

CS 251  
Fall 2007  
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Assignment 2

**Due Monday September 10, 11:59PM**

## Running Time Analysis

1. Write a C function that takes an array of  $n$  integers and prints out all pairs to the standard output. Given  $\{a, b, c\}$ , the function should print out  $(a, b)$ ,  $(a, c)$ ,  $(b, a)$ ,  $(b, c)$ ,  $(c, a)$ ,  $(c, b)$ , regardless of the values of  $a$ ,  $b$ , and  $c$ .
2. Measure the function's running time as a function of  $n$ .
  - a. Generate random input arrays and time the function.
  - b. Double the value of  $n$  starting from 64 until the running time becomes greater than 20 seconds.
  - c. Plot the running time as a function of  $n$  on both a linear and a logarithmic graph.
3. Write a pseudocode description of the function.
  - a. Find the number of primitive operations as a function of  $n$ .
  - b. Perform the asymptotic running time analysis using the  $O$ ,  $\Omega$ ,  $\Theta$ ,  $\omega$ , and  $o$  notations.
  - c. Argue that the problem of printing out all pairs is  $\Theta(n^2)$ .
4. Consider a function that prints out unordered pairs. For the example above, the pairs printed are  $(a, b)$ ,  $(a, c)$ , and  $(b, c)$ . How does the actual running time change? Does the asymptotic running time change? Explain.
5. **Extra-credit:** Write a function that prints all pairs  $(a, b)$  where both  $a$  and  $b$  are multiples of 5, and that has a linear best case running time. What is the worst case running time? What is the average case running time? Explain. (3%)
6. Turn in instructions:
  - a. Assignment specific
    - i. For turn in purposes, set up your function for question 1 with a main function that accepts input from the stdin and then calls the function; the main function should read in the length of the array  $n$  and then each of the array elements.
    - ii. Turn in a PDF document with your answers to questions 2-4.
    - iii. Question 5 requires separate code and PDF.
  - b. General: see website