

Byzantine Preferential Voting



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Wishlist for Christmas



1.



2.

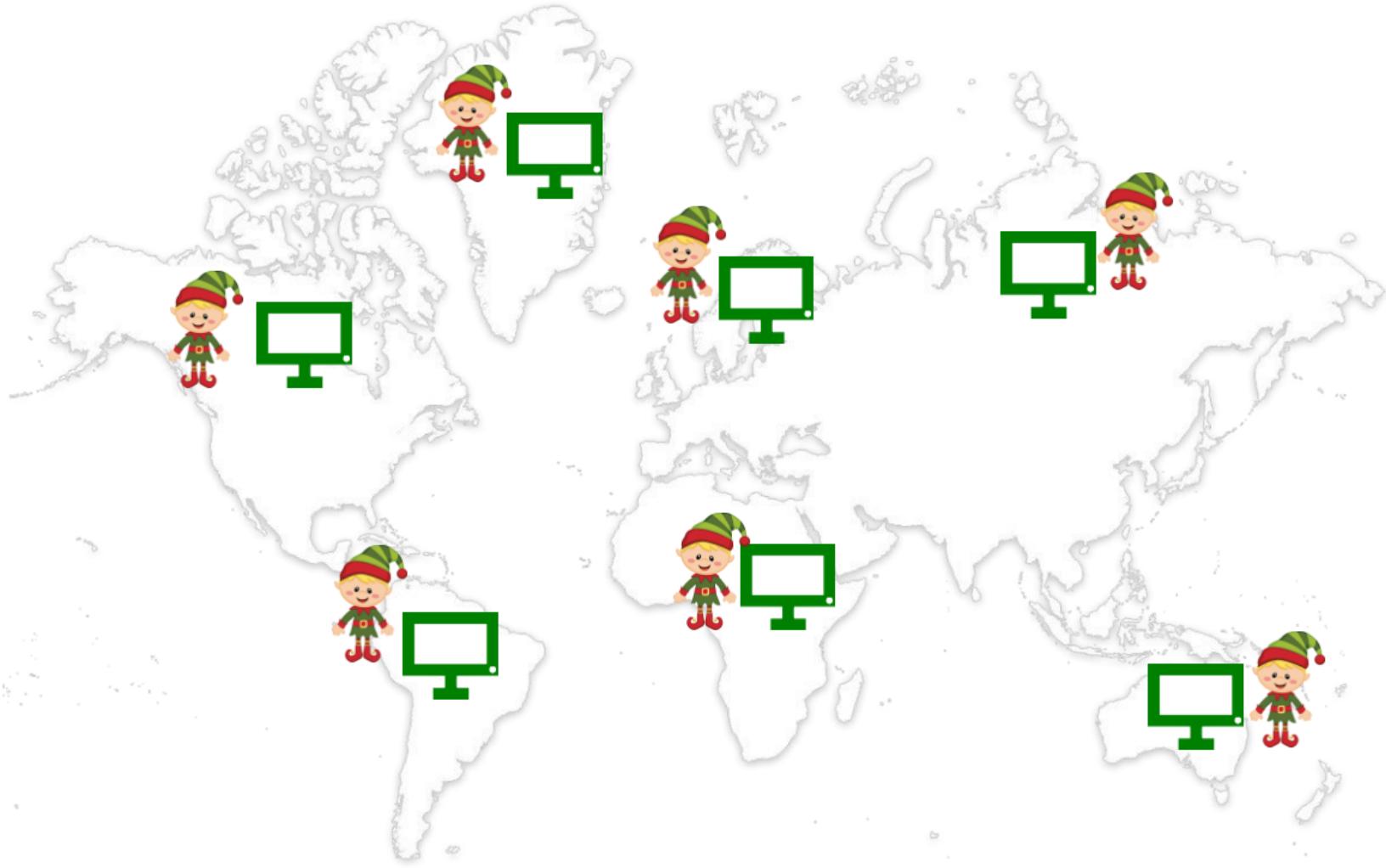


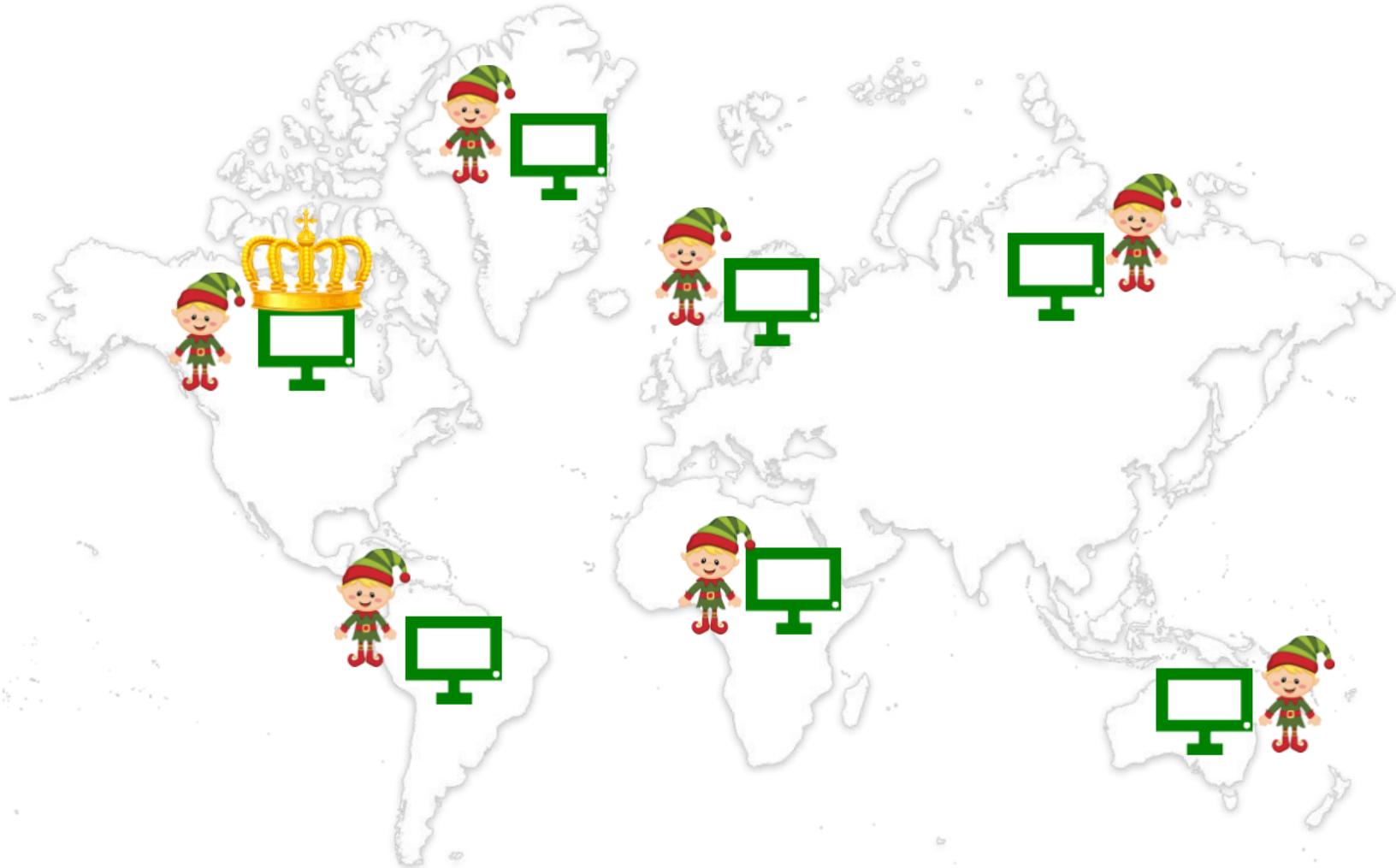
3.

