AUTONOMOUS SYSTEMS INITIATIVE

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Path Based Hierarchical Clustering on Knowledge Graphs

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Overview

- Knowledge graphs - introduction
- Motivation for our work
- Brief overview of proposed method

What is a knowledge graph?

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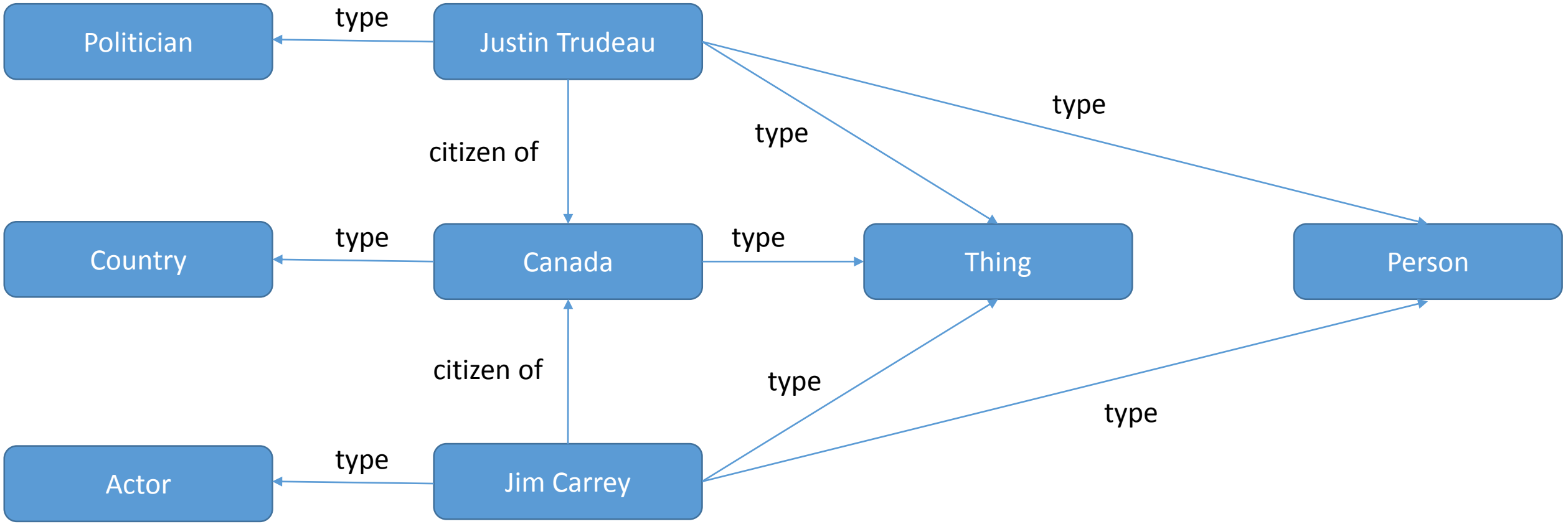
- A medium for storing information as a graph
- Information in knowledge graphs is expressed as **triples**
- Triples link a subject to an object via a predicate

<subject, predicate, object>

<Justin Trudeau, citizen of, Canada>

Toy knowledge graph



Motivation

- Problem: knowledge graphs are
  - Flat
  - No hierarchical relations between entities
- Objective:
  - find a way to induce a hierarchical clustering of knowledge graph subjects and provide a label for each cluster

