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ICT
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Information Technology - irst

SE
SOFTWARE
ENGINEERING

Stakeholders Prioritization

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Requirements Engineering
Advanced topics

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Outline

What is a stakeholder?

Who are the stakeholders for today's lecture?

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In general, considering all the stakeholders is not feasible. In particular for huge systems (too much effort) or open systems (don't know the stakeholders in advance).

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We need to make a trade-off to minimize the effort and maximize the value: we need to **prioritize the stakeholders**.

How to prioritize?

Several dimensions can be considered:

- level of expertise

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Several dimensions can be considered:

- level of expertise
- influence on the project
- availability
- etc.

Different approaches focus on different dimensions.
In this lecture, we focus on approaches used in RE.

Outline

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- Context: stakeholders participating in forums

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- Context: stakeholders participating in forums
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- Goal: recommend relevant stakeholders given the topic
- Technique:
  - *rely on stakeholders participation*
  - *rely on participation in related topics*
  - *rely on stakeholders similarities*

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Can be done manually (forum moderators) or automatically (clustering).

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TF-IDF + cosine similarity = typical in Information Retrieval.

Topic = set of participations, not single, well-identified name.

Direct Participation

Retrieve topic's participants:

1. Identify topic
   - *manual (forum organization)*
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Retrieve topic's participants:

1. Identify topic
   - *manual (forum organization)*
   - *automatic (clustering)*
2. Retrieve stakeholders' participation in the topic
   - *Contribution (% of participation in the topic)*
   - *Specialization (inverse of number of topics involved in)*

Indirect Participation

Retrieve similar topics' participants:

1. Identify similar topics
   - *TF-IDF + cosine similarity above a threshold*
   - *1 vector = 1 topic instead of 1 message*
   - *Ex: encryption ← payments, security, database*

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Note: Direct participants are also retrieved.

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   - *1 stakeholder = 1 binary vector* $s = (s_i)_{i=1}^{T}$
2. Compute stakeholders similarity
   - *cosine similarity*
3. Predict interest in the topic
   - s_a *participate* + s_b *similar* $\Rightarrow$ s_b *interested*
   - *proportional to similarity*

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Yes, because she is a direct participant in the topic *flight booking*.

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Bob participates in a discussion about *French cooking*. Will he be recommended to participate in a discussion about *Italian cooking*? Why?

Questions

Bob participates in a discussion about *French cooking*. Will he be recommended to participate in a discussion about *Italian cooking*? Why?

Yes, because he is an indirect participant due to the similarity between the topics *French cooking* and *Italian cooking*.

Questions

Alice participates in a discussion about *flight booking* and Bob in another discussion about *French cooking*. Will Bob be recommended to participate in a discussion about *flight booking*? Why?

Questions

Alice participates in a discussion about *flight booking* and Bob in another discussion about *French cooking*. Will Bob be recommended to participate in a discussion about *flight booking*? Why?

Probably not, because there is no visible similarity.

Questions

Alice participates in several discussions about *flight booking*, *French cooking* and *train reservation*. Bob participates in several discussions about *French cooking*, *train reservation* and *local festivals*. Will Bob be recommended to participate in a discussion about *flight booking*? Why?

Questions

Alice participates in several discussions about *flight booking*, *French cooking* and *train reservation*. Bob participates in several discussions about *French cooking*, *train reservation* and *local festivals*. Will Bob be recommended to participate in a discussion about *flight booking*? Why?

Yes, because Alice and Bob have similar participations and Alice participates in the topic *flight booking*.

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Lim et al. [2010]:

- Context: stakeholders of a large-scale project

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Lim et al. [2010]:

- Context: stakeholders of a large-scale project
- Problem: hard to identify the relevant stakeholders
- Goal: prioritize stakeholders by influence on the project
- Process:
  1. *identify core stakeholders and roles*
  2. *get recommendations for others*
  3. *build the corresponding social network*
  4. *prioritize by using social network measures*

Core Roles

Process:

1. Identify initial roles from users, developers, legislators, and decision-makers

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Example: A university has students as users, interacting with the university staff, who interacts with the department administrators. Hence, students, university staff and department administrator are stakeholder roles for a university-related project.

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Non-significant roles can be elicited (e.g. prospective students interact with the department administrators).

Core Stakeholders

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- Bob and Carla are students, but Bob is the student representative, hence he takes the role.

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Example:

- Alice is the official department administrator, hence she takes the role.
- Bob and Carla are students, but Bob is the student representative, hence he takes the role.
- Dilan, Ema and Fabian are staff members, but no representative is provided. Ema is then nominated to take the role.

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Recommendation process:

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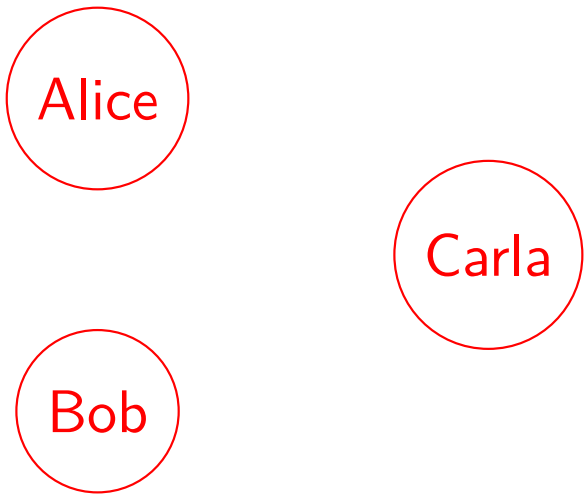
Recommendation format:

- stakeholder recommended
- stakeholder role
- salience, from 1 to 5
  - *influential power, legitimacy and claim urgency*

Social Network Measures



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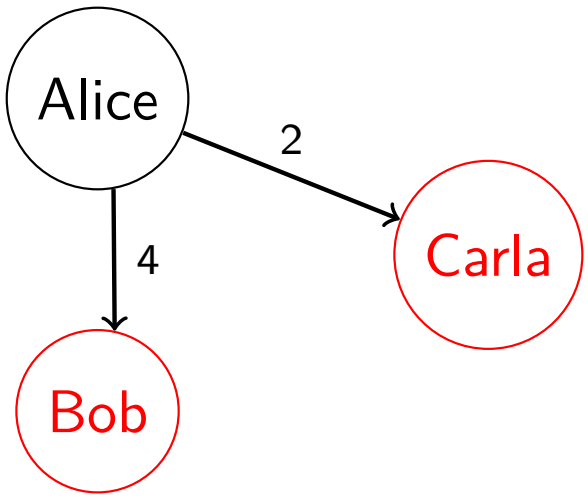

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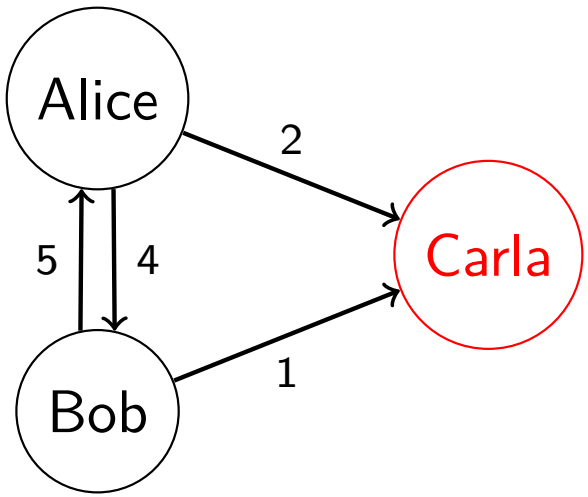

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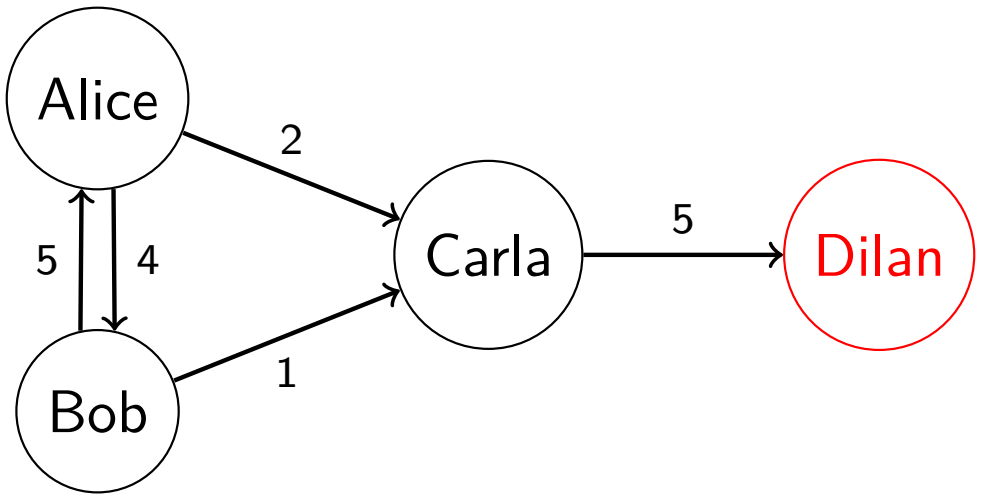

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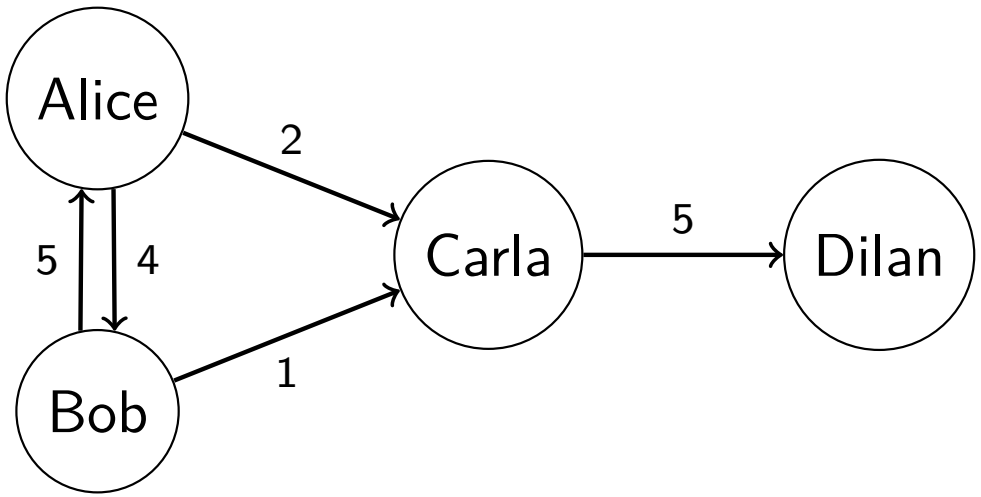

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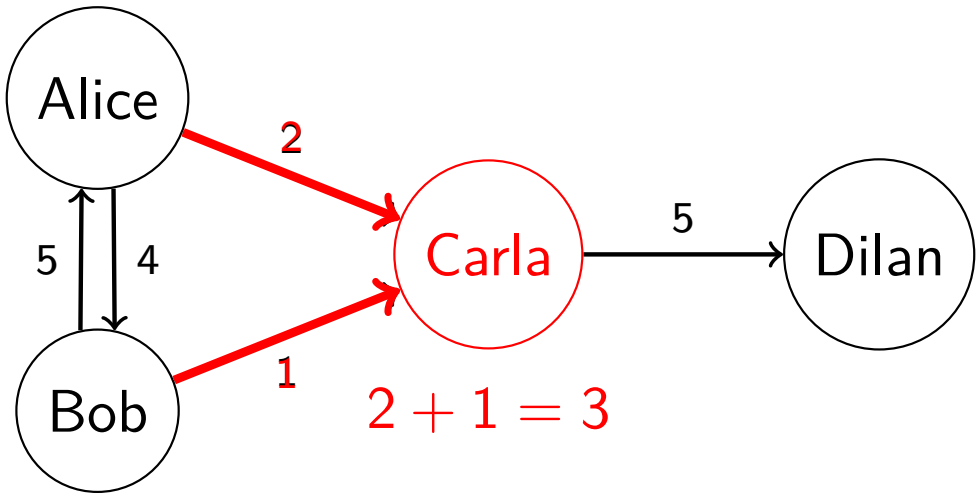

In-degree centrality: Sum of incoming recommendations.
Highlight most recommended stakeholders.

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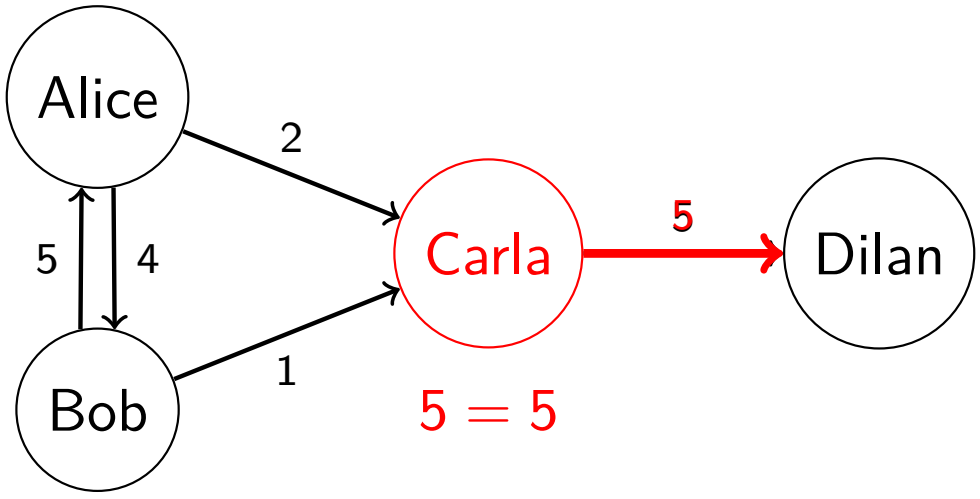

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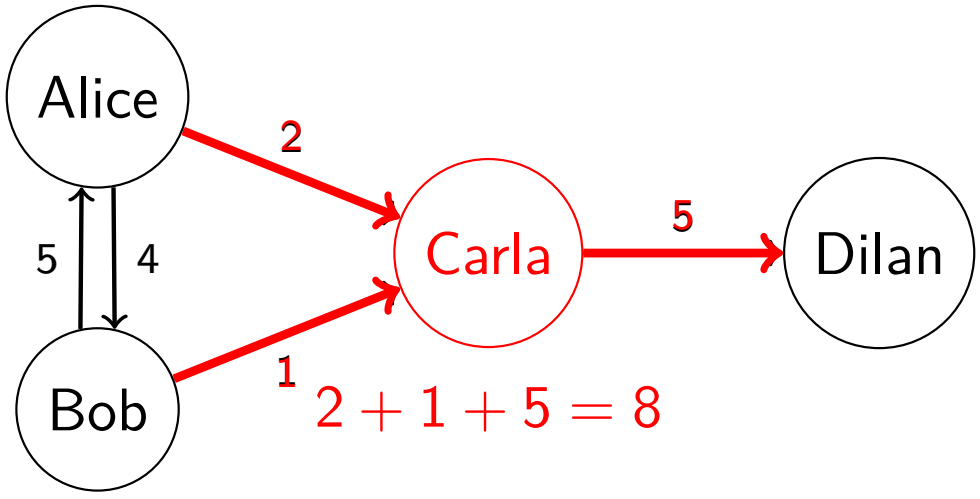

Degree centrality: In-degree + out-degree centrality.
Highlight most related stakeholders (many or strong ties).

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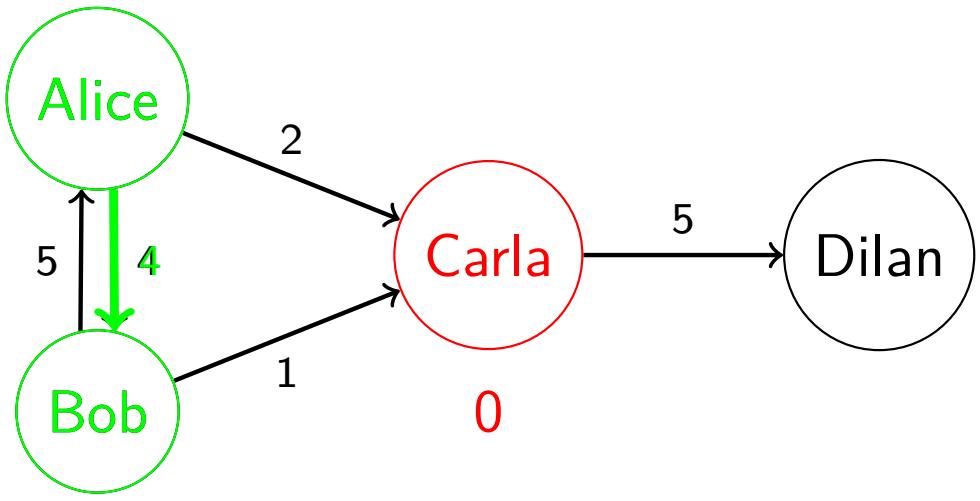

Betweenness centrality: number of shortest paths passing there. Highlight brokers (bridge between parts of the network).

