A New Way to Aggregate Preferences: Application to Eurovision Song Contests

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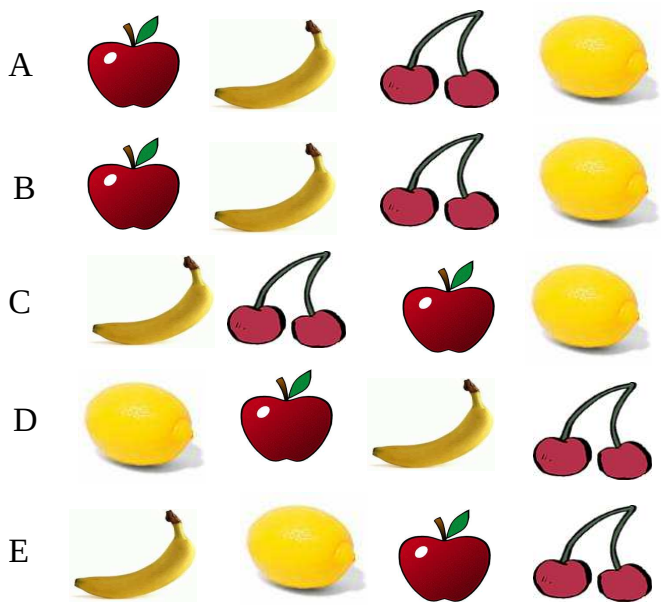
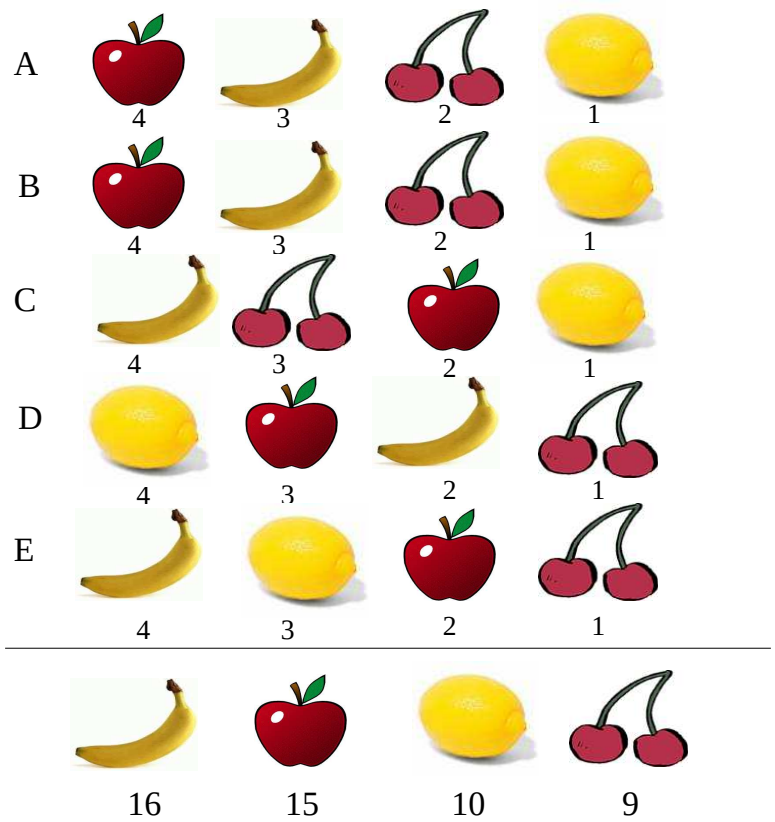
Outline

