1 ? 1 :  fib_rec( n - 1 ) + fib_rec( n - 2 )
end
```

N	Running Time
1	2.0e-06
2	1.0e-06
3	1.0e-06
4	1.0e-06
5	2.0e-06
6	2.0e-06
7	3.0e-06
8	4.0e-06
9	1.3e-05
10	1.2e-05
11	1.9e-05
12	2.9e-05
13	9.4e-05
14	0.000129

N	Running Time
15	0.000124
16	0.000232
17	0.000355
18	0.000559
19	0.000886
20	0.001376



2. Fibonacci Continued

Iterative Fibonacci

```
def fib_it(n, sequence=[1])
  n.times do
    current_number, last_number = sequence.last(2)
    sequence << current_number + (last_number or 0)
  end

  sequence.last
end
```

N	Running Time
1	1.2e-05
2	3.0e-06
3	2.0e-06
4	3.0e-06
5	3.0e-06
6	3.0e-06
7	4.0e-06
8	3.0e-06
9	7.0e-06
10	7.0e-06
11	5.0e-06
12	5.0e-06
13	1.0e-05
14	6.0e-06
15	6.0e-06
16	6.0e-06
17	6.0e-06
18	7.0e-06
19	6.0e-06
20	8.0e-06

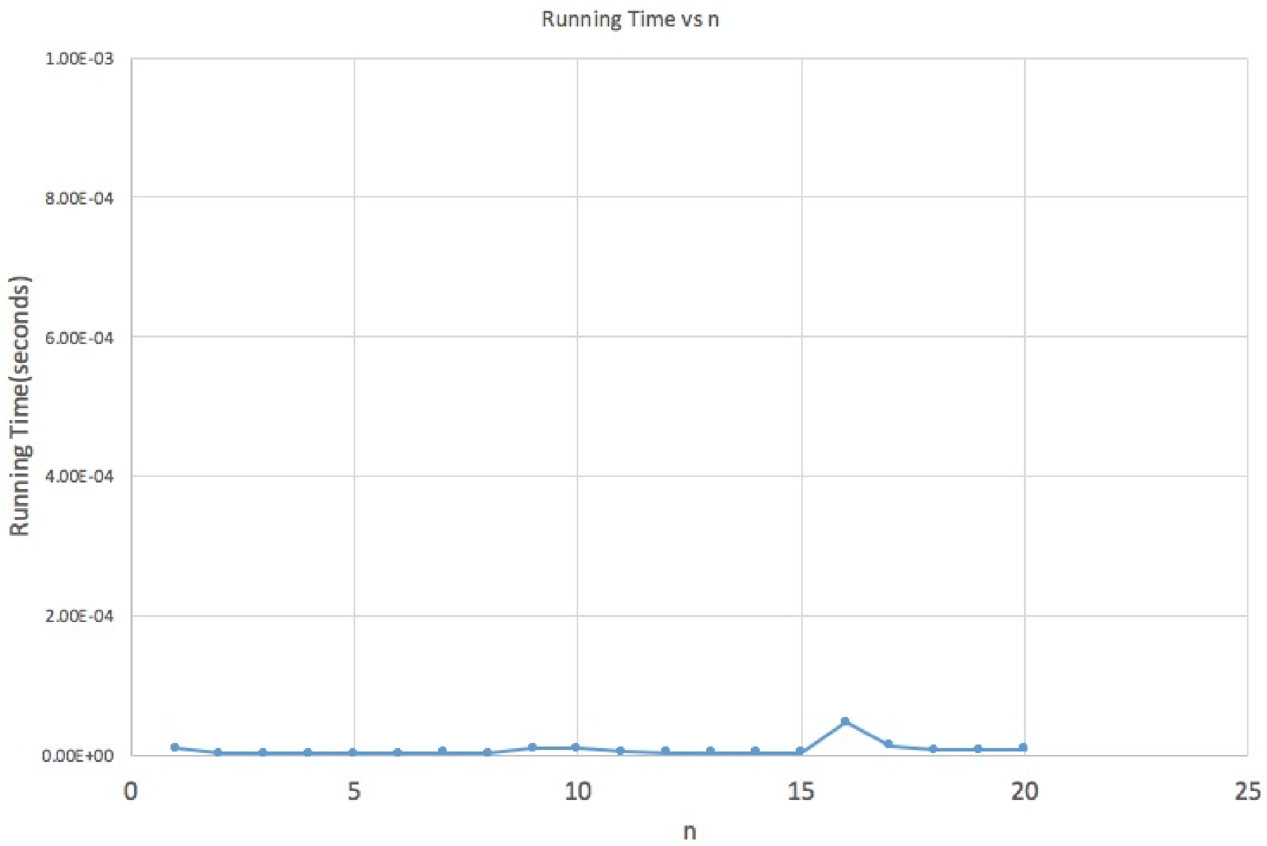
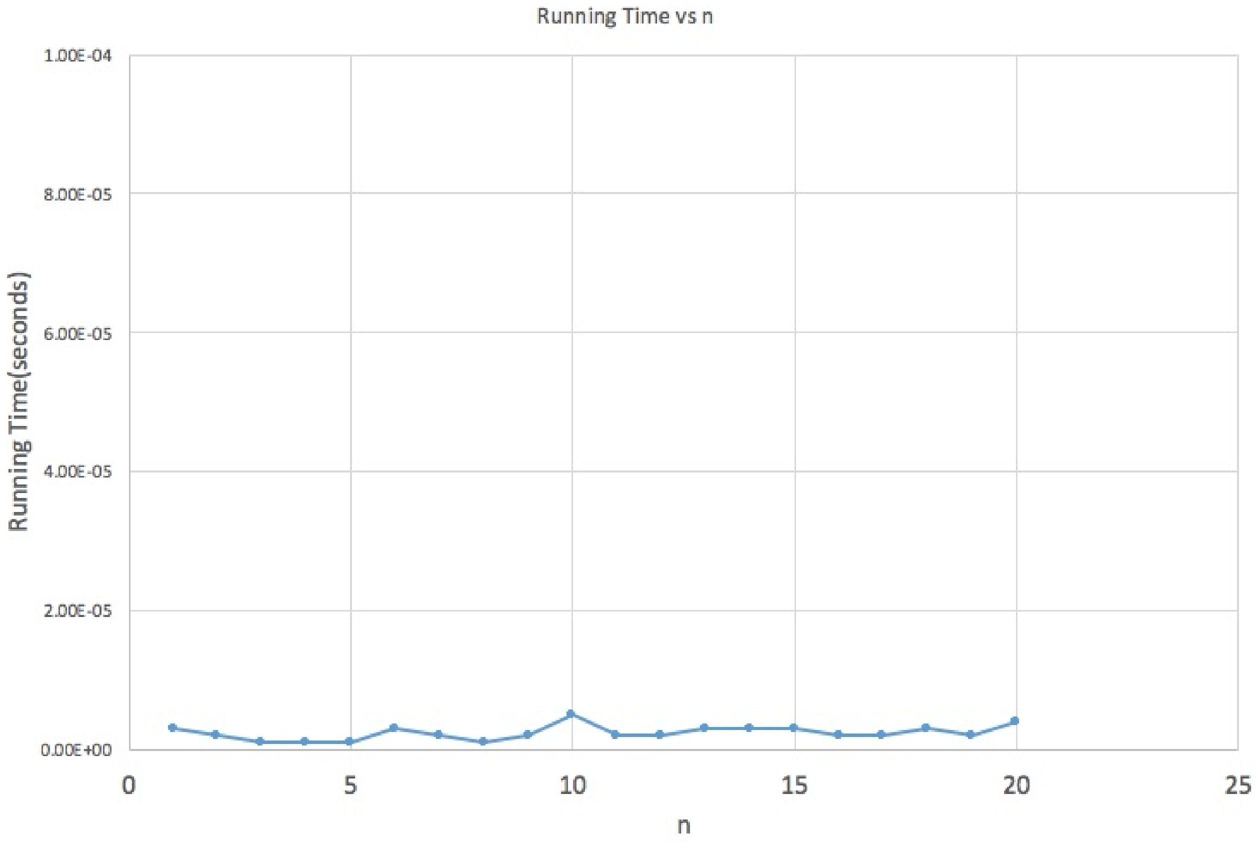


Table lookup

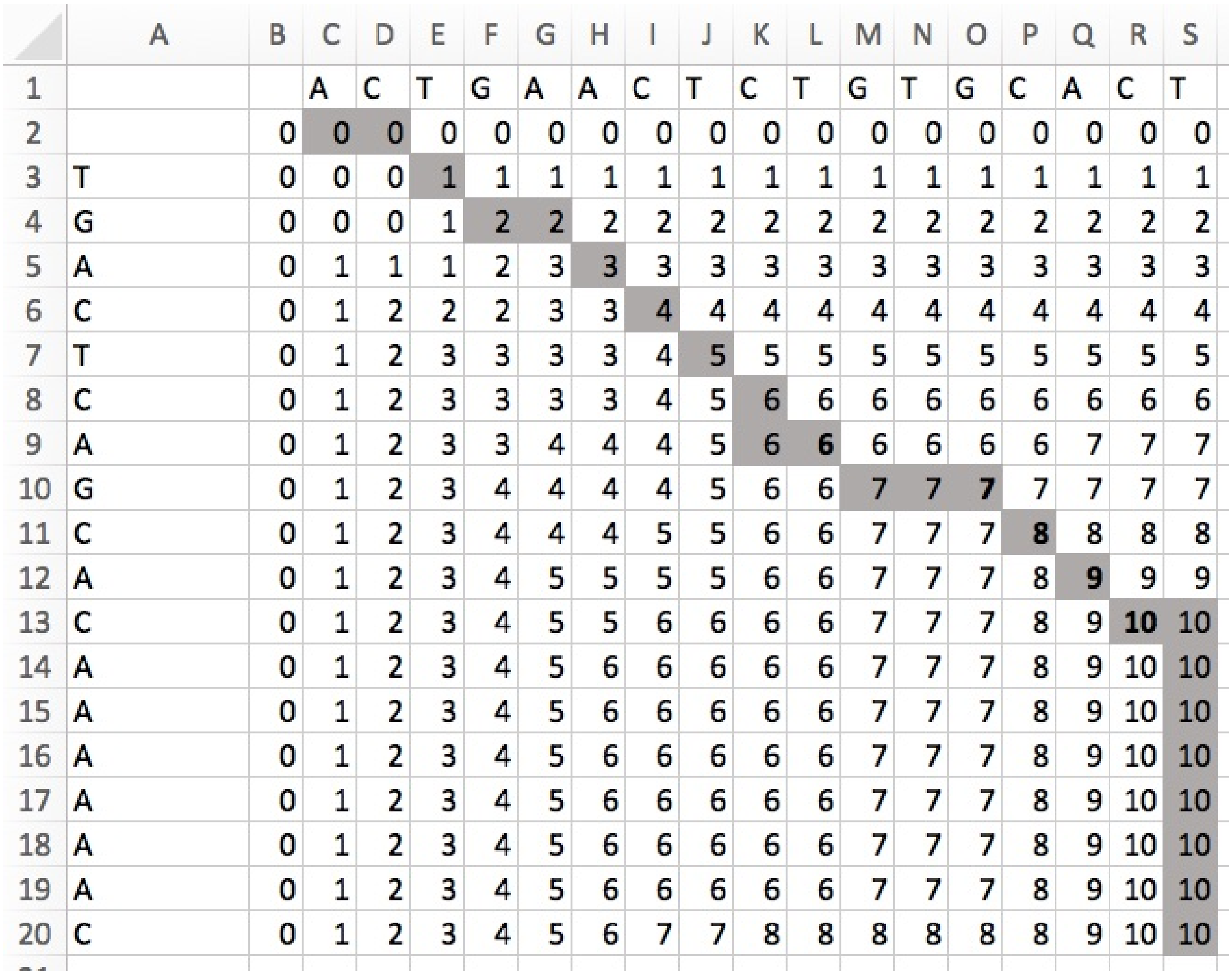
```
fib = Hash.new do |f, n|
  f[n] = if n <= -2
           (-1)**(n + 1) * f[n.abs]
         elsif n <= 1
           1
         else
           f[n - 1] + f[n - 2]
