CS 170   Algorithms
Spring 2013   C. Papadimitriou, P. Raghavendra   HW 3

Due Friday February 15th at 5pm

Instructions: Get an EECS instructional computer account if you don't have one already. Register with the grading system.

Please write your name, the username for your instructional account, student ID, GSI's name and discussion section time (e.g., Wed 11am) prominently on the first page of your homework. In a separate file called `collab.txt`, list your study partners for this homework, or "none" if you had no partners.

You are welcome to form small groups (up to four people) to work through the homework, but you **must** write up all your solutions strictly by yourself, and you must acknowledge any ideas you got from others (including from books, papers, web pages, etc.). Please read the collaboration policy on the syllabus (available on Piazza).

This homework is due Friday February 15th at 5pm electronically. You need to submit it using your instructional computer account with the command "`submit hw3`". Please submit two files: `hw3.pdf` should contain your answers, and `collab.txt` should list the people you worked with, or "`none`" if you worked completely on your own.

1. **(15 pts.) Fixed Point** Problem 2.17. It begins "Given a sorted array of distinct integers $A[1,\ldots,n]\ldots$"

2. **(15 pts.) Funny Money**

   You are in charge of the United States Mint. The money-printing machine has developed a strange bug: it will only print a bill if you give it one first. If you give it a d-dollar bill, it is only willing to print bills of value $d^2 \pmod{400}$ or $d^2+1 \pmod{400}$. For example, if you give it a \$5 bill, it is willing to print \$25 and \$26 bills, and if you then give it a \$26-dollar bill, it is willing to print bills of value \$276 or \$277. ($276 \equiv 26^2 \pmod{400}$.)

   You start out with only a \$1 bill to give the machine. Every time the machine prints a bill, you are allowed to give that bill back to the machine, and it will print new bills according to the rule described above. You want to know if there is a sequence of actions that will allow you to print a \$50 bill, starting from your \$1 bill.

   (a) Model this as a graph problem: give a precise definition of the graph involved and state the specific question about this graph that needs to be answered.

   (b) What algorithm should be applied to solve the problem?

3. **(15 pts.) Pre- and Post-Ordering** Problem 3.12. It begins "Either prove or give a counterexample: if $\{u,v\}$ is an edge..."

4. **(20 pts.) Preprocessing for Ancestors** Problem 3.18. It begins "You are given a binary tree $T = (V,E)$ (in adjacency list format),..."

5. **(20 pts.)** **Bipartite Graph** Problem 3.7. It begins "A *bipartite graph* is a graph $G = (V, E)$ whose vertices can be partitioned into two sets..."

6. **(15 pts.)** **Odd Pairs** Problem 3.27. It begins "Two paths in a graph are called *edge-disjoint* if they have no edges in common..."