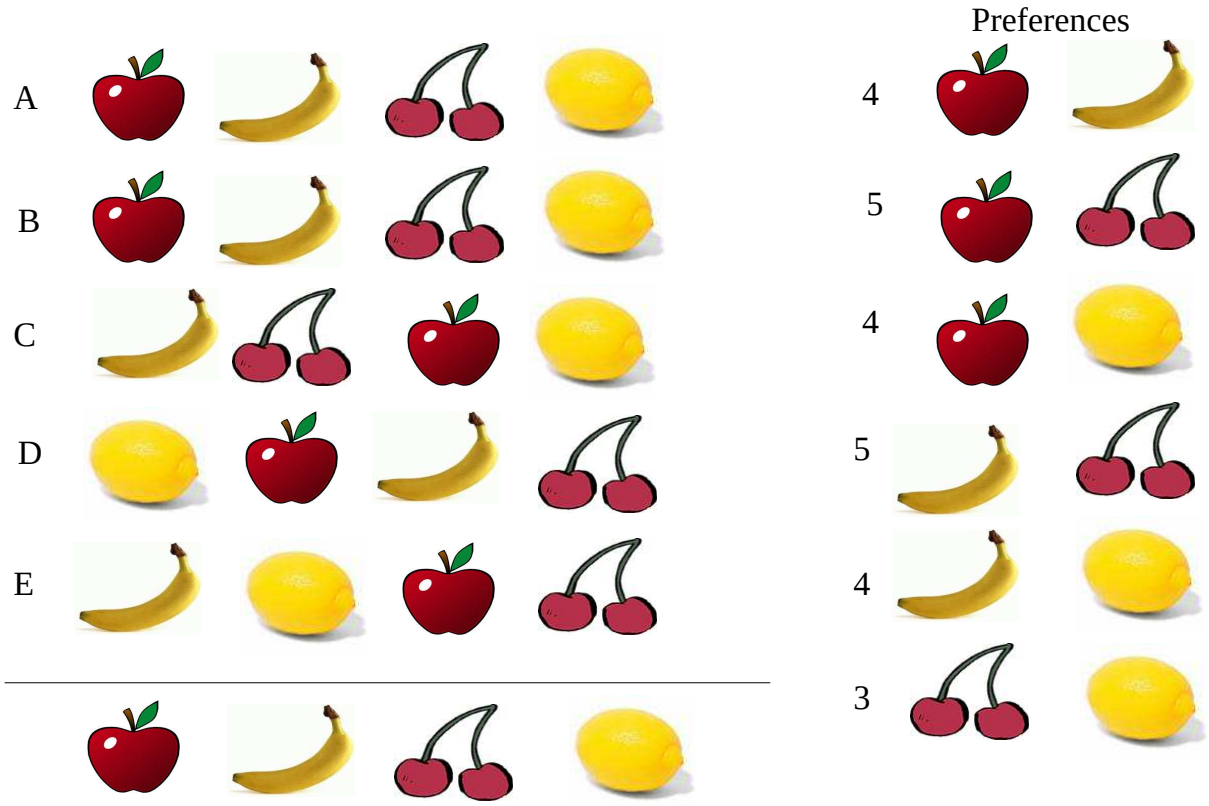
Five individual preferences



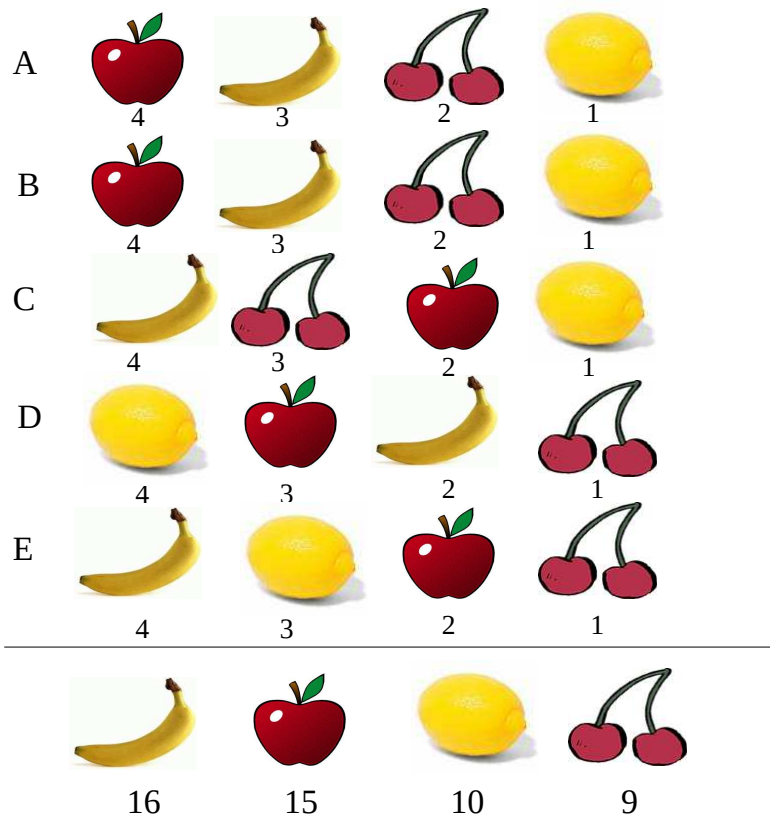
Borda count output



Condorcet majority rule



Limit of Borda count



