

# Grouping of clusters

Knowledge Graph Visual browser

Oskar Razyapov

# Knowledge graph

- Semantic network of real-world entities
  - Relationships between entities are then represented as edges
- Usually represented in the RDF format
- Available through SPARQL endpoint
- Examples:
  - DBpedia<sup>[1]</sup>
  - Wikidata<sup>[2]</sup>

[1] <https://www.dbpedia.org>

[2] <https://www.wikidata.org>

# Knowledge Graph Visual browser

- Visual exploration of knowledge graphs for non-specialists
- Reusable visual configurations
  - Domain-specific operations
  - Starting nodes
  - Detail, preview, expansion queries

# Starting nodes

## Scientists

Discover famous scientists and relationships between them.

### Choose a starting node

You can type in IRI identifier of the node or try to search it if searching is supported by the configuration.



### Predefined nodes

Charles Darwin

scientist

male

Albert Einstein

scientist

male

Marie Curie

scientist

female

[BACK](#) [GO TO GRAPH](#)

English

# Example of visual knowledge graph

KG  
VB

KGVisualBrowser  
Project website

MENU

+ Add nodes

View options

Hidden nodes

Layout options

Load graph

Save graph

+ New graph

Source configuration

Language

Settings

FILTERING

Insert IRI, name, code...

Marie Curie

Preview Query




image - Wikidata

Marie Curie

scientist female

Detail

Detail Query

label Marie Curie

Description Polish physicist and chemist nationalized French (1867-1934)

image - Wikidata <http://commons.wikimedia.org/wiki/Special:FilePath...>

date of birth - Wikidata 1867-11-07T00:00:00Z

number of awards 13

burial coordinate location Point(2.3461054 48.846198)

Available views

Expansion Query

Scientist

Awarded scientist EXPAND

Colleague EXPAND

Family member EXPAND

<http://www.wikidata.org/entity/Q7186>

scientist scientist

REMOVE REFRESH LOCATE HIDE UNLOCK

+ - ↻ ↺ ↻

# Expansion example

KG  
VB

KGVisualBrowser  
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Insert IRI, name, code...

MENU

+

Add nodes

👁

View options

⚙

Hidden nodes

📐

Layout options

📄

Load graph

💾

Save graph

+

New graph

⚙

Source configuration

🌐

Language

⚙

Settings

FILTERING

```
graph TD; MC((Marie Curie)) -- awarded by --> AS1[Accademia Nazionale delle Scienze detta dei XL]; MC -- awarded by --> APS[American Philosophical Society]; MC -- awarded by --> RS[Royal Society]; MC -- awarded by --> ASM[Académie des Sciences Morales et Politiques]; MC -- awarded by --> FR[France]; MC -- awarded by --> JU[Jagiellonian University]; MC -- awarded by --> RSA[Royal Swedish Academy of Sciences]; MC -- awarded by --> ACS[American Chemical Society]; MC -- awarded by --> FI[Franklin Institute]; MC -- awarded by --> PC[Philadelphia City Council]; MC -- awarded by --> RI[Royal Institution]; MC -- awarded by --> RSAr[Royal Society of Arts];
```

image - Wikidata

Marie Curie

scientist

female

Detail

🌐 label Marie Curie

🌐 Description Polish physicist and chemist nationalized French (1867-1934)

