A toolbox for verifiable tally-hiding e-voting systems

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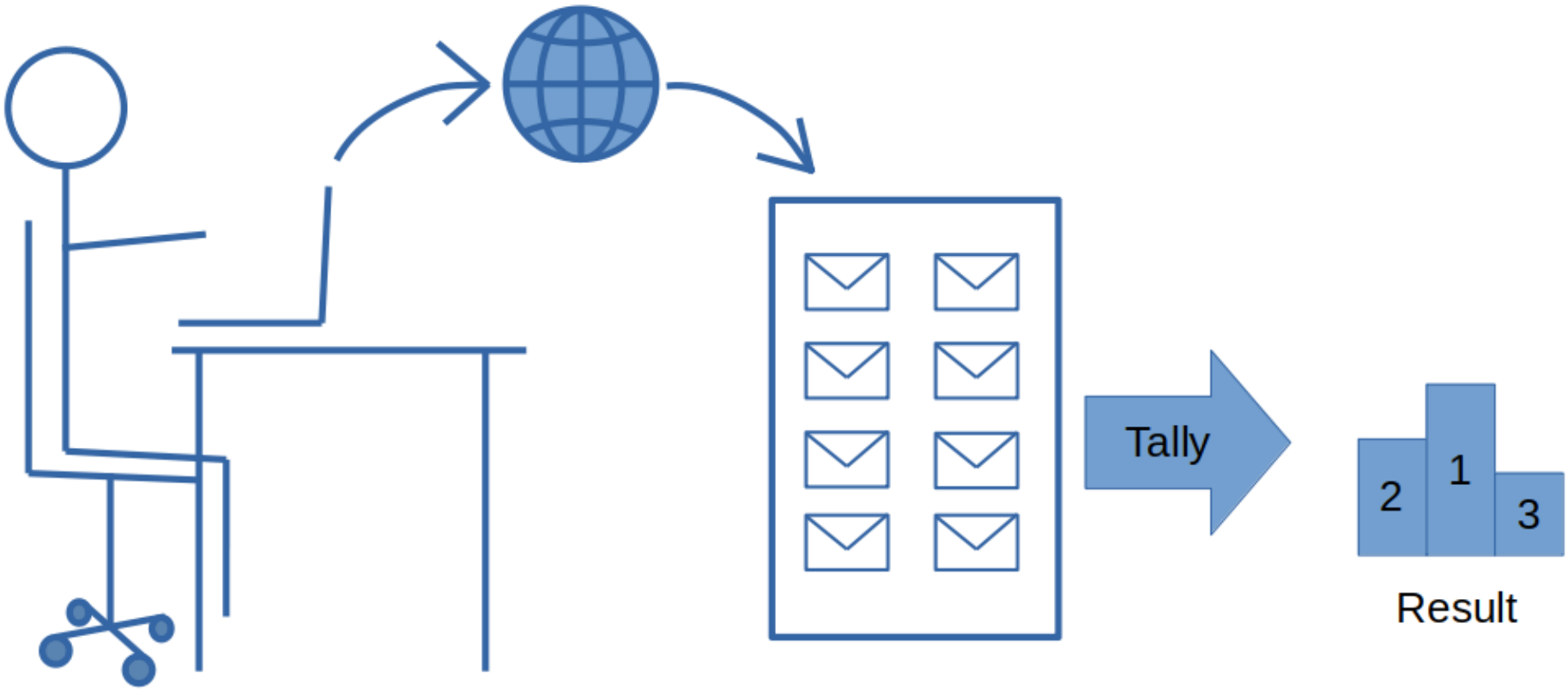
Université de Lorraine, CNRS, Inria Nancy - Grand-Est

ESORICS, September 2022

What is electronic voting?



