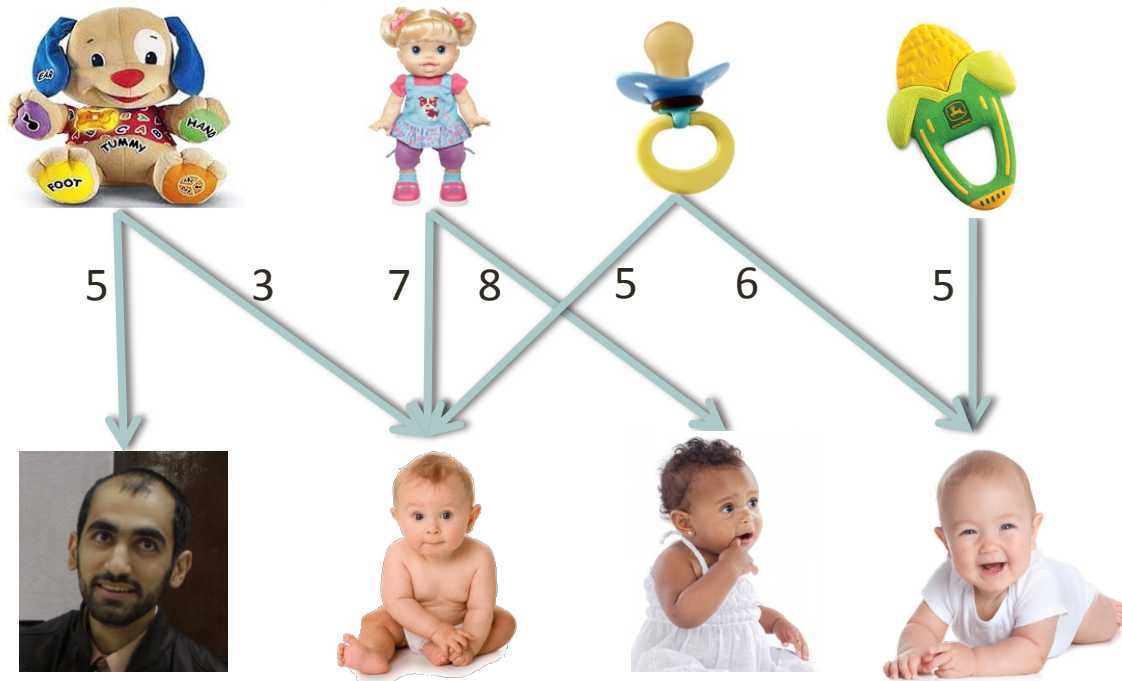# Market Allocations in Big Data

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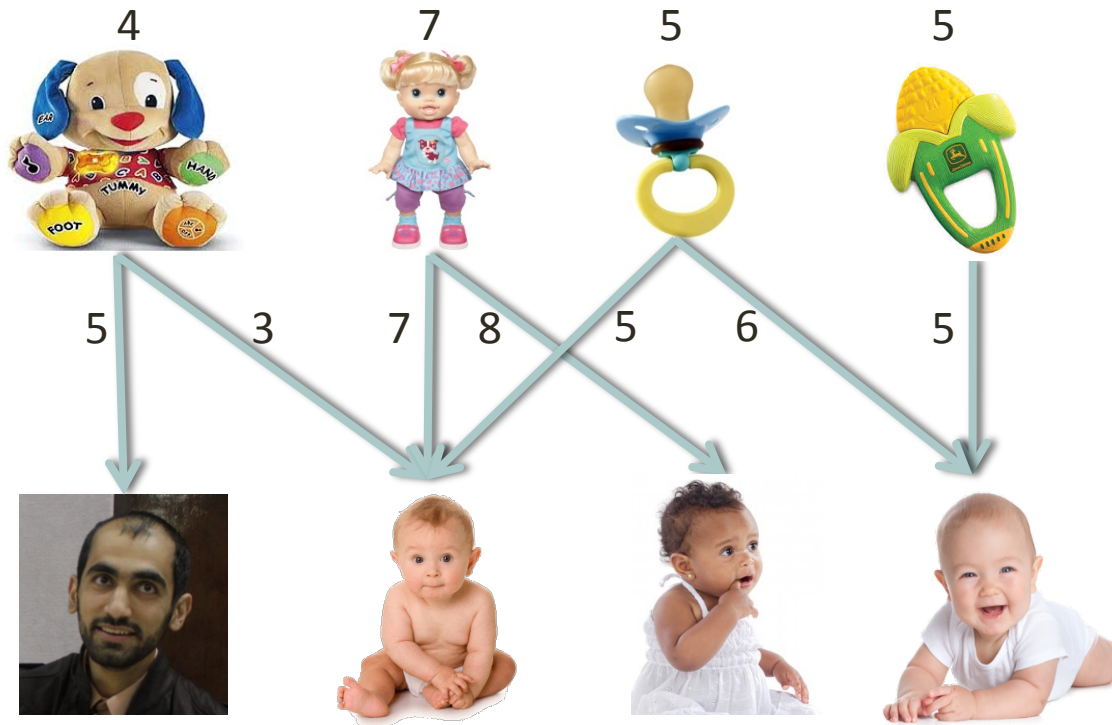
Hadi Yami