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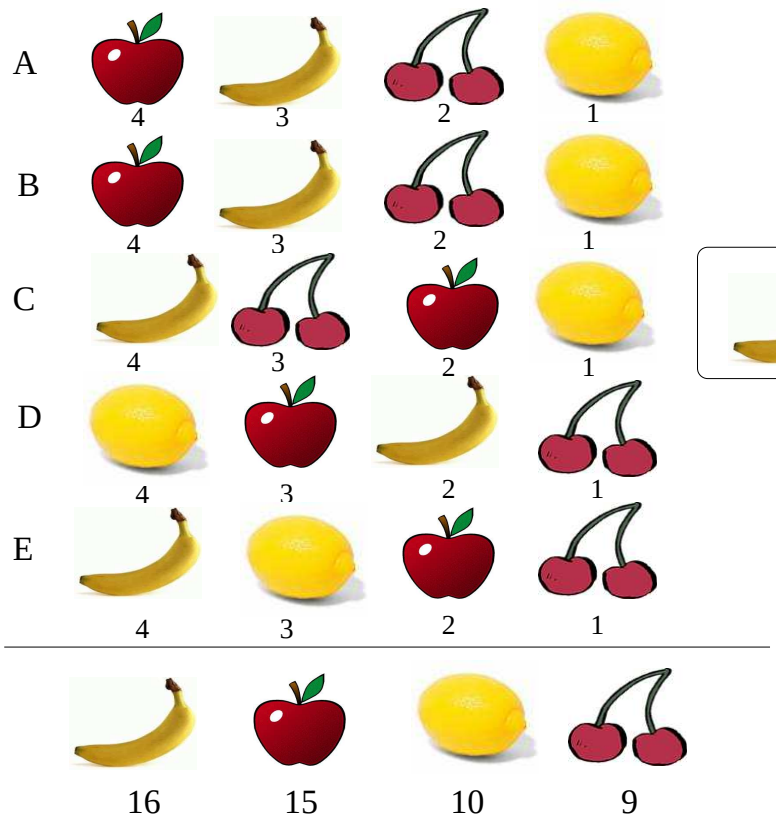

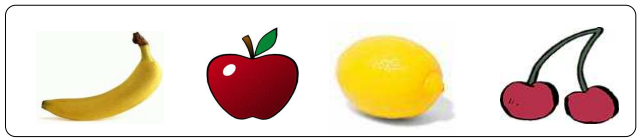

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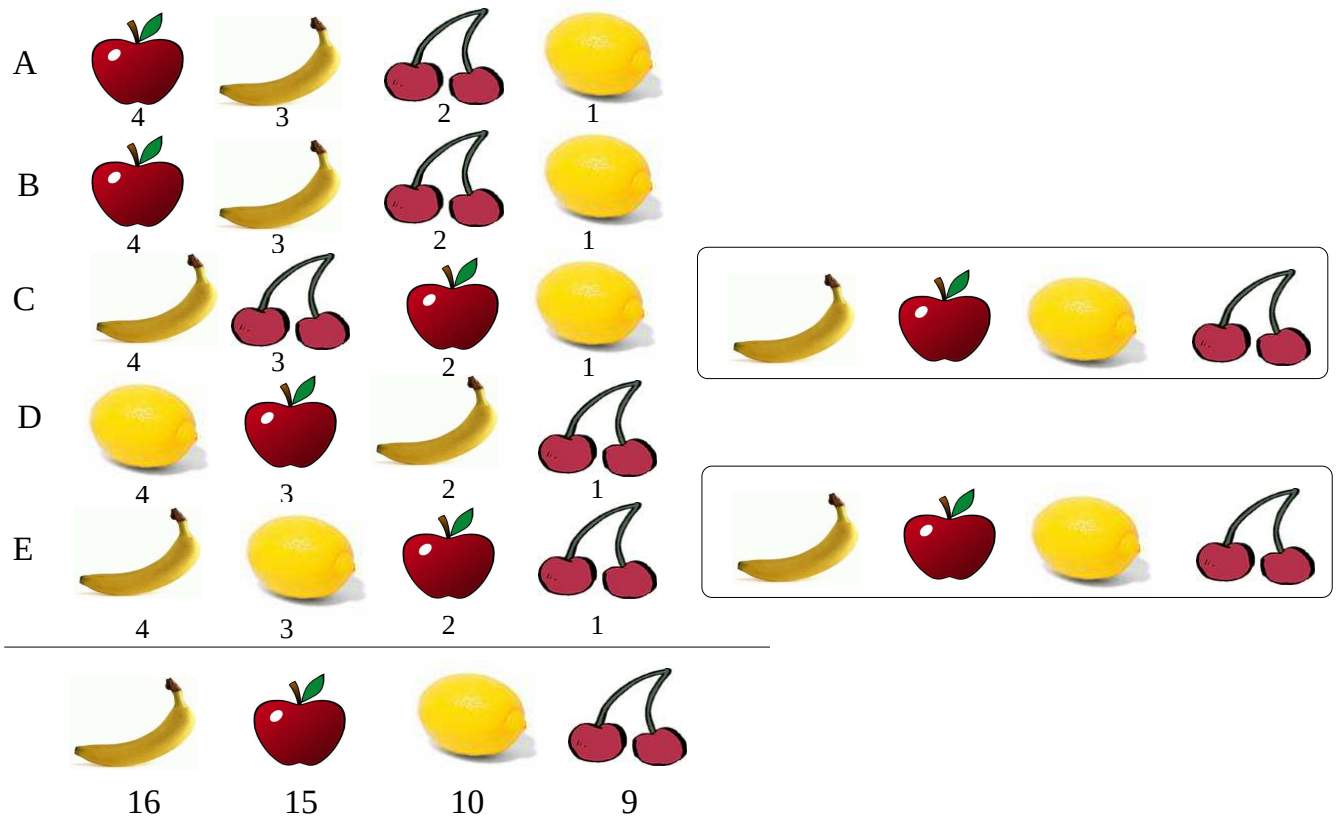