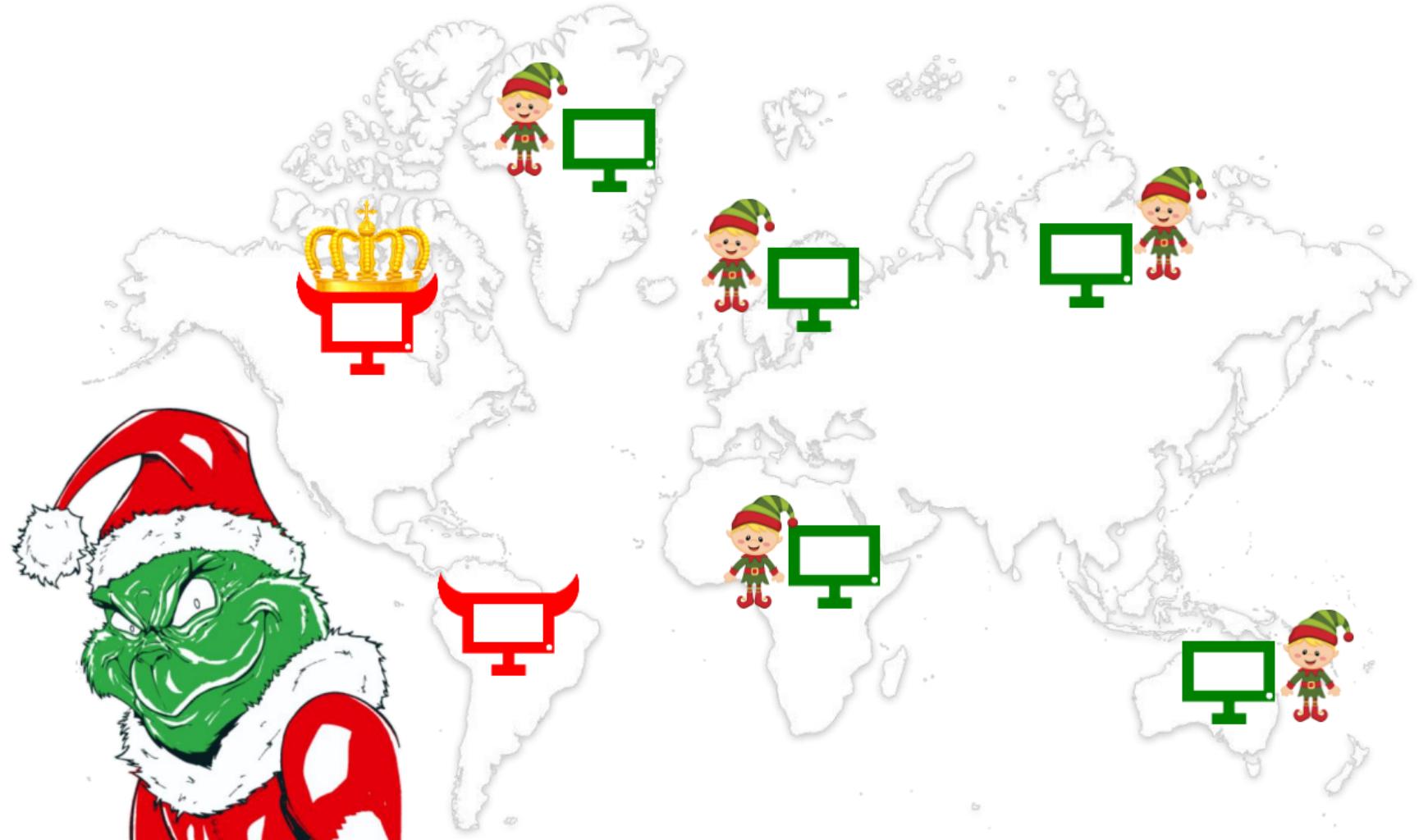


Help from Elfs





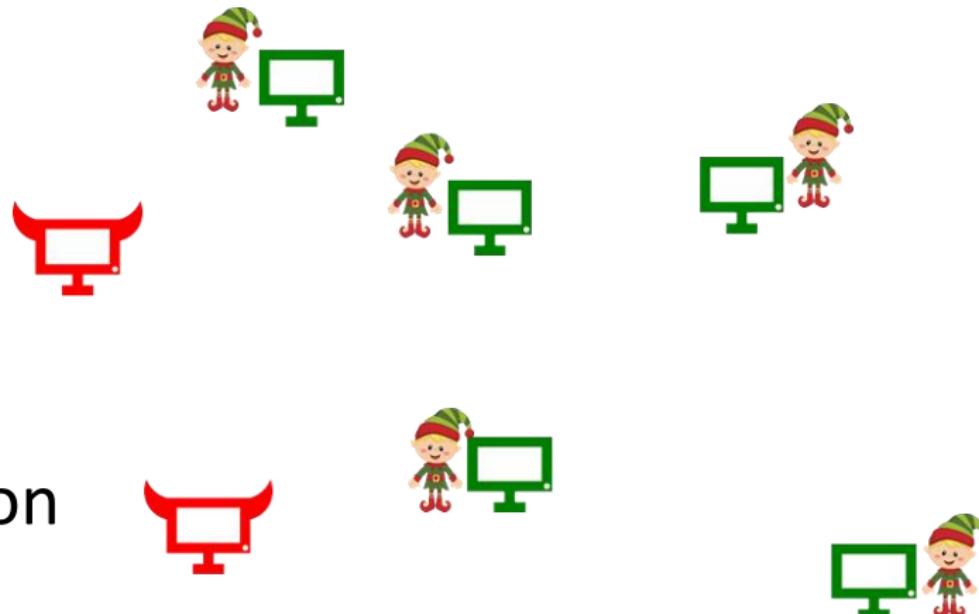




Synchronous Communication

One round:

- broadcast input
- receive input from neighbors
- do local computation



While the Grinch...



