

CMSC 471 Pretest
Thursday, August 27, 2015
DUE: Tuesday, September 1, 2015

You **may** use written reference materials. You **may not** work on or discuss the pretest with anyone else. You will receive 10 points of extra credit on your first homework for turning in the completed pretest on time. The score on the pretest will not affect the homework points that you receive; your score is primarily to assess your knowledge of prerequisite material that you are expected to know for CMSC 471. If you have trouble with this pretest, you may want to put in some time now reviewing basic concepts.

Please fill in the “Previous Coursework” questions below and attach separate pages with your answers to the other questions.

Previous Coursework

Please fill in with your previous coursework. (Not all of these courses are prerequisites for CMSC 471, so you may not have taken all of them. That’s fine: just indicate “N/A” for courses you haven’t taken.)

Course	Semester taken	Grade	Instructor	Where taken
CMSC 203				
CMSC 331				
CMSC 341				
CMSC 441				
MATH 152				
MATH 221				
STAT 355				

1 Logic (20 pts)

Represent the following sentences in first-order logical notation. Use the following predicates (you may also use = and \neq):

- $\text{likes}(x,y)$ – x likes y
- $\text{student}(x)$ – x is a student
- $\text{grade}(x,y,c)$ – x receives grade y in course c
- $\text{person}(x)$ – x is a person
- $\text{study}(x,c)$ – x studies for course c

1. Everybody likes Raymond.
2. At least one student will get an A.
3. At least two students will get a B.
4. If a student studies for a course, they will get an A or a B in that course.
5. Everybody likes somebody who also likes them.

2 Combinatorics (15 pts)

For an alphabet with N symbols, how many words (sequences of symbols) are there of length k or less? (The *symbols* in the alphabet are just the letters, and the *words* are the strings that you can make from those symbols. So an alphabet with one symbol, X , has three words of length 2 or less: the empty word (or string) λ , the word X , and the word XX . Hint: Your answer should use summation notation.)

3 Algorithm Design and Programming Principles (25 pts)

Write a **recursive** function `Words` in pseudocode (or in Java, C, or Python if you prefer) that accepts at least two arguments: an alphabet `alph` (represented as an array of N symbols) and a word length `k` (represented as a positive integer). The function should print a list of all of the words of length `k` (using the symbols in the alphabet), in alphabetical order. You will most likely want to include additional arguments for the recursion; deciding what to add is part of the exercise.

4 Algorithmic Complexity (15 pts)

What is the “big-O” complexity of the function in Section 3, in terms of N and k ? Justify your answer.

5 Probability and Statistics (25 pts)

1. Suppose that you are given three unbiased six-sided dice. (In case you’re not familiar with the term: “unbiased” just means that each side has an equal probability (i.e., $1/6$) of being rolled. In case you’re not familiar with dice, a standard six-sided die has the numbers 1 through 6 labeled on its six sides.) What is the probability of rolling a 10 (i.e., that the total of the three dice is equal to ten)? Show your work.
2. Now suppose that *one* of the dice is biased, so that it shows a 1 half of the time, and a 2 half of the time. (It **never** rolls a 3, 4, 5, or 6.) What is the probability of rolling a 10 (using two unbiased dice and the one biased die)? Show your work.