Structure in a knowledge graph

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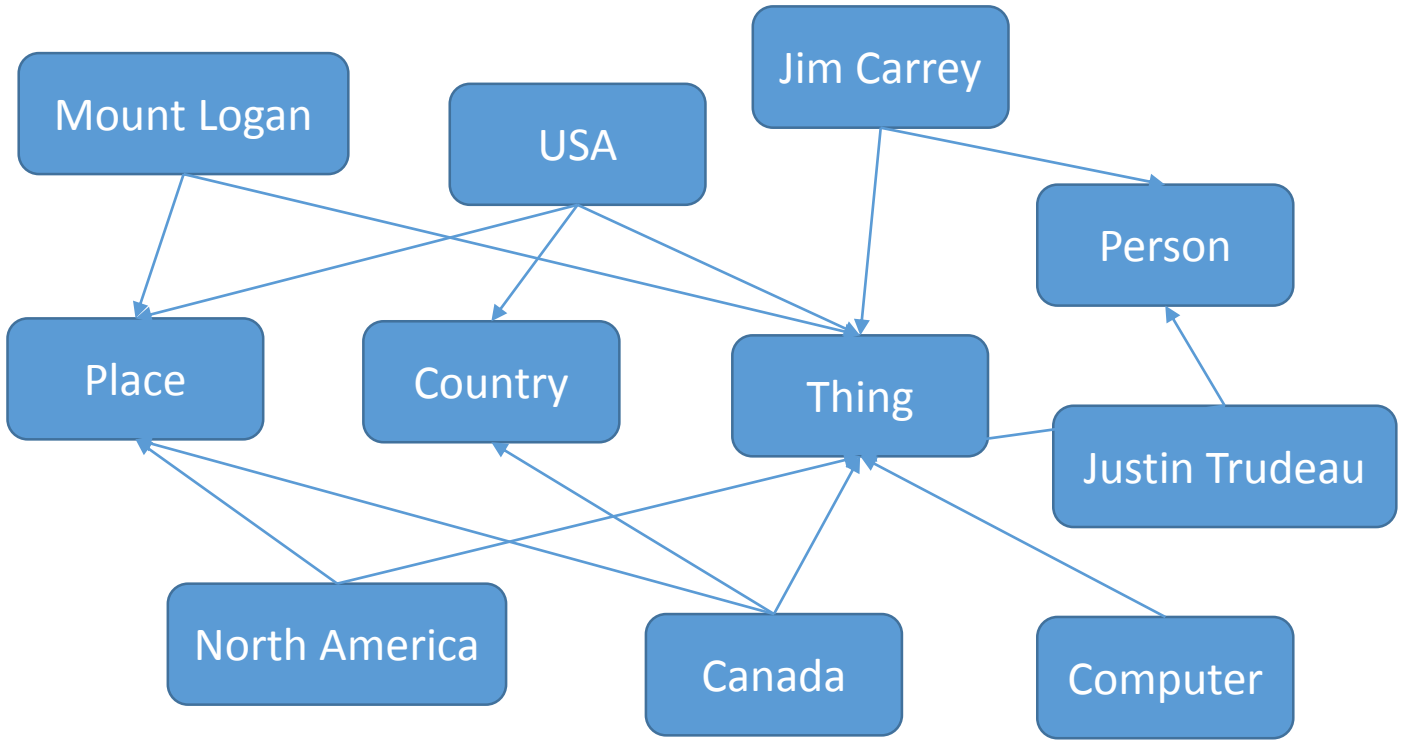
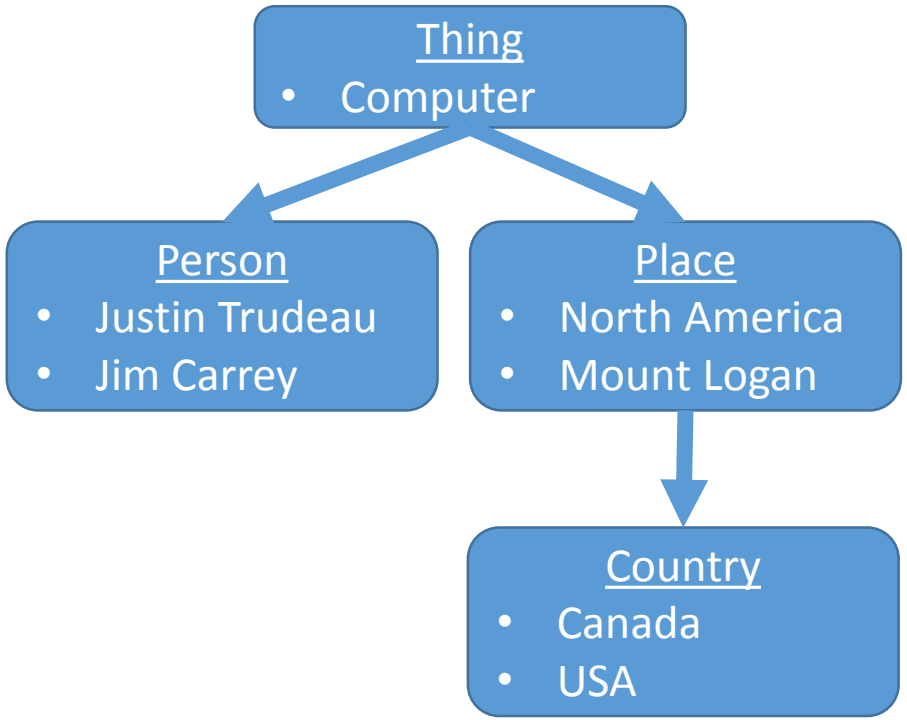
Flat



