



Name:

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1. (20 Points: 10 Points Each) Find all Nash equilibria in the two games below (both pure and randomized). In each payoff matrix the rows correspond to player A's strategies and the columns correspond to player B's strategies. The first entry in each box is player A's payoff and the second entry is player B's payoff.

	L	R
U	8,4	5,5
D	3,3	4,8

	L	R
U	0,0	-1,1
D	-1,1	2,-2

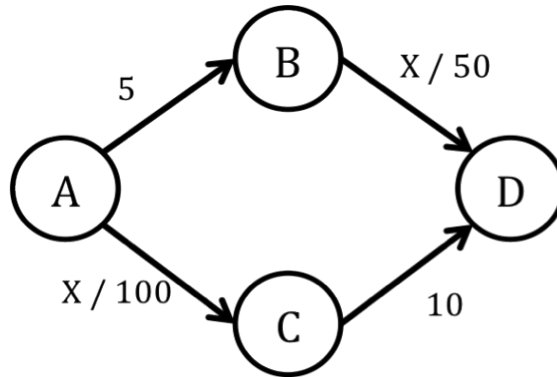
2. (15 points) In this question we examine how the irrational behavior of one bidder affects the optimal behavior of other bidders. Suppose that we have one item being sold in a second-price, sealed-bid auction. Assume that there are three bidders (1, 2, and 3) who have independent, private values (A , B , and C , respectively) for the good, which are distributed uniformly on $[0,1]$.
- a) Suppose that all bidders behave rationally; that is, they submit bids to maximize their payoff (their valuation – how much they pay). Which bidder wins the auction and how much does that bidder pay? Your answer can reference the values A , B , and C and properties of them such as ‘the largest’, ‘the smallest’, etc.
 - b) Suppose now that bidder 3 bids more than his true value for the good. In particular, he bids $(C+1)/2$. All other bidders know that bidder 3 will bid in this way, although they do not know the value of C . How does this affect the behavior of bidders 1 and 2?
 - c) What is the effect of bidder 3’s behavior on the expected payoff of bidder 1? Here the expectation is over the randomness of the values of B and C . You don’t have to write down a closed form solution, but you should analyze any cases (for example, one case would be “ $A < B < C$ ”) that are relevant to the analysis.

3. (10 Points) Suppose that you have produced the movie “OMG PONIES!!! (a CMU Student’s Perspective)” and want to have Netflix recommend it to users who generally enjoy romantic comedies. How might you go about accomplishing this task? In particular, think about how you could create fake accounts and reviews in order to skew the recommendations. Also, try to make it difficult for Netflix to detect that their system is being manipulated (making 1000 accounts which all give the movie 5 stars is not very believable).

4. (10 points) Explain the role of an advertiser's quality score in Google's ad auction (i.e., why does Google not look at only the advertiser bids). For a fixed bid price of \$1.00, precisely explain how having a higher quality score affects your ad position and the price you pay for that position.

5. (10 Points) Suppose a search engine has three ad slots that it can sell. Slot A has a clickthrough rate of 10, slot B has a clickthrough rate of 6, and slot C has a clickthrough rate of 2. There are three advertisers who are interested in these slots. Advertiser X values clicks at \$3 per click, advertiser Y values clicks at \$5 per click, and advertiser Z values clicks at \$1 per click. Compute the socially optimal allocation and the VCG prices for it. Give a brief explanation for your answer.

6. (10 Points) Calculate the traffic pattern (number of cars along each route) and the latency at Nash equilibrium if 1000 cars decide to travel from point A to point D in the network below. Network edge latencies are given as a function of X , the number of cars going along each edge. Be sure to explain your answer.



What happens at equilibrium if we add a very expensive, 0 latency road (teleporter) from C to B? Be sure to explain your answer.

7. (25 Points) Essay Question. Using what you've learned in class, how would you implement "real-time, personalized search" – a search engine that is focused on returning timely results from social media websites such as Twitter and Facebook. What signals would you use to rank, aggregate, and recommend content? What vulnerabilities or weaknesses does your system have? Please be as precise as possible in your description (you may use the back of this page if you need extra room).