🌐 image - Wikidata <http://commons.wikimedia.org/wiki/Special:FilePath...>

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Scientist

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🌐 scientist scientist

+

-

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📄

REMOVE

REFRESH

LOCATE

HIDE

LOCK

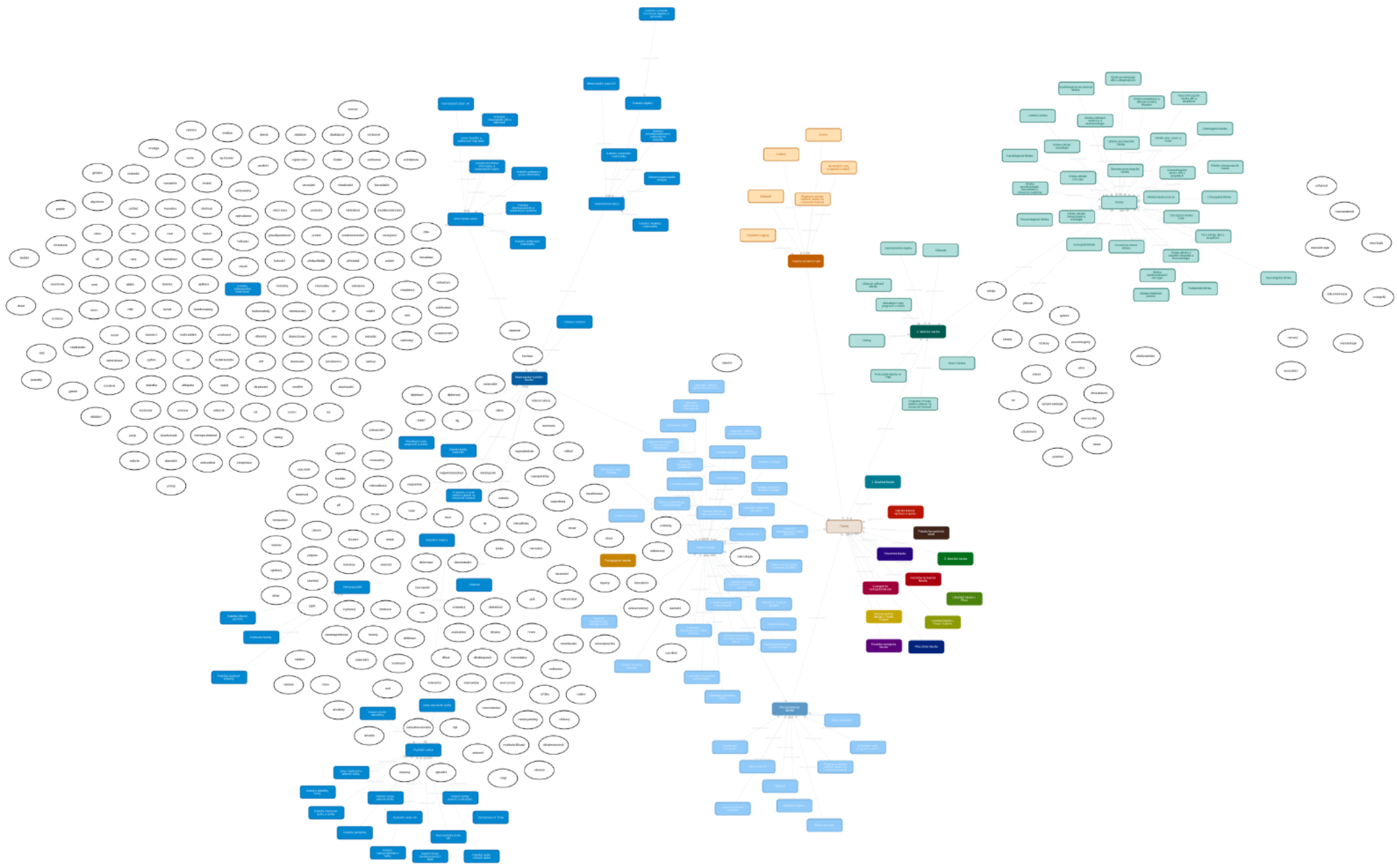
# Team members

- Martin Nečaský
  - Supervisor
- Štěpán Stenclák
  - Original KGVB
    - Github: <https://github.com/linkedpipes/knowledge-graph-browser-frontend>
    - Research paper: <https://www.sciencedirect.com/science/article/pii/S1570826822000105>
- Jiří Resler
  - Faceted filtering
    - Github: <https://github.com/JiriResler/knowledge-graph-browser-frontend>
- Oskar Razyapov
