

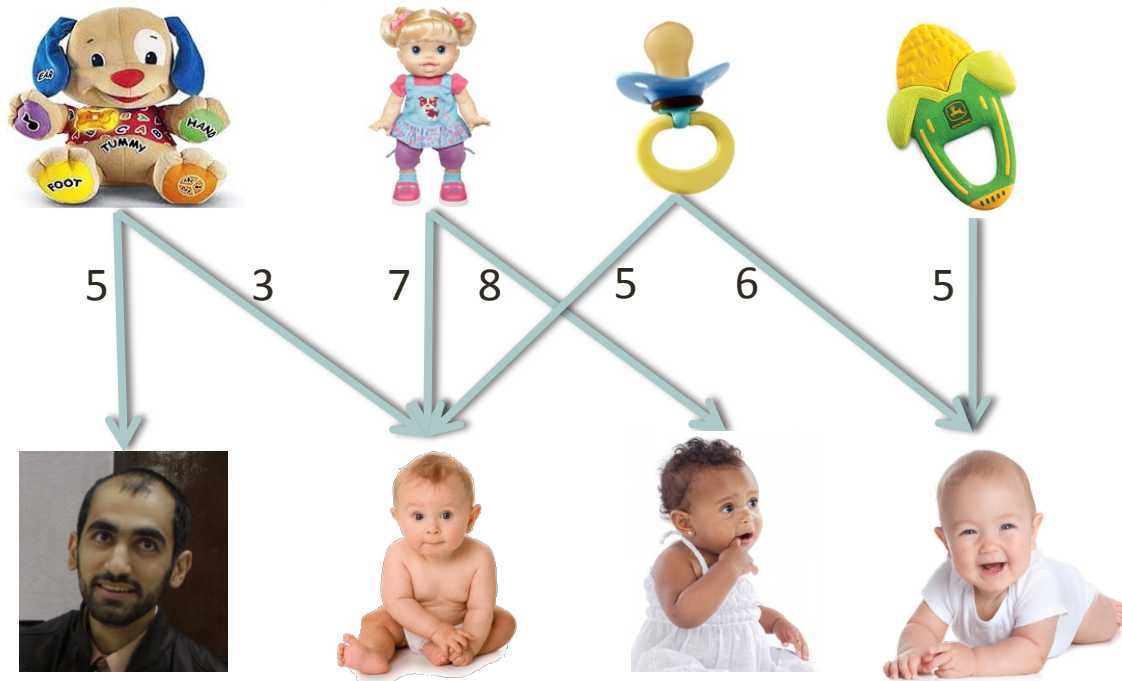
Market Allocations in Big Data

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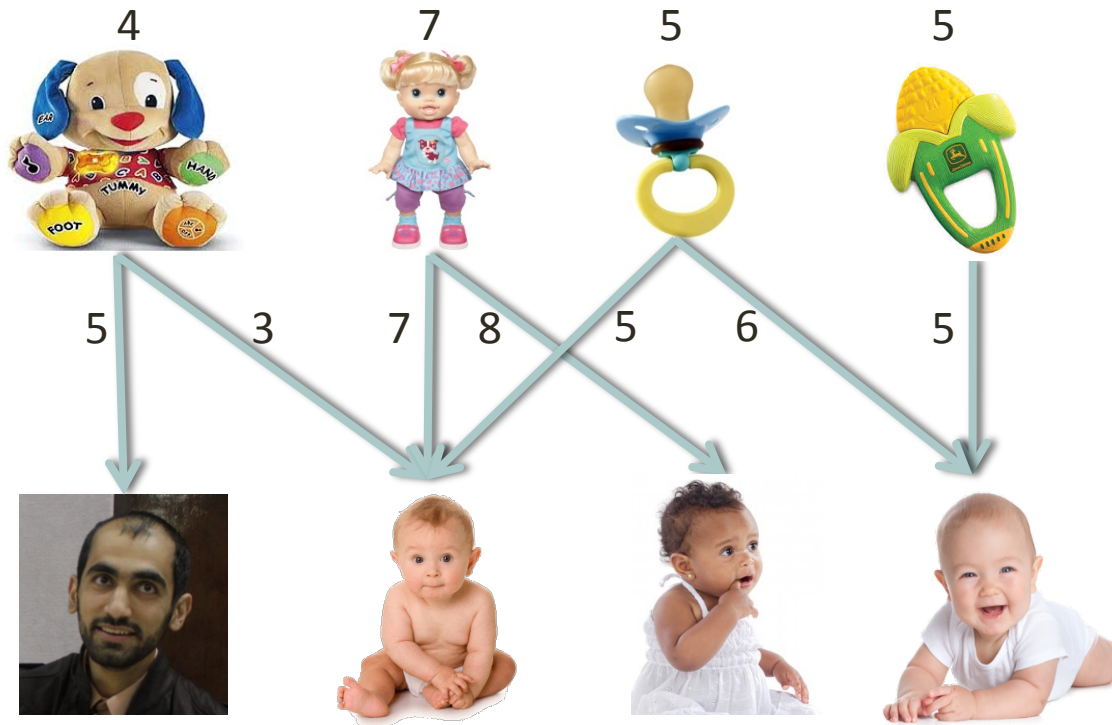
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Market Allocations