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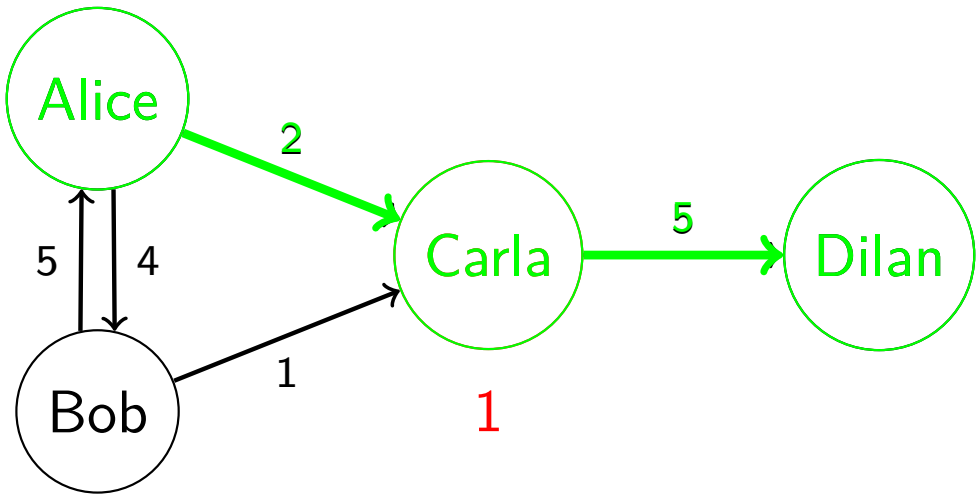

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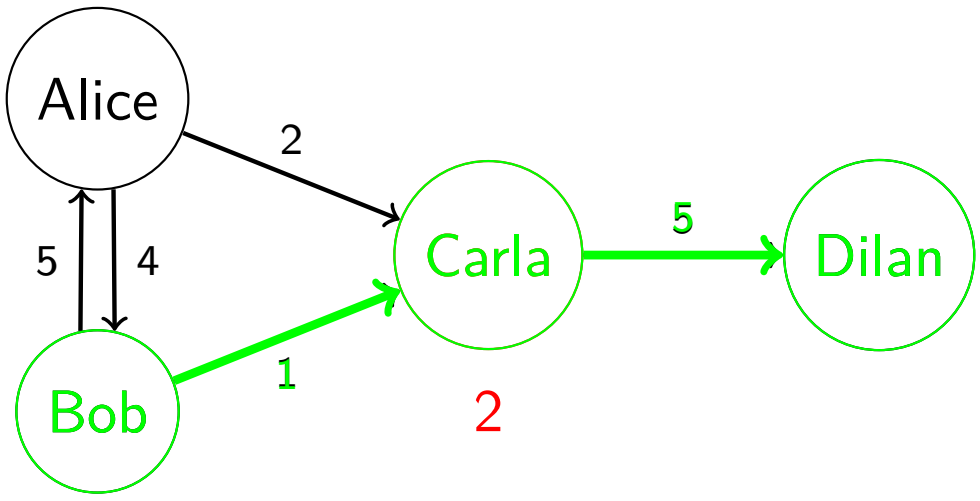

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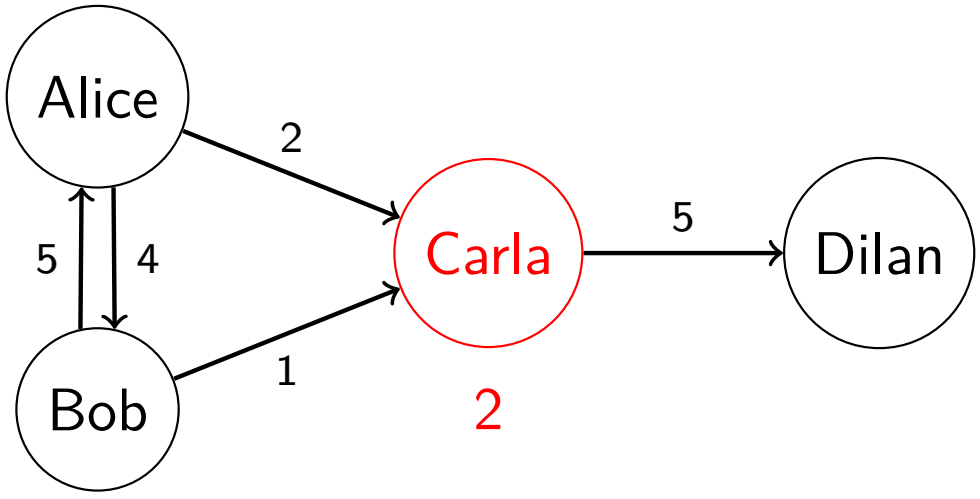

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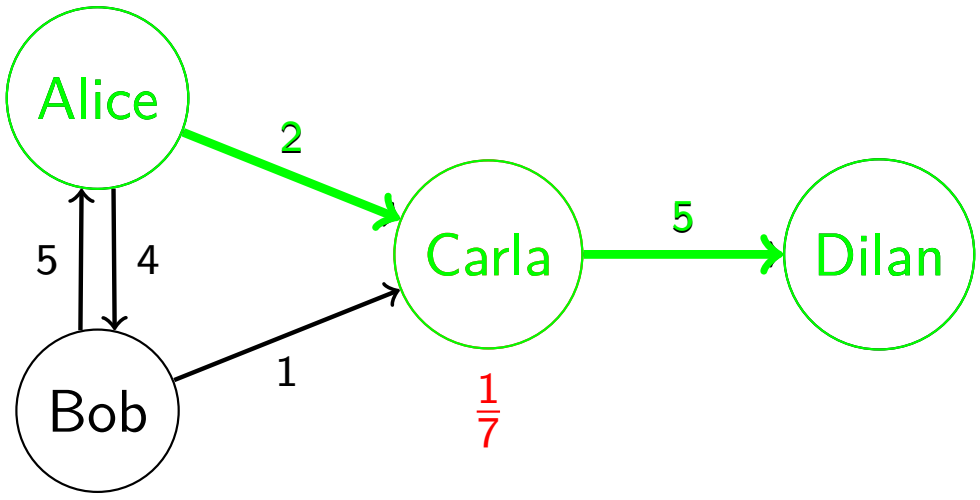

Closeness centrality: inverse average shortest path.
Highlight "close to everyone" stakeholders.

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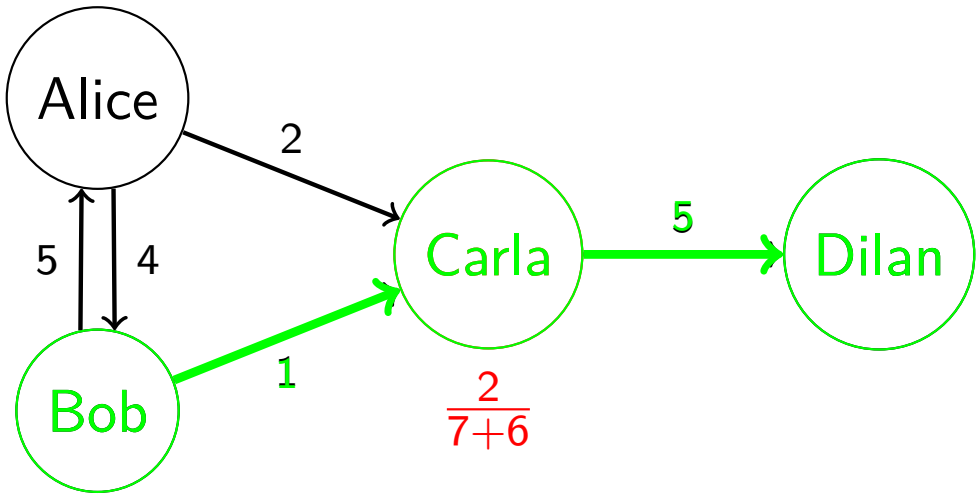

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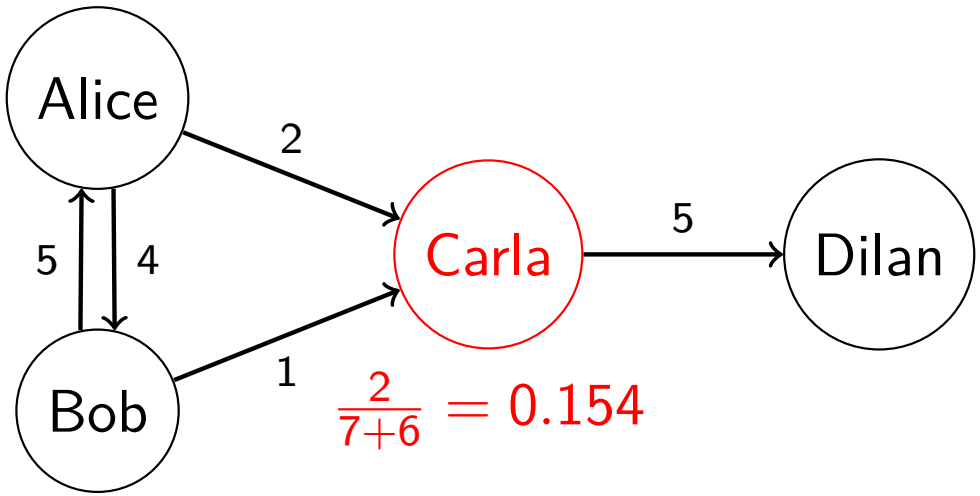

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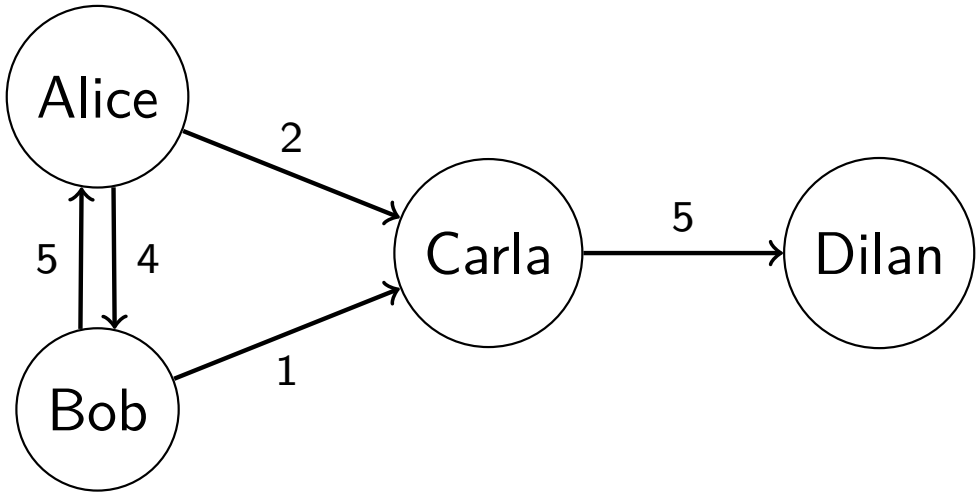

PageRank: incoming redistributed on outgoing (recursive).
Highlight strong cycles (e.g. Alice and Bob reinforce each other).

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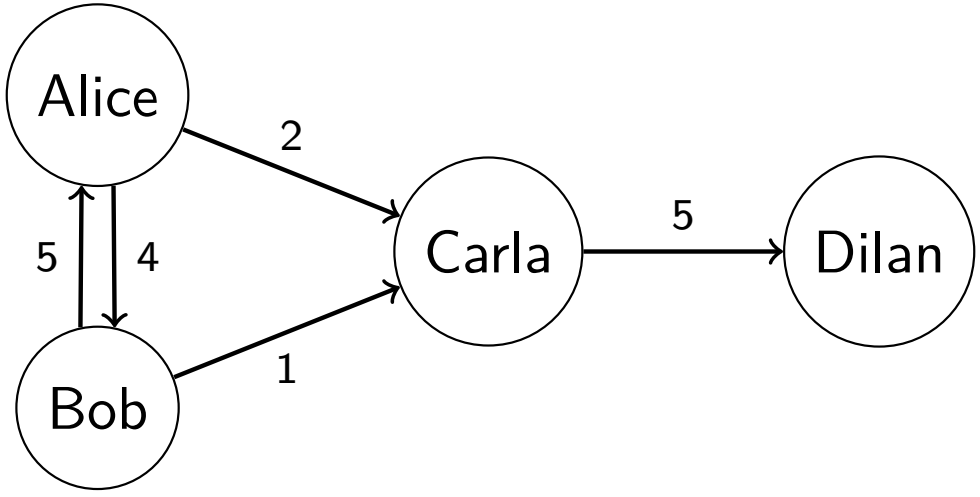

Local measures (direct neighbouring) are easy to parallelise, but global measures (whole graph) are more accurate, especially betweenness centrality and PageRank.

Questions

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The core stakeholders are the stakeholders that we interview first.
True or false?

Questions

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True, because the core stakeholders are the only one we know at the beginning. All the others are discovered during the interview process from the recommendations.

Questions

If no official representative can be provided for a given role, the technique does not work. True or false?

Questions

If no official representative can be provided for a given role, the technique does not work. True or false?

False, we can nominate a stakeholder to play as a representative.

Questions

What are the information provided by a recommendation?

Questions

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The stakeholder, his/her role and his/her salience in the project.

Questions

All the measures presented need to compute the full network to evaluate a single node. True or false?

Questions

All the measures presented need to compute the full network to evaluate a single node. True or false?

False, the in-degree, out-degree and degree centralities are local measures. Only the PageRank, the betweenness and the closeness centralities need a full computation.

Outline

Overview

Vergne and Susi [2014]:

- Context: stakeholders in OSS projects

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- Context: stakeholders in OSS projects
- Problem: heterogeneous and dynamic set of stakeholders
- Goal: search for experts through contributions and social aspects
- Process:
  1. *extract stakeholders, terms, topics and roles*
  2. *extract weighted relations among them*
  3. *compute probability to be an expert using Markov networks*
  4. *infer stakeholders ranking*

Information Extraction

Entities examples:

- Stakeholders s: forum participant, document's author, ...

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Which weight for each relation?

- Amount of evidence: $w_{xy} \in \mathbb{R}^+$

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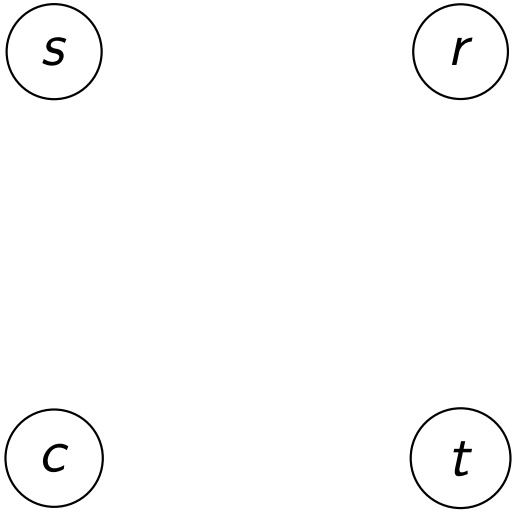
- Challenge: have meaningful weights

4-Partite Weighted Graph

Metamodel and example with 2 nodes per type:



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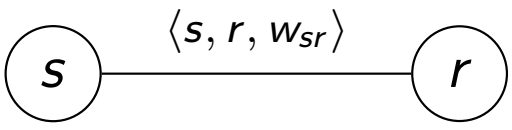

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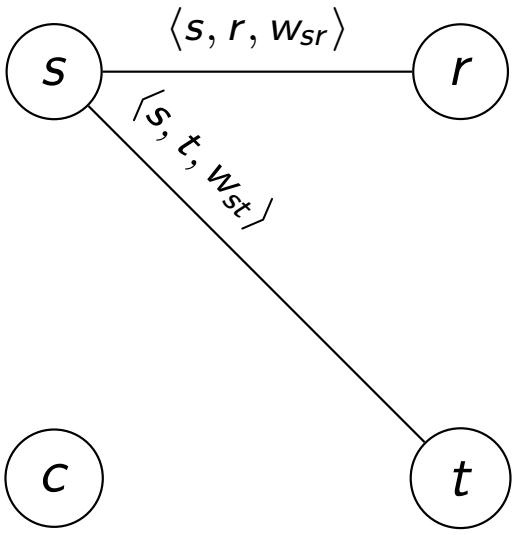

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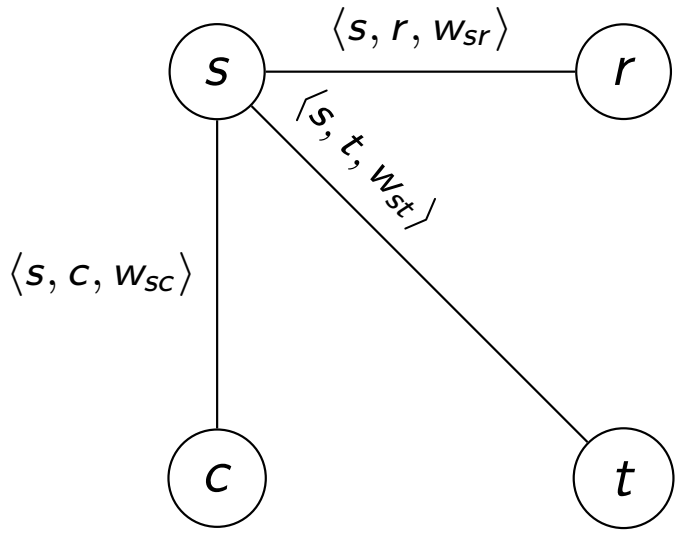