  - Grouping of clusters
    - Github: <https://github.com/Razyapoo/knowledge-graph-browser-frontend-grouping-of-clusters>

# Motivation

- Large graphs:
  - Contain a lot of detail (often redundant)
  - Long time to render
  - Difficult to visualize
  - Not user-friendly





# The output of the research project

The output of the project is:

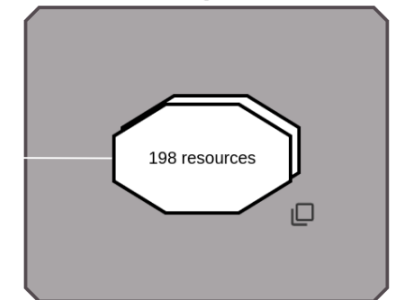
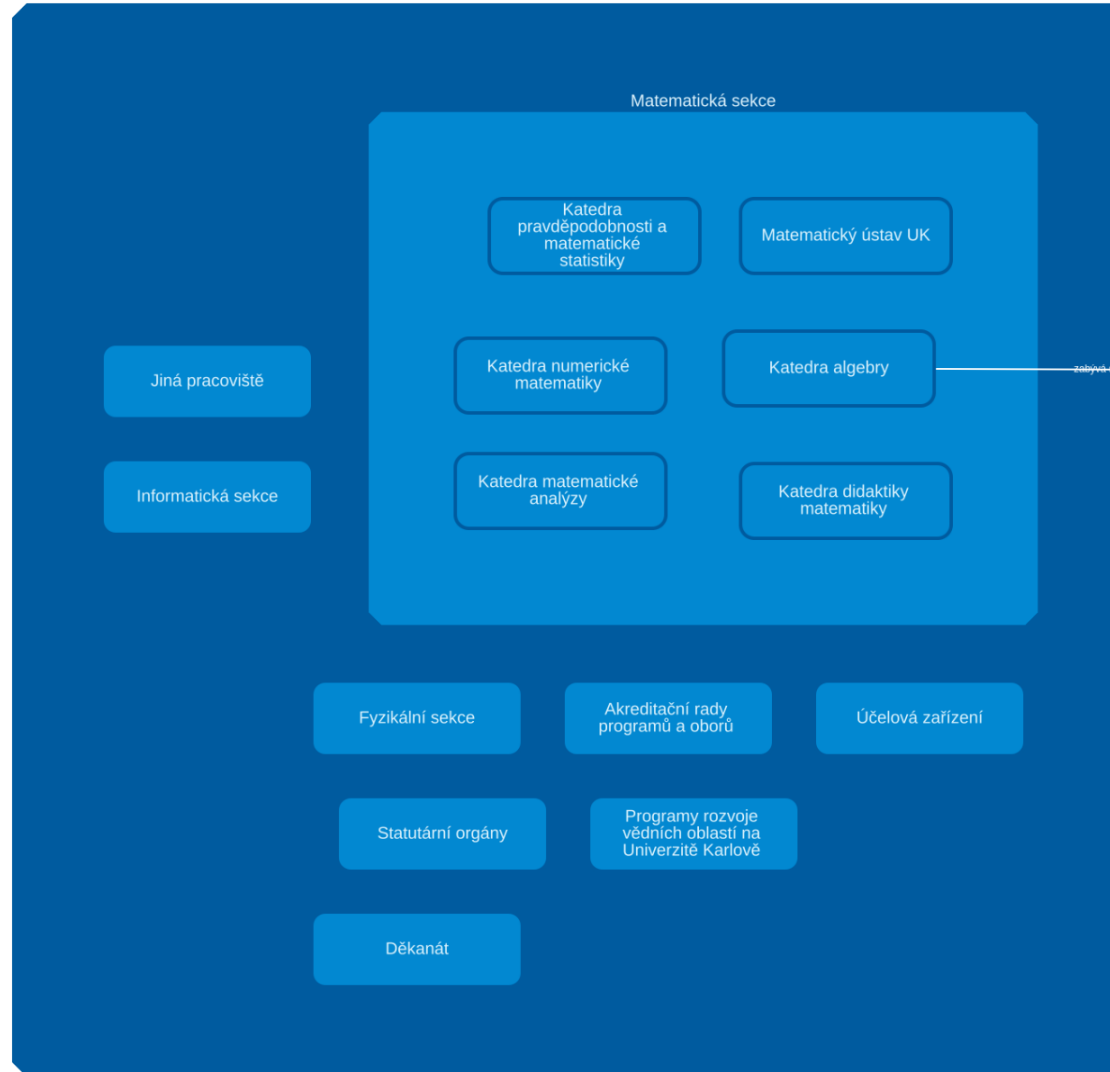
- the extension of the existing project to support visualization and exploration of large knowledge graphs
- text for publication, describing the techniques used and examples of their use (supplement to the existing publication)
  - Research paper: <https://www.sciencedirect.com/science/article/pii/S1570826822000105>