Market Allocations

- Envy free:
 - No one wants to change.



Market Allocation in Big Data

The image is a screenshot of a LiveScience website page. At the top, there is a dark blue navigation bar with the LiveScience logo on the left and social media icons (Facebook, Twitter, LinkedIn, Google+) on the right. A search bar is also present. Below the navigation bar is a yellow-bordered advertisement for the Lenovo YOGA 900 laptop, featuring the Intel Core i7 processor logo and a 'Buy now' button. The main content area has a dark blue header with the text 'TRENDING: Wearable Tech // Archaeology // Military & Spy Tech // 3D Printing // OurAmazingPlanet // Best Fitness Trackers // Human Origins'. The main article is titled 'What Is the World's Largest Tree?' by Elizabeth Howell, dated April 29, 2013. To the left of the article is a vertical sidebar with social sharing buttons: Facebook (281), Twitter (46), and Reddit (20), along with 'Submit' and 'More' options. The article image shows a large sequoia tree. To the right of the article is a yellow-bordered advertisement for CAT D6N bulldozers, featuring a construction worker and the text 'I FOR REAL DOZE IN MY STEEL TOES' and 'WATCH NOW >>'. The CAT logo is visible at the bottom of the ad.

Sketching



Streaming Setting

- Edges arrive in adversarial order.
 - e_1, e_2, \dots, e_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 $k^{1/2}$.
- 2- $k^{1/2}$ is possible.

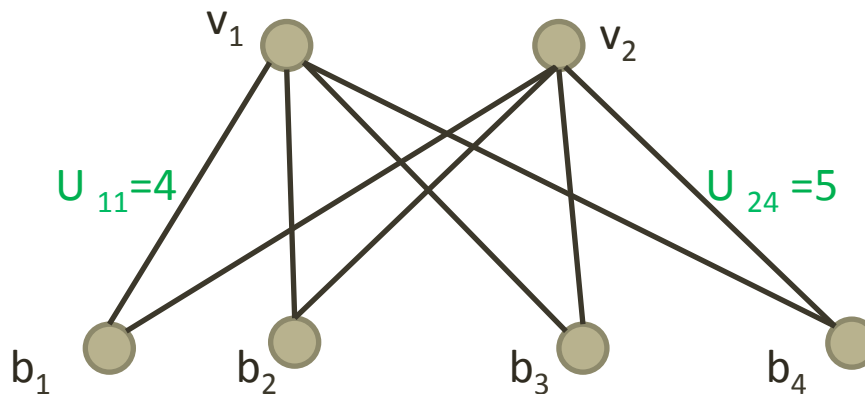
Our goals in this project

- 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



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
 $u_{i,j} - p(i) \geq u_{l,j} - p(l)$ 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