Towards supporting argumentation with knowledge graph visualization

a legal use case

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ContextMinds (contextminds.com)

- Any large data viewed as nodes (concepts) and links (relationships between them)

- Usually (semi-)automatically generated
  - Often with NLP

- Examples
  - Wikipedia articles and links between them
  - Proteins, genes and diseases
  - Laws and relationships between them and their subjects and objects
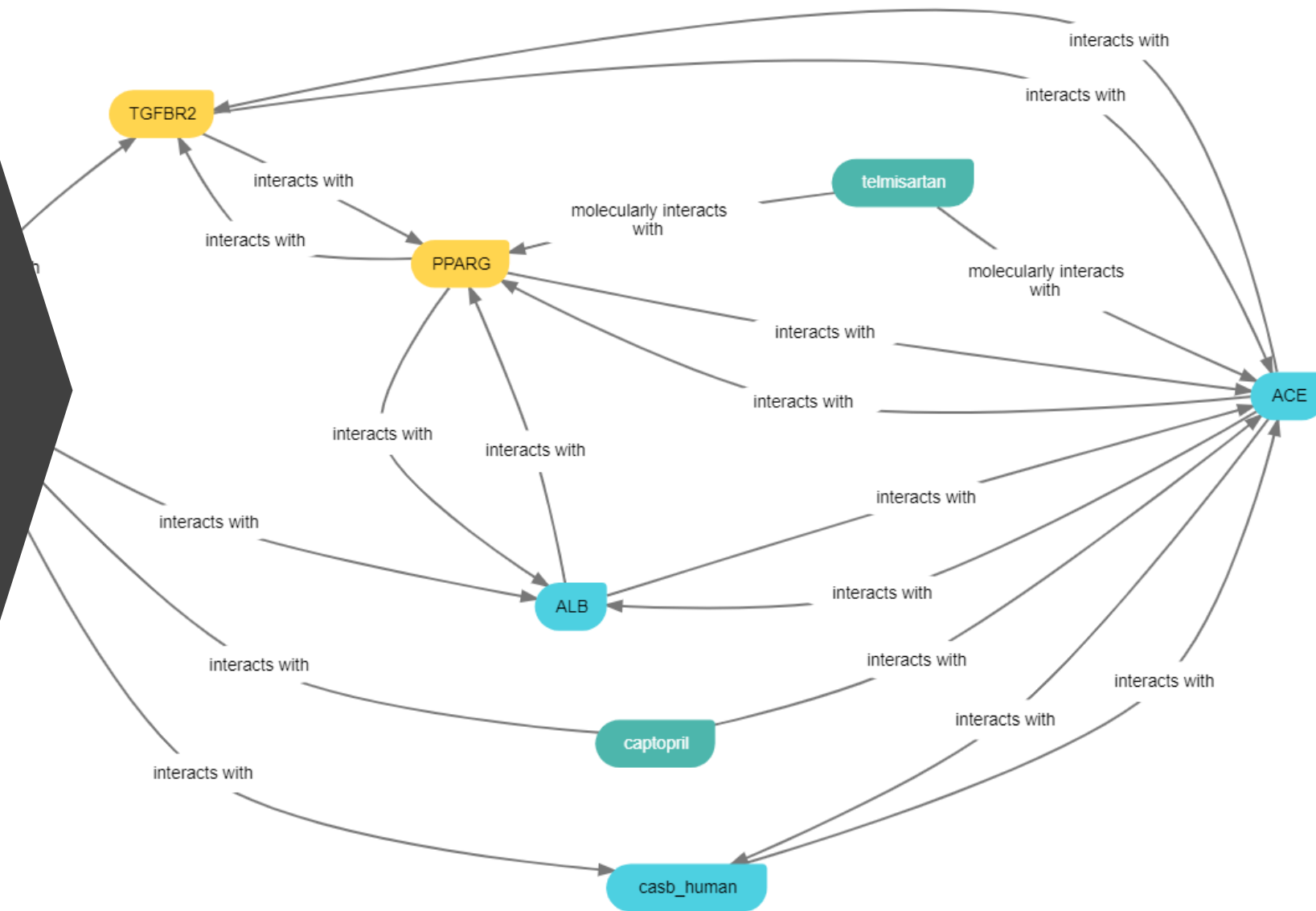 - Diseases, vaccinations, their symptoms and side-effects

What is a Knowledge graph (KG)?

