Combinatorial Auctions

Best algorithms and bounds

Looking for algorithms with:

- good approximation ratio
- Polynomial time / number of value queries
- Truthful?

Randomization over deterministic truthful mechanisms

Every (universally) truthful $m^{\frac{1}{2}-\epsilon}$ −approximation mechanism with submodular bidders makes exponentially many value queries. [Dobzinsky 2011]

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Possible allocations and prices he could get by the algo depending on the other bidders.

- Truthfulness ↔ each bidder faces a *menu* where each bundle has a price and is assigned the most profitable bundle (the taxation principle)
- In every algorithm with good approximation ∃ instance in which at least one bidder faces an exponentially large menu
- # value queries to find profit maximizing bundle = size of the menu

Class	Queries	Approx	IC approx	Lower bound
Gen	Any	$\sqrt{m}$	$\frac{m}{\sqrt{\log m}}$ $\sqrt{m}$ (rand)	$m^{\frac{1}{2}-\epsilon}$ Section 1.6, [NS06]
	Value	$\frac{m}{\sqrt{\log m}}$	$\frac{m}{\sqrt{\log m}}$ [HKDMT04]	$\frac{m}{\log m}$ [BN05a, DS05]
	Demand	$\sqrt{m}$ [BN05a]	$\frac{m}{\sqrt{\log m}}$ $\sqrt{m}$ (rand) [LS05, DNS06]	$m^{\frac{1}{2}-\epsilon}$
SubA	Value	$\sqrt{m}$	$\sqrt{m}$ [DNS05]	$m^{\frac{1}{4}}$
	Demand	2 (rand) [Fei06]	$\sqrt{m}$	2 [DNS05]
XOS	Value	$\sqrt{m}$	$\sqrt{m}$	$m^{\frac{1}{4}}$ [DS06]
	Demand	2 [DNS05] $\frac{e}{e-1}$ (rand) [Fei06]	$\sqrt{m}$ $\log^2 m$ (rand) [DNS06]	$\frac{e}{e-1}$ [DNS05]
SubM	Value	2 [LLN06]	$\sqrt{m}$	$\frac{e}{e-1}$ [KLMM05]
	Demand	2 $\frac{e}{e-1}$-10^{-4} (rand) [FV06]	$\sqrt{m}$ $\log^2 m$ (rand)	$\frac{276}{275}$ [FV06]
Subs	Value	1 [Ber05]	1	
	Demand	1 [GS99, BM97]	1	
***k*Dup**	Demand	$m^{\frac{1}{k+1}}$ [BKV05, DS05]	$k \cdot m^{\frac{1}{k-2}}$ [BGN03]	$m^{\frac{1}{k+1}-\epsilon}$ [BGN03, DS05]
Proc	Any	$\ln n$ [NS06]	-	$\log n$ [Nis02]

$\frac{e}{e-1}$ [V08]

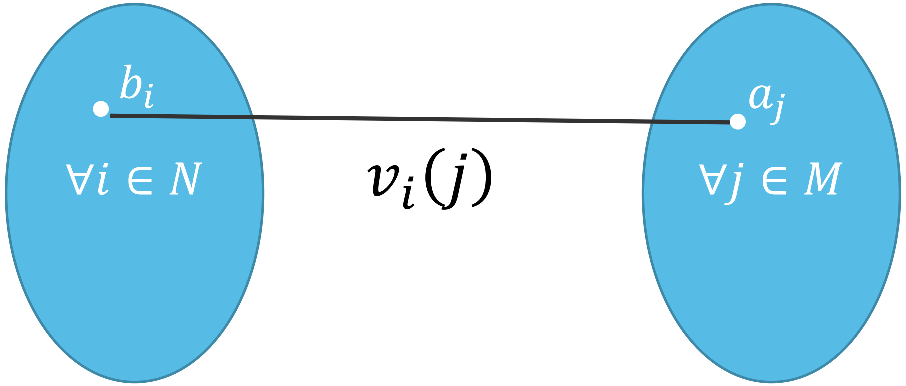
$m^{\frac{1}{2}-\epsilon}$ [D11]
(truthful)

$m^{\frac{1}{3}-\epsilon}$ [DSS15]
(truthful)

Truthful $O(\sqrt{m})$ −approximation for subadditive bidders [DNS05]

1. Query each bidder i for $v_i(M)$ and $v_i(j), \forall j \in M$.

2. Construct bipartite graph between bidders and items and compute the maximum weighted matching P.



3. Allocate the items according to P, unless $\max_i v_i(M) = v_k(M)$ is higher than the value of P. In this case, give all the items to k.

4. Let each bidder pay her VCG price.

Truthful $O(\sqrt{m})$ −approximation for subadditive bidders [DNS05]

- ✓ Truthful
- ✓ Polynomial time
- ✓ $\sqrt{m}$ − approx.

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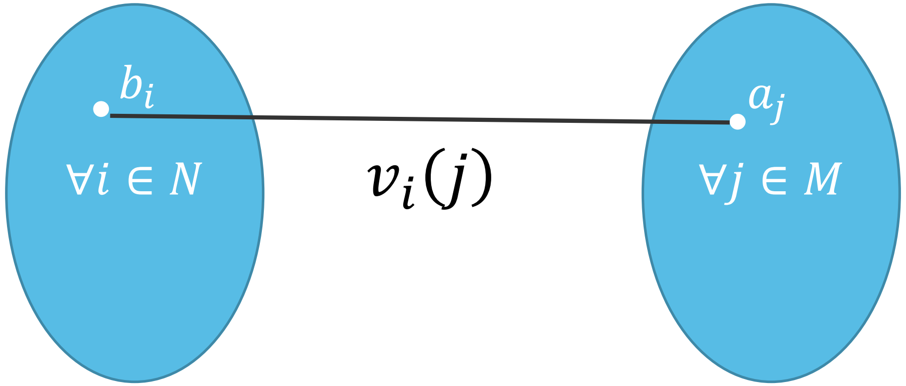

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