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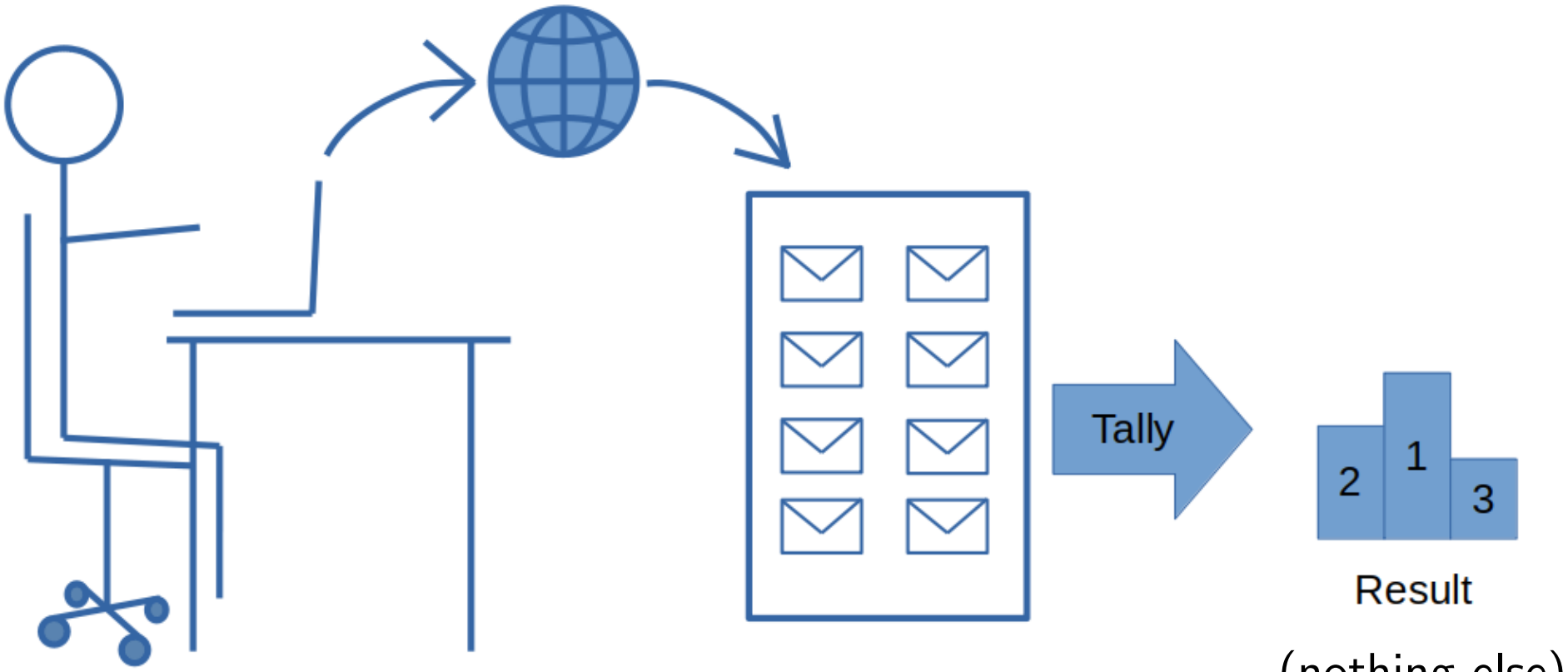
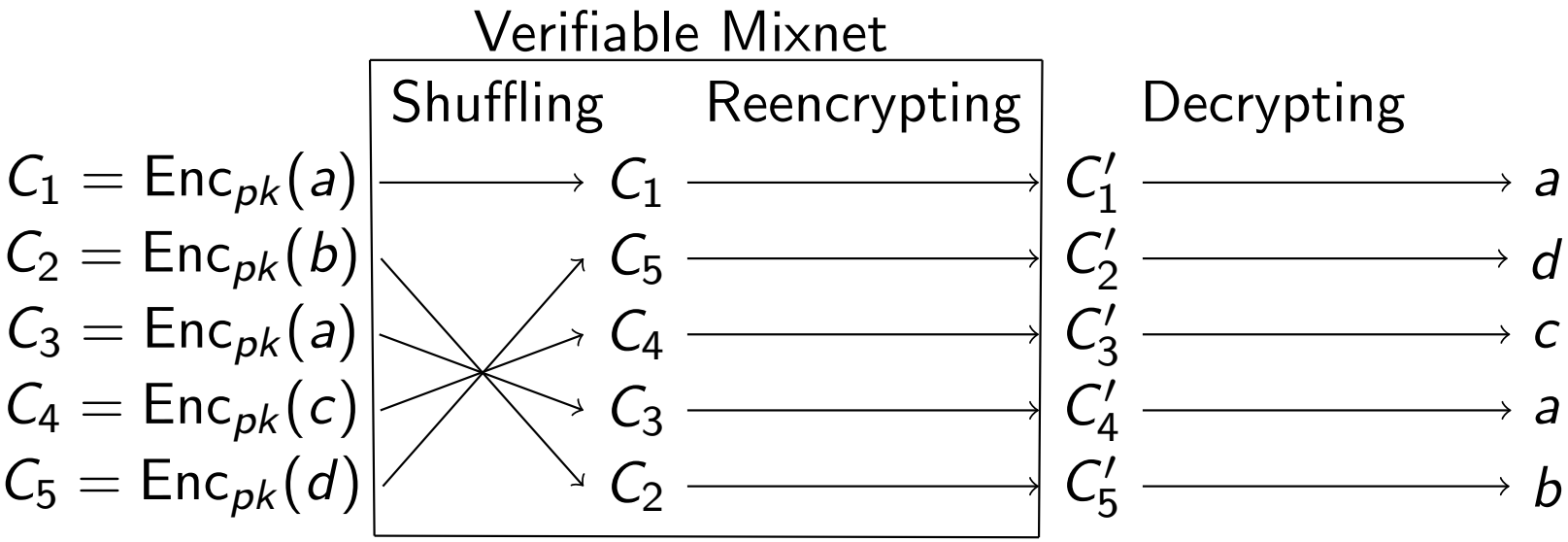


(nothing else)

Why tally hiding?