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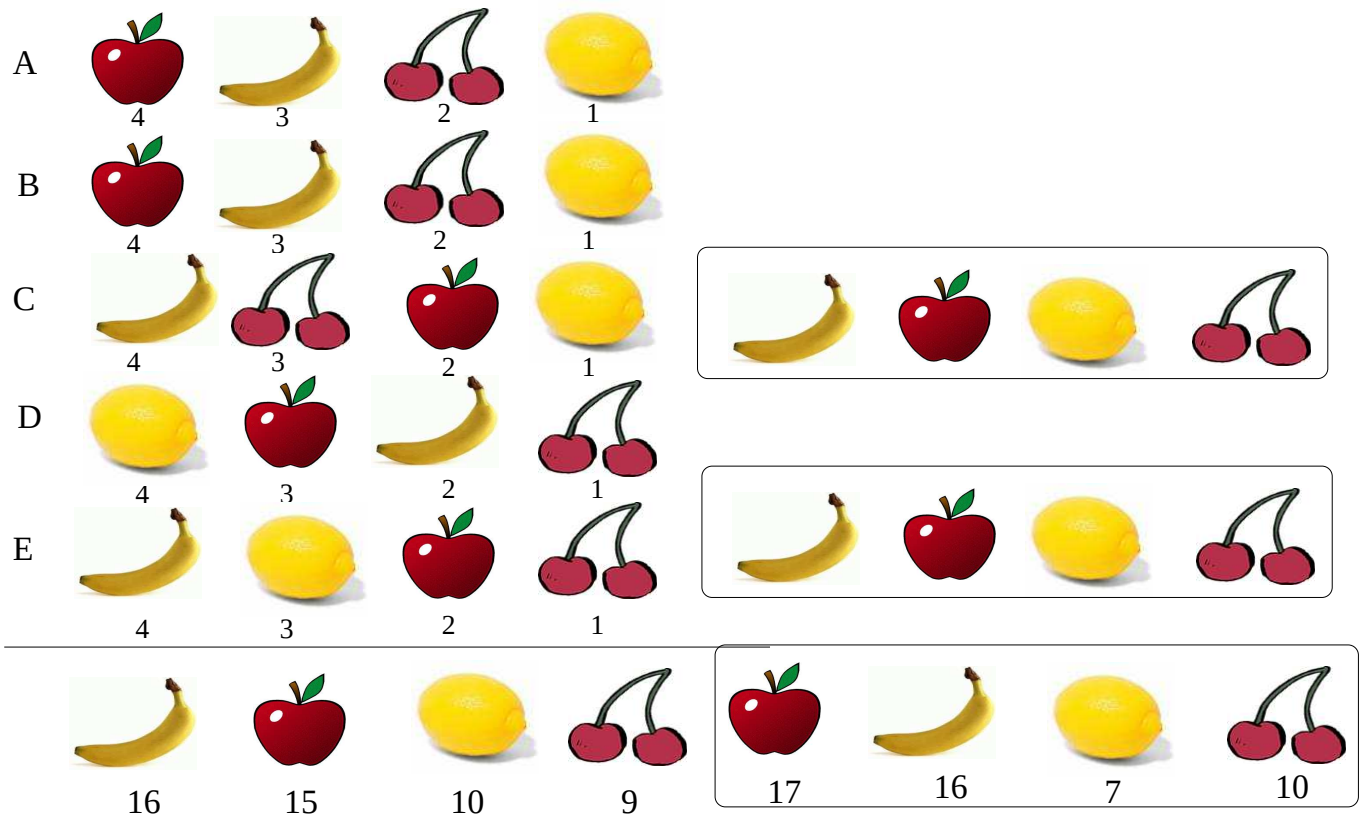