# What is added?

- Extended visual configuration
  - Support for visual layout constraints
  - Reusable
- Extended Backend
  - Preparation of visual layout constraints
- Extended Frontend
  - Application of layout constraints
  - Clustering (based on position)
    - KMeans
    - KMedoids
  - Grouping
  - Zooming

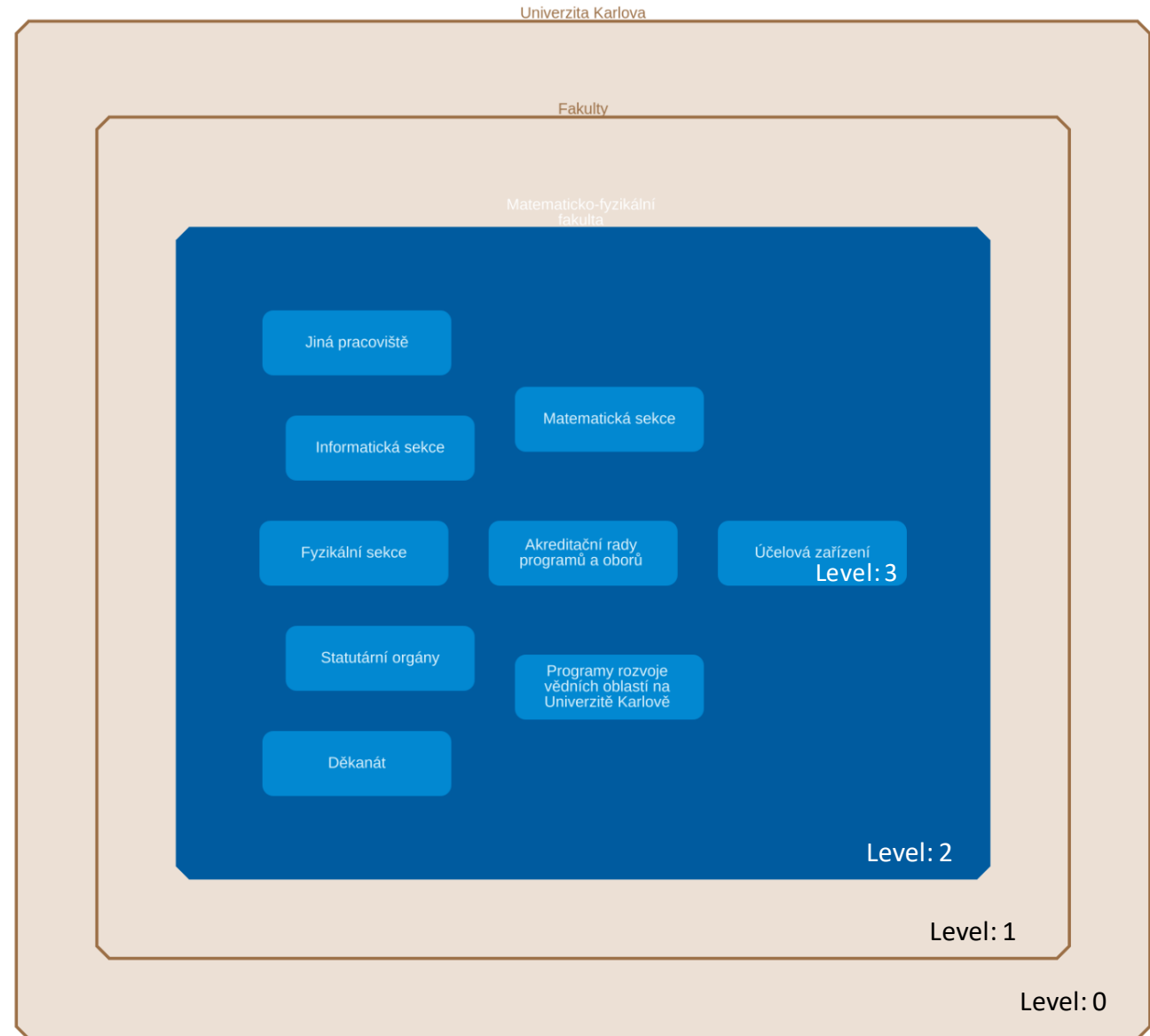
# New approaches

- Hierarchical relationships
- Non-hierarchical relationships



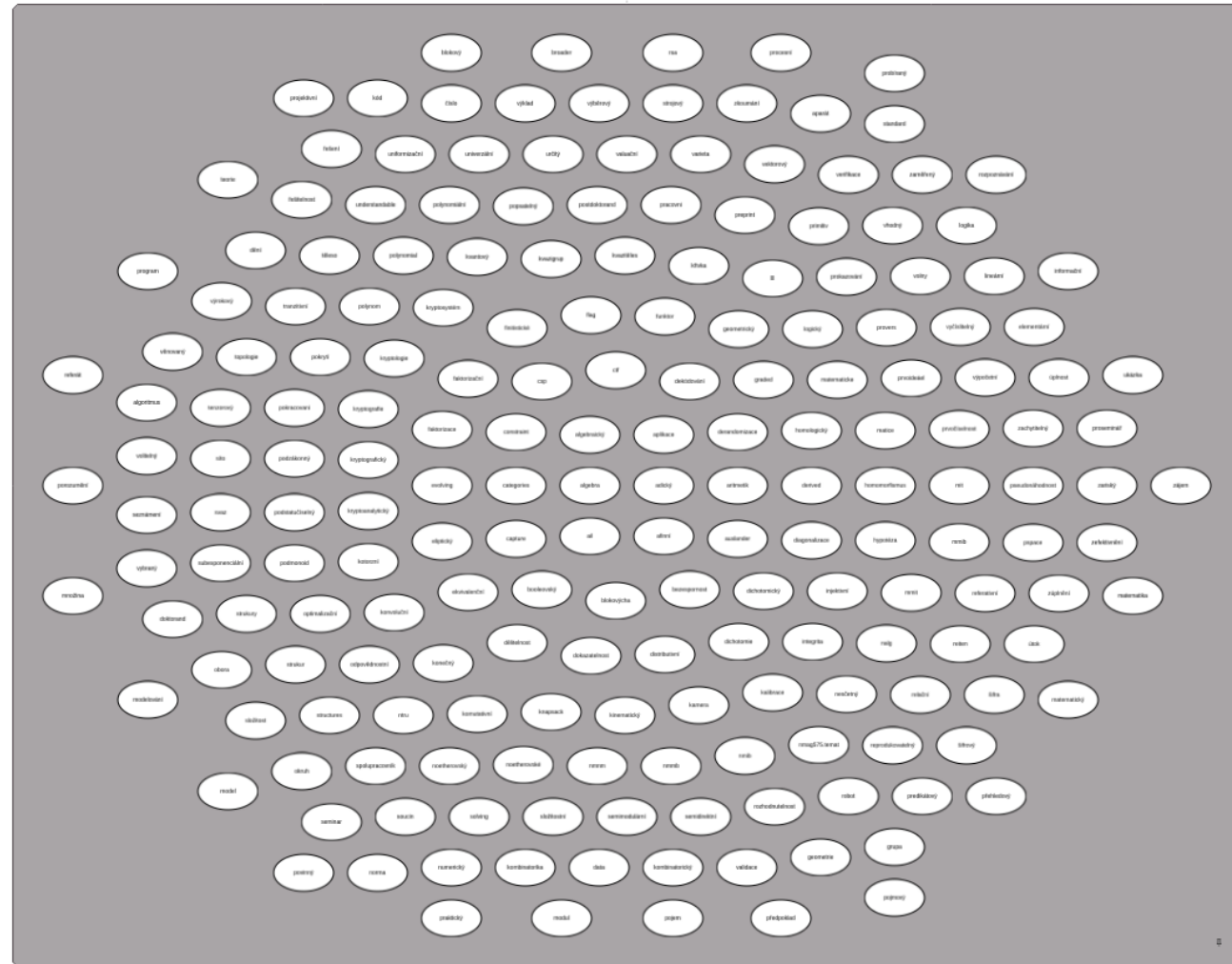
# New approaches

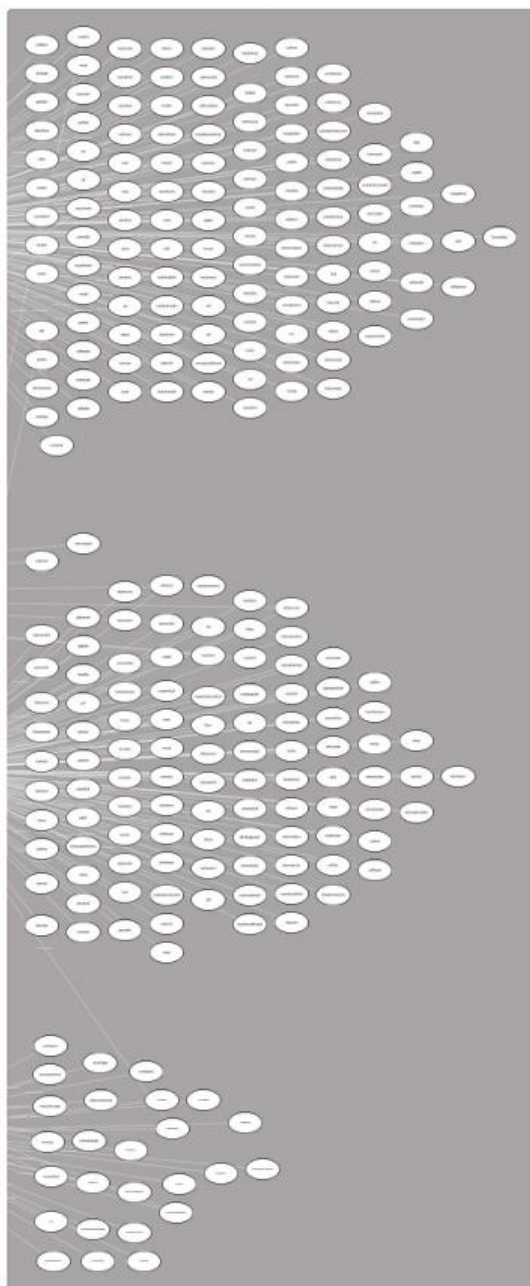
