CPSC 455/555 // ECON 425/563, Fall 2011, Exam 2

Answer all of the questions. Please remember to write your name, the course number, and today's date on all blue books that you submit.

This is a closed-book exam; please do not refer to any books or notes, and please do not talk to any of the other students.

Question 1:

(a) (15 points) For five points each, give the definitions of the terms *sybil strategy*, *max-flow reputation function*, and *Pathrank reputation function*.

(b) (10 points) Show that, in the trust graph of Figure 1, there is a sybil strategy for v that improves its rank with respect to the max-flow reputation function but no such strategy for v that improves its rank with respect to the Pathrank reputation function.

Question 2:

Parts a, b, and c of this question concern the *peer-prediction method* and *simultaneous reporting game* of Sec. 27.4. Each rater i is asked to report the signal that he receives. The transfer, or reward, paid to i is $\mathcal{T}(x^{r(i)} \mid x^i)$, where $r(i)$ is the *reference rater* for i, x^j is rater j's report, and $\mathcal{T}$ is a scoring rule. As we saw in Lectures 17 and 18, if $r(i) \neq i$, for all i, and $\mathcal{T}$ is a strictly proper scoring rule, then truthful reporting is a strict Nash equilibrium (NE) of the simultaneous reporting game.

(a) (5 points) Define the term *strictly proper scoring rule*.

(b) (5 points) Give an example of a strictly proper scoring rule.

(c) (5 points) The goal of the peer-prediction method is to compare raters' reports to their peers' reports and to reward agreement. Yet, the method does not simply reward i when his report is identical to that of $r(i)$ and penalize him when it isn't. Why would this simpler approach not work?

(d) (10 points) Recall that the feasibility of *whitewashing* is one of the major obstacles to reputation management in large-scale peer-to-peer (P2P) interaction. Consider a large-scale P2P system in which, during each round of interaction, N peers are paired at random to play a Prisoners' Dilemma (PD) game. The peers have unique IDs. At the end of each round, αN randomly chosen IDs are retired, and at the beginning of the next round αN new IDs are added. If a player's ID is retired, then he must leave the system. If it is not retired, but he is dissatisfied with his reputation, he has the ability to whitewash, *i.e.*, to abandon his ID and re-enter the system at the beginning of the next round with a new ID.

If $\alpha \leq \frac{1}{2}$, then the profile in which each player's strategy is *public Grim* (play D if any player has played D is an earlier round, and otherwise play C) is a subgame-perfect Nash equilibrium (SPNE) for this game, and it has full social efficiency. Nonetheless, it is considered an unsatisfactory approach to large-scale P2P interaction in the presence of whitewashing. What is wrong with it?

Question 3:

(a) (20 points) Let $f(x_1, \ldots, x_n) = 1$ if and only if $n < k$ or $n \geq k$ and the number of inputs x_i that are 1 is at least k, and let $g(x_1, \ldots, x_n) = 1$ if and only if the number of inputs x_i that are 1 is divisible by 3. Which of f and g can be computed by the simplified Shapley-Shubik market game that we studied? Justify your answers.

(5) (5 points) Recall that this game, while serving as a good starting point for analysis, is not a

realistic model of the behavior of rational agents in a market. Explain briefly one aspect of such agents' behavior that the model fails to capture.

Question 4:

(a) (5 points) Recall that the unchoking algorithm in the BitTorrent reference client is based on the tit-for-tat strategy for repeated Prisoners' Dilemman (rPD). Precisely what is tit-for-tat? You may specify it in words or use an automaton.

(b) (15 points) Sketch the proof that the strategy profile in which both players play tit-for-tat is a NE in a two-player, infinite rPD game with discount factor $\delta = .9$ but that it is not an SPNE of this game for this value of δ. Use the same payoff matrix for the stage game as we did in class when we covered SPNE: $(3, 3)$ for (C, C); $(1, 1)$ for (D, D); $(0, 5)$ for (C, D); and $(5, 0)$ for (D, C).

(c) (5 points) Recall that the strategy vector in which all peers use the BitTorrent reference client is not an equilibrium of the BitTorrent game. Give a brief, high-level explanation of one way in which a peer could profitably deviate from it.

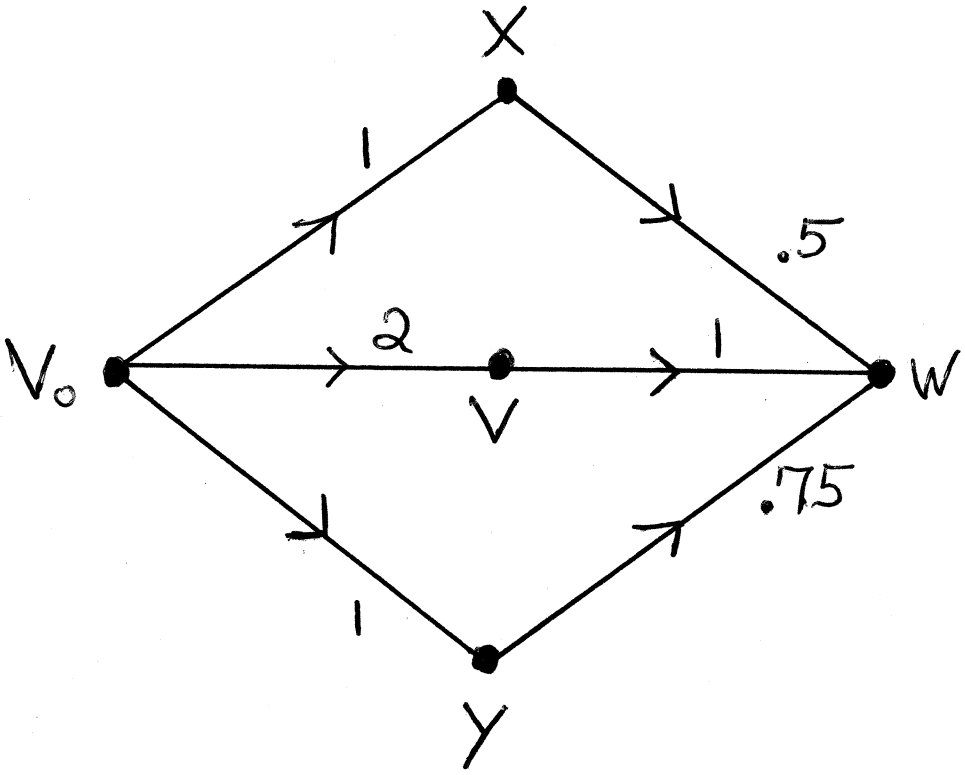

Figure 1