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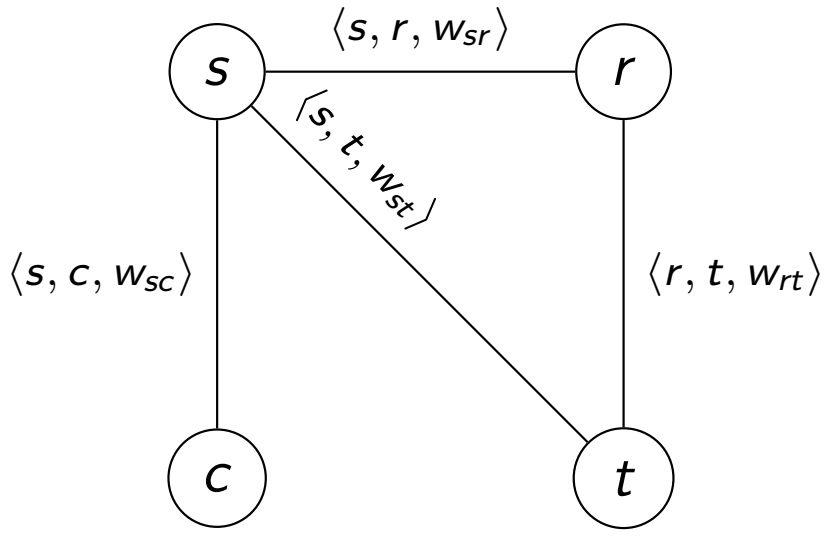

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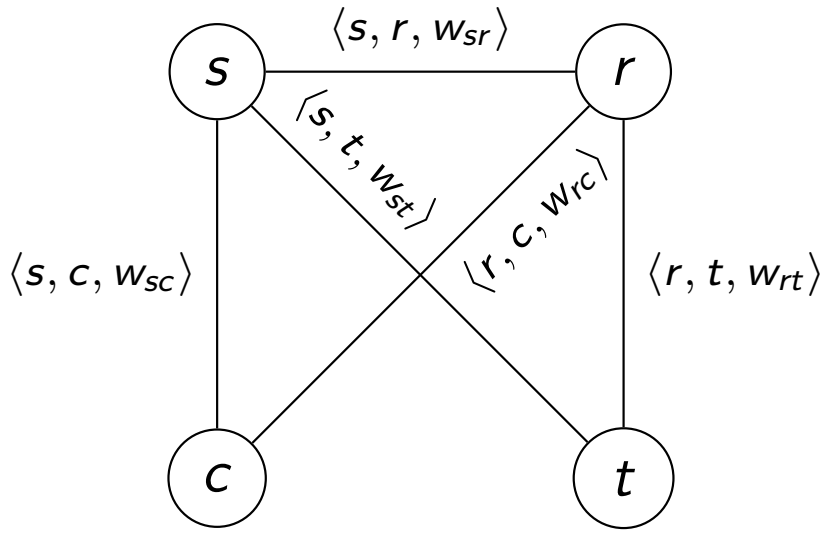

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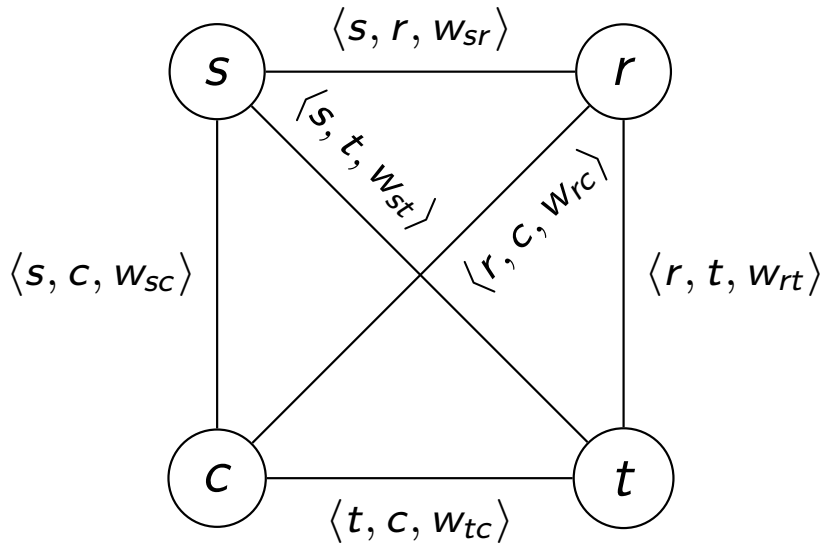

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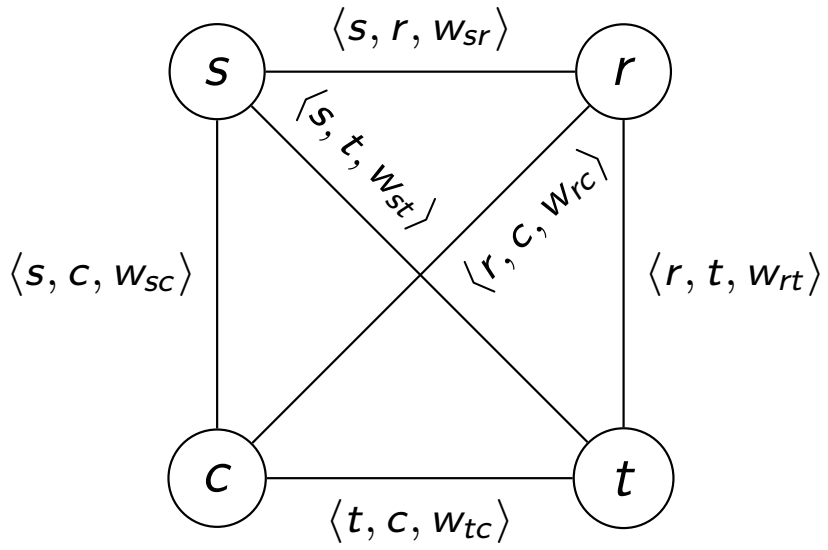

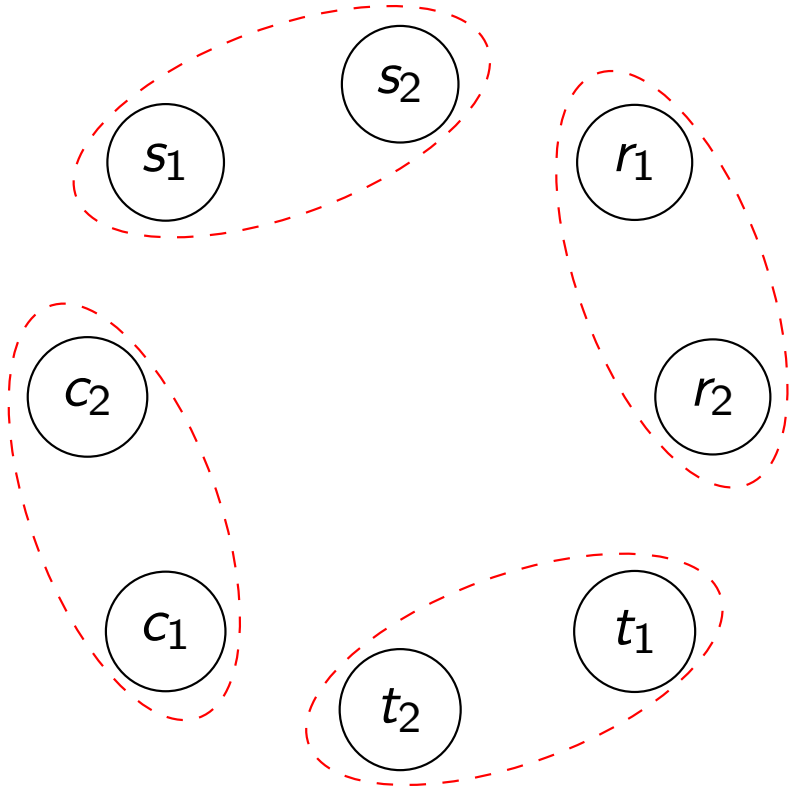

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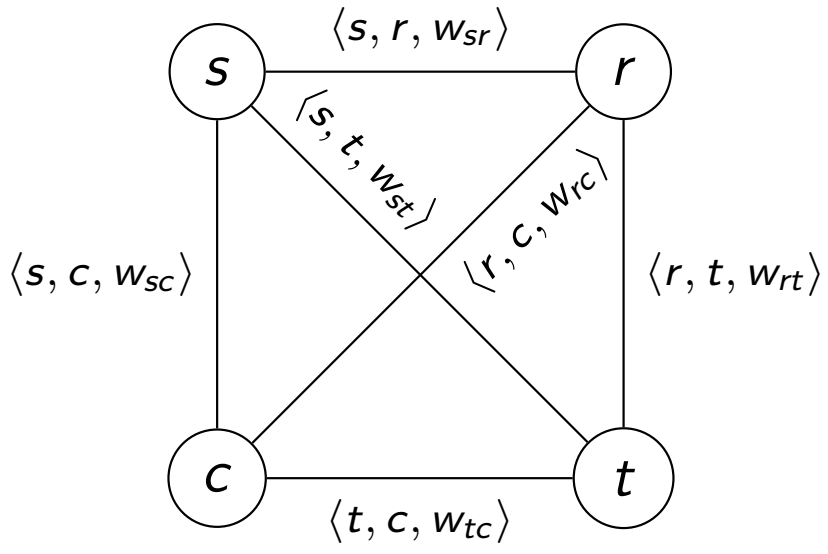

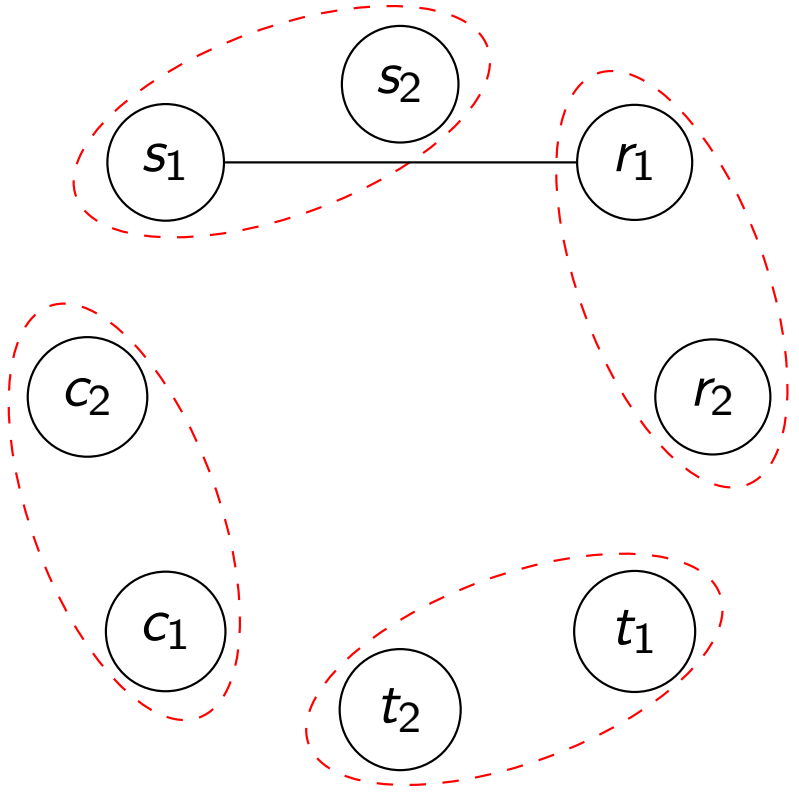

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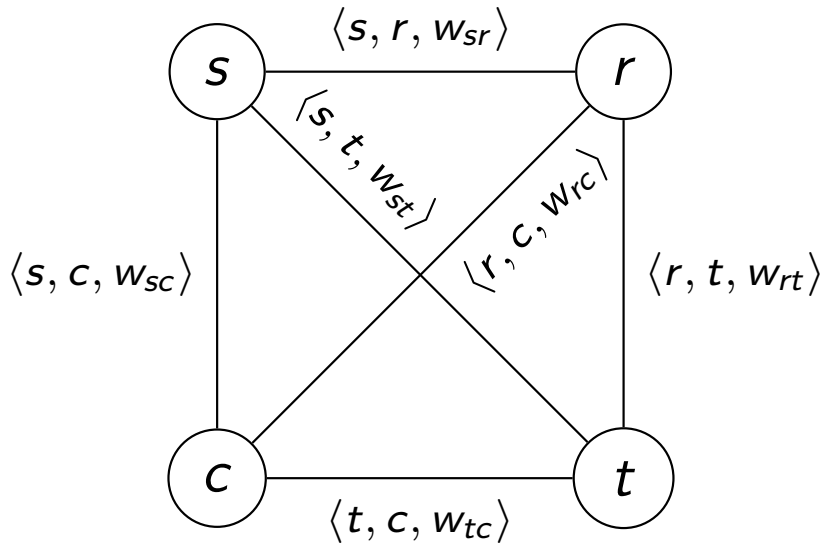

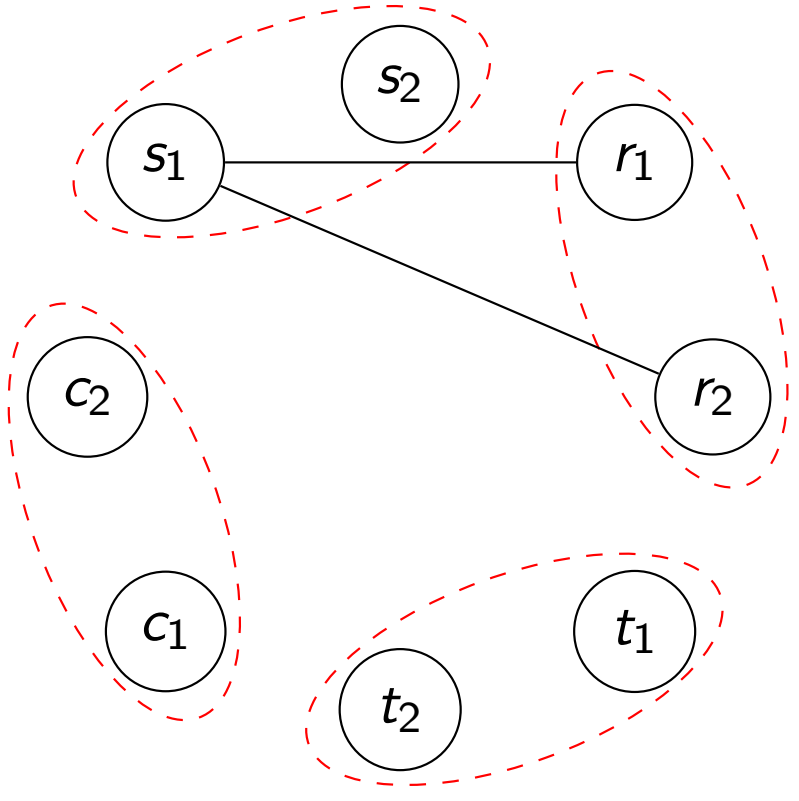

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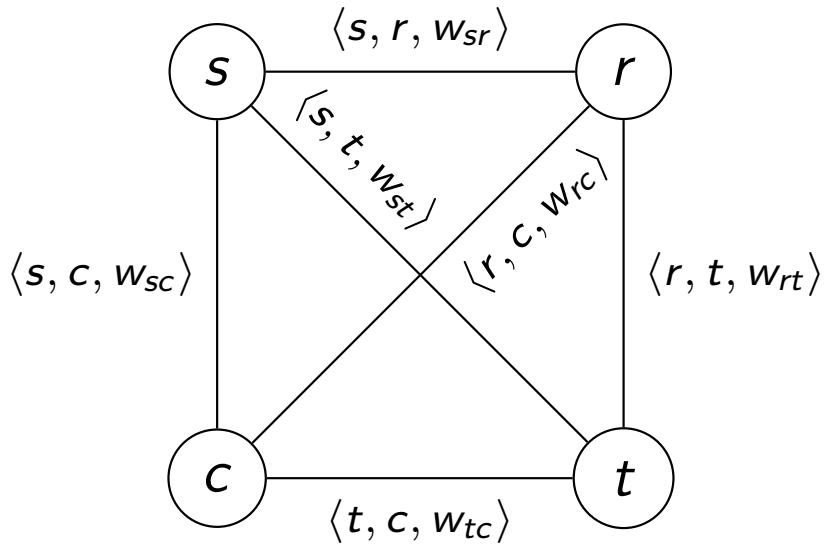