Knowledge graph from Wikipedia
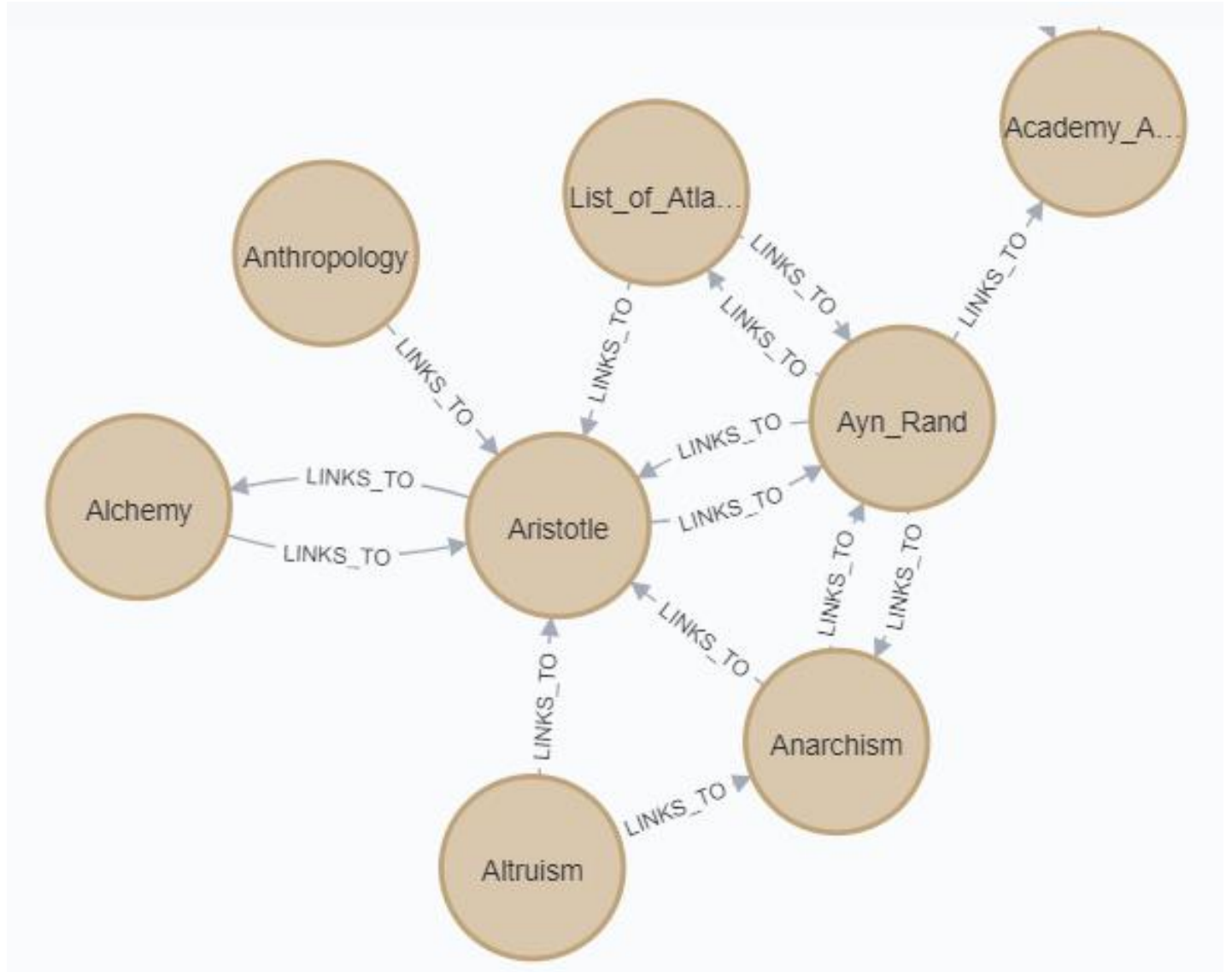