Hierarchical



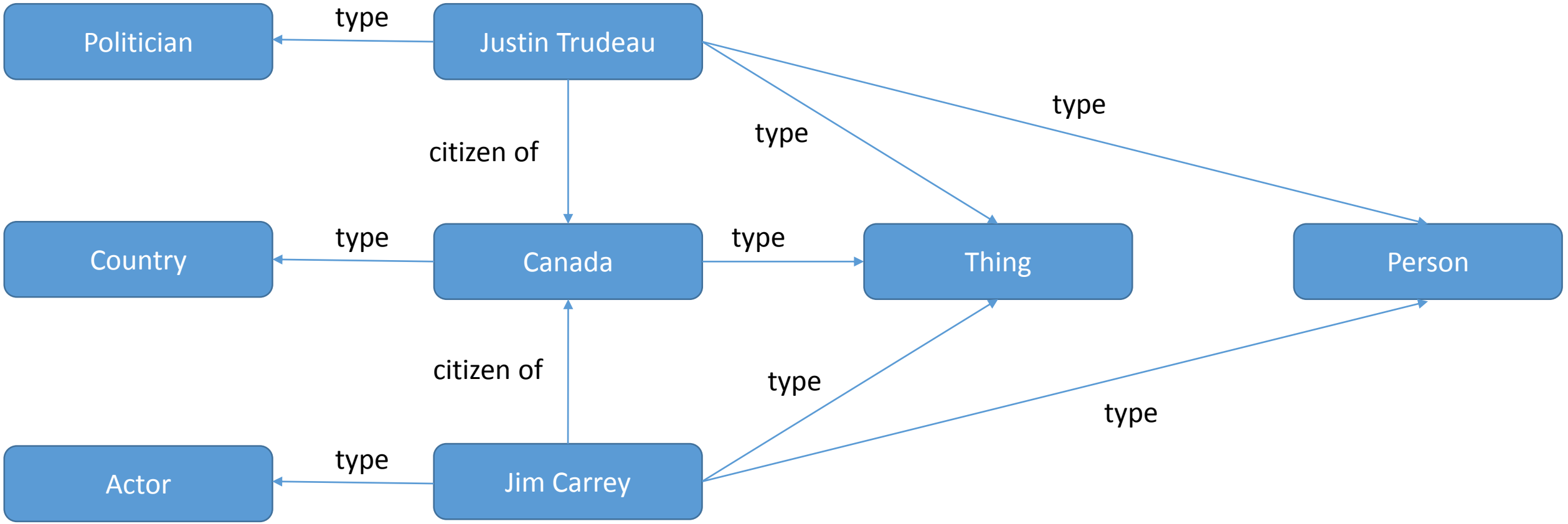
Approach

- Three steps:
  1. Induce a hierarchy of classes
  2. Assign subjects to the induced hierarchy
  3. Prune the hierarchy of empty clusters

Step 1

- We induce a class hierarchy using the *smict* method proposed in our earlier work
  - Pietrasik, Marcin, and Marek Reformat. "A Simple Method for Inducing Class Taxonomies in Knowledge Graphs." In *European Semantic Web Conference*, pp. 53-68. Springer, Cham, 2020. 2020.
- Hierarchy built on class frequencies and co-occurrences