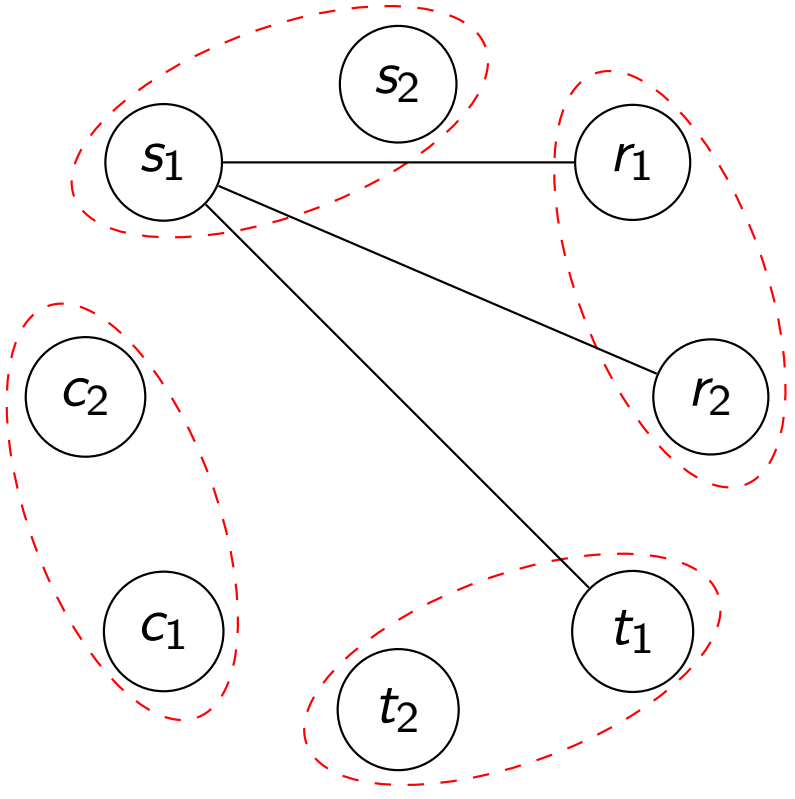

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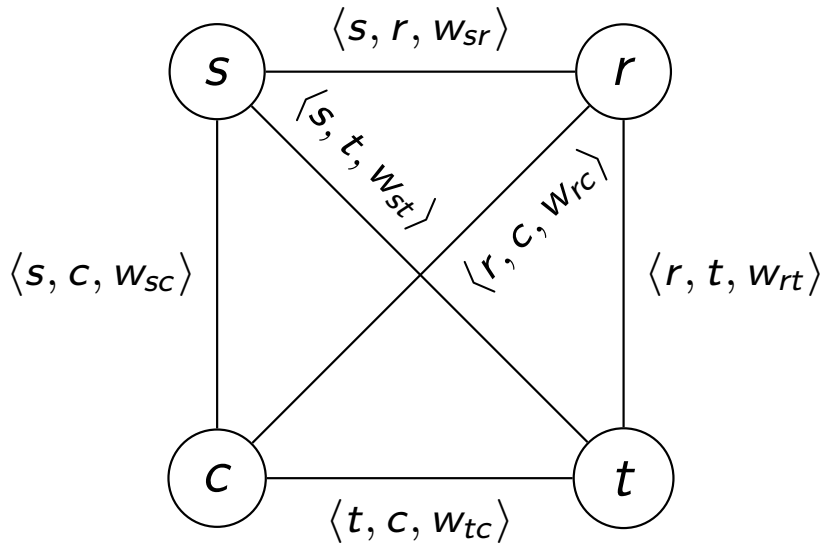

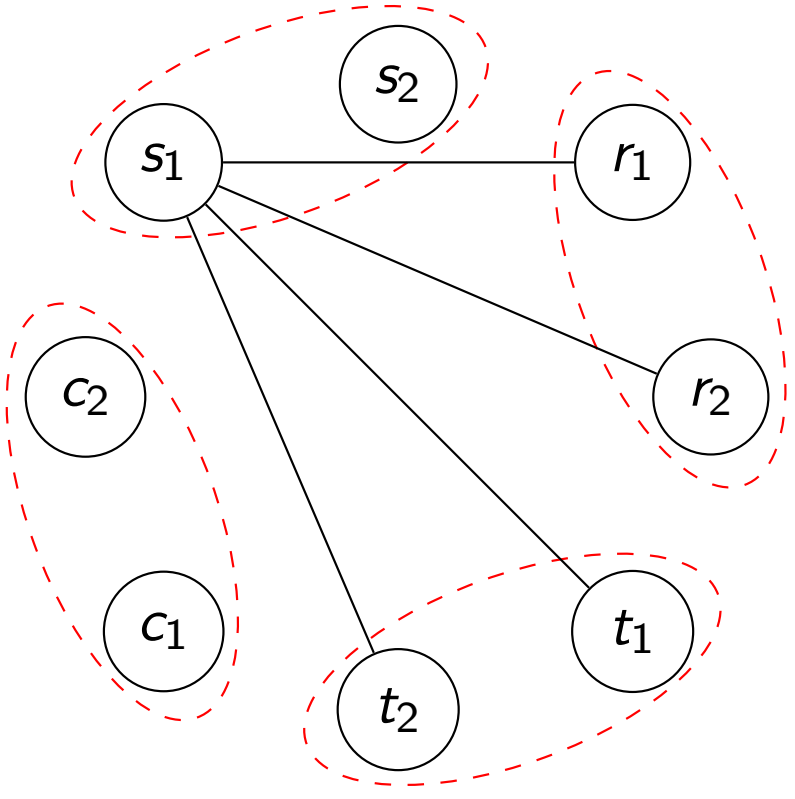

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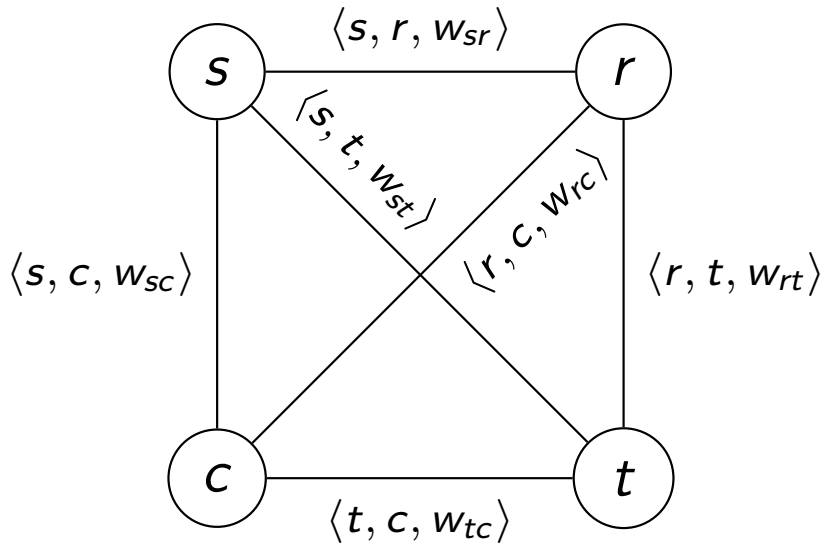

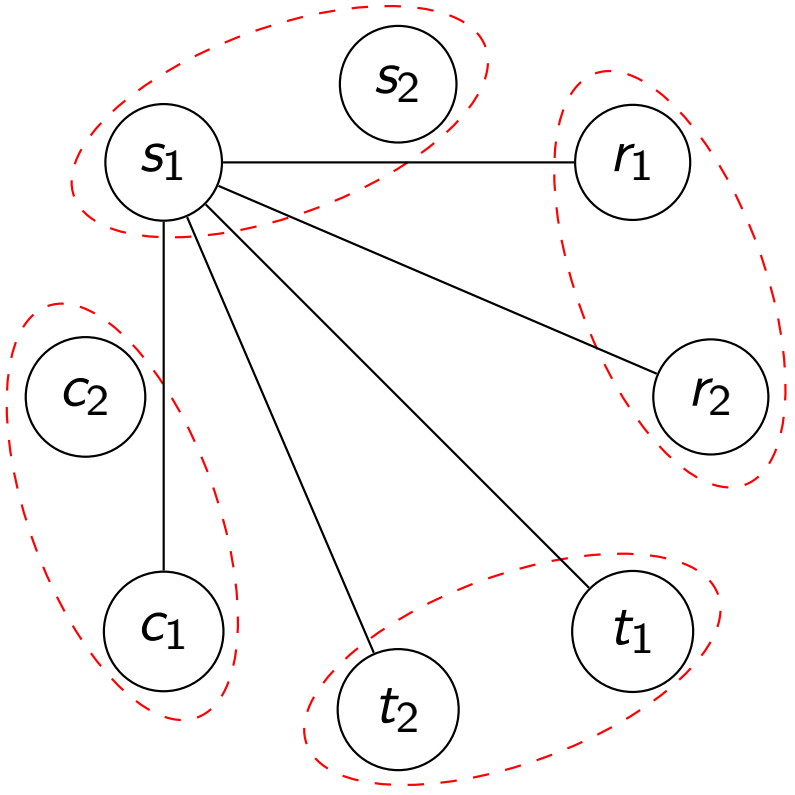

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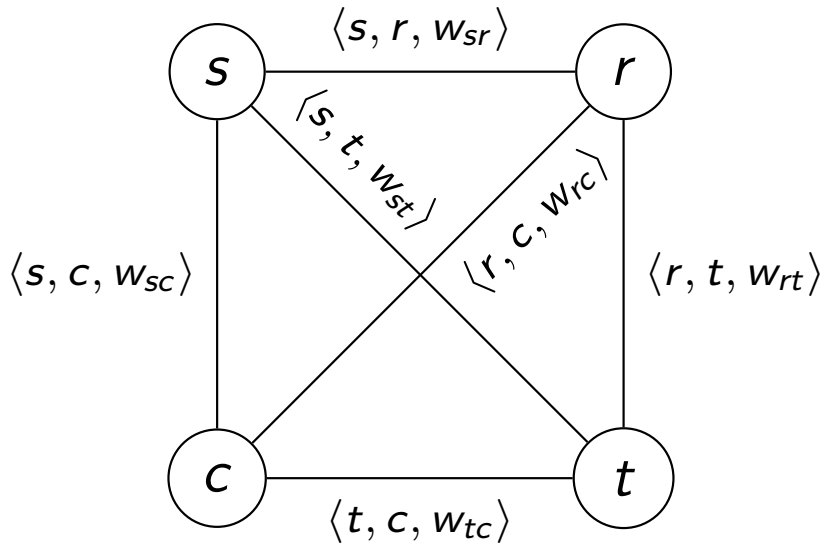

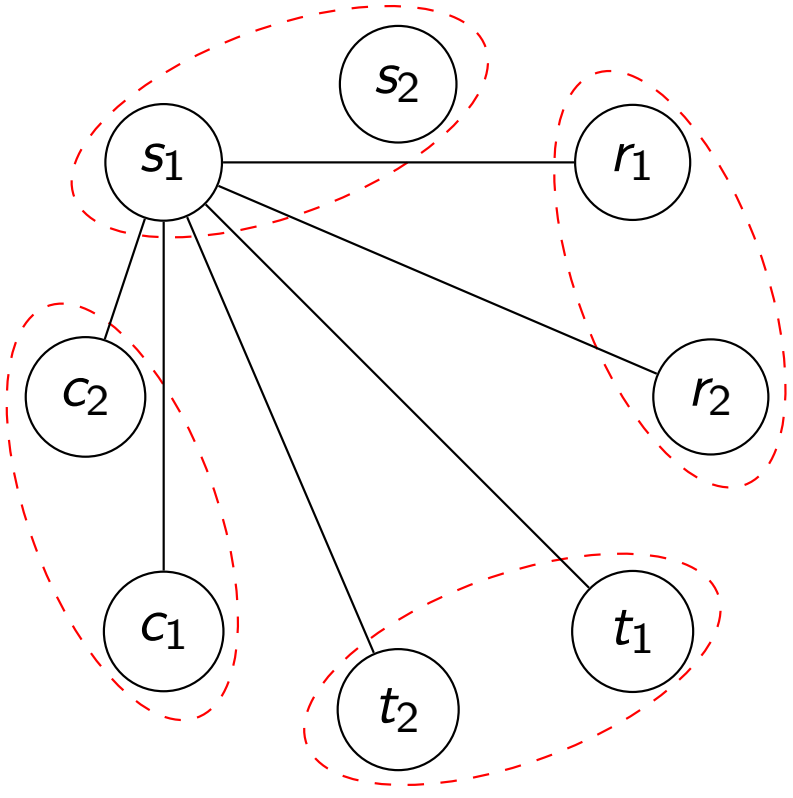

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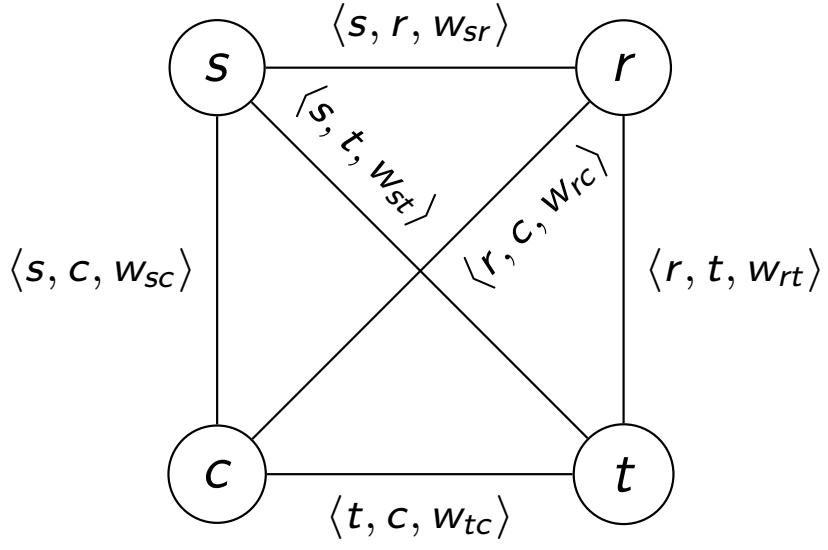

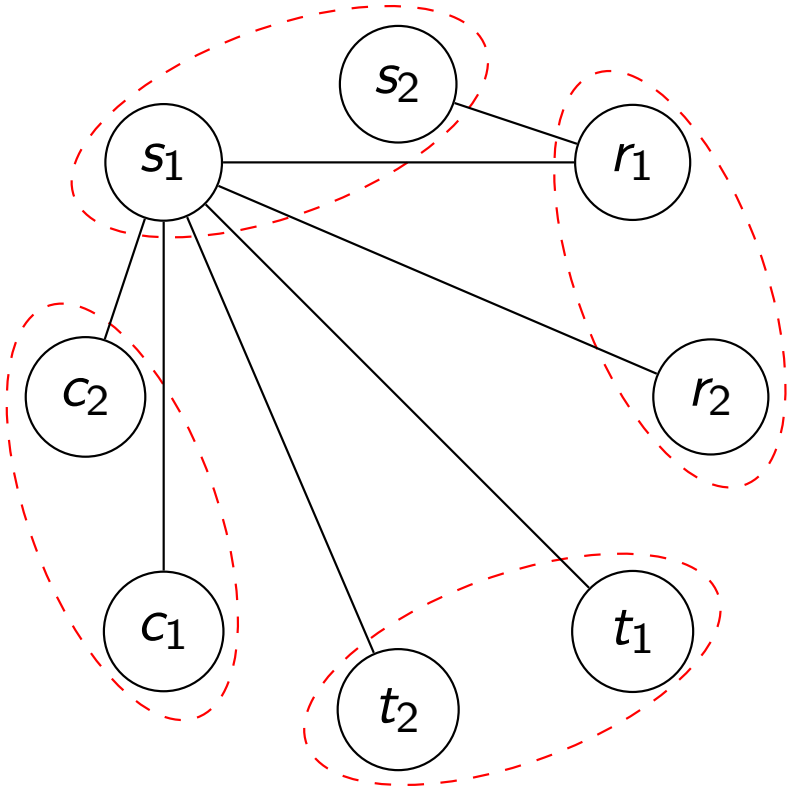

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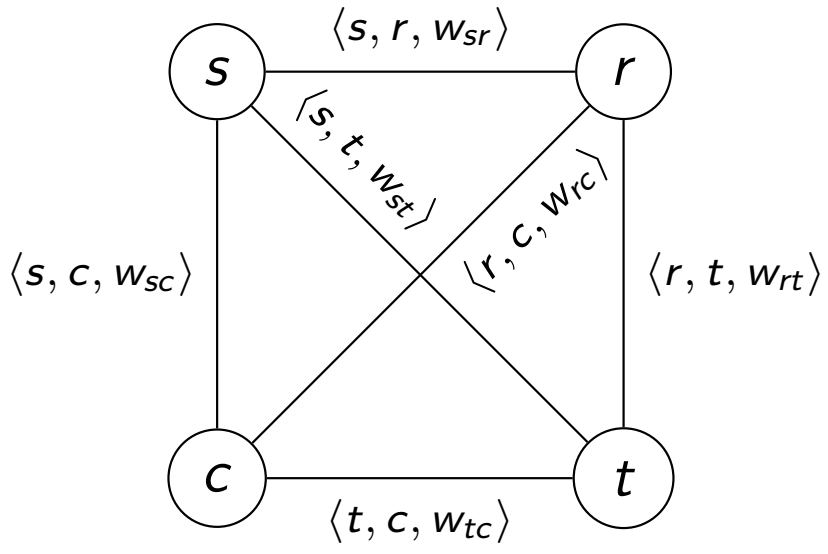