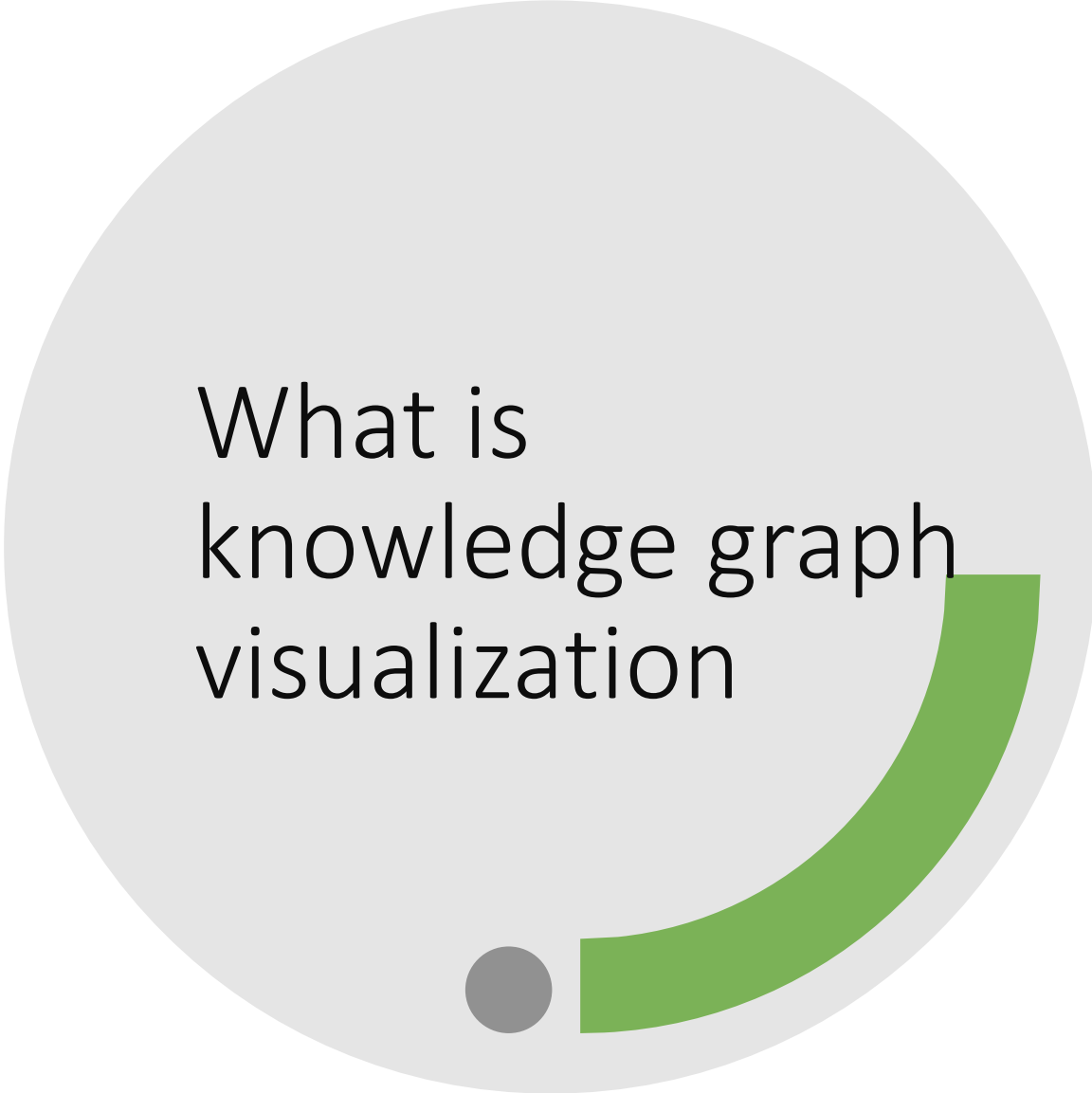Protein & drug interactions KG