         end
end
```

N	Running Time
1	3.0e-06
2	2.0e-06
3	1.0e-06
4	1.0e-06
5	1.0e-06
6	3.0e-06
7	2.0e-06

N	Running Time
8	1.0e-06
9	2.0e-06
10	5.0e-06
11	2.0e-06
12	2.0e-06
13	3.0e-06
14	3.0e-06
15	3.0e-06
16	2.0e-06
17	2.0e-06
18	3.0e-06
19	2.0e-06
20	4.0e-06



3. Longest Common Subsequence



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1			A	C	T	G	A	A	C	T	C	T	G	T	G	C	A	C	T
2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	T	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	G	0	0	0	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	A	0	1	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3
6	C	0	1	2	2	2	3	3	4	4	4	4	4	4	4	4	4	4	4
7	T	0	1	2	3	3	3	3	4	5	5	5	5	5	5	5	5	5	5
8	C	0	1	2	3	3	3	3	4	5	6	6	6	6	6	6	6	6	6
9	A	0	1	2	3	3	4	4	4	5	6	6	6	6	6	6	7	7	7
10	G	0	1	2	3	4	4	4	4	5	6	6	7	7	7	7	7	7	7
11	C	0	1	2	3	4	4	4	5	5	6	6	7	7	7	8	8	8	8
12	A	0	1	2	3	4	5	5	5	5	6	6	7	7	7	8	9	9	9
13	C	0	1	2	3	4	5	5	6	6	6	6	7	7	7	8	9	10	10
14	A	0	1	2	3	4	5	6	6	6	6	6	7	7	7	8	9	10	10
15	A	0	1	2	3	4	5	6	6	6	6	6	7	7	7	8	9	10	10
16	A	0	1	2	3	4	5	6	6	6	6	6	7	7	7	8	9	10	10