- lies about inputs
- pretends to have different inputs
- knows all other rankings
- knows the protocol
- is unpredictable

Synchronous Byzantine Agreement

Agreement, Termination, Validity



Agreement, Termination, Validity



$t < n/3$ Byzantines



King-Algorithm



Fix A



Fix A



- pick $t+1$ kings
- check validity



Fix A



King-Algorithm



King round:

- adapt input



King-Algorithm



King round:

- adapt input



Rankings vs. Top Alternatives



1.

A

B

A

C

2.

B

A

C

B

3.

C

C

B

A

Pareto-Validity



1.

A

B

A

C

2.

B

A

C

B

3.

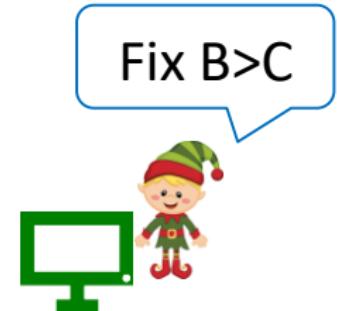
C

C

B

A

King-Algorithm

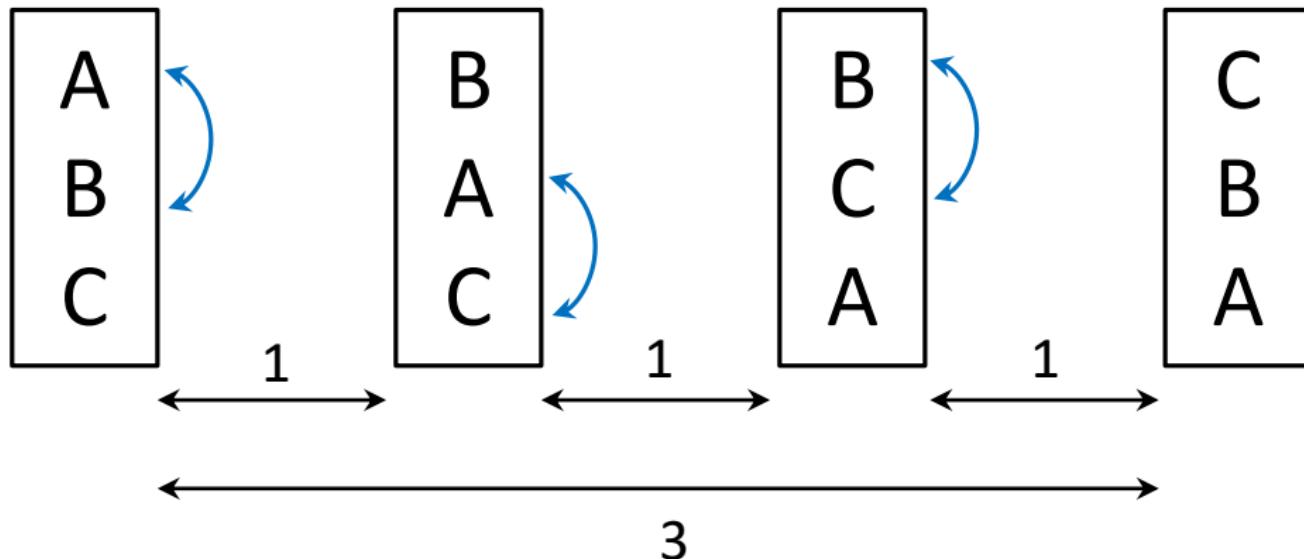


- pick $t+1$ kings
- check validity

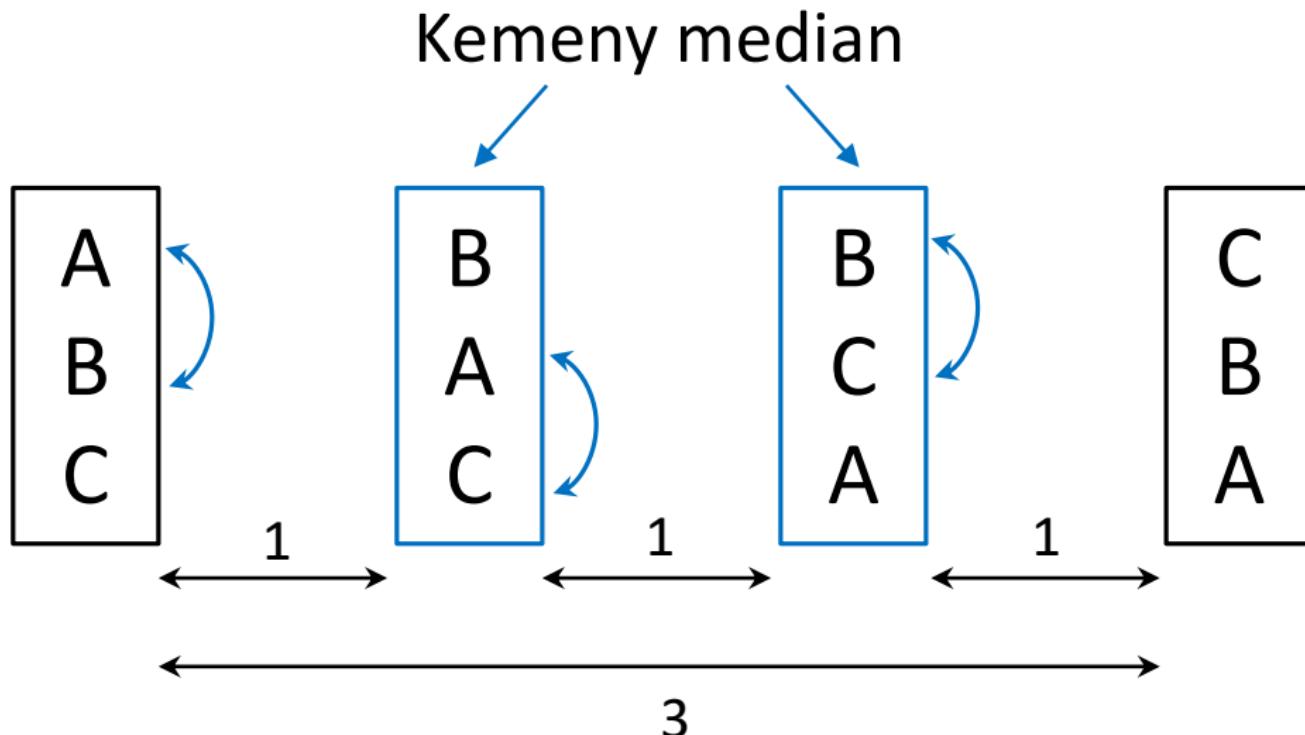


Better: Kemeny Median

Kendall tau Distance



Kendall tau Distance





1.

A B A C

2.

B A C B

3.

C C B A

A
B
C



1.

A B A C

2.

B A C B

3.

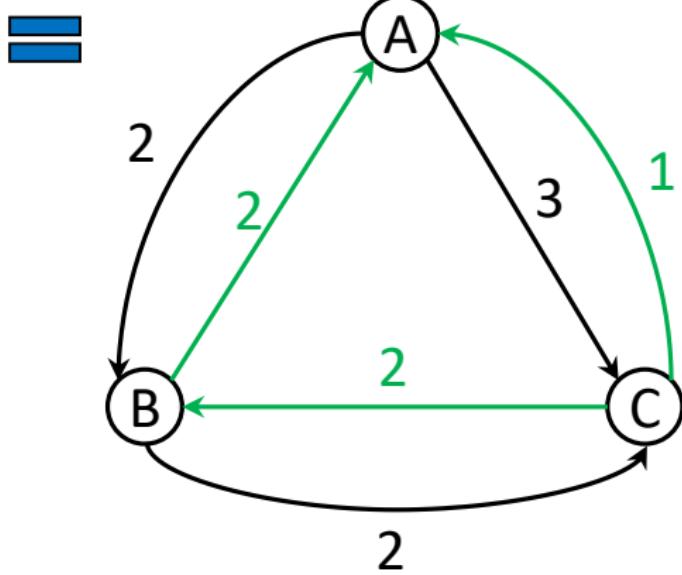
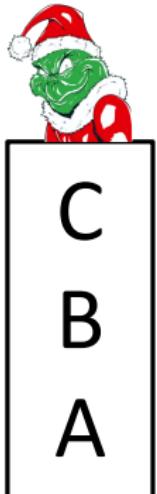
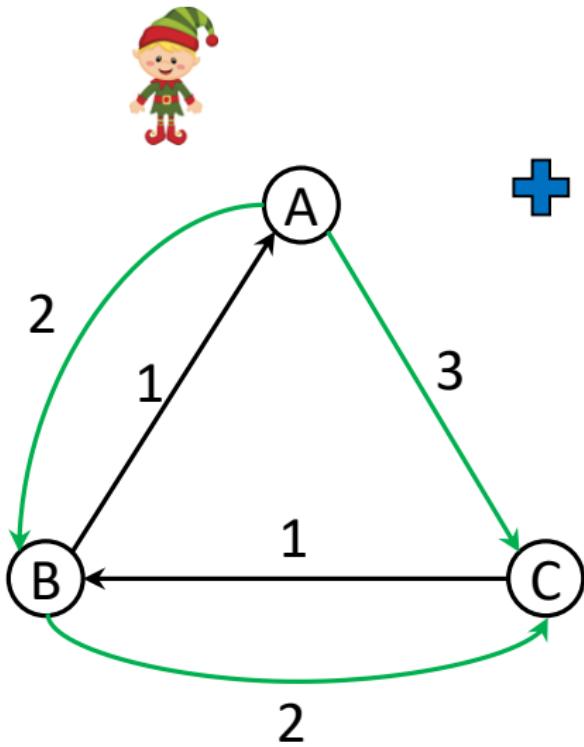
C C B A