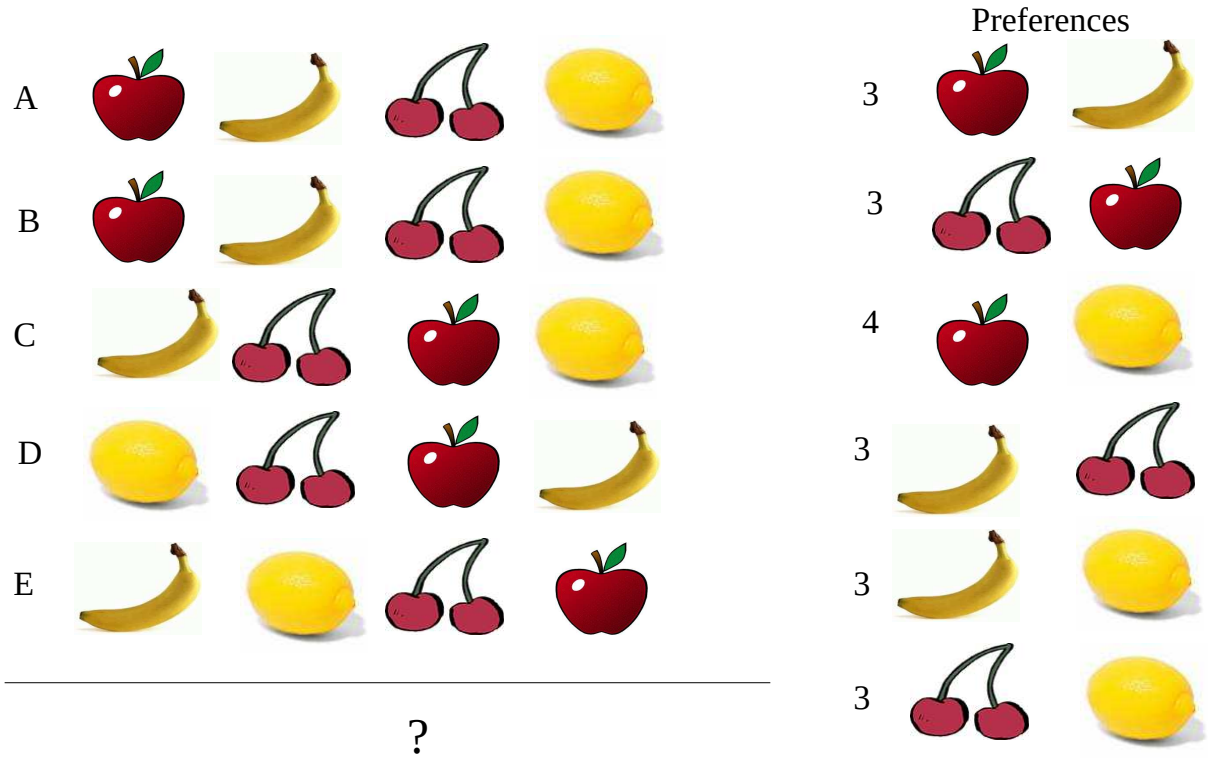
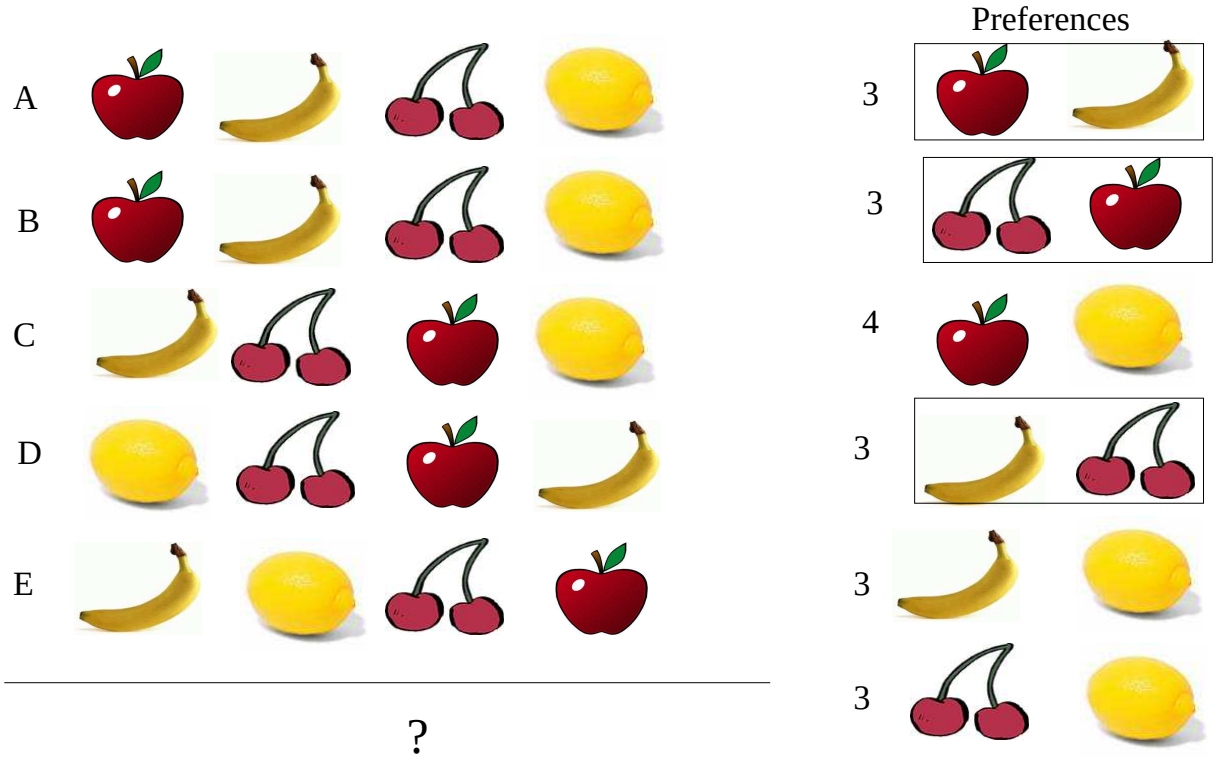