- Showing the nodes and links from the graph
- Interactively explorable
  - incrementally expand nodes, showing more relationships
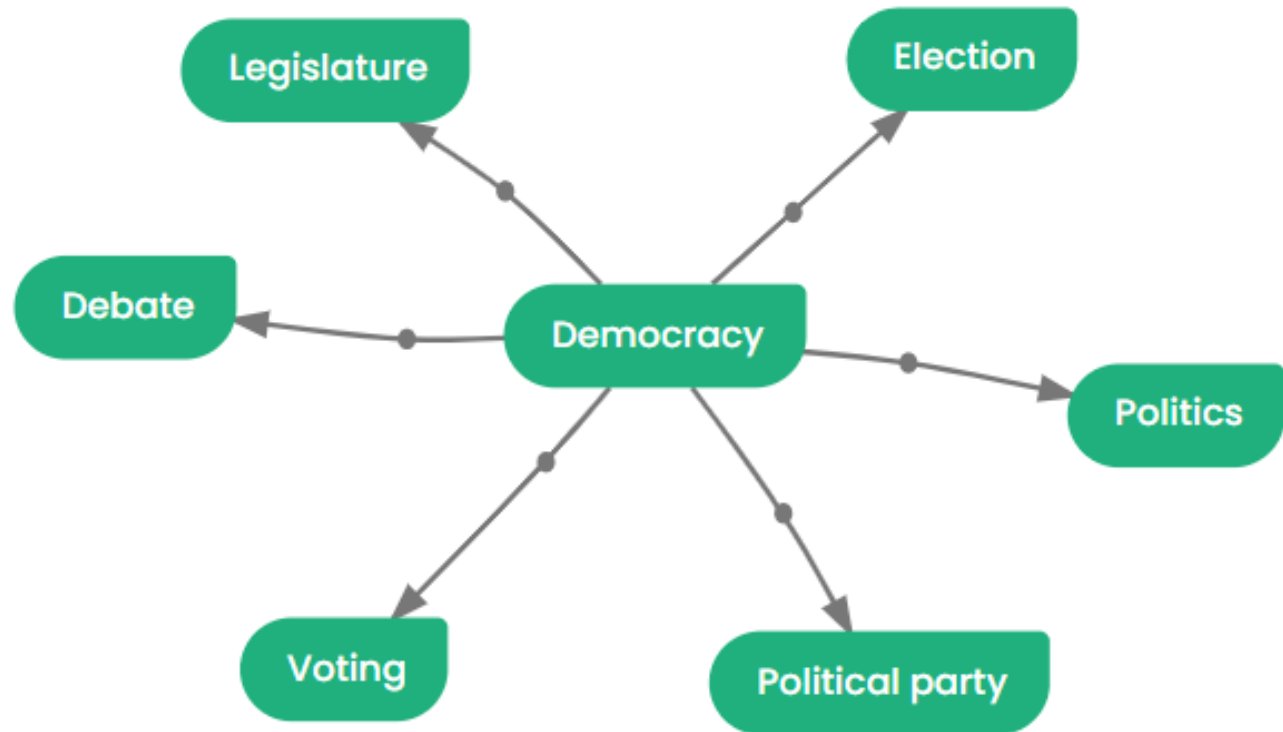
What is knowledge graph visualization