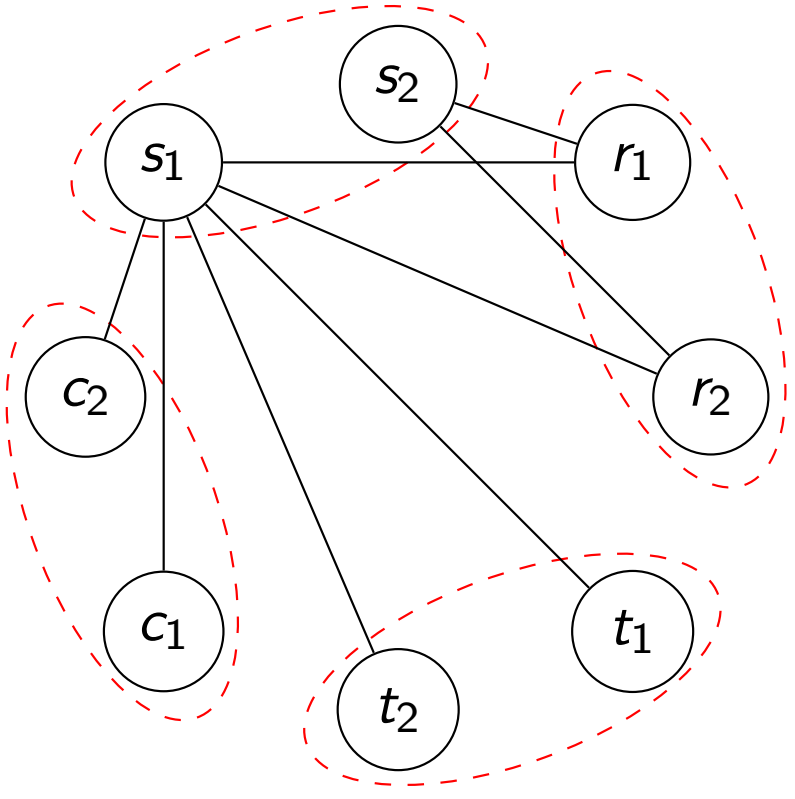

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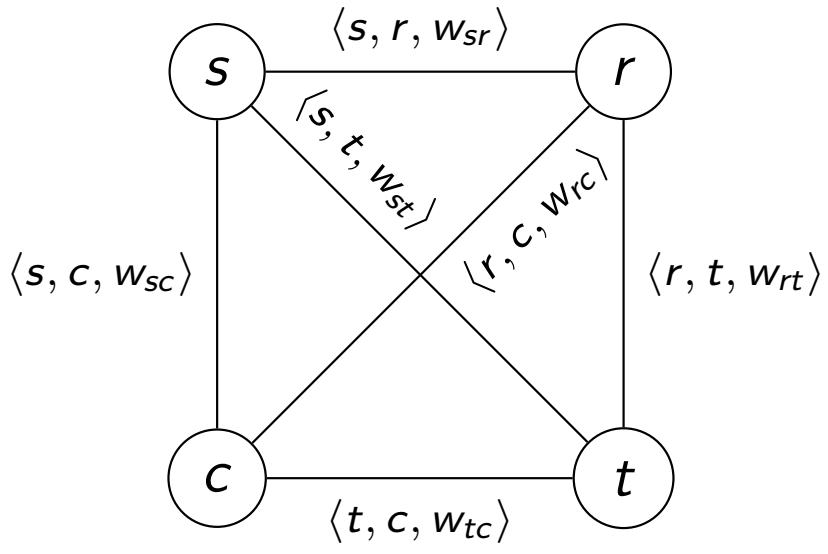

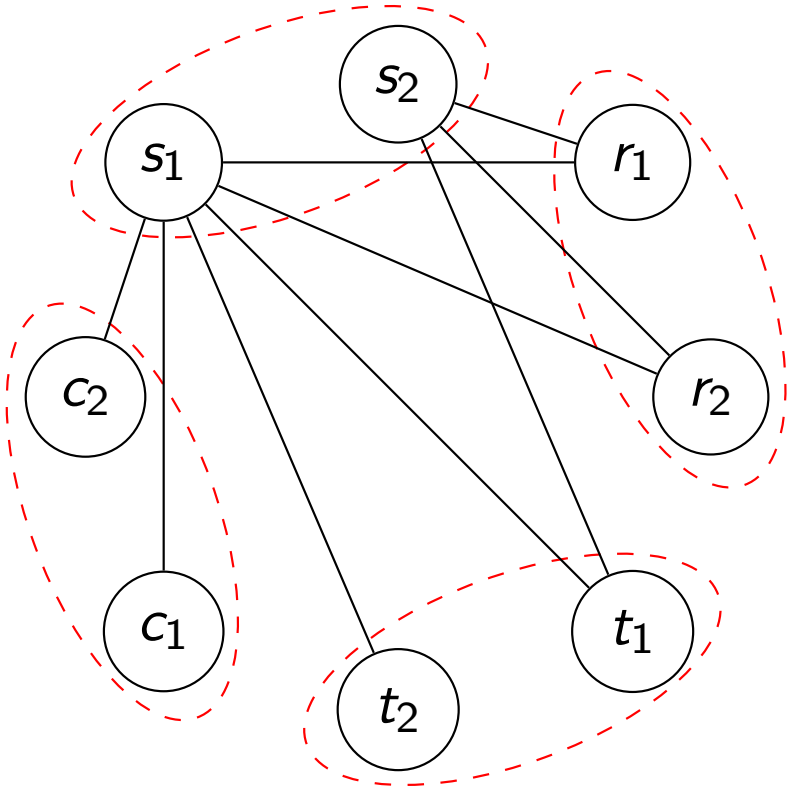

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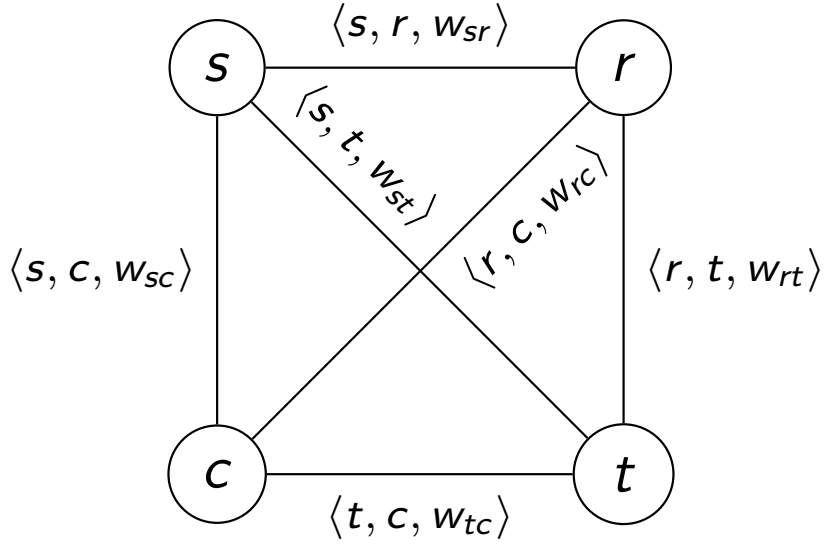

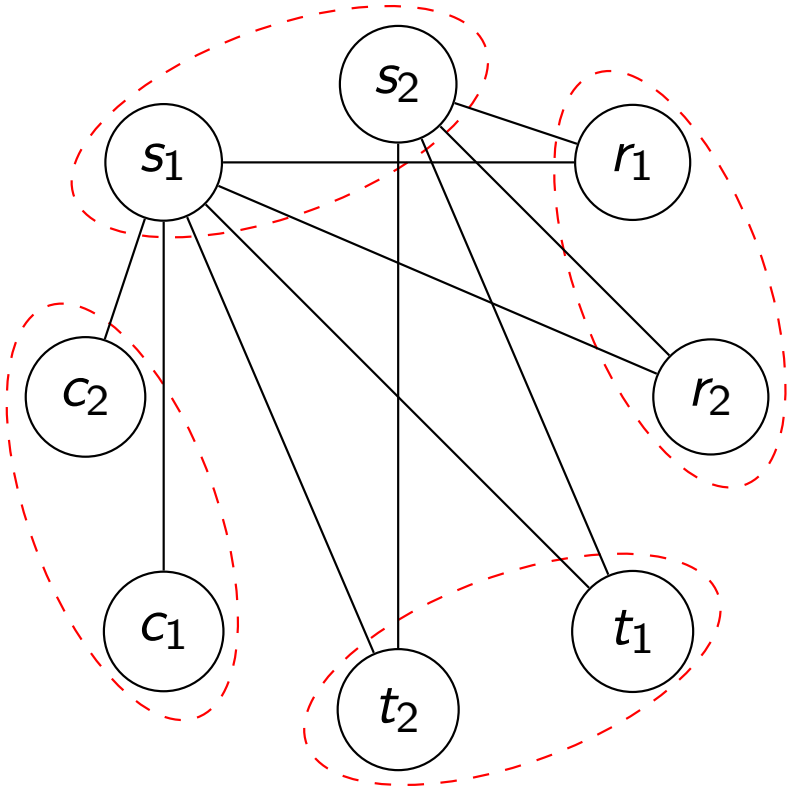

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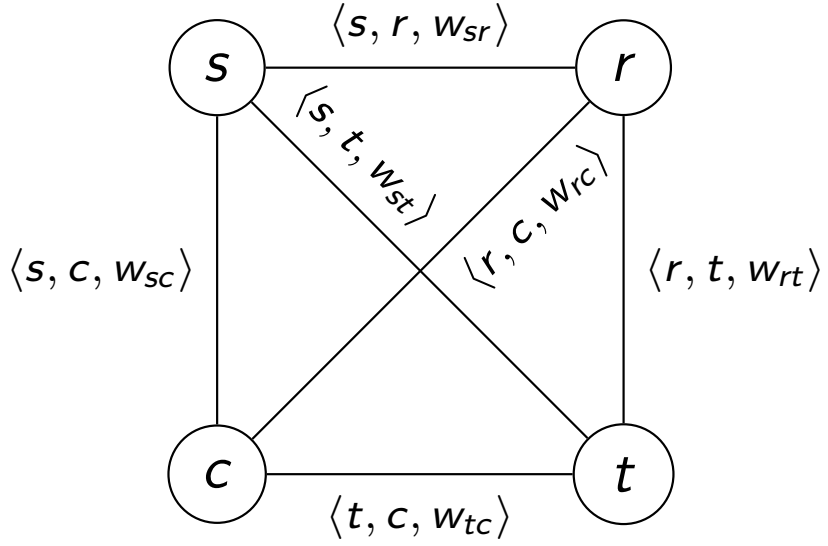

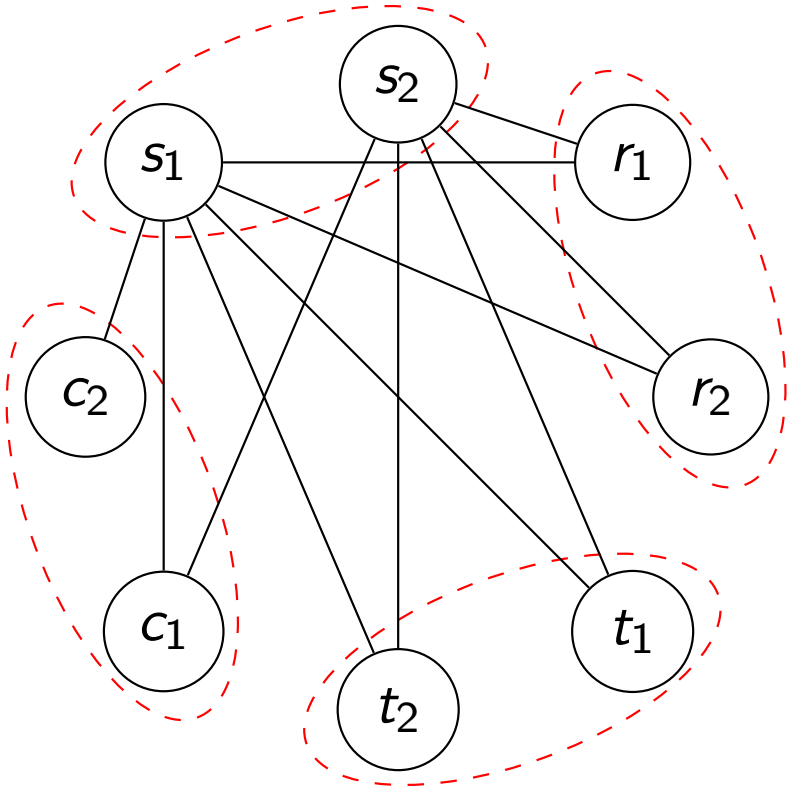

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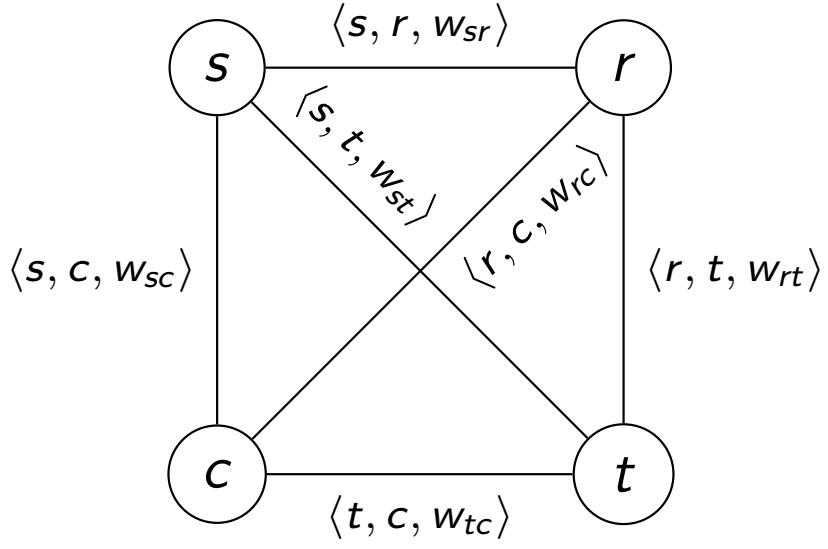

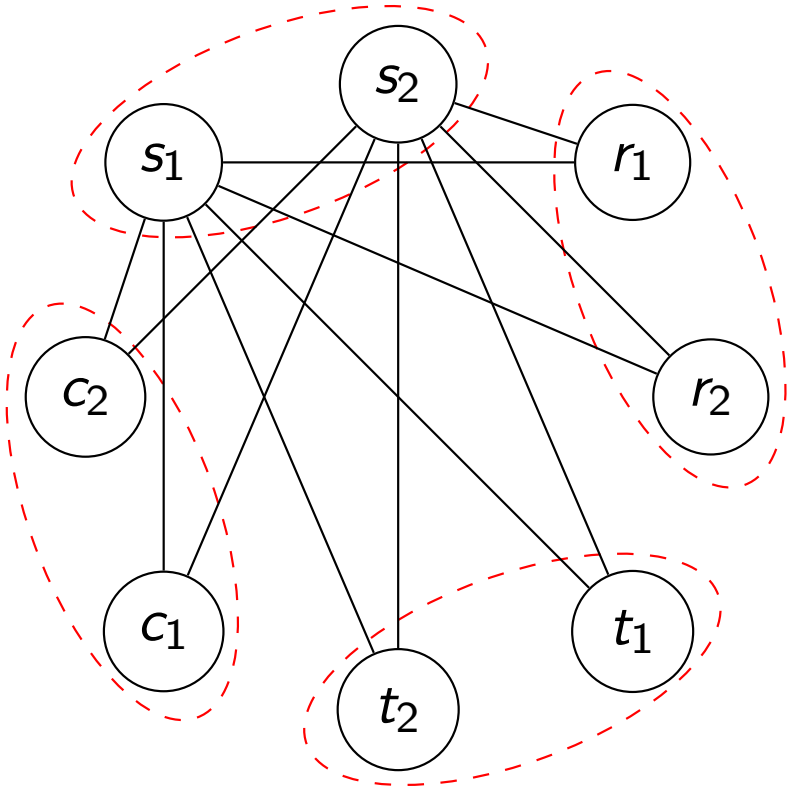

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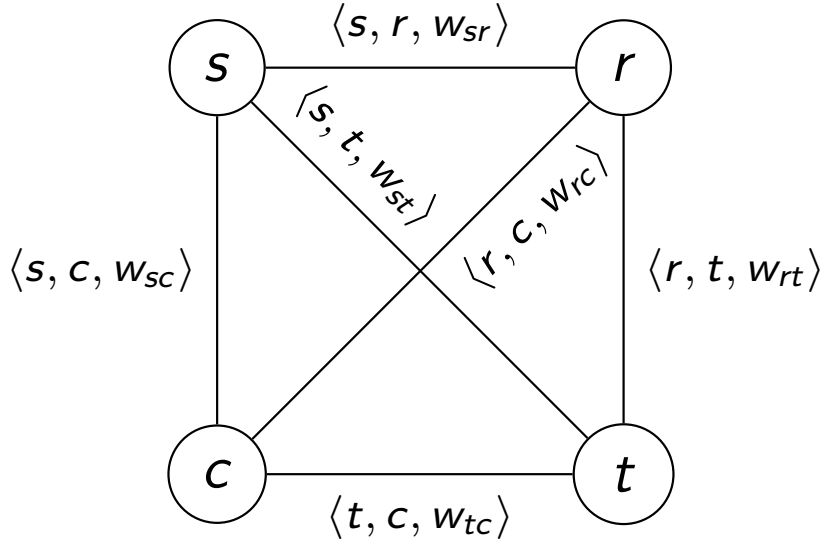