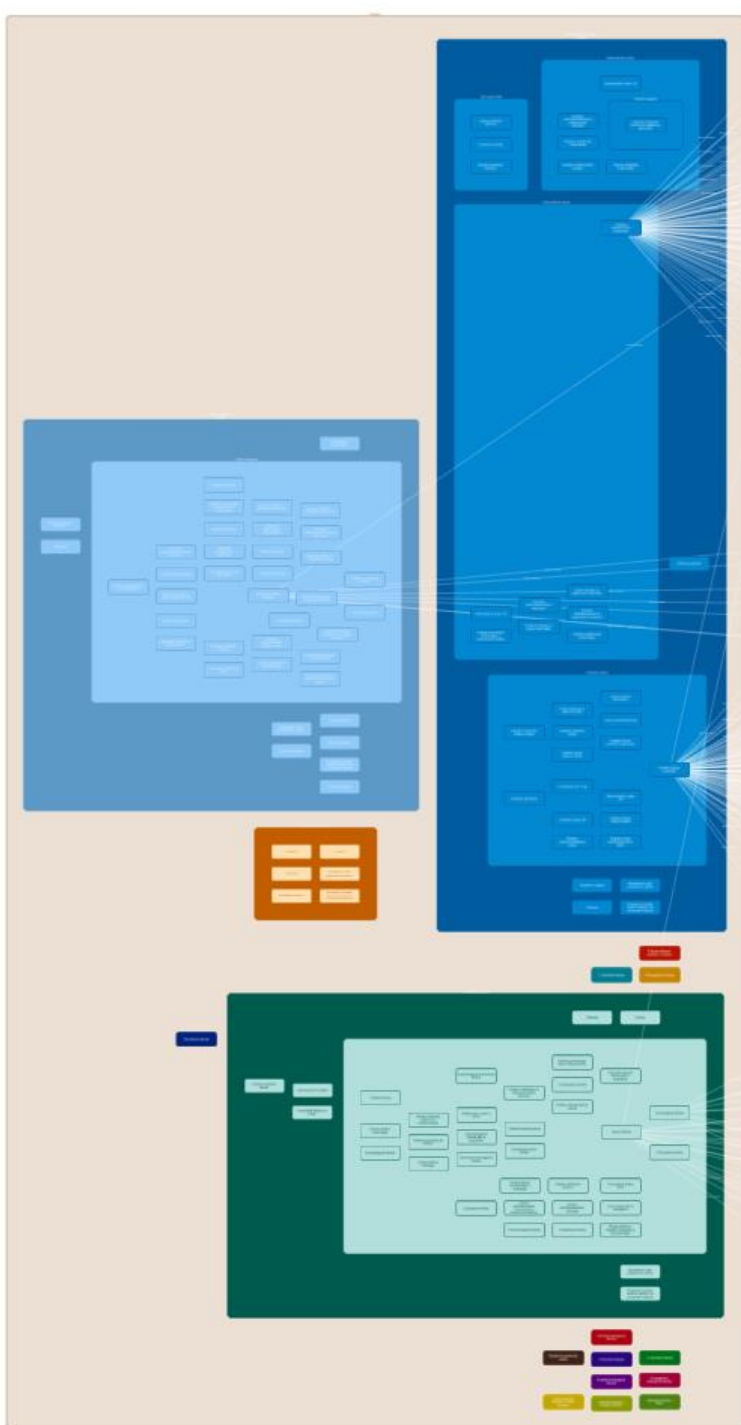
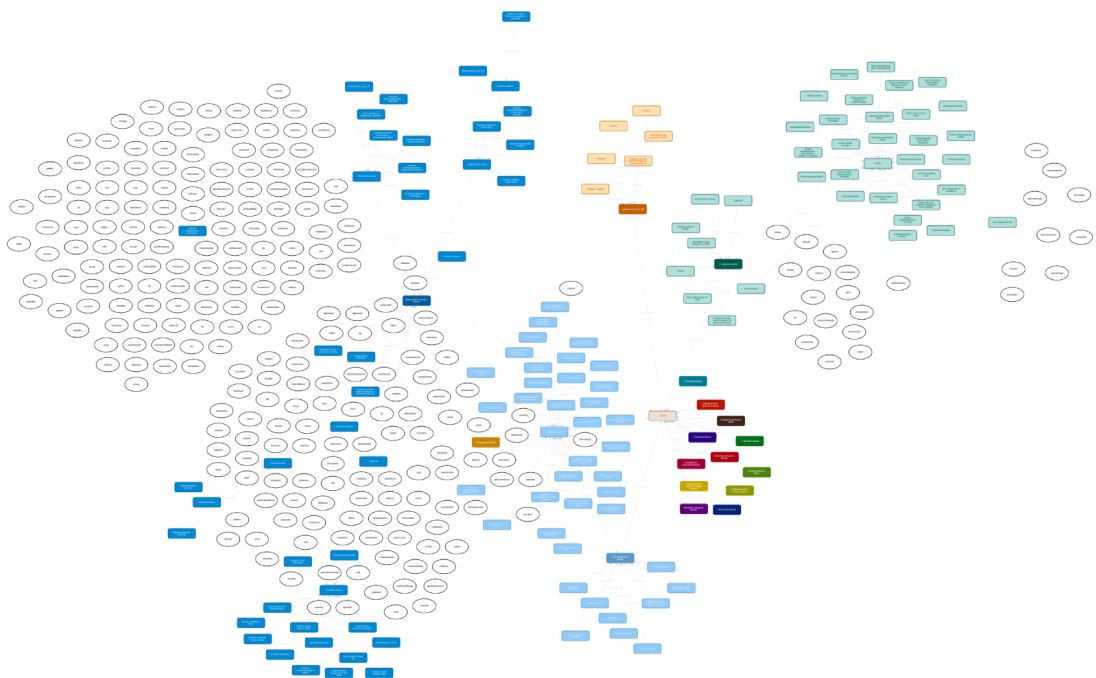
- Hierarchical groups  
parent-child relationship
- Each node has:
  - Hierarchical class
  - Hierarchical level (0 .. 3 in the example)
  - Parent node
  - Child node list



