

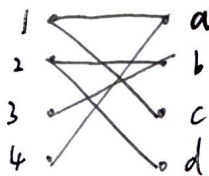
Quiz: Web Advertising

Name: _____ ID: _____

1) (2pts) Explain and write the definition of the competitive ratio.

$$\text{Competitive ratio} = \max_{\text{all possible inputs}} (|M_{\text{greedy}}| / |M_{\text{optimal}}|)$$

2) (2pts) Show a case using 4 ads and 4 queries to demonstrate the worst-case scenario in the greedy algorithm.

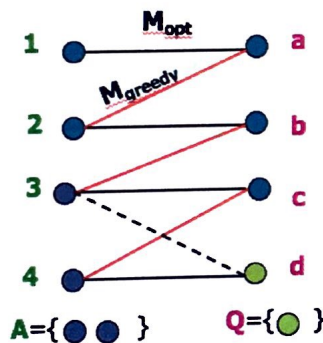


optimal: $\{(1, c), (2, d), (3, b), (4, a)\}$

greedy: $\{(1, a), (2, b)\}$

competitive ratio = $\frac{1}{2}$

3) (4pts) Using the example below to show that the competitive ratio of the greedy algorithm is $\frac{1}{2}$.



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4) (2pts) Fill up the table below with the Balance algorithm

- ◆ Bidder A_1 : bid $x_1 = 20$ budget $b_1 = 40$
- ◆ Bidder A_2 : bid $x_2 = 10$ budget $b_2 = 50$
- ◆ Assume ties are broken in favor of A_1

Query q	Assigned to Bidder (A_1, A_2 or No Ad)	Remaining Budget for A_1	Remaining Budget for A_2
At start	---	40	50
1 st query q	A_1	40	40
2 nd query q	A_1	20	40
3 rd query q	A_2	20	30
4 th query q	A_2	20	20
5 th query q	A_1	0	20
6 th query q	A_2	0	10
7 th query q	A_2	0	0
8 th query q	No Ad	0	0