Step 1 Visualization



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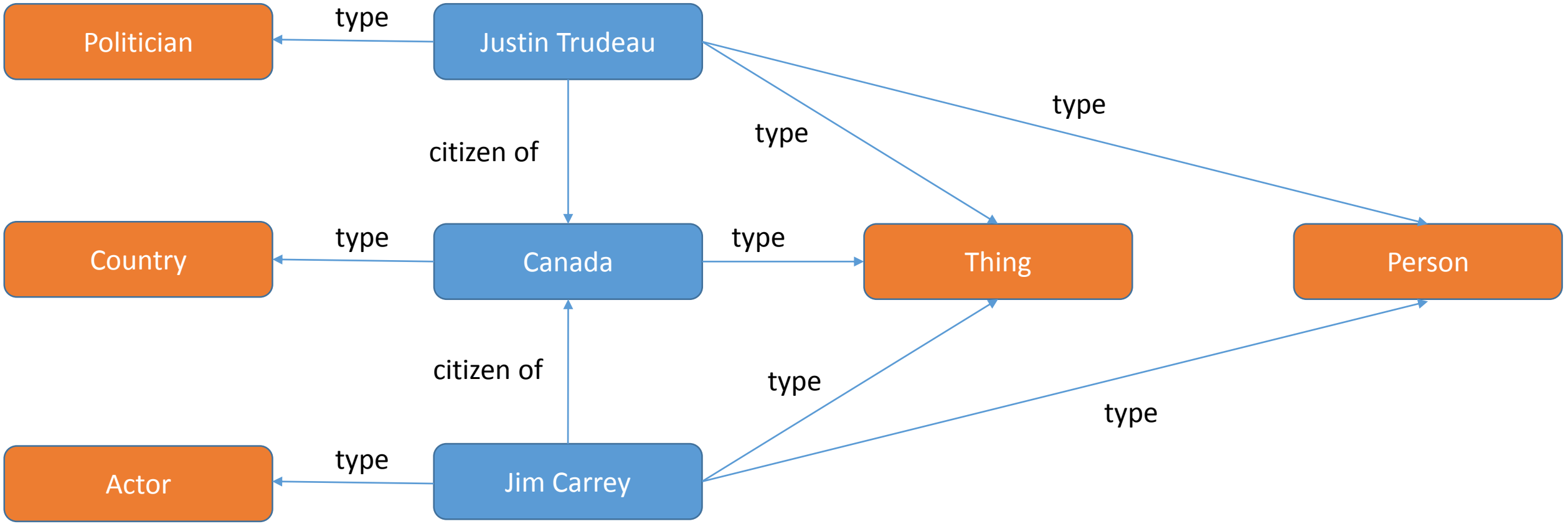