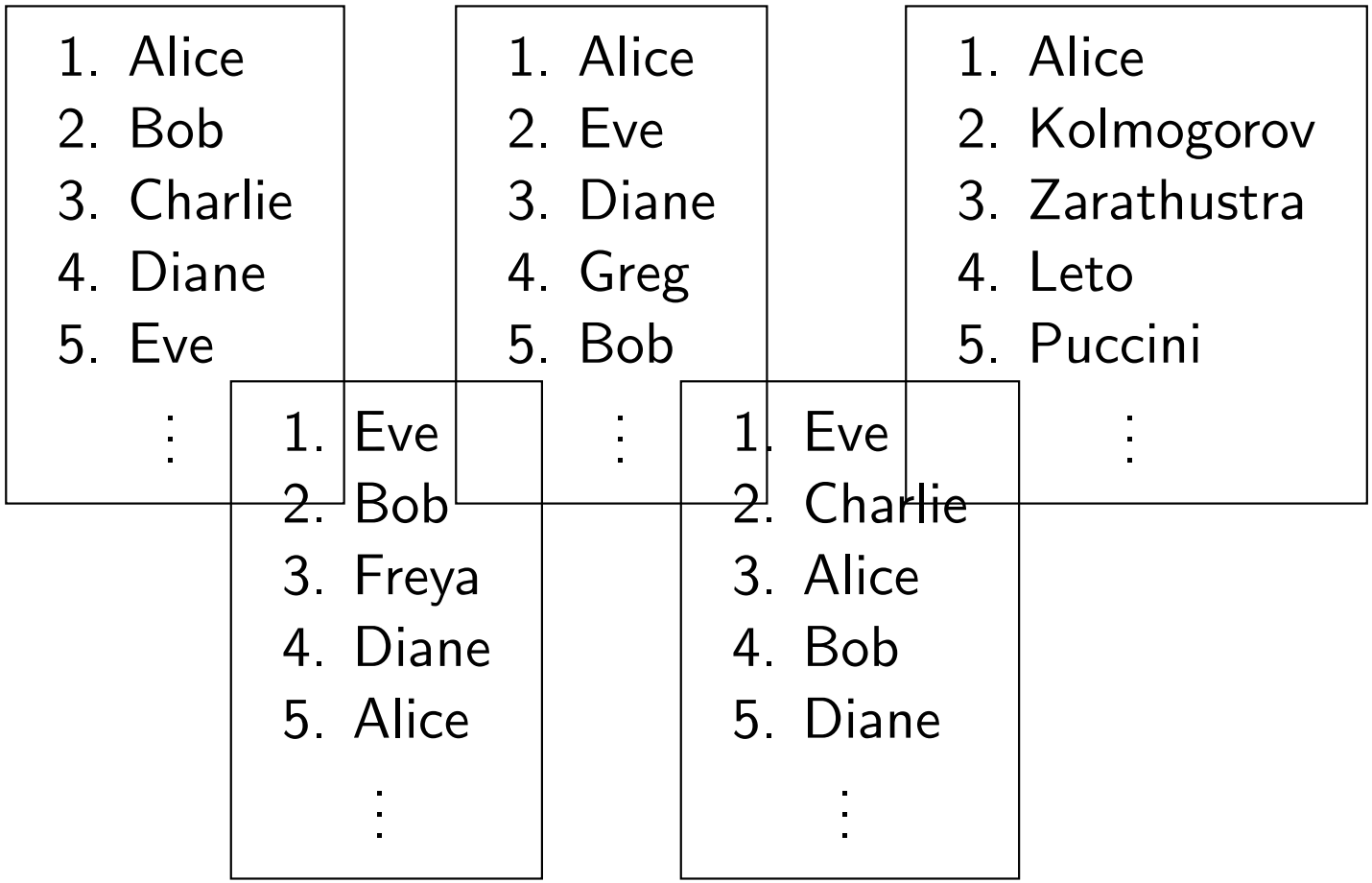
One key step is tallying, which is often done with shuffling.



Shuffling reveals the list of voting options chosen.

Why tally hiding?

Some voting systems (Condorcet, STV) let you choose any permutation of the candidates.