A
B
C

B
A
C

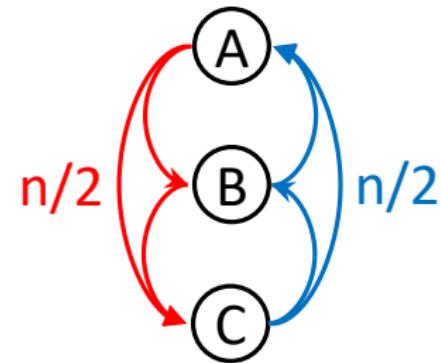
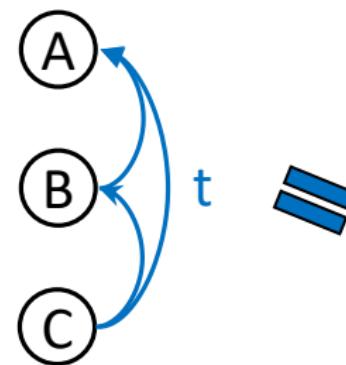
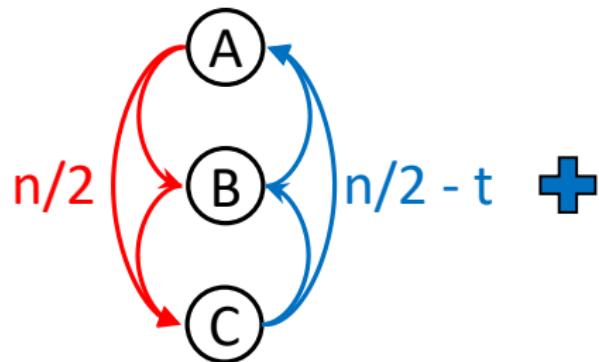
A
B
C