# New approaches

- Visual groups  
clusters of nodes
- Each node has:
  - Visual group class







# Map-style zooming

maps.google.com



Zoom in



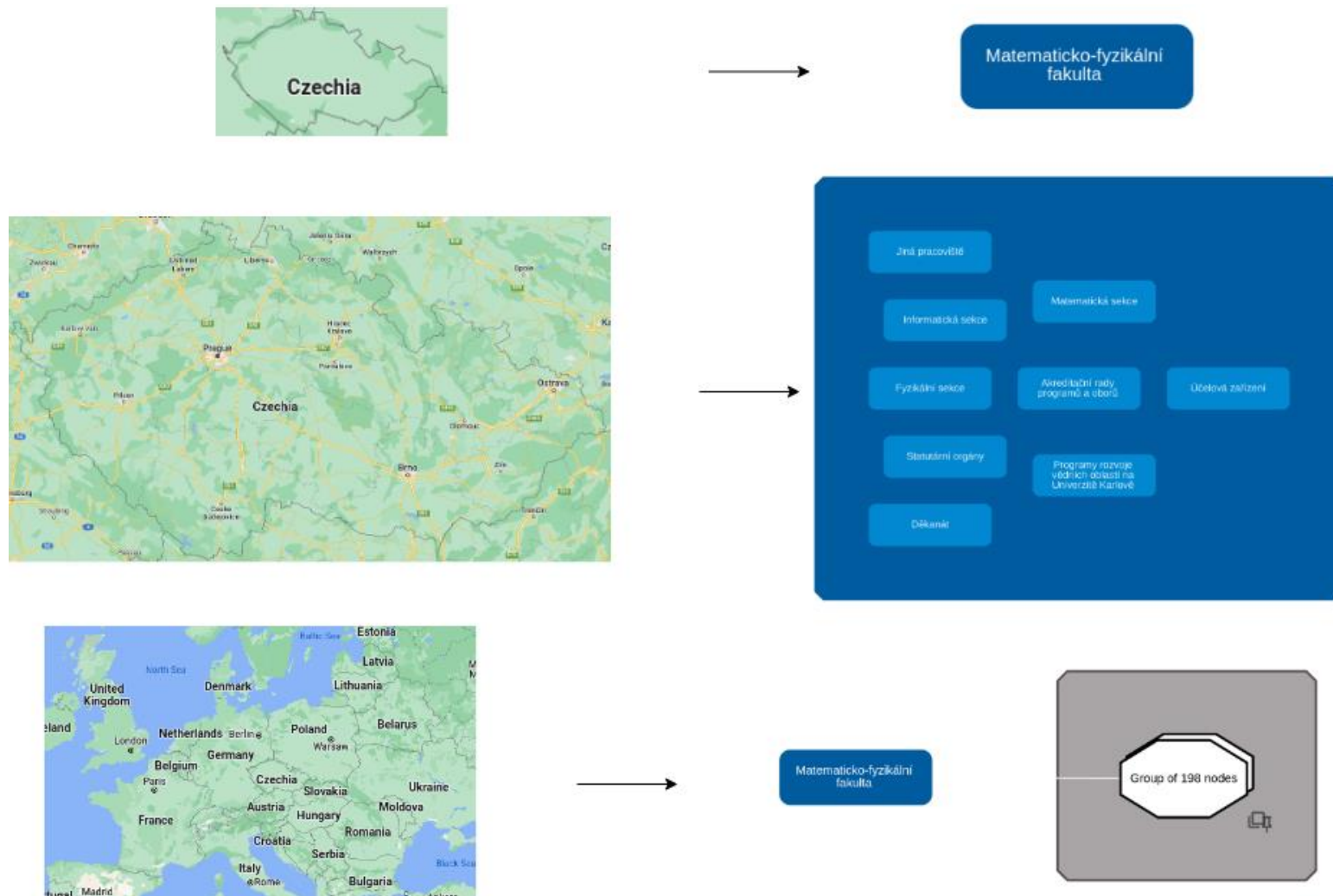


# Map-style zooming inspiration

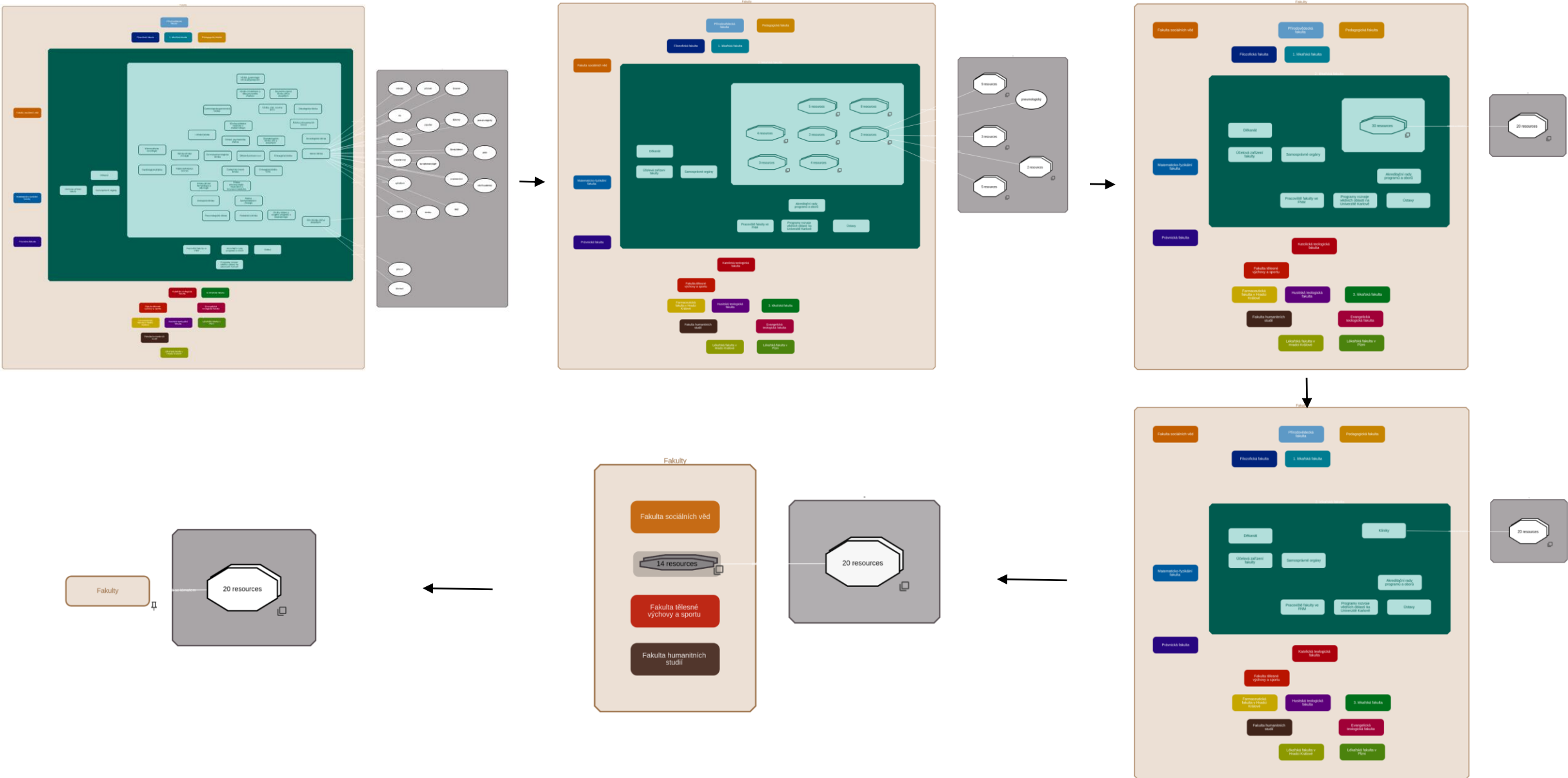
- First, to cluster, then to group
  - K-Means<sup>[1]</sup>
  - K-Medoids<sup>[2]</sup>
- Based on
  - Hierarchical class
  - Hierarchical level  
must be equal to current hierarchical level
  - Parent node
  - Same visual class  
Unless multiple classes specified

[1] [https://en.wikipedia.org/wiki/K-means\\_clustering](https://en.wikipedia.org/wiki/K-means_clustering)