Market Allocations

Market Allocations

- Envy free:
  - No one wants to change.

Market Allocation in Big Data

Sketching

Streaming Setting

- Edges arrive in adversarial order.
  - e_1 , e_2 , ..., $e_{\downarrow m}$
- Few passes over the input
  - Usually just one
- Small space
- Fast per element processing time

Matching in Streaming

- *Parameterized Streaming: Maximal Matching and Vertex Cover.*
  - CCHM SODA 2015.

- *New Streaming Algorithms for Parameterized Maximal Matching & Beyond.*
  - CCEHM SPAA 2015.

- *Kernelization via Sampling with Applications to Dynamic Graph Streams.*
  - CCHMMV SODA 2016.

1- There is nothing better than $k\!\uparrow\!2$.
**2-** $k\!\uparrow\!2$ is possible.

Our goals in this project

- Provide a sketch
  - Lighter, better!
  - Preferably, a function of # of items.
- For two version of the problem
  - Social welfare
    - The total weight of edges that we match.
  - Revenue
    - The total price of the items that we match.

$k \Uparrow 2$ is possible for both versions

Formal definition

- A weighted bipartite graph with n unit demand buyers and k distinct items

- Utility of buyer b_j for item v_i is u_{ij} (Weight of edges)

- Goal : Assign non-negative price to items and items to buyers such that

  - Market clears

  - Assignment is envy free

  - Social welfare (revenue) is maximized

v_1 v_2

$U_{11}=4$ $U_{24}=5$

b_1 b_2 b_3 b_4
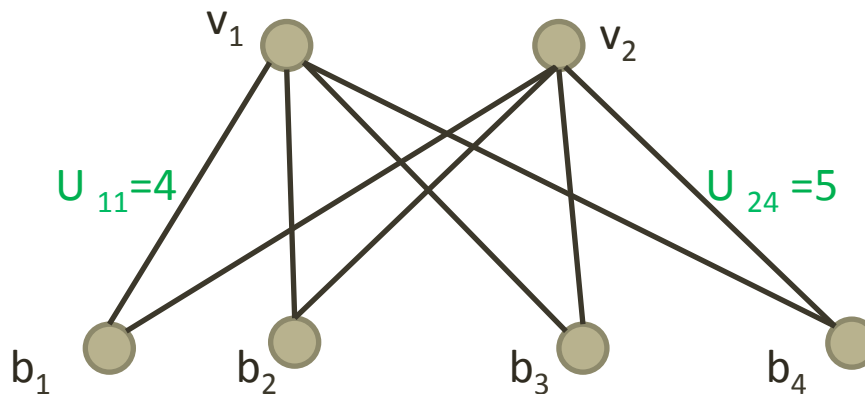
Envy-freeness

An envy-free division is one in which **no one wants someone else's share more than his own.**

Envy-freeness In our setting: Profit of each buyer over the item he gets should be more than any other item.

- For each buyer b_j if item v_i is assigned to him

    $u_{i,j-}\, p(i) >= u_{l,j} - p(l)$ for any other item v_l

Main results

- Our result : Having $O(k^2)$ available memory we can solve the problem as efficient as the offline case.
  - K is the number of items.

- We show this for both objective functions :
  - Social welfare
  - Revenue