Limit of Condorcet count

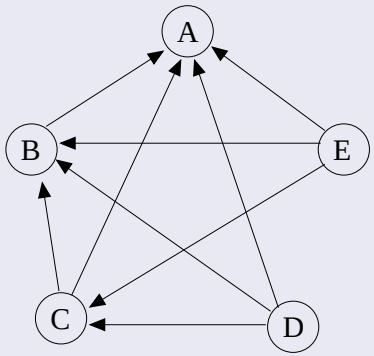


Limit of Condorcet count



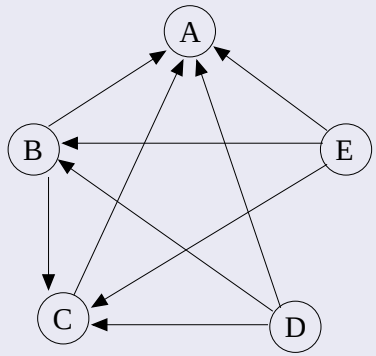
Graph representation of voters' rankings

Voter 1



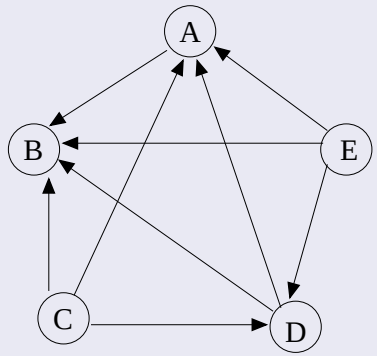
$A > B > C$

Voter 2

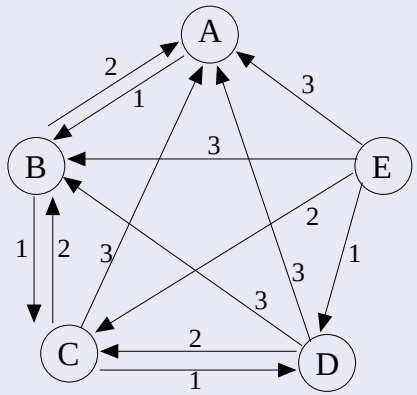


$A > C > B$

Voter 3



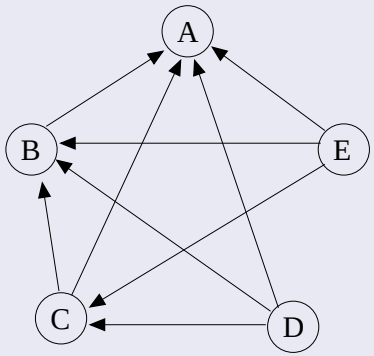
$B > A > D$



G_m

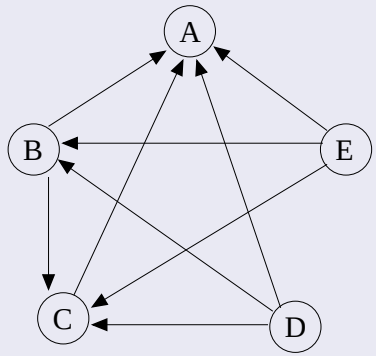
Graph representation of voters' rankings

Voter 1



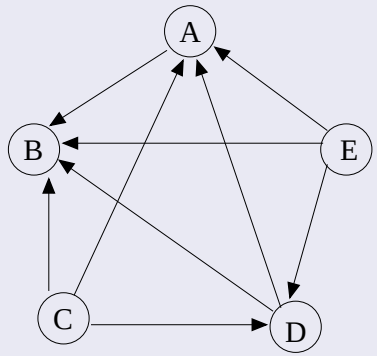
$A > B > C$

Voter 2

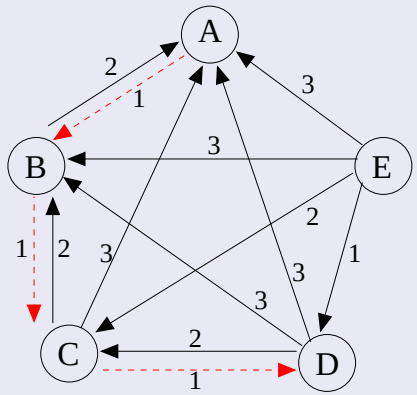


$A > C > B$

Voter 3



$B > A > D$



G_O

Problem formalization

Computing an order G_O such that:

- D_1 the number of votes of G_m in conflict with G_O is minimized
- D_2 the number of comparable candidates in G_O is maximized

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Definition

$$G_O \subseteq G_m$$

G_O is a DAG

$$D_2(G_O) \geq \alpha$$

minimizing $D_1(G_O)$

Computational aspects

- Data mining framework takes advantages from an appropriate enumeration process that turns the constraints and objective function to be monotonic:

$$If\ G_1 \subseteq G_2,\ \mathcal{C}(G_1) \Rightarrow \mathcal{C}(G_2)$$

- If the enumeration starts from G_m and consists in removing arcs, D_1 and D_2 are monotonic.
- The DAG constraint is ensured by construction: at least one arc by cycle is removed.

Computational aspects

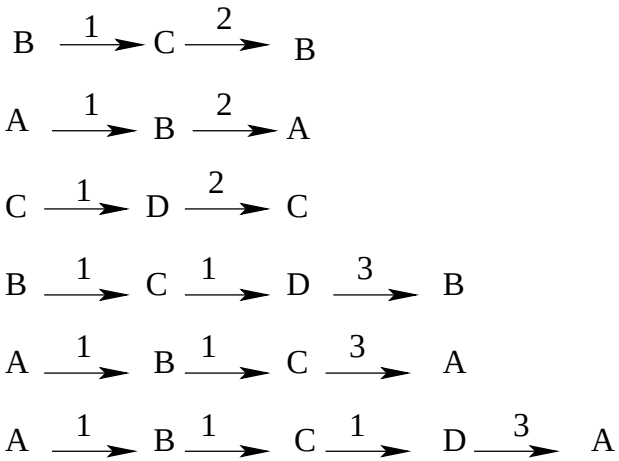
Algorithm

It proceeds in two phases:

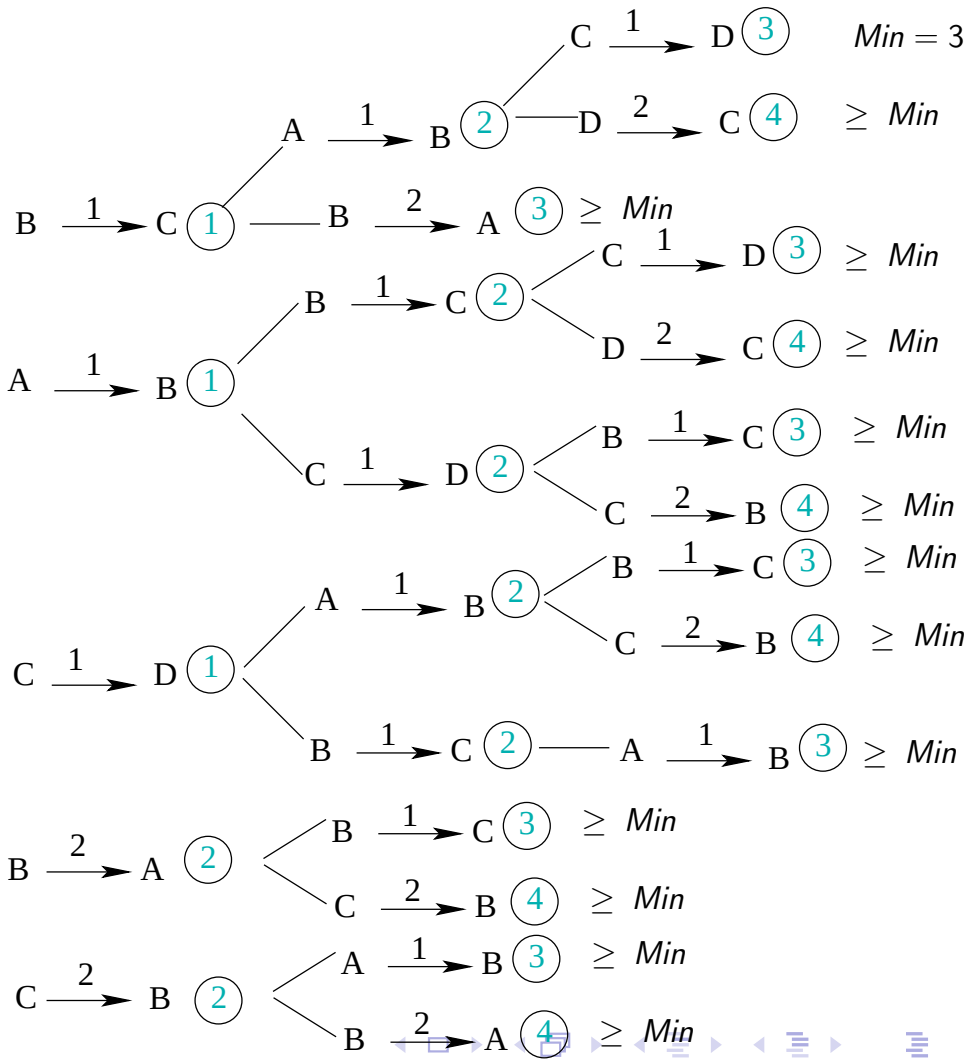
- Computing all cycles of G_m.
- Generating the partial orders by removing at least one arc of each cycle:
  1. If a current solution G is such that $D_2(G) < \alpha$, then this branch is ended.
  2. If $D_1(G)$ is greater or equal to an already extracted partial order, then this branch is ended.
  3. If G is a DAG, then G is the current best solution.
  4. Else, another arc is chosen.