Manually created visual aids for representing knowledge and thoughts

- Mind maps
- Argumentation maps
- Concept maps

Mind mapping

Simple outline of associations between concepts & thoughts

Argumentation mapping

Outline of arguments for and against

Voting should be compulsory.
Compulsory voting - Wik...

because
Compulsory voting ensures that the Government is representative.

because
Political parties do not have to waste money on persuading people to turn up to the voting booth.

but
Compulsory voting is an infringement of democratic principles.

because
A large majority of the voting population will vote when it is compulsory.

but
Everyone does not have to vote for the Government to be called representative.

because
With compulsory voting people will get fined if they don't turn up to the voting booth.

however
Citizens living in a democracy have the right and the responsibility to vote.

because
People living in a democracy should have the freedom to decide whether to vote.

Example from https://www.rationaleonline.com/

Concept maps

- Shows relationships between concepts (which can also be arguments)

- Mind and argumentation maps can be considered as special cases of concept maps.

- Knowledge graph visualization looks the same as a concept map.
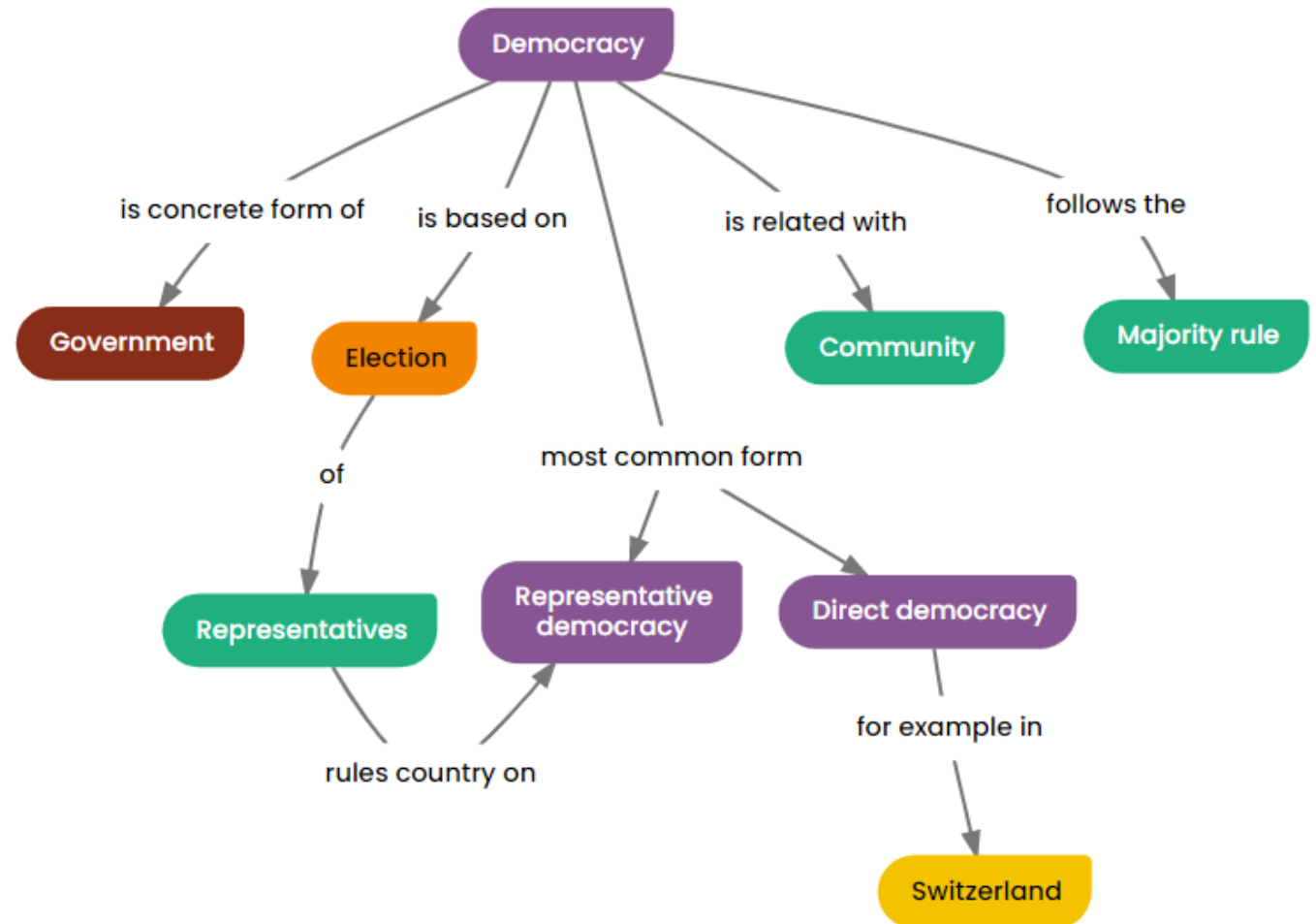
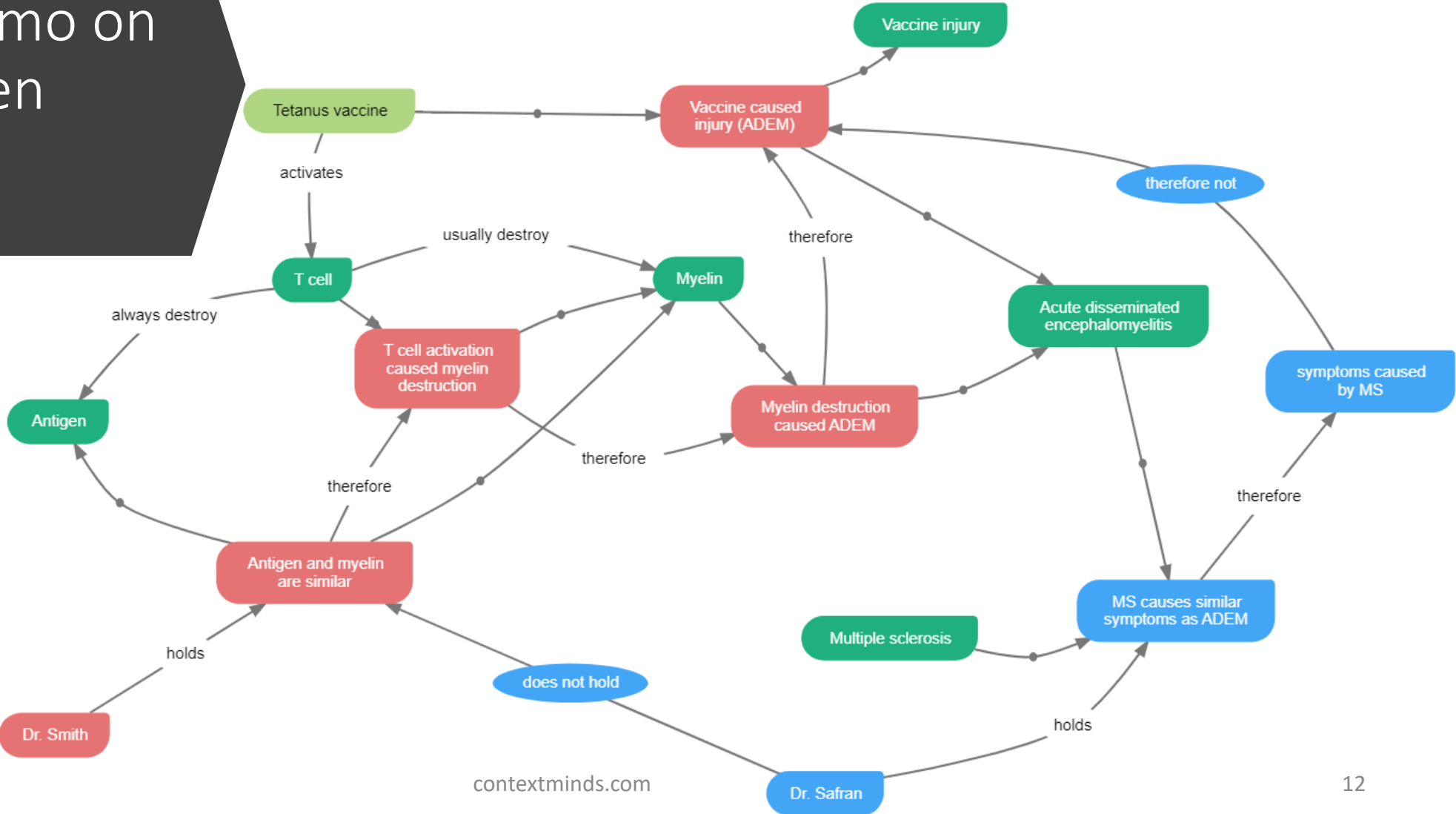# ContextMinds: a combination of knowledge graphs and concept mapping