[2] <https://en.wikipedia.org/wiki/K-medoids>



# Map-style zooming example



# Map-style zooming checkbox

KG  
VB

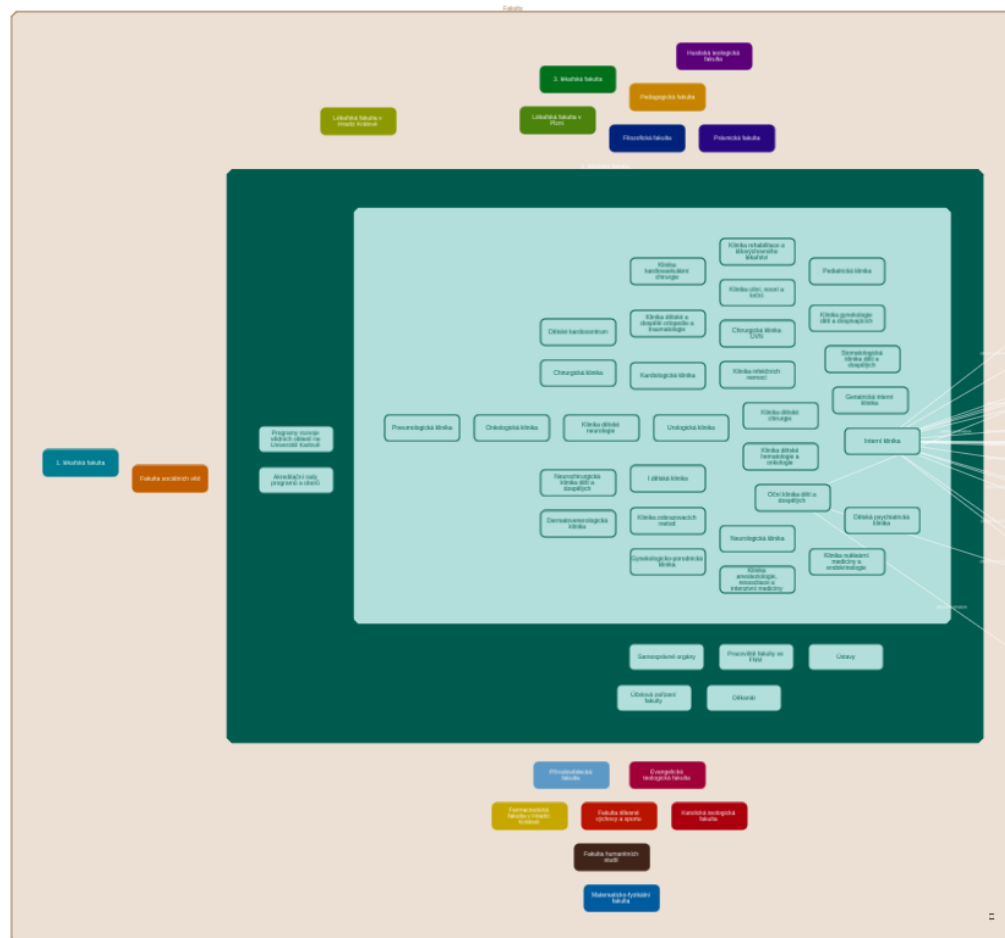
KGVisualBrowser  
Project website

## MENU

## FILTERING

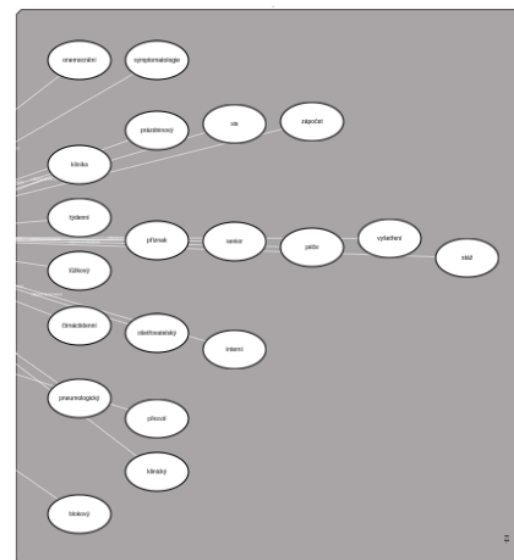
- + Add nodes
- View options
- Hidden nodes
- Layout options
- Load graph
- Save graph
- + New graph
- Source configuration
- Language
- Settings

Insert IRI, name, code...



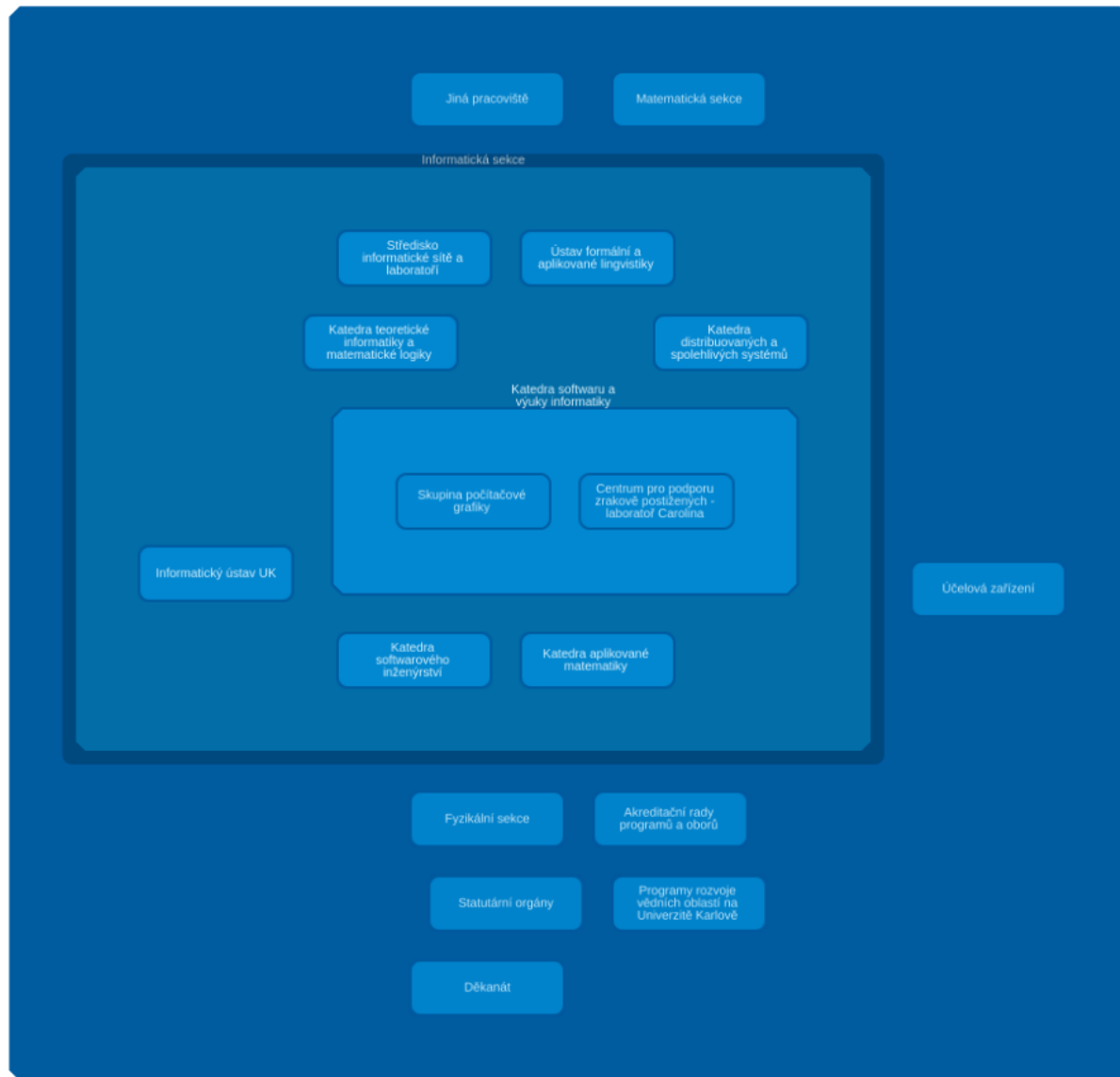
## Scaling options

- ☐ Grouping of clusters
- ☒ Zoom



# Node removal

Before:



After:



# Restrictions

- It is not possible to:
  - group nodes placed in different hierarchical groups, hierarchical levels, visual classes (unless explicitly predefined in the configuration), or having different parent node
  - add pseudo-parent node to a group
  - explicitly delete a pseudo-parent node
    - It will be deleted with last child
- In case the user wants to ungroup an explicit group, he/she must first select that group and then press ungroup button, or double-click

# What is next?

1. Add possibility for the user (in user interface) to:
  - Choose which hierarchical groups to cluster
  - Delete/add pseudo-parent for a visual group
  - Cluster nodes based on attributes other than their positions
2. Switching between hierarchical and normal views.

# Publication

- Extension of an existing publication
  - <https://www.sciencedirect.com/science/article/pii/S1570826822000105>

# Discussion