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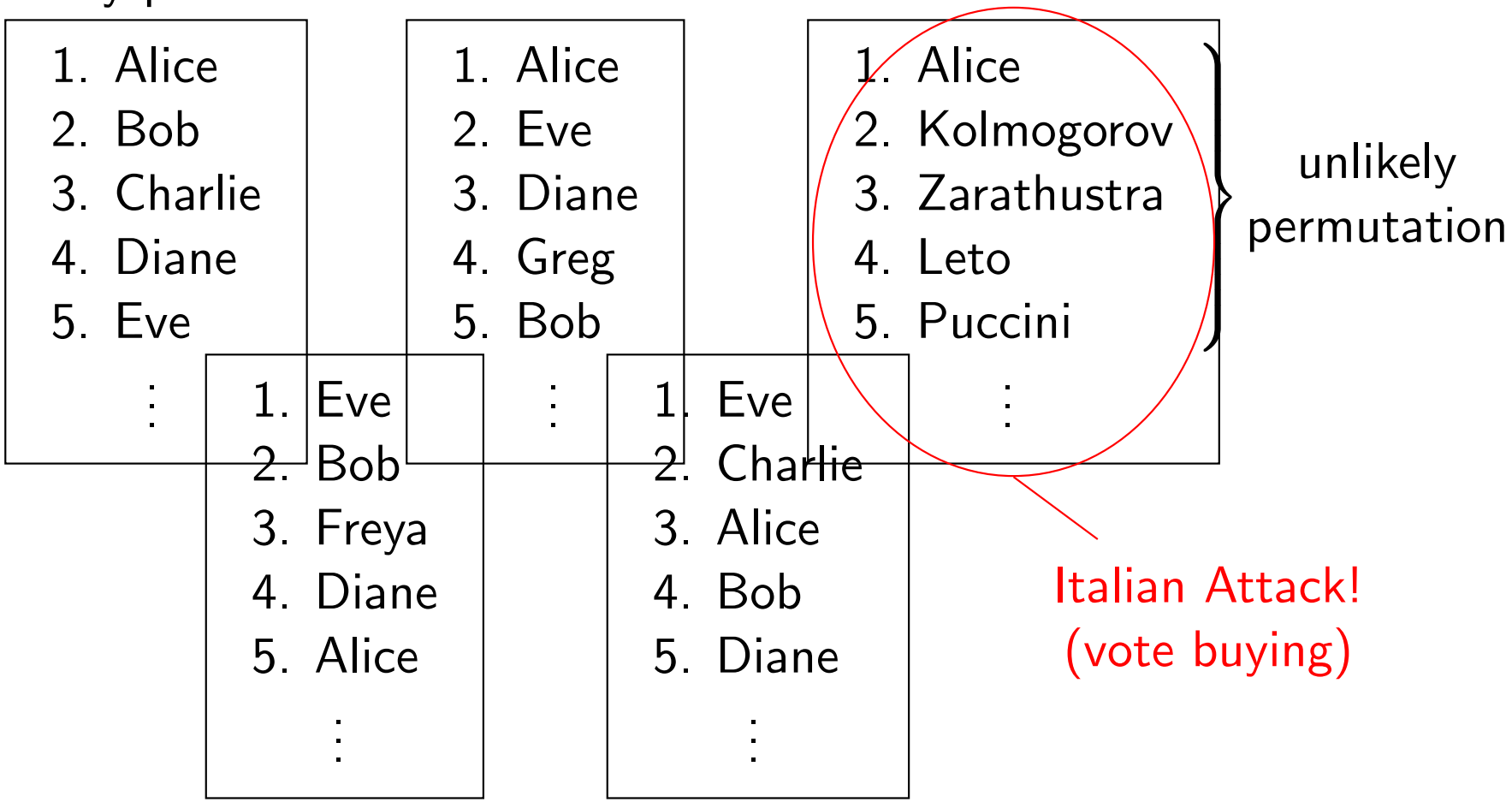

