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Homework 1

1)

a) O(n)
b) $O(n^2)$
c) $O(n^3)$
d) $O(n^2)$
e) $O(n^3)$
f) O(n)
g) $O(n^2 \log(n))$
h) $O(n^2)$
I) $O(n^3)$

2)

a) O(1)
b) O(n)
c) $O(n^2)$
d) $O(n^2)$
e) $O(n^3)$
f) O(n)
g) $O(n^2)$
h) $O(n^3)$
i) O(log(n))
j) $O(\log(n^2))$
k) O(log(n))

3)n^3, n^2, $n^{1.5}$, n, n/2, $\sqrt{n}$, $n(\log(n))^2$, n(log(n))

4)

a).05 * 4 = .2
b).05 * 4^2 = .8
c).05 * 4^4 = 12.8

5) BigO(n^2)

6) $3n^2 + 2n\log(n) + 6n + 19 < 4n^2$, for all n >23.
Therefore $3n^2 + 2n\log(n) + 6n + 19$ is :
$O(n^2)$.

7) Actual Times :

n	MaxSubsequenceSum1 $O(n^3)$	MaxSubsequenceSum2 $O(n^2)$	MaxSubsequenceSum4 $O(n)$
128	0.011471	0.000274	0.000006
256	0.071488	0.000732	0.000015
512	0.554718	0.004116	0.000014
1024	4.547063	0.011785	0.000017
2048	35.321503	0.047188	0.000033
4096	283.882132	0.185119	0.000059

8) Predicted Times :

n	MaxSubsequenceSum1 $O(n^3)$	MaxSubsequenceSum2 $O(n^2)$	MaxSubsequenceSum4 $O(n)$
128	0.011471	0.000274	0.000006
256	0.09177	0.0011	0.000012
512	0.73414	0.00438	0.000024
1024	5.87315	0.01754	0.000048
2048	46.9852	0.07014	.00096
4096	375.882	0.28058	0.00019

9) Formula Approximate for $O(n^k) = r^k * t0$, where t0 is time on input size n0 and r= n/n0

$n=2^{18}$,$n0=2^7$, so $r = 2^{11}$

For MaxSubsequenceSum1:
$O(n^3)$
k=3, t0 = 0.011471

$(2^{11})^3 * 0.011471 \sim 9.853 * 10^7$

For MaxSubsequenceSum2:
$O(n^2)$
k=2, t0 = 0.000274

$(2^{11})^2 * 0.000274 \sim 1149.239$

For MaxSubsequenceSum4:
O(n)
k=1, t0 = 0.000006

$(2^{11})^1 * 0.000006 \sim .012288$

10)
For MaxSubsequenceSum1:
162 weeks, 6 days, 7 hours, 12 minutes, ~00 seconds

For MaxSubsequenceSum2:
0 week, 0 days, 0 hours, 19 minutes, ~9.239 seconds

For MaxSubsequenceSum4:
0 week, 0 days, 0 hours, 0 minutes, 0.12288 seconds

11)Actual Times:

n	2b	2c	2d	2e
256	0.000004	0.000506	0.000260	0.078574
512	0.000003	0.000938	0.000473	0.264881
1024	0.000003	0.001937	0.001006	2.002783
2048	0.000004	0.007782	0.003921	16.132270
4096	0.000008	0.031581	0.015779	128.05107

Yes it matched my predictions. 2b should O(n), which it is according to the times present. 2C should be $O(n^2)$, which we see through the time elapsed. We can see that it is approximately 4 times more than the last time when it gets larger. 2d was a bit tricker, but if you write it all out it would be a variation of gauss' formula, which is $O(n^2)$. It follows this pattern as it gets larger. 2e is $O(n^3)$ as shown through the times.

12)True

13)True