

Assignment - 10 Computational Advertising

Question 1: Balance Algorithm

Advertiser A : Bids on query words x, y

Advertiser B : Bids on query words x, z

Budget of A & B : 2\$

Case 1: Consider $x \quad x \quad y \quad y$
 $\downarrow \quad \downarrow$
 $A \quad A$

Budget exhausted for A.

So, handling is not optimal.

A	B
2	2
1	
0	

Budget exhausted

Case 2: Consider $x \quad y \quad z \quad x$
 $\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$
 $A \quad A \quad B \quad B$

A	B
2	2
1	1
0	0

Balance algorithm handles this case optimally.

Question 2: Set Cover

Dumb, Simple, Largest-First, Most help

Given sets are

AB, BC, CD, DE, EF, FG, GH, AH, ADG, ADF

Dumb: Select sets for the collection in the order in which they appear on the list. Stop when all elements are covered.

(AB, BC, CD, DE, FF, FH, GH)

Simple: Consider sets in the order in which they appear on the list. When it is considered, select a set if it has at least one element that is not actually covered. Stop when all the elements are covered.

(AB, BC, CD, DE, FF, FH, GH)

~~Largest / First~~: ~~Consider sets in order in which they appear on the list. When it is considered~~

Largest - first: Consider sets in order of their size. If there are ties, break the tie in favour of the one that appears first on the list. When it is considered, select a set if it has at least one element that is not actually covered. Stop when all the elements are covered.

(ADF, ADG, AB, BC, DE, GH)

Most-help: Consider sets in order of the number of elements they contain that are not already covered. If there are ties, break the tie in favour of the one that appears first on the list. Stop when all the elements are covered.

~~AD, EF~~

AD, CH, BC, EF, GH

The optimum solution is 4.

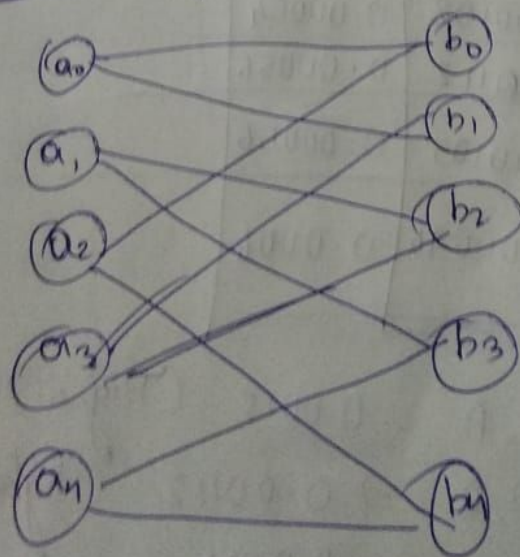
Ratio of dumb = $7/4$

Ratio of simple = $7/4$

Ratio of largest first = $6/4$

Ratio of most-help = $4/4 = 1$

Question - 3 Bipartite graph



$a_0 - b_0$	$a_0 - b_1$
$a_1 - b_2$	$a_1 - b_3$
$a_2 - b_4$	$a_2 - b_0$
$a_3 - b_1$	$a_3 - b_2$
$a_4 - b_3$	$a_4 - b_4$

Question - 4

exp1 = Expected revenue for position 1 = Bid \times CTR 1

exp2 = Expected revenue for position 2 = Bid \times CTR 2

exp3 = Expected revenue for position 3 = Bid \times CTR 3

Advertiser	Bid in dollars	CTR1	CTR2	CTR3	exp1	exp2	exp3	budget in dollars
A	0.10	0.015	0.010	0.005	0.0015	0.001	0.0005	1
B	0.09	0.016	0.012	0.006	0.00144		0.00054	2
C	0.08	0.017	0.014	0.007	0.00136		0.00056	3
D	0.07	0.018	0.015	0.008	0.00126			4
E	0.06	0.019	0.016	0.010	0.00114			5

	exp1	exp2	exp3
A	0.0015	0.001	0.0005
B	0.00144	0.00108	0.00054
C	0.00136	0.00112	0.00056
D	0.00126	0.00105	0.00056
E	0.00114	0.00096	0.0006

Slot 1 \Rightarrow A = 0.0015 (Higher)

Slot 2 \Rightarrow C \Rightarrow 0.00112 (Higher)

Slot 3 \Rightarrow E = 0.0006 (Higher)

Slot	Advertiser	CTR	Click-Through
1	A	0.015	$10 \times \frac{\text{Budget}}{\text{Bid}} = \frac{1}{0.1} = 10$
2	C	0.014	$9 \rightarrow 10 \times \frac{0.014}{0.015}$
3	E	0.010	$7 \rightarrow 10 \times \frac{0.01}{0.015}$

The 1st phase finishes where A gets 10 clicks -
 P has exhausted its budget. So it ~~can't~~ is not
 eligible for other phase.

B takes the 1st slot because ~~0.00144~~ is higher than C, D, E
~~0.00112~~ C - 2nd slot 0.00112
 F - 3rd slot 0.0006

Slot	Advertiser	CTR	Click-Through
1	B	0.016	$22 \rightarrow \frac{\text{Budget}}{\text{Bid}} = \frac{2}{0.09}$
2	C	0.014	$19 \rightarrow 22 \times \frac{0.014}{0.016}$
3	E	0.01	$14 \rightarrow 22 \times \frac{0.01}{0.016}$

In the 2nd phase B gets 22 click-throughs
 & exhausts its budget. So he can't participate
 in future phases.

Slot 2 : C = 0.00136 (High)
 Slot 2 : D = 0.00105 (High)
 Slot 3 : E = 0.0006 (High)

Slot	Advertiser	CTR	Clickthrough
1	C	0.017	37 \Rightarrow $\frac{\text{Budget}}{\text{Bid}} = \frac{3}{0.08}$
2	D	0.015	32 $\Rightarrow 37 \times \frac{0.015}{0.017}$
3	E	0.01	21 $\Rightarrow 37 \times \frac{0.01}{0.017}$