A
C
B

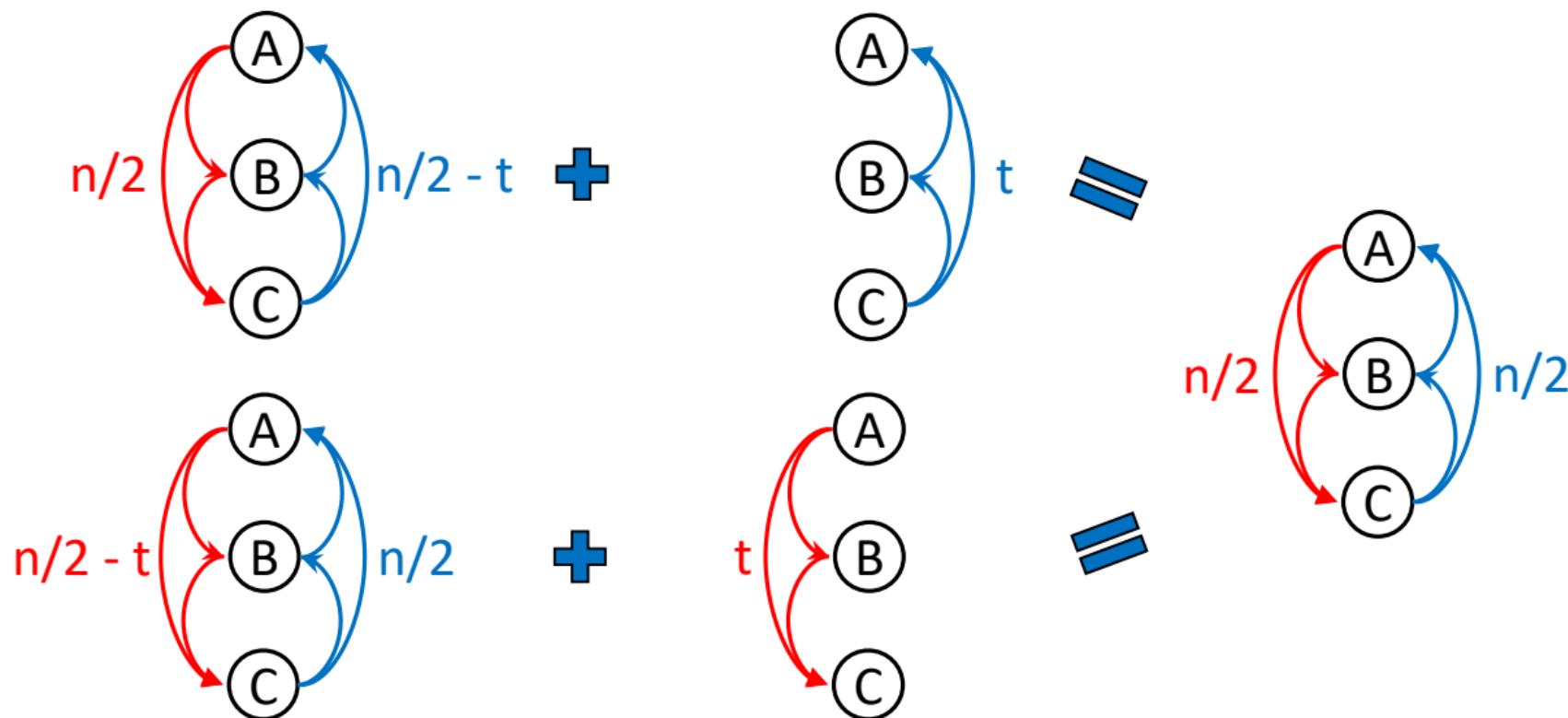


Best Possible Approximation of the Kemeny-Median

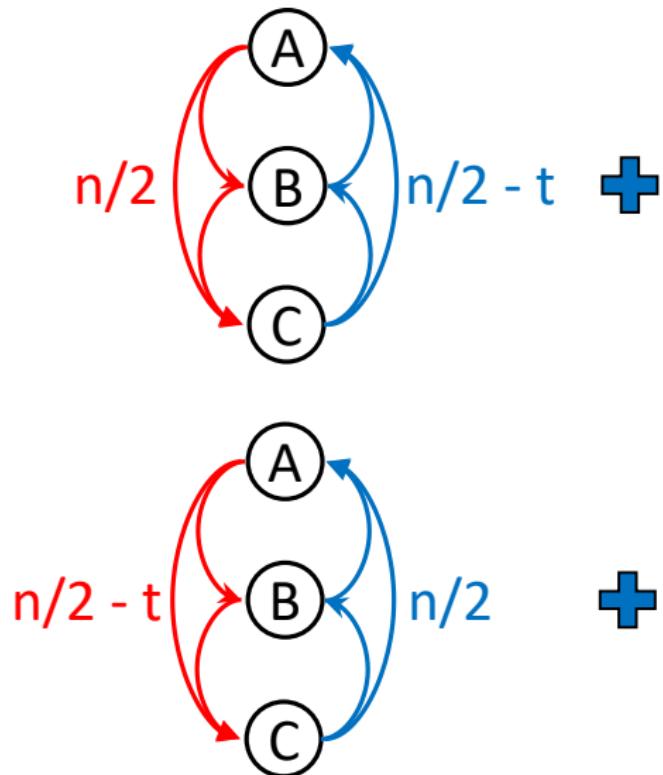
Binary Rankings



Binary Rankings



Binary Rankings

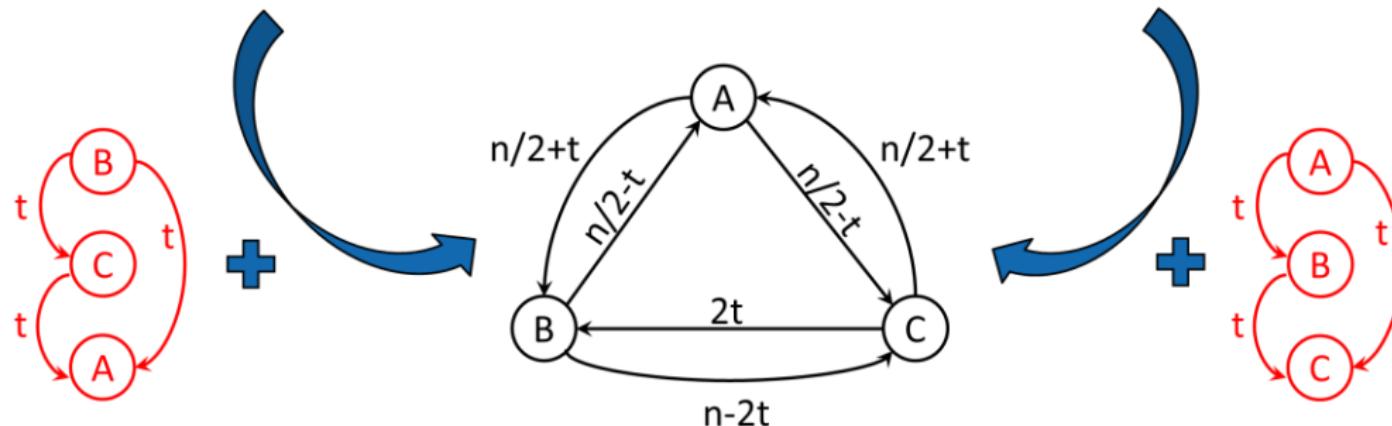
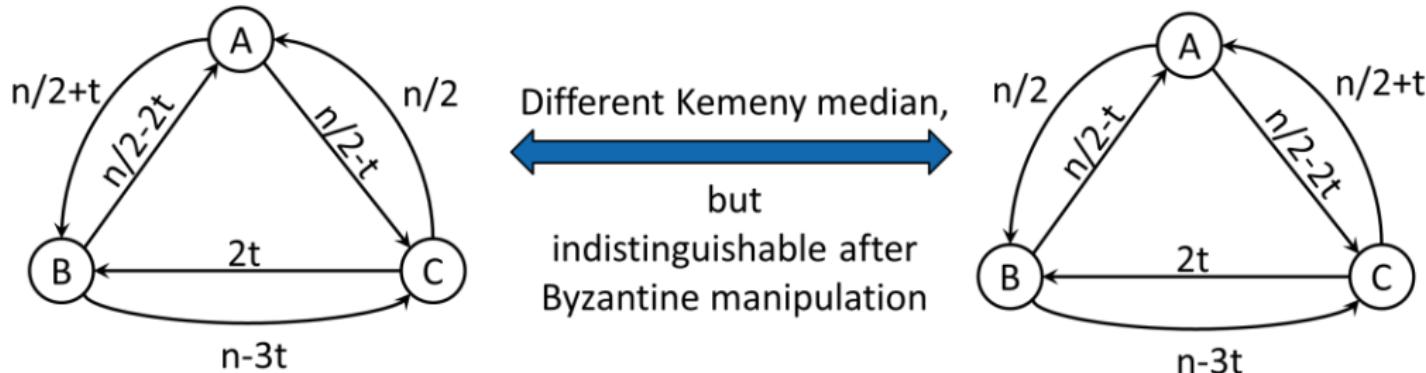


$$\frac{n/2}{n/2 - t} < 3$$

\equiv

The diagram shows the resulting ranking when the condition $\frac{n/2}{n/2 - t} < 3$ is met. It features three nodes (A, B, C) arranged vertically. Red edges form a cycle between A and B, and another cycle between B and C. Blue edges also form cycles between A and B, and between B and C. The label $n/2$ is placed near the red edges, and $n/2$ is placed near the blue edges. A blue double-equals sign (\equiv) is positioned to the left of the final ranking, which is identical to the top configuration in the first diagram.

Non-Binary Rankings



Algorithm for Kemeny-Median

- Broadcast own ranking
- Choose Kemeny Median locally
- Apply King algorithm with Pareto-Validity

Byzantine Preferential Voting

- Other voting rules
 - e.g. Scoring rules
- Alternative communication models
 - Asynchronous model
 - graphs



Thank You!

Questions & Comments?



Thanks to my co-authors
Yuyi Wang, Roger Wattenhofer