

**Harvard University
Computer Science 121**

Problem Set 1

Due Tuesday, September 18, 2012 at 11:59 PM.

Submit your solutions electronically on the course website, located at <http://people.seas.harvard.edu/~salil/cs121/fall12/>. On the site, click the "Problem Set Submission" button and provide your login info. Once logged in, place the solutions to Parts A and B, in separate files named lastname+ps1a.pdf and lastname+ps1b.pdf respectively, in the appropriate dropboxes.

Late problem sets may be turned in until Friday, September 21, 2012 at 11:59 PM with a 20% penalty.

Problem set by ****ENTER YOUR NAME HERE****

Collaboration Statement: ****FILL IN YOUR COLLABORATION STATEMENT HERE
(See the syllabus for information)****

See syllabus for collaboration policy.

PART C (Graded by Thomas)

PROBLEM 1 (3+3+3 points)

Are the following statements true or false for all languages L_1 , L_2 , and L_3 ? Justify your answers with a proof or counterexample.

(A) $(L_1 \cap L_2)^* = L_1^* \cap L_2^*$.

(B) $(L_1 \cup L_2) \cdot L_3 = (L_1 \cdot L_3) \cup (L_2 \cdot L_3)$, where \cdot is concatenation.

(C) $\{\varepsilon\} \cdot L_1 = \emptyset \cdot L_1$.

PROBLEM 2 (Challenge 1 points)

A DFA M reads its input x once from left to right. What if M can read x again? That is, M reads x from left to right then goes back to the start and reads x from left to right again. Call this a *two-pass DFA*. Does re-reading the input help a DFA overcome its limited memory? Prove that a two-pass DFA is equivalent to a normal DFA.