17	A	0	1	2	3	4	5	6	6	6	6	6	7	7	7	8	9	10	10
18	A	0	1	2	3	4	5	6	6	6	6	6	7	7	7	8	9	10	10
19	A	0	1	2	3	4	5	6	6	6	6	6	7	7	7	8	9	10	10
20	C	0	1	2	3	4	5	6	7	7	8	8	8	8	8	8	9	10	10

The longest common subsequence is TGACTCGCAC.

4. Dice

Value	Dice 1	Dice 2	Dice 3
0	0	0	0
1	1	0	0
2	2	3	0
3	2	6	9
4	1	7	24
5	0	7	39
6	0	6	41
7	0	5	39

Value	Dice 1	Dice 2	Dice 3
8	0	2	34
9	0	0	22
10	0	0	9

a. How many of the rolls will sum to the value of 6: 41

b. How many of the rolls will sum to the value of 7: 39

c. How many of the rolls will sum to the value of 8: 34

d. How many of the rolls will sum to the value of 9: 22

e. How many of the rolls will sum to the value of 10: 9

5. Extended Euclidian Algorithm

A	B	Q	R	alpha	beta
				1	0
12103	9889	1	2214	0	1
9889	2214	4	1033	1	-1
2214	1033	2	148	-4	5
1033	148	6	145	9	-11
148	145	1	3	-58	71
145	3	48	1	67	-82
3	1	3	0	-3274	4007
1	0	-	-	9889	-12103

Since 4007*9889 + (-3274)*12103 = 1 then,
4007*9889 = (3274)*12103 + 1 and therefore,
4007*9889 = 1 modulo 12103
So 1/9889 = 4007 modulo 12103

6. 0-1 Knapsack