- User manually creates a **map of concepts or arguments**

- The system automatically looks for relevant relationships and important related concepts and suggests them to the user

- User can combine **system suggestions** with adding own insights manually

- Such as **combining argument chains with existing knowledge**

Example: examining causation in the Althen case

- Liepiņa, R., Sartor, G., & Wyner, A. (2020). Arguing about causes in law: a semi-formal framework for causal arguments. *Artificial intelligence and law*, *28*(1), 69-89.
  - Framework shown on the Althen case – a dispute whether vaccine caused an injury
    - Causation represented formally
  - Could be further supported by ContextMinds
    - Represent causation visually
    - Opposing views in a single map
    - Related knowledge retrieved from the KG
  - ContextMinds could also support building the arguments

Short demo on the Althen case

https://app.contextminds.com/?m=A1x5x

Tetanus vaccine

Vaccine caused injury (ADEM)

Vaccine injury

therefore not

activates

usually destroy

T cell

Myelin

therefore

Acute disseminated encephalomyelitis

symptoms caused by MS

always destroy

T cell activation caused myelin destruction

Myelin destruction caused ADEM

Antigen

therefore

therefore

Antigen and myelin are similar

MS causes similar symptoms as ADEM

therefore

holds

Multiple sclerosis

Dr. Smith

does not hold

holds

Dr. Safran

contextminds.com

12

Framework draft for integrated knowledge & argument mapping

Map **known facts** from the case – by selecting corresponding concepts from the knowledge graph

System suggests **important concepts related** to these facts

Select relevant related concepts and add them to the map

System automatically **shows known links** between the concepts

Use the map as an **aid to build arguments**

Add arguments as separate concepts and interlink them in the map

ContextMinds: now and future

Started with **Wikipedia** for background knowledge graph

Future: support **legal** data?
- Emerging legal KGs
- Potential in supporting LegalRuleML

Biomedical data from monarchinitiative.org on the way
- Could be used to show knowledge overview based on a text snippet like this: https://youtu.be/z1tWip1rduI

Emerging legal KGs for future use in ContextMinds

- Sovrano, F., Palmirani, M., & Vitali, F. (2020). **Legal Knowledge Extraction for Knowledge Graph** Based Question-Answering**. *JURI SAYS*, 143.

- Robaldo, L., Bartolini, C., & Lenzini, G. (2020, May). The DAPRECO knowledge base: representing the **GDPR in LegalRuleML**. In *Proceedings of The 12th Language Resources and Evaluation Conference* (pp. 5688-5697).

- Montiel-Ponsoda, E., & Rodríguez-Doncel, V. (2018, May). Lynx: Building the **legal knowledge graph** for smart compliance services in multilingual Europe. In *Proceedings of the 1st workshop on LREC (language resources and technologies for the legal knowledge graph) workshop* (pp. 19-22).

- Ostendorff, M., Blume, T., & Ostendorff, S. (2020, August). Towards an **Open Platform for Legal Information**. In *Proceedings of the ACM/IEEE Joint Conference on Digital Libraries in 2020* (pp. 385-388).
  - openlegaldata.io