

Equitable Division of a Path

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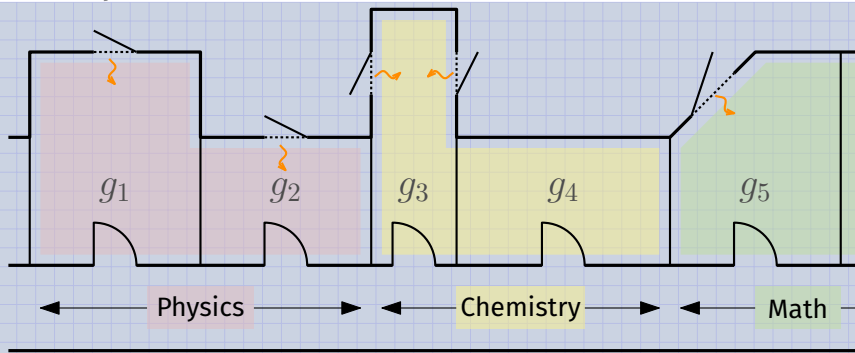
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Fairly distribute goods placed on a path. Agents require connected bundles.

Example



- Allocate university rooms to departments (dep.)
- Each dep. gets contiguous stretch
- Every room is different: size, lighting conditions
- Departments have different preferences
- $u_i(A_j)$: utility of dep. j 's rooms for dep. i

Fairness Notions

Equitability (EQ)

$$u_i(A_i) \geq u_j(A_j)$$

Equitability up to 1 good (EQ1)

$$u_i(A_i) \geq u_j(A_j \setminus \{v\})$$

Hardness results

	Exists	Compute
EQ1+comp	Yes	Poly
EQ1+PO	No	NP-c
EQ1+NW	No	NP-c

- reduction from highly structured version of SATISFIABILITY:
LINEAR NEAR-EXACT SATISFIABILITY
- (a, b) -sparse instances:
at most a preferred goods,
at most b preferring agents
- PO: Pareto-Optimality
- NW: Non-wastefulness
(no good unassigned)

Algorithmic results

Thm: Polytime algo to find conn. complete EQ1 allocation

1. Compute optimal utility by minimally assigning goods via $\overrightarrow{\text{scan}}$
2. Find pivotal agent via $\overrightarrow{\text{scan}}$
3. Assign remaining goods via $\overleftarrow{\text{scan}}$

- Works for any ordering of agents
- Egalitarian-optimal
- Works for monotonic valuations and chores

Thm: Polytime algo to find conn. EQ1+NW allocation for extremal valuations

Open Problems

- tractability on less restricted domains (e.g. interval valuations) ?
- extension to general graphs ?