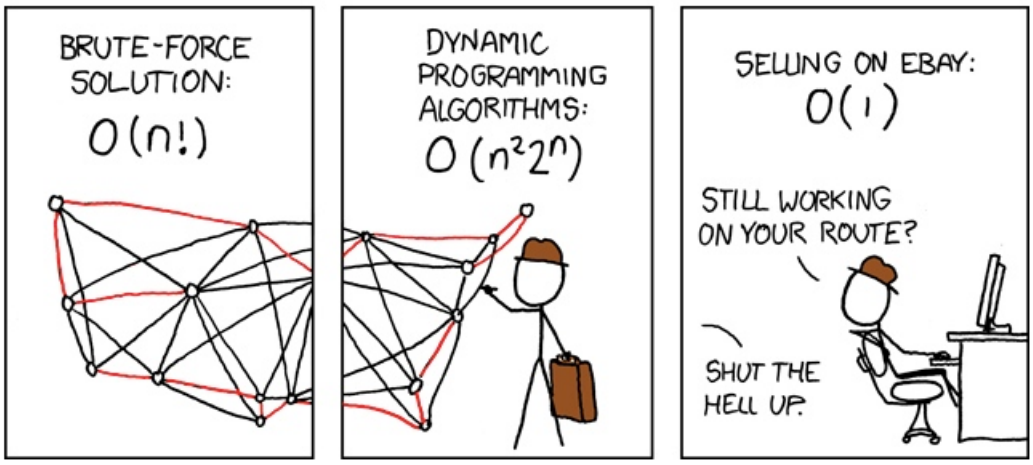
CS302 - Assignment 2

Due: Tuesday, Feb. 19 at the beginning of class
Hand-in method: paper



http://xkcd.com/399/

1. (7 points) Revisiting problem 4 from last assignment

   (a) Copy your pseudocode for `sum_positive` from assignment 1 and include it here.

   (b) Prove that your function is correct by stating a loop invariant and then proving that the invariant is true.

2. (6 points) The table below contains *actual* run times for 6 different algorithms. The input sizes ranged from 1000 to 32000 seen at the top of the table. For each of the algorithms, give the θ complexity of the algorithms based on the running times and include a brief explanation for your answer.

Algorithm	1000	2000	4000	8000	16000	32000
A_1	50	378	3,345	26,300	215,680	1,658,002
A_2	99	110	105	976	103	100
A_3	60	130	237	501	954	1999
A_4	1005	1095	1201	1289	1420	1540
A_5	5	21	84	311	1304	5280
A_6	10	22	50	108	245	533

3. (8 points) Arrange the functions below in ascending order of growth rate. Specifically, if $f(n) = O(g(n))$ then $f(n)$ should be before $g(n)$ in the list. If two functions are asymptotically equal, i.e. $f(n) = \Theta(g(n))$ then note this in the list by including all elements in a set. For example, given: $n, \log n$, $n+4$, and n^2 the list would be: $\log n, (n, n+4), n^2$.

$(\frac{3}{2})^n$	7	$5n + 20$	3^{3^n}
n	3^n	$n3^n$	n^5
$n!$	$3\sqrt{logn}$	$n^{\log n}$	$\frac{1}{2}n\log(n+5)$
10^6	n^n	$(3n)^2$	$\log\log n$

4. (15 points) Big O

   For each of the statements below, state whether it is **true** or **false** and then *prove* your answer.

   (a) $15n^3 \log n + 10n^2 + 50$ is $O(n^3 \log n)$.
   (b) $3n^2 - 12n + 2$ is $\Omega(n^3)$
   (c) 2^{n+1} is $\Theta(2^n)$
   (d) 2^{2n} is $O(2^n)$
   (e) $\log(n!)$ is $O(n \log n)$ (Hint: compare $n!$ and n^n)

5. (5 points) Insertion sort

   Inspired by all the cool new sorting algorithms you've heard about in your career as a CS student, you decide to come up with a new sorting algorithm called <*your_name_here*>sort. You notice that $Insertion - Sort$ seems inefficient in how it finds the correct location to insert the next value. You decide that rather than linearly searching one at a time to find the correct place, you're going to use binary search to find the correct place. Is this an improvement? If yes, state the running time of this new algorithm. If no, explain why this is not an improvement. Be specific and clear.