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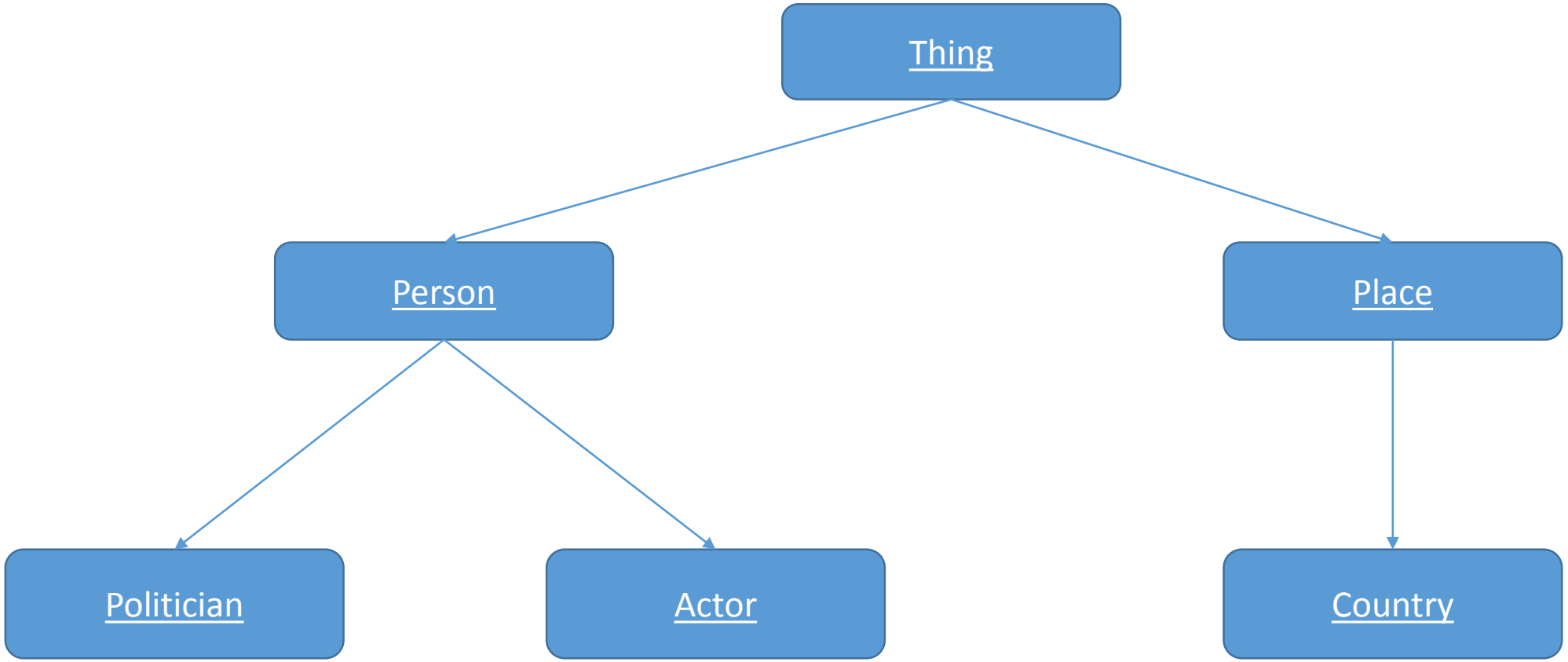
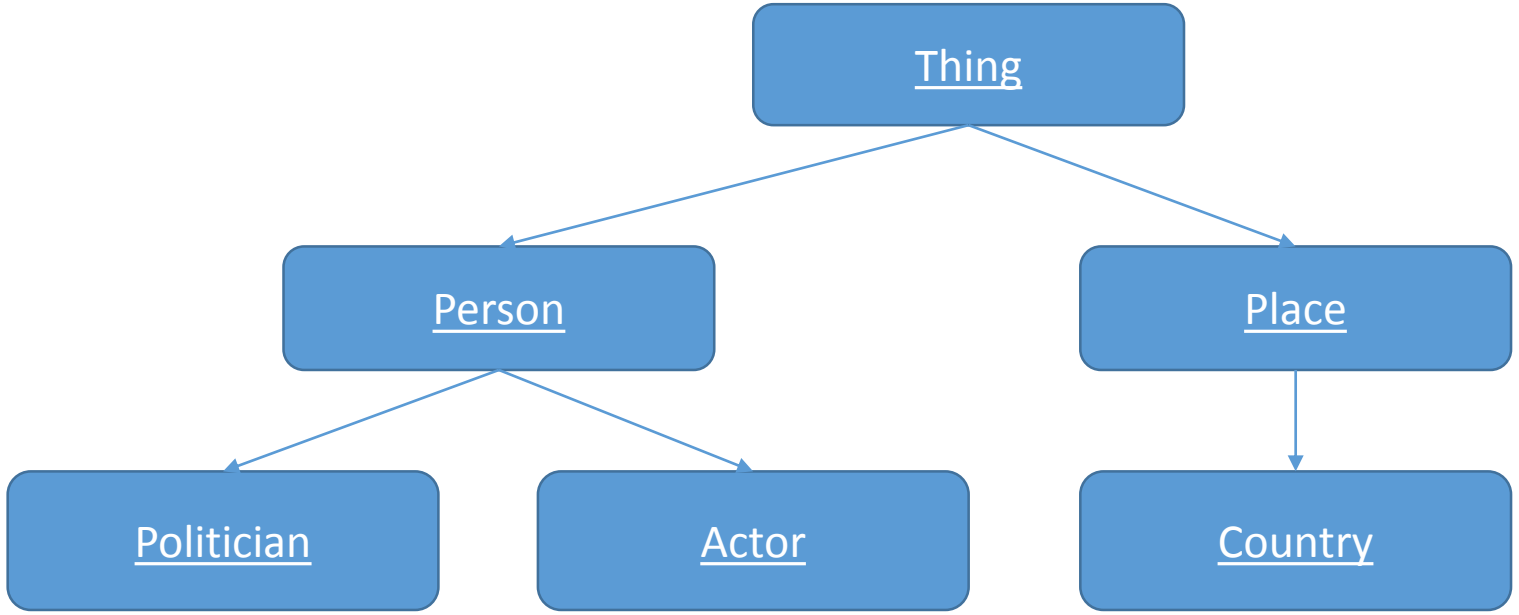


Step 2