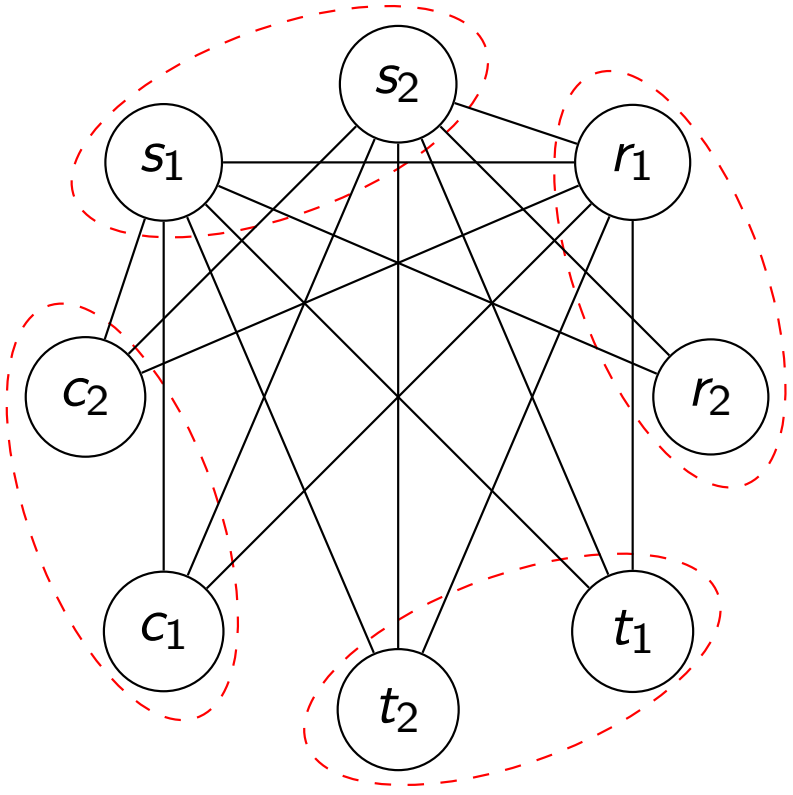

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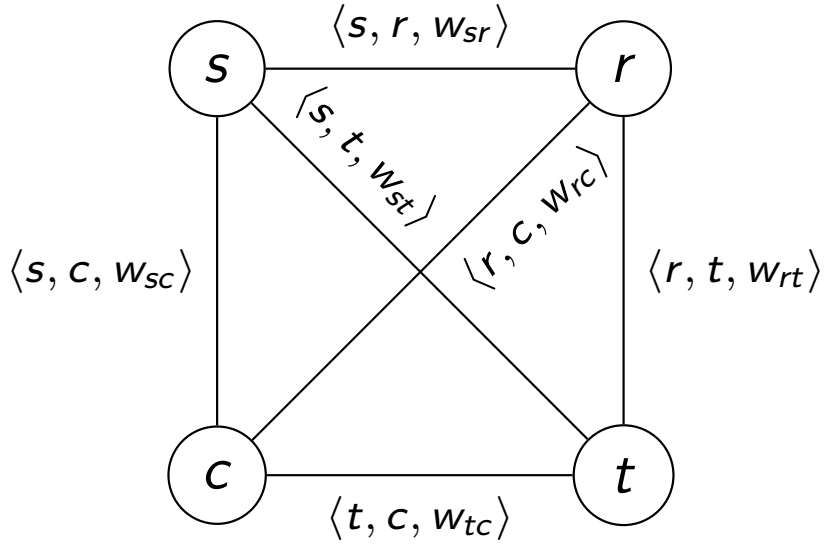

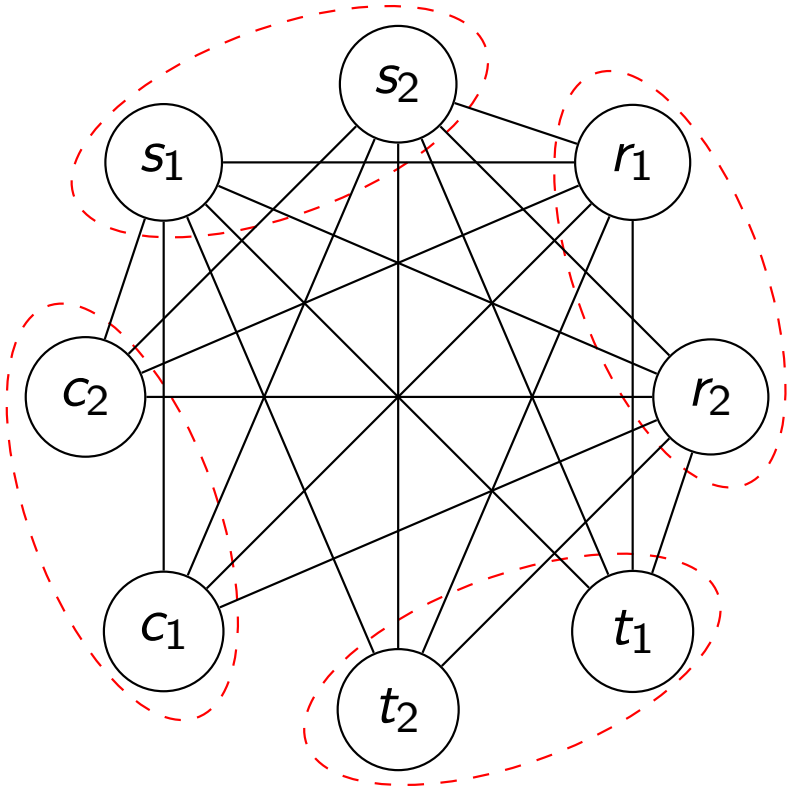

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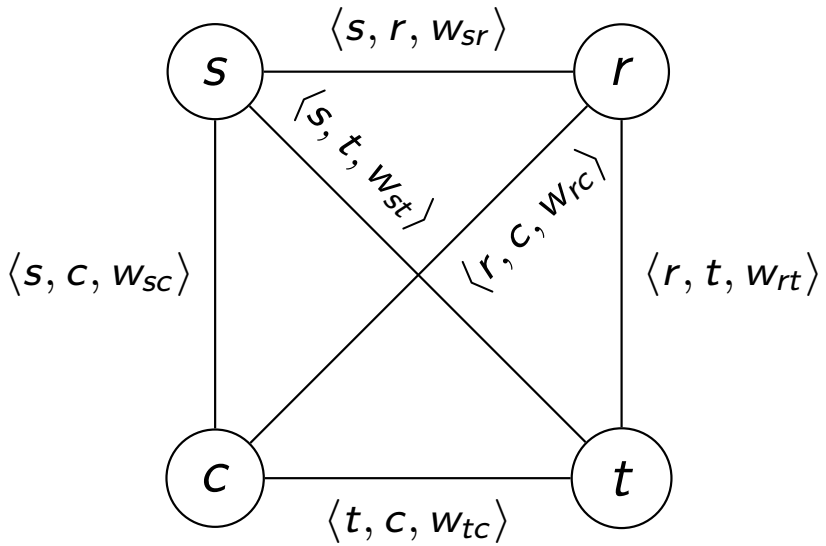
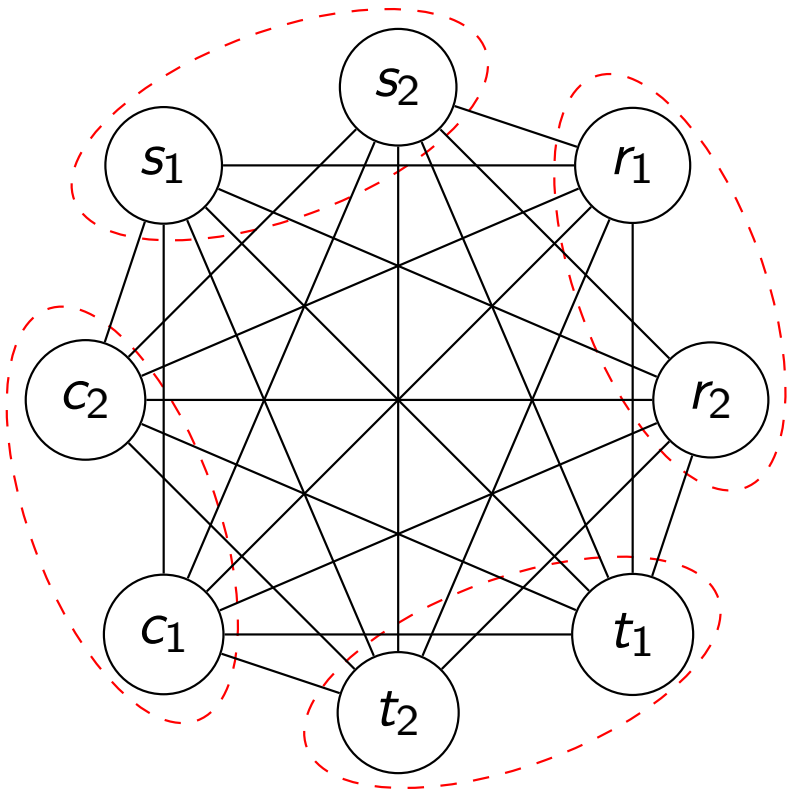
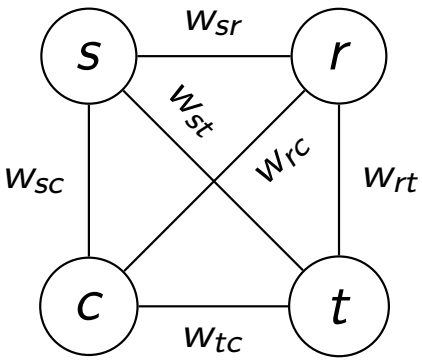




Markov Network (or Markov Random Field)



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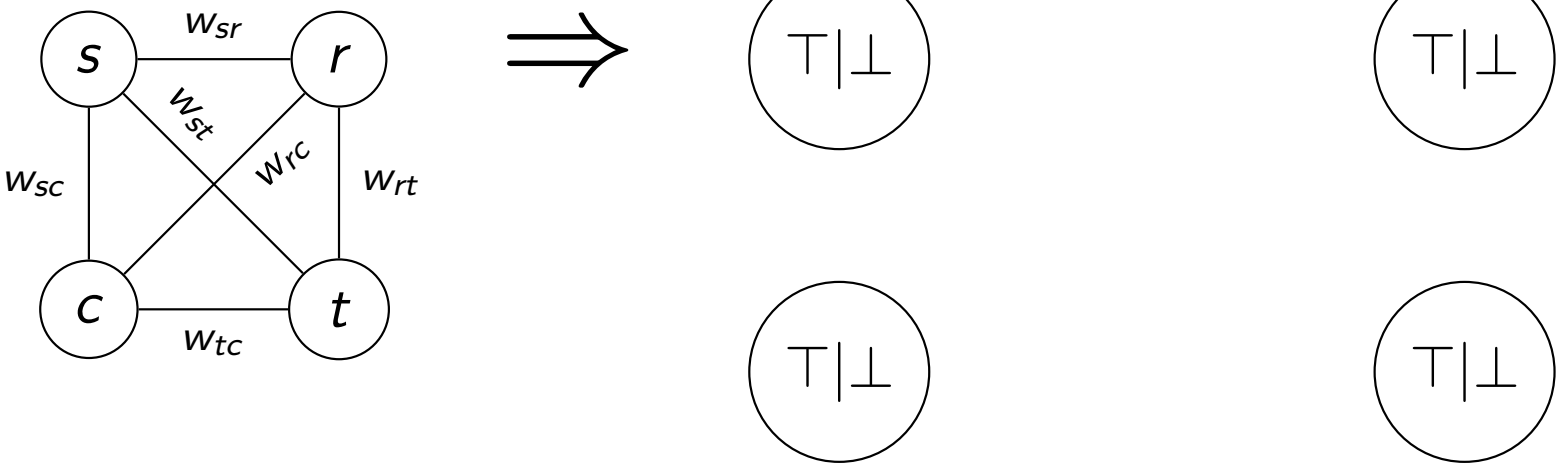

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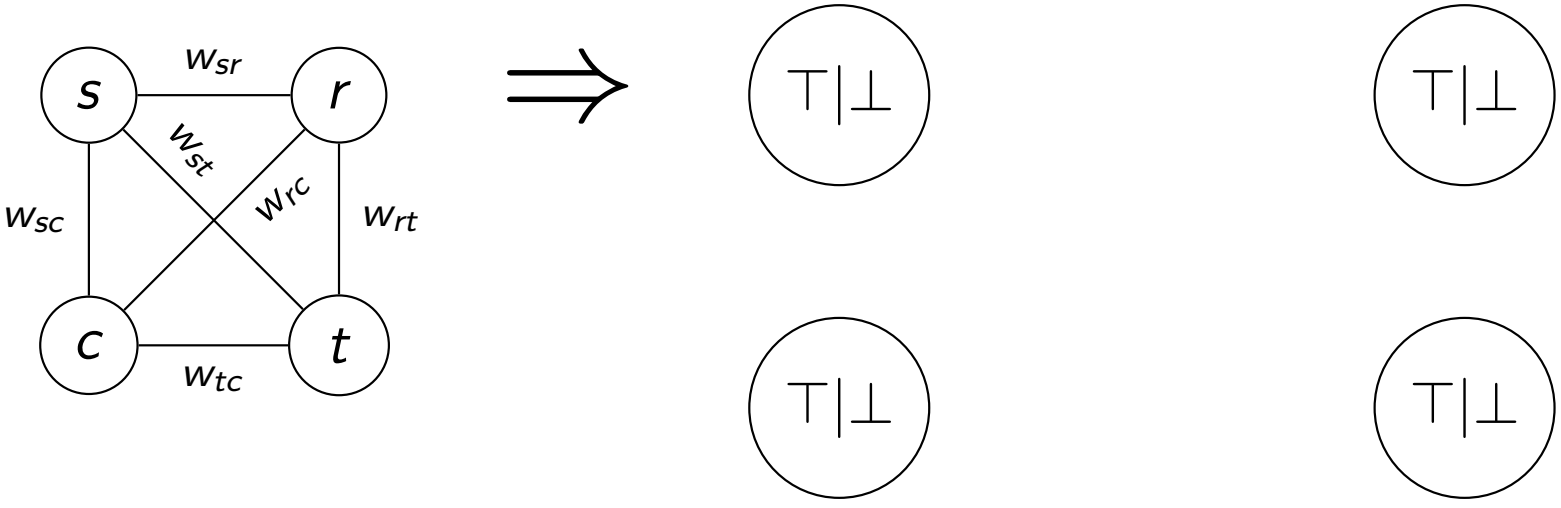

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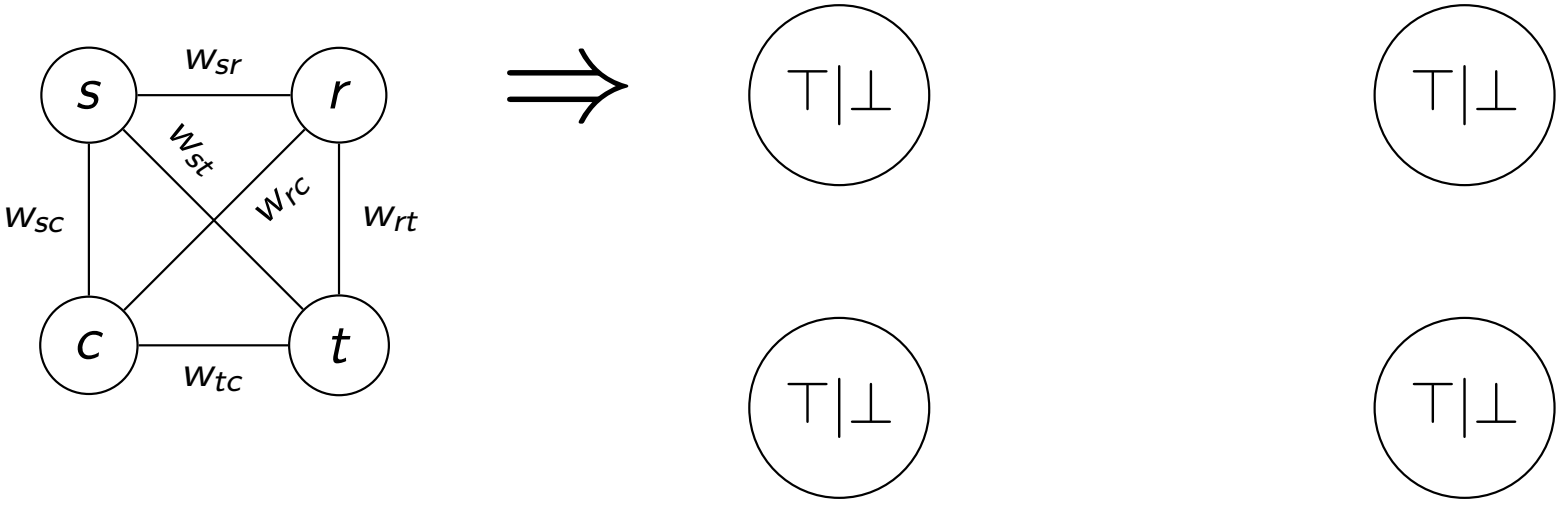

