Asymptotic Analysis

1. Review Array.setSize implementation
   a. Write the **in**efficient Array.setSize in your notebook
   b. Write the efficient Array.setSize in your notebook

Asymptotic Time[1] of Operations for Collections of *n* Elements

	Trivial ArrayList	Good ArrayList	LinkedList
Insert beginning			
Insert end			
Get length			
Get i^{th} element			

2. Remember: apply to space as well as time! Consider implications for your lab…
3. Formal definitions:
   a. O[2]

   b. Ω

   c. Θ

4. Common orders of growth:

   $O(1) \leq O(\log n) \leq O(n^{1/k}) \leq O(n) \leq O(n \log n) \leq O(n^k) \leq O(k^n) \leq O(n!)$

5. Programming Tip: &&, ||, ? :, and assert :
   a. These operators only evaluate as many arguments as necessary
   b. boolean and(boolean a, boolean b) { return a && b; }
   c. if (x != null && x.equals("hello")) {…
   d. if (and(x != null, x.equals("hello")) {…
   e. assert vs. Assert

[1] Expected, amortized time
[2] This is technically the Greek letter omicron, not the Roman "O"; this notation was first used in 1894 by Bachmann!

Ten Orders of Growth

Let's assume that your computer can perform 10,000 operations (e.g., data structure manipulations, database inserts, etc.) per second. Given algorithms that require lg n, $n^{½}$, n, n^2, n^3, n^4, n^6, 2^n, and $n!$ operations to perform a given task on n items, here's how long it would take to process 10, 50, 100 and 1,000 items.

	n			
	10	**50**	**100**	**1,000**
lg n	0.0003 sec	0.0006 sec	0.0007 sec	0.0010 sec
$n^{½}$	0.0003 sec	0.0007 sec	0.0010 sec	0.0032 sec
n	0.0010 sec	0.0050 sec	0.0100 sec	0.1000 sec
n lg n	0.0033 sec	0.0282 sec	0.0664 sec	0.9966 sec
n^2	0.0100 sec	0.2500 sec	1.0000 sec	100.00 sec
n^3	0.1000 sec	12.500 sec	100.00 sec	1.1574 day
n^4	1.0000 sec	10.427 min	2.7778 hrs	3.1710 yrs
n^6	1.6667 min	18.102 day	3.1710 yrs	3171.0 cen
2^n	0.1024 sec	35.702 cen	4×10^{16} cen	1×10^{166} cen
$n!$	362.88 sec	1×10^{51} cen	3×10^{144} cen	1×10^{2554} cen

Table 1: Time required to process n items at a speed of 10,000 operations/sec using eight different algorithms.

Note: The units above are seconds (sec), minutes (min), hours (hrs), days (day), years (yrs), and centuries (cen)!

From: http://www.ccs.neu.edu/home/jaa/CSG713.06F/Information/Handouts/order.html