The correct solution would be to take Job 1 and Job 3 for Processor 1 which would take up the full 10 seconds.

--	Job 1	Job 2	Job 3	Job 4
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	4	4	4	4
5	4	5	5	5
6	4	5	6	6
7	4	5	6	7
8	4	5	6	7
9	4	9	9	9
10	4	9	10	10

Appendix - Code for 1 & 2

```
## Adapted from Rosetta Code

def fib_rec(n)
  n <= 1 ? 1 :  fib_rec( n - 1 ) + fib_rec( n - 2 )
end

def fib_it(n, sequence=[1])
  n.times do
    current_number, last_number = sequence.last(2)
    sequence << current_number + (last_number or 0)
  end

  sequence.last
end

fib = Hash.new do |f, n|
  f[n] = if n <= -2
           (-1)**(n + 1) * f[n.abs]
         elsif n <= 1
           1
         else
           f[n - 1] + f[n - 2]
         end
end
```

```
nums = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,
12, 13, 14, 15, 16, 17, 18, 19, 20, 30]

nums.each do |n|
  start_time = Time.now
  fib_rec(n)
  end_time = Time.now
  # puts n

  start_time = Time.now
  # fib_it(n)
  puts fib[10]
  end_time = Time.now
  # puts end_time - start_time
end
```