Computational aspects

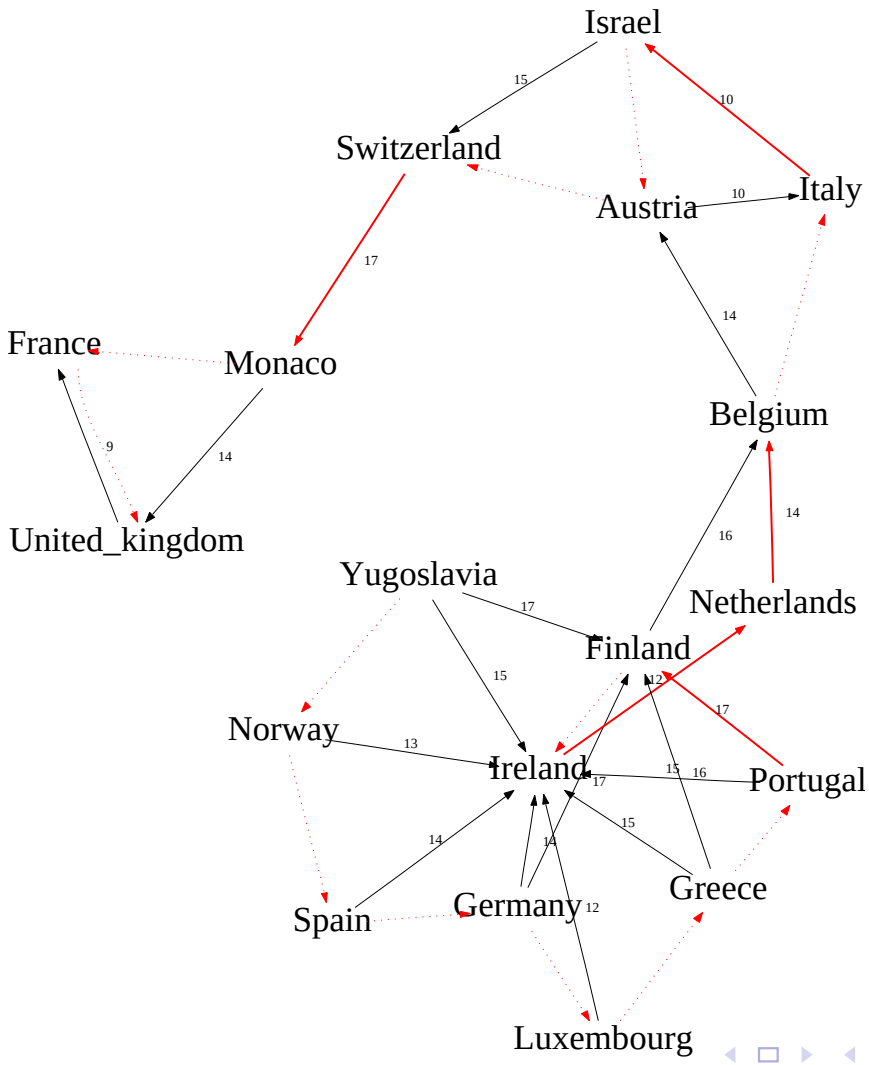
Cycles



Enumeration tree



Eurovision Song Contest result for the year 1975



Conclusion

The new method to aggregate vote preferences

- preserves most of pairwise preferences embedded in the ranking votes,
- uses a parameter to make the partial order converge towards a total order.
- minimizes a function which increases during the enumeration

First results show coherent order with the Borda method but better synthesizes votes.

Additional experimentation, especially to further study the impact of parameter α, is on going.