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CS201-3  
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## HOMework 2

### Computer Specifications:

MacBook Pro (Retina, 15-inch, Early 2013)  
Processor: 2.4 GHz Intel Core i7  
Memory: 8 GB 1600 MHz DDR3  
Storage: 256 GB SSD

### Observations and Comments:

Generally, the data I obtained was higher than the expected values. However, they followed the pattern that they were supposed to follow. Meaning that, the orders were right, indeed. Furthermore, the plots did not look like polynomials, they looked like line segments. This is because I did not have enough data point for it to be plotted like an exact polynomial. The important thing is the growth rate.

The execution times belonging to relatively small sized arrays were fluctuating, they were not obeying the pattern. This is probably because of the hardware. For instance, the temperature of the computer might be affecting the execution times. This might be why the first execution times is always higher, since the CPU was not working before.

*Please note that the table and plots are included on the next pages. Plots were done by implementing the data in MATLAB and plotting them. The code that was used to plot the data is below.*

```
duration1 = [ 0.006 0.001 0.002 0.001 0.002 0.016 0.107 0.836  
6.698 51.144 410.293 3136.73 25330.8 214618 ] * 10^6;  
duration2 = [ 0.005 0.001 0 0.002 0.001 0.002 0.007 0.021 0.078  
0.306 1.211 4.725 19.739 77.951 324.343 1228.96 4982.73 21066.1  
77308.9 326454 ] * 10^6;  
duration3 = [ 0.005 0.001 0.001 0 0 0.002 0.002 0.005 0.01 0.02  
0.043 0.094 0.196 0.409 0.966 1.918 3.754 7.888 15.934 33.674  
73.262 147.992 302.365 615.693 1267.57 2609.53 5281.39 11236.9  
24664.5 47726.5 ] * 10^6;  
duration4 = [ 0.006 0 0.001 0 0 0.002 0 0.001 0.002 0.003 0.005  
0.011 0.021 0.042 0.083 0.162 0.322 0.55 1.025 1.977 4.342 9.084  
16.534 33.524 69.197 143.382 275.015 515.383 1013.55 2173.18  
4357.44 ] * 10^6;
```

```

size = zeros(1, 31);

for i = 0:30
    size(i+1) = 2^i;
end

plot(size(1:14), duration1);
title('Cubic Algorithm Analysis');
xlabel('Size');
ylabel('Time');
hold on;
x = linspace(0, 8100);
plot(x, x.^3);

figure();
plot(size(1:20), duration2);
title('Quadratic Algorithm Analysis');
xlabel('Size');
ylabel('Time');
hold on;
x = linspace(0, 6*10^5);
plot(x, x.^2);

figure();
plot(size(1:30), duration3);
title('Recursive Algorithm Analysis');
xlabel('Size');
ylabel('Time');
hold on;
x = linspace(0, 10^9);
plot(x, log(x).*x);

figure();
title('Linear Algorithm Analysis');
xlabel('Size');
ylabel('Time');
plot(size, duration4);
hold on;
x = linspace(0, 13*10^8);
plot(x, x);

```

	$O(N^3)$	$O(N^2)$	$O(N\log N)$	$O(N)$
1	0.006	0.005	0.005	0.006
2	0.001	0.001	0.001	0
4	0.002	0.002	0.001	0.001
8	0.001	0.001	0	0
16	0.002	0.002	0	0
32	0.016	0.007	0.002	0.002
64	0.107	0.021	0.002	0
128	0.836	0.078	0.005	0.001
256	6.698	0.306	0.01	0.002
512	51.144	1.211	0.02	0.003
1,024	410.293	4.725	0.043	0.005
2,048	3,136.73	19.739	0.094	0.011
4,096	25,330.8	77.951	0.196	0.021
8,192	214,618	324.343	0.409	0.042
16,384	NA	1,228.96	0.966	0.083
32,768	NA	4,982.73	1.918	0.162
65,536	NA	21,066.1	3.754	0.322
131,072	NA	77,308.9	7.888	0.55
262,144	NA	326,454	15.934	1.025
524,288	NA	NA	33.674	1.977
1,048,576	NA	NA	73.262	4.342
2,097,152	NA	NA	147.992	9.084
4,194,304	NA	NA	302.365	16.534
8,388,608	NA	NA	615.693	33.524
16,777,216	NA	NA	1,267.57	69.197
33,554,432	NA	NA	2,609.53	143.382
67,108,864	NA	NA	5,281.39	275.015
134,217,728	NA	NA	11,236.9	515.383
268,435,456	NA	NA	24,664.5	1,013.55
536,870,912	NA	NA	47,726.5	2,173.18
1,073,741,824	NA	NA	NA	4,357.44