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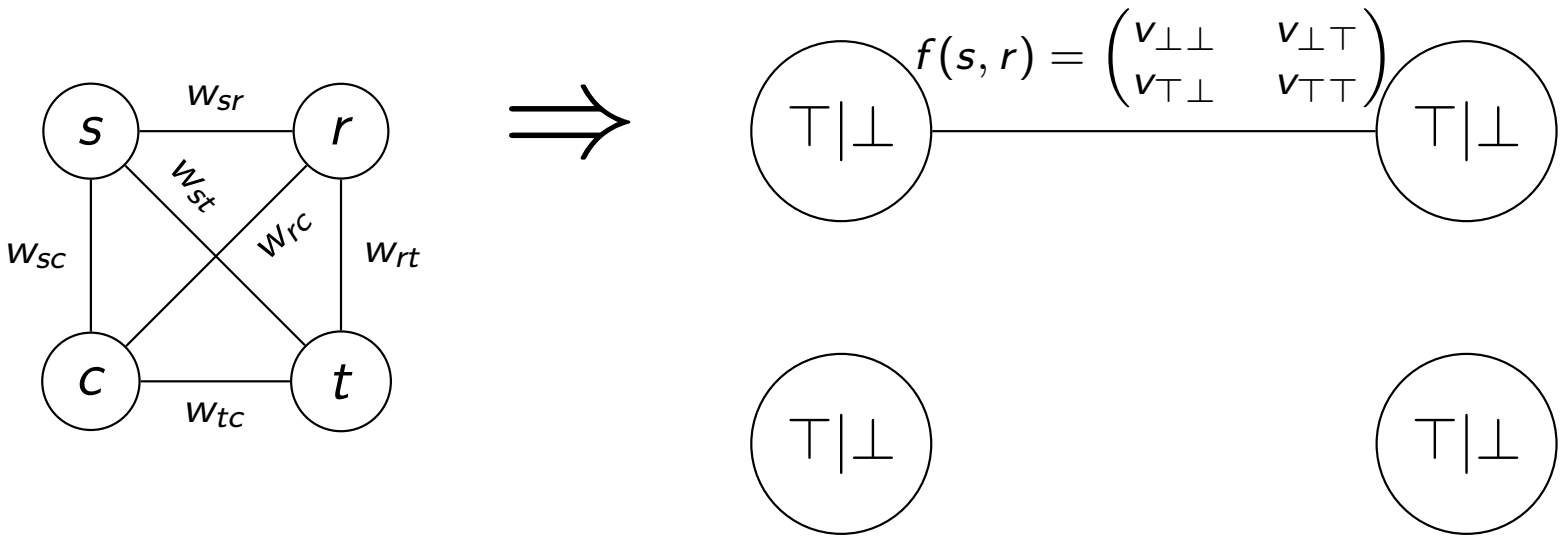

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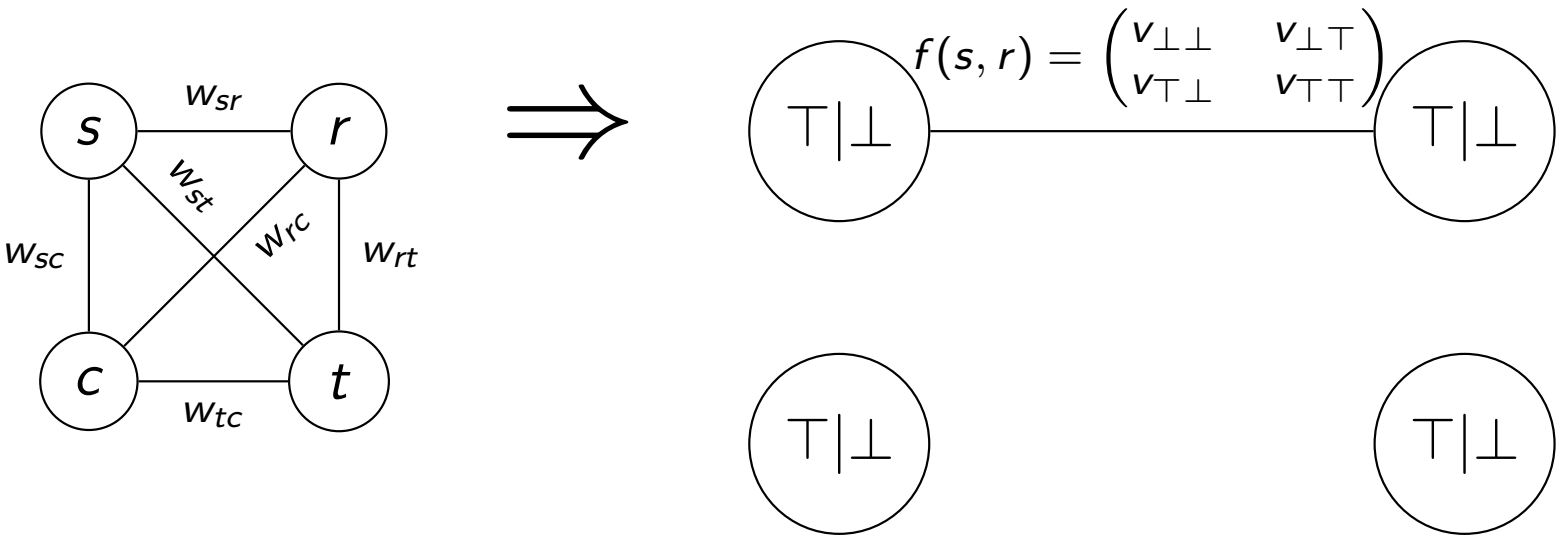

Interpretation:

- $s = \top \Rightarrow s$ is an expert
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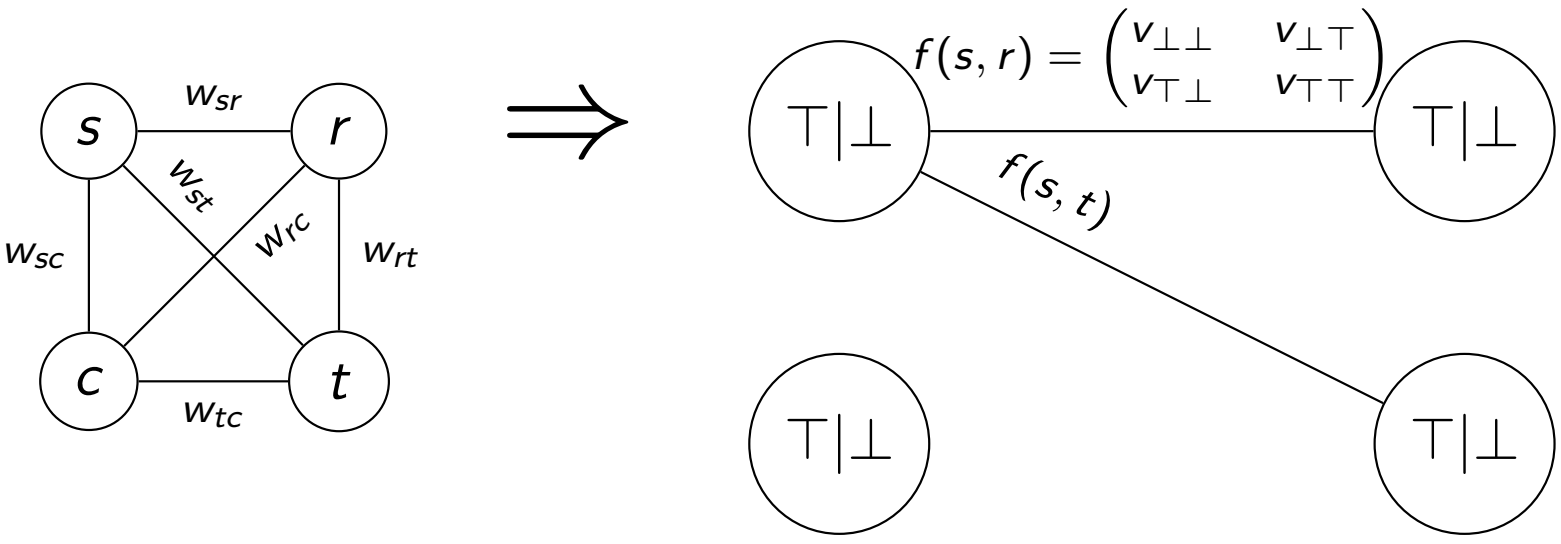

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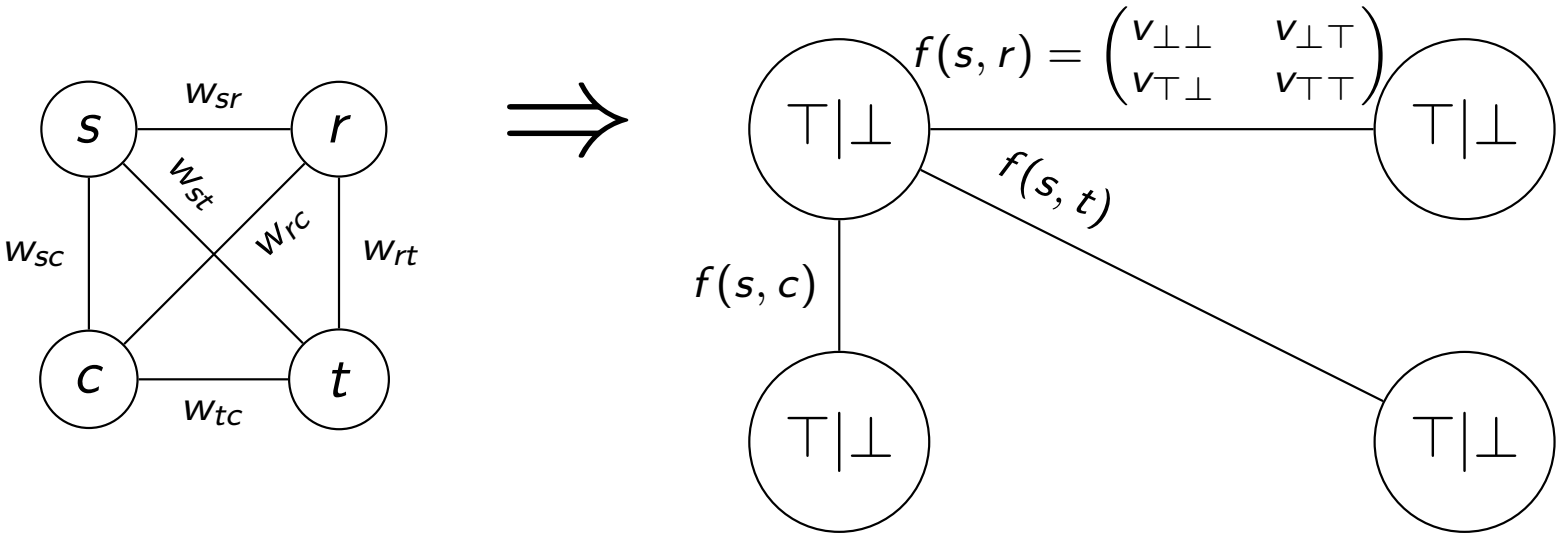

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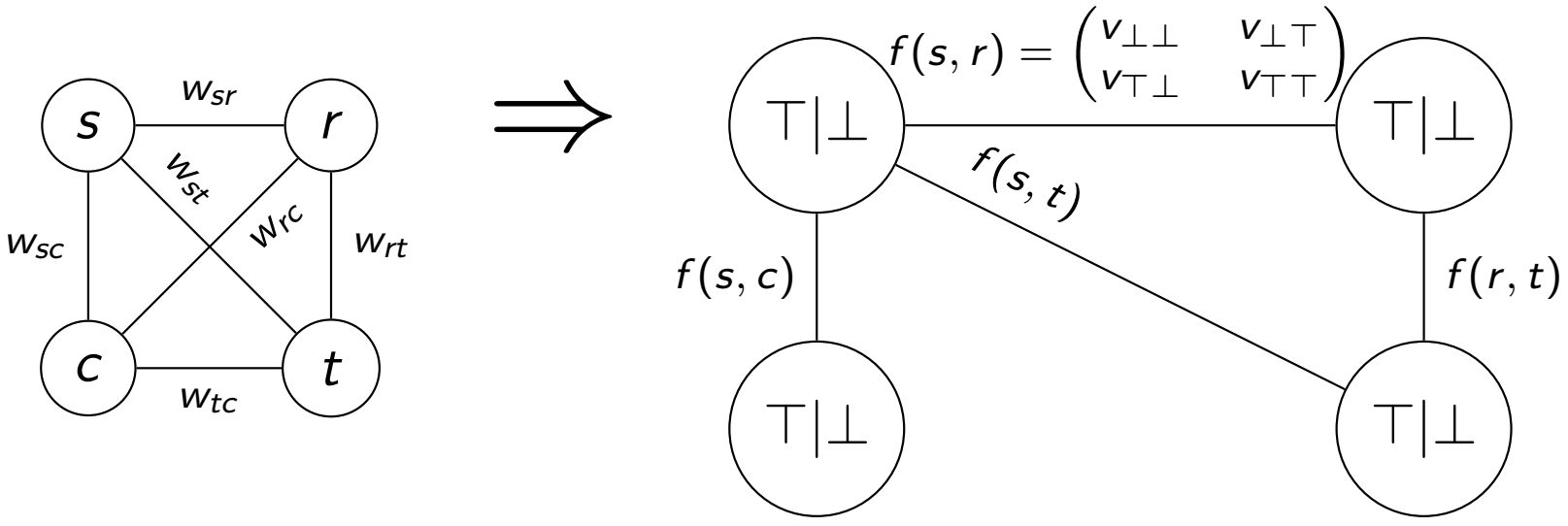

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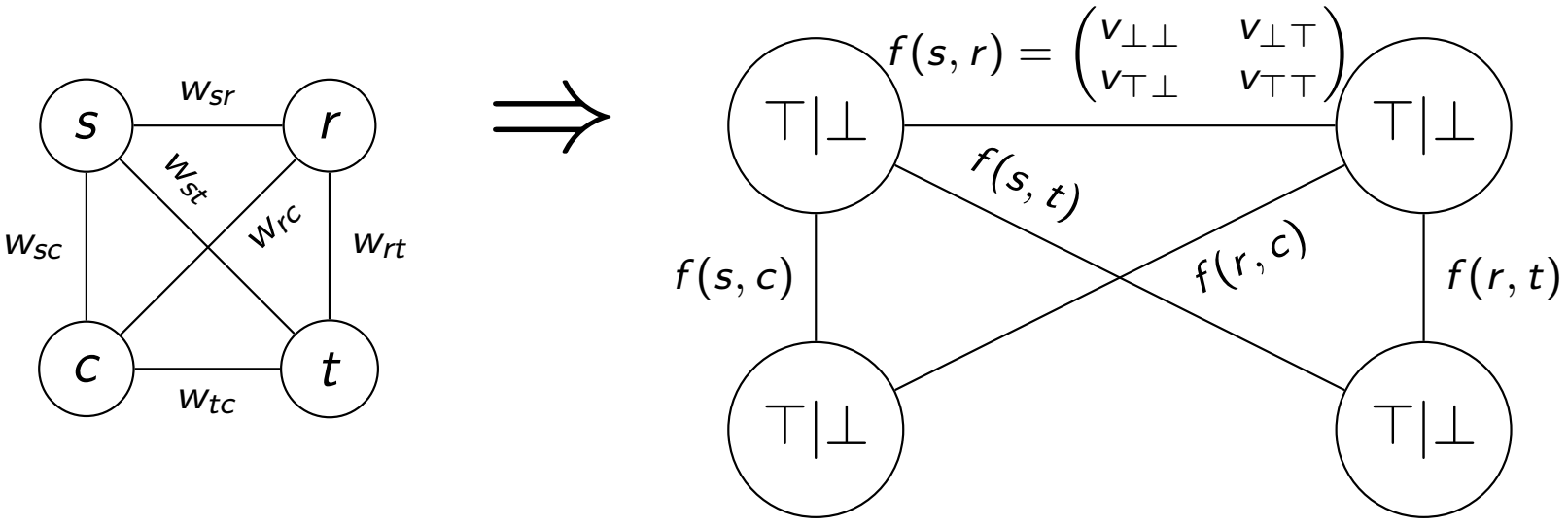