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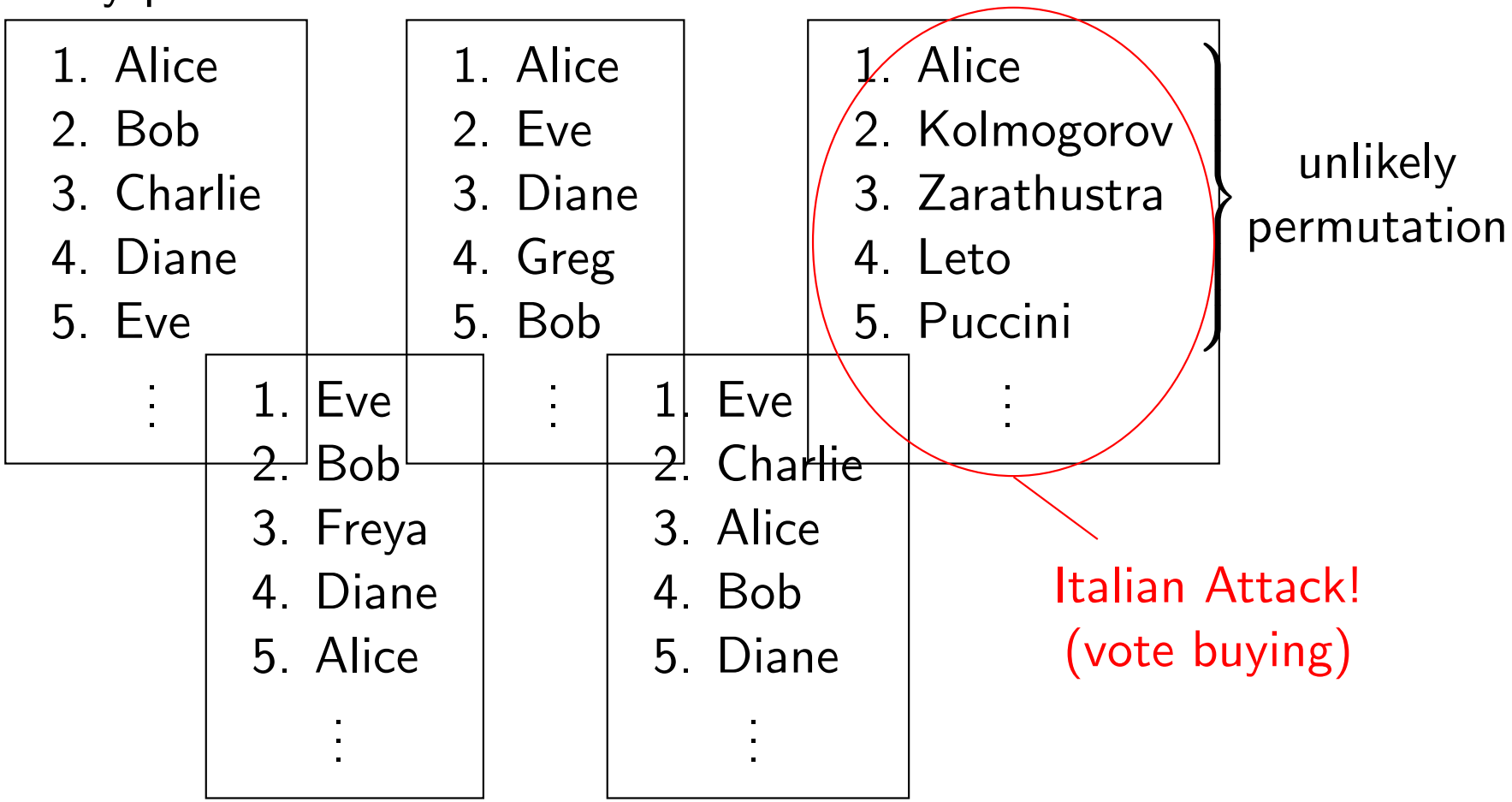

Tally hiding: Alice wins.

Why tally hiding?

Articolo pubblicato il 15 Marzo 2014

VOTO

QUEL SEGRETO CHE LA MAFIA CONOSCE

La nostra libertà di voto oggi costa appena 50€

Se in Italia, e soprattutto in terra di mafia, i cittadini fossero effettivamente liberi di votare per chi vogliono, la qualità degli eletti sarebbe certamente migliore.

Da tempo denunciamo questa vergognosa realtà ma nessuno prende provvedimenti; evidentemente il controllo del voto torna utile a molti. Abbiamo anche scritto al Presidente Napolitano nel marzo del 2012 ma non abbiamo ricevuto risposta. Ascolta lo SPOT AUDIO _il VOTO quel segreto che la mafia conosce_(1) della campasgna

L'Art. 48 della Costituzione fra l'altro stabilisce che: Il voto è personale ed eguale, libero e

Petition to stop vote buying in Italia (Libero Futuro)

Le Monde

Consulter le journal

Se connecter S'abonner

ACTUALITÉS PRÉSIDENTIELLE 2022 ÉCONOMIE VIDÉOS DÉBATS CULTURE M LE MAG SERVICES

INTERNATIONAL • LETTRES DE

Partage

« Beaucoup d'électeurs sont prêts à vendre leur voix » : l'achat de votes, un fléau bulgare

A la veille des élections législatives en Bulgarie du 4 avril, une étude confirme une pratique endémique et partagée par tous les partis du pays : payer les électeurs pour s'assurer leur voix.

Par Jean-Baptiste Chastand (Vienne, correspondant régional)

Publié le 02 avril 2021 à 00h14 - Mis à jour le 02 avril 2021 à 12h18 · Lecture 4 min.

Article about vote buying in Bulgaria (Le Monde)

Tally hiding in the literature

Single choice voting: Voters select one candidate or list.

- $s-$best. Küsters, Liedtke, Mueller, Rausch and Vogt, EuroS&P'20 (Ordinos).
- Hare-Niemeyer. Hertel *et al.*, E-VoteID'20.

Tally hiding in the literature

Ranked Voting: Voters rank candidates.

- Condorcet. Haines, Pattinson and Tiwari, VSTTE'19.

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- Canard, Pointcheval, Santos, Traoré (ESORICS'18).

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  Privacy breach when two candidates are ranked equal.
- Condorcet. Hertel *et al.*, E-VoteID'20.

  Does **not** allow equal ranking.
- Borda. Hertel *et al.*, E-VoteID'20.
- Single Transferable Vote. Benaloh, Moran, Naish, Ramchen and Teague, IEEE TIFS'10. (Not fully tally-hiding.)
- Instant Run-off Voting. Culnane, Pereira, Ramchen and Teague, FC'19. (Not fully tally-hiding.)
- ~~Instant Run-off Voting. Hertel *et al.*, E-VoteID'20.~~

  Super-exponential complexity.

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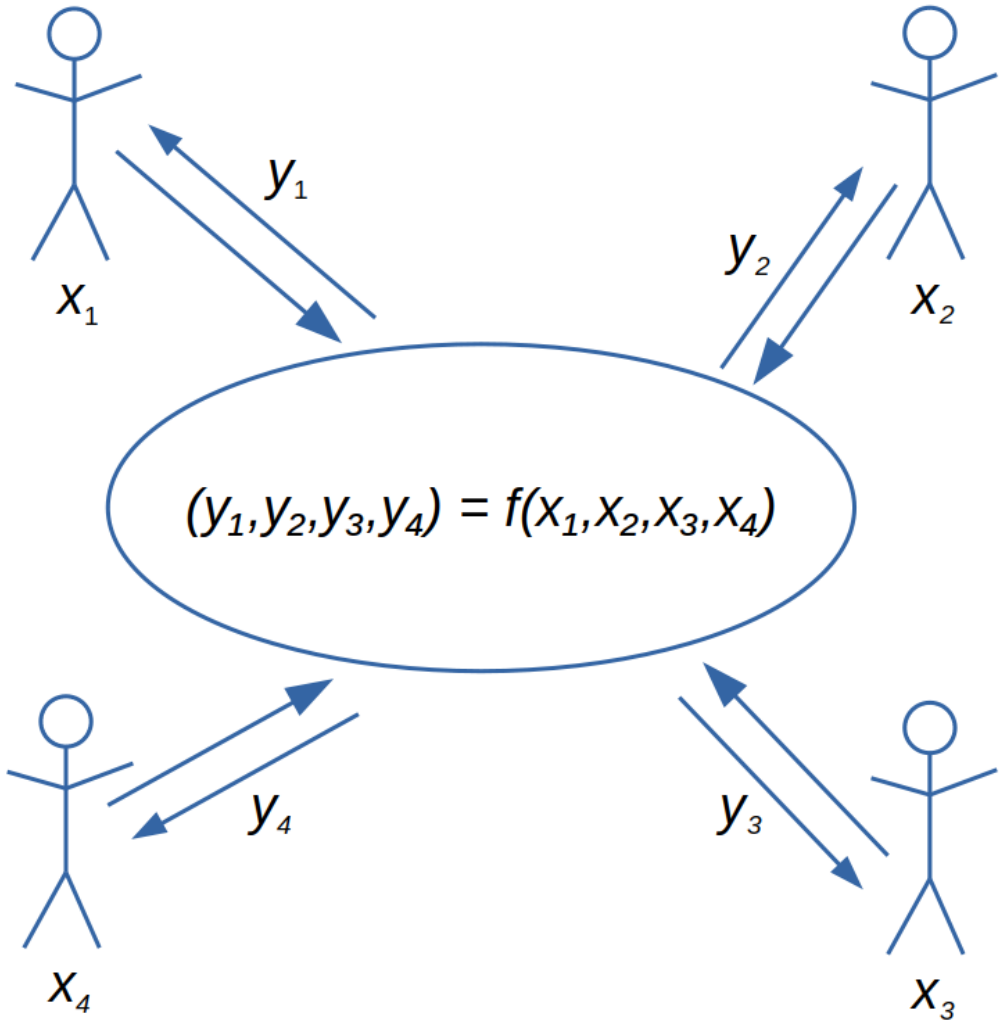
  Fails to tally in some not-so-rare cases.

Multi-party computation



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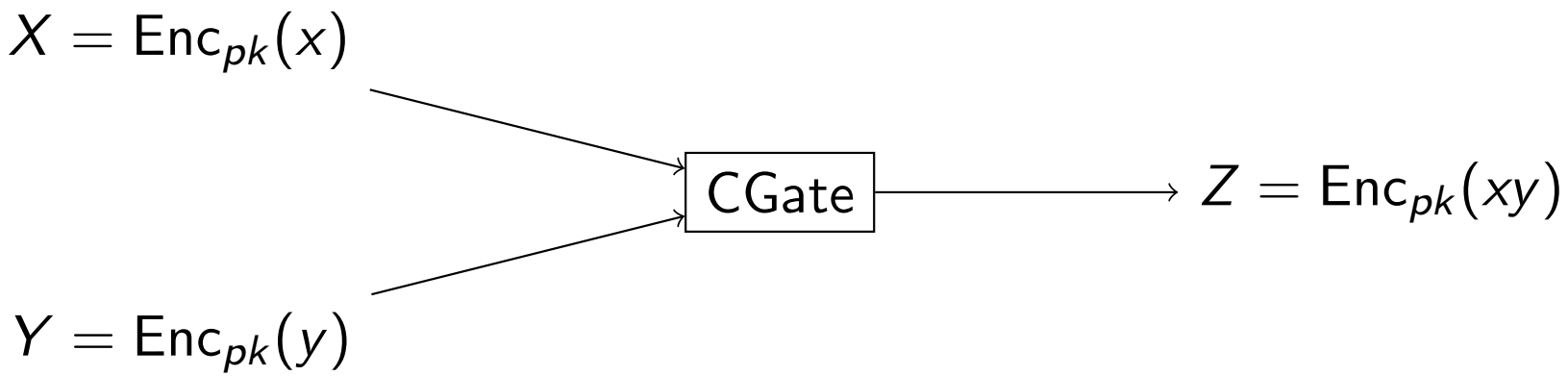
Libraries	??	Libsodium, OpenSSL, Crypto++, $\cdots$

Multi-party computation

We use the CGate primitive to build our MPC protocols:



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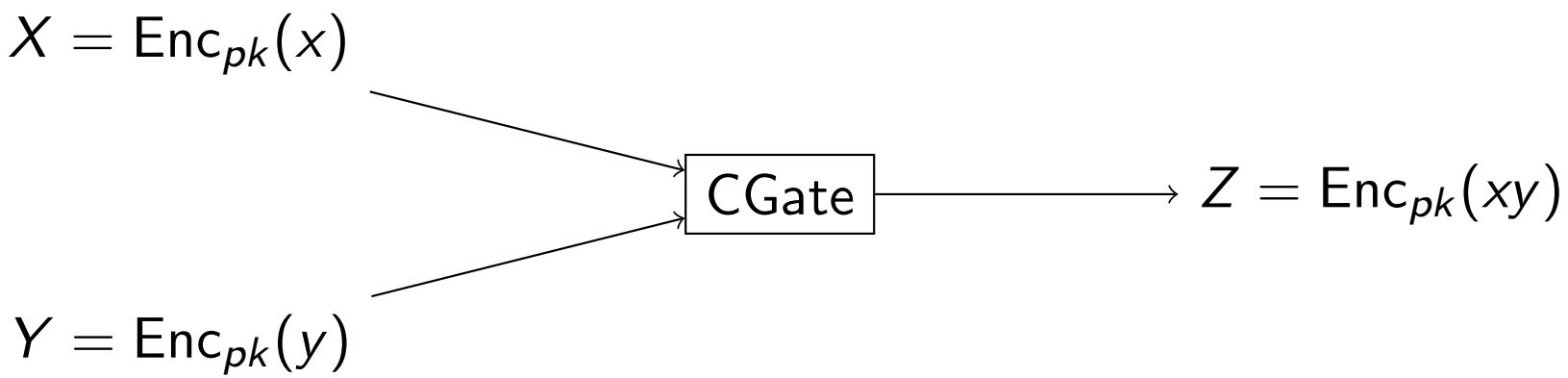

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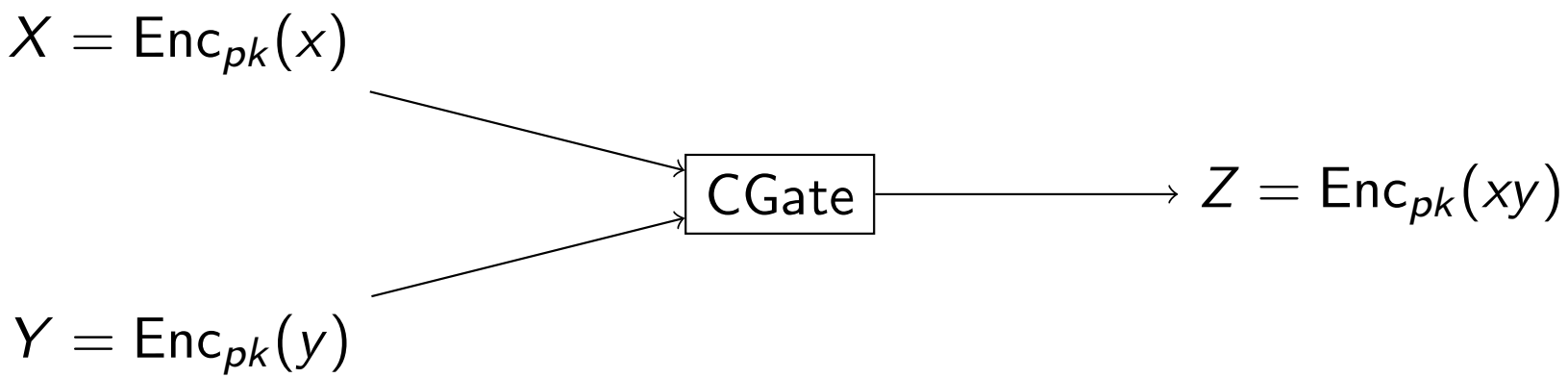

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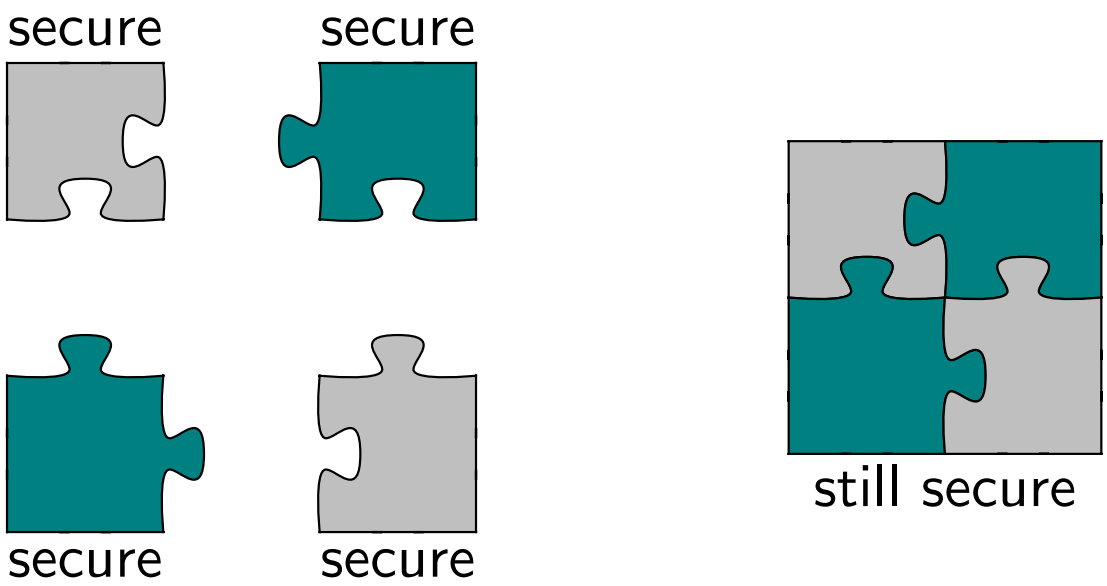
Universally composable security



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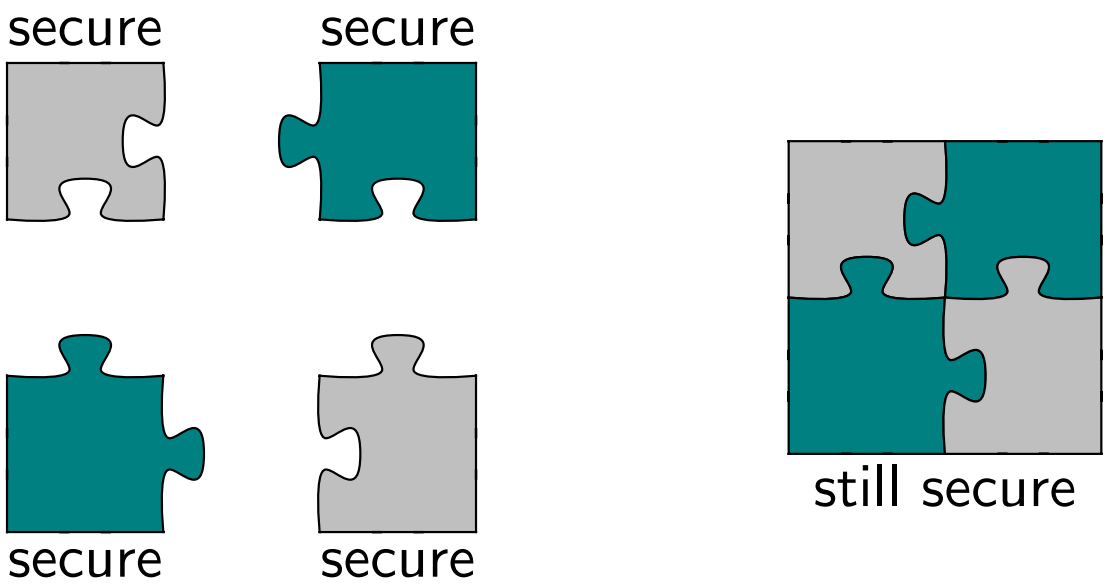

We use the security framework of Canetti, Cohen and Lindell, Crypto'15.

Our Contribution

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Operation	Comment
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Fixed-point division	$/$
Comparisons	$\leq, <, =$

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Support complex operations: Sorting, Finding the s greatest values...

All of those come with several optimizations and trade-offs.

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Another counting function? We can do it!

Thank you!

Security proofs:

- Privacy
- Verifiability
- UC-security

Complete algorithmic description:

- Optimizations and trade-offs
- Original ballot encodings

Full version available on eprint:
eprint.iacr.org/2021/491

New algorithms:

- Majority Judgment
- Homomorphic Condorcet

Implementation:

- Condorcet-Schulze
- It is fast!