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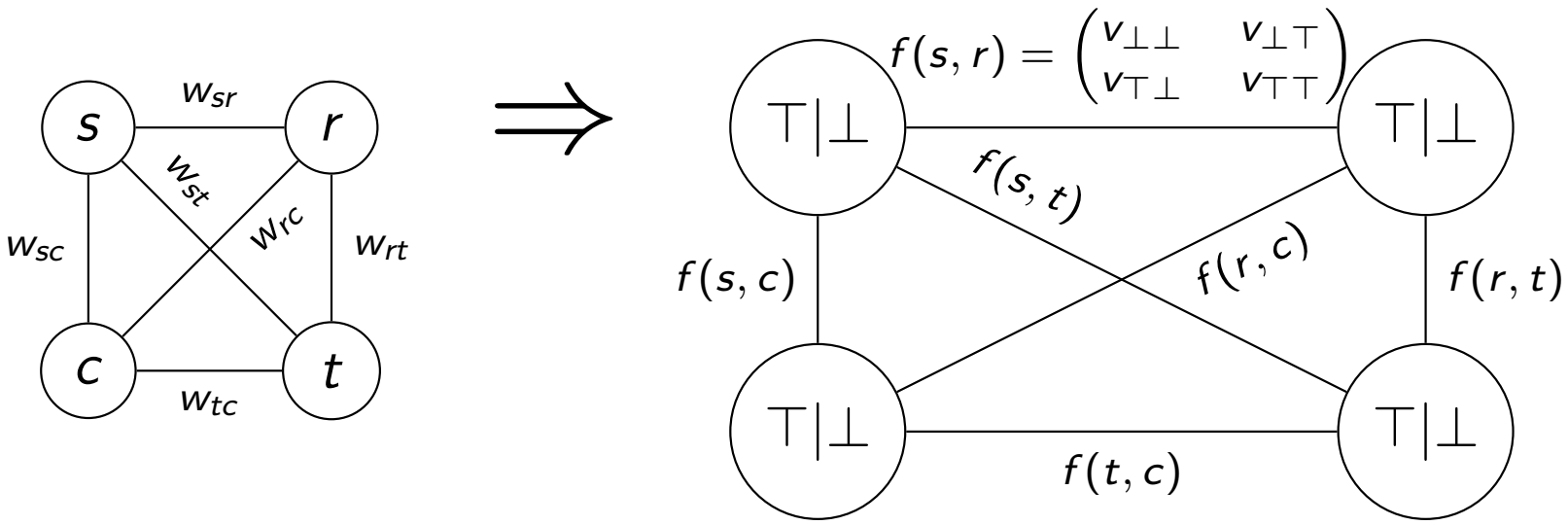

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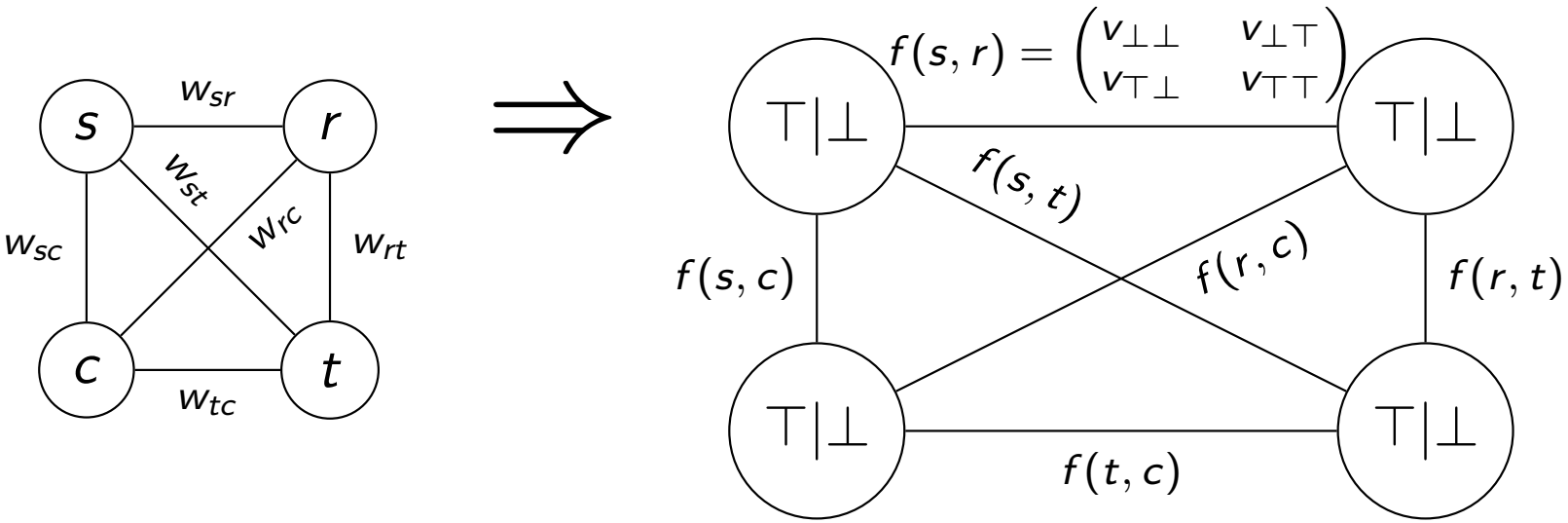

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- *Network* = (N nodes, M functions)

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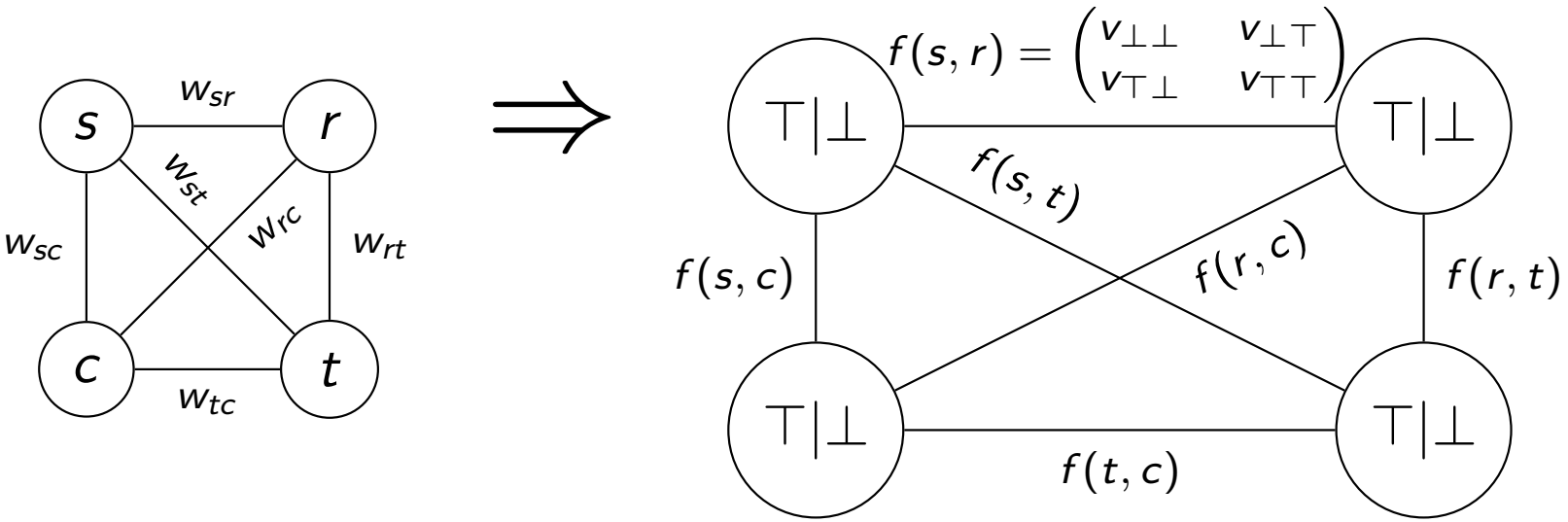

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- $P(n_1 = \perp, ..., n_N = \top) = \frac{\prod_{i=1}^{M} f_i(n_\alpha, n_\beta)}{Z}$ (Z = normalization factor)

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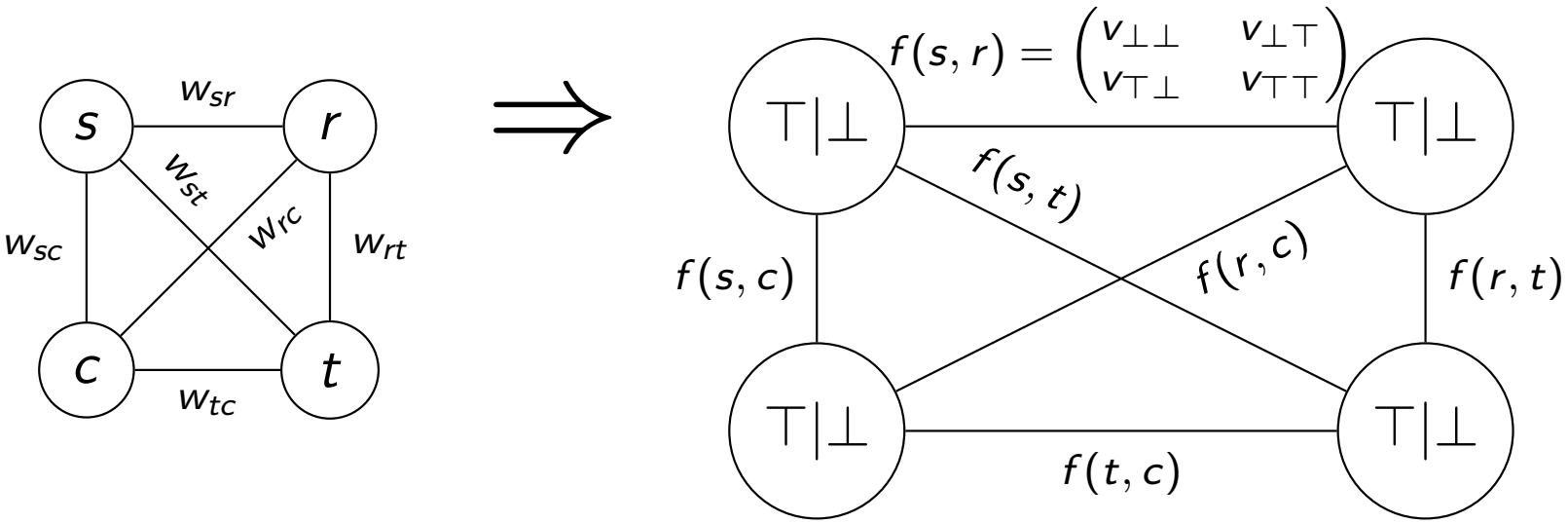

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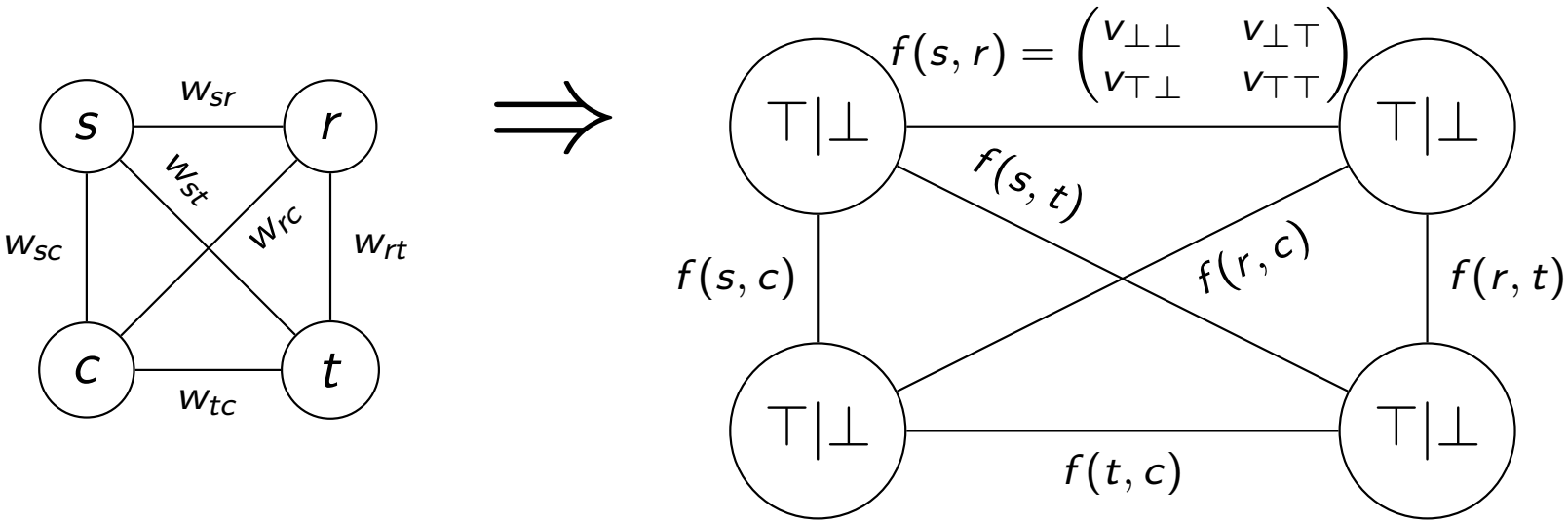

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Experts Ranking with MN

Computation:

- Query: $P(s_i = \top | t_{cryptography} = \top)$

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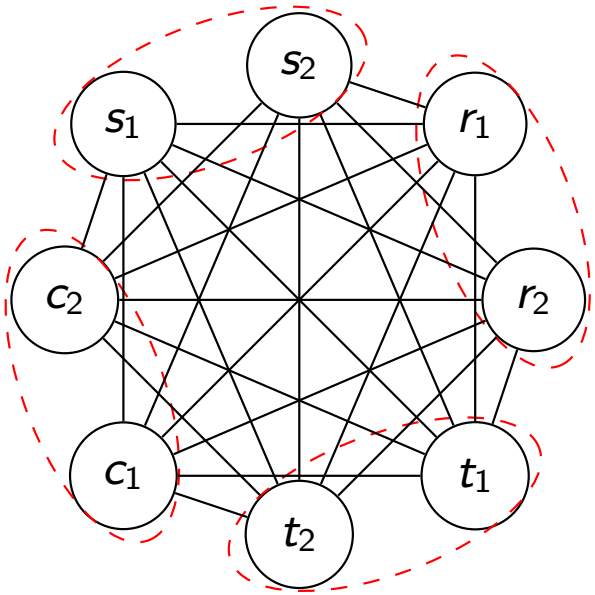

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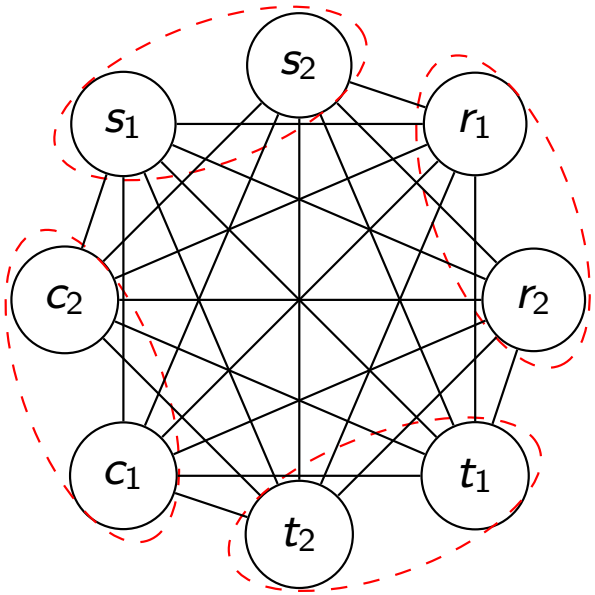

Results:

- $P(s_1|t_1) = 0.365$
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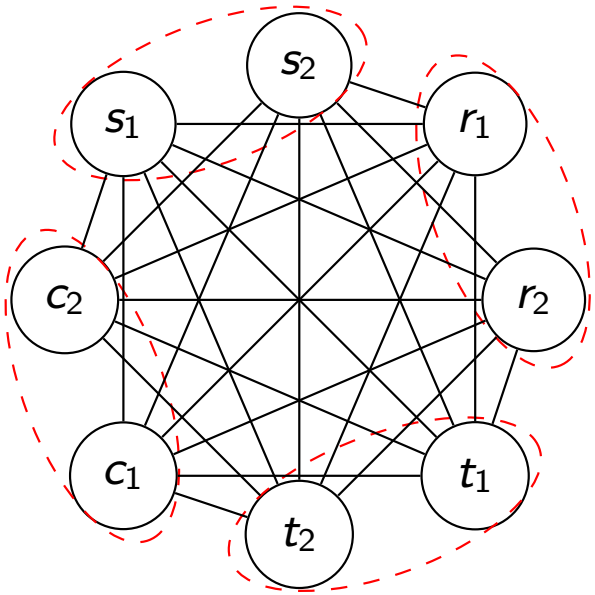

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Ranking:

1. s_2
2. s_1

Questions

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What are the 4 types of entities extracted?

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Stakeholder, term, topic and role.

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6 types: $s - r, s - t, s - c, r - t, r - c, t - c$

Questions

A Markov network allows to compute statistics. True or false?

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False, they allow to compute probabilities, but we use statistical evidences to feed it.

Questions

Which ranking for:

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- $P(Bob|cryptography) = 0.82$
- $P(Carla|cryptography) = 0.95$
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Answer:

1. Carla
2. Bob
3. Dilan
4. Alice

Outline

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Out of the RE field, many other works can be considered: expert finding in companies by using document repositories, expert on source code by using source history, etc.

C. Castro-Herrera and J. Cleland-Huang. A machine learning approach for identifying expert stakeholders. In 2009 Second International Workshop on Managing Requirements Knowledge (MARK), pages 45 –49, Sept. 2009. doi: 10.1109/MARK.2009.1.

S. L. Lim, D. Quercia, and A. Finkelstein. StakeNet: using social networks to analyse the stakeholders of large-scale software projects. In Proceedings of the 32nd ACM/IEEE International Conference on Software Engineering - Volume 1, ICSE '10, pages 295–304, New York, NY, USA, 2010. ACM. ISBN 978-1-60558-719-6. doi: http://doi.acm.org/10.1145/1806799.1806844. URL http://doi.acm.org/10.1145/1806799.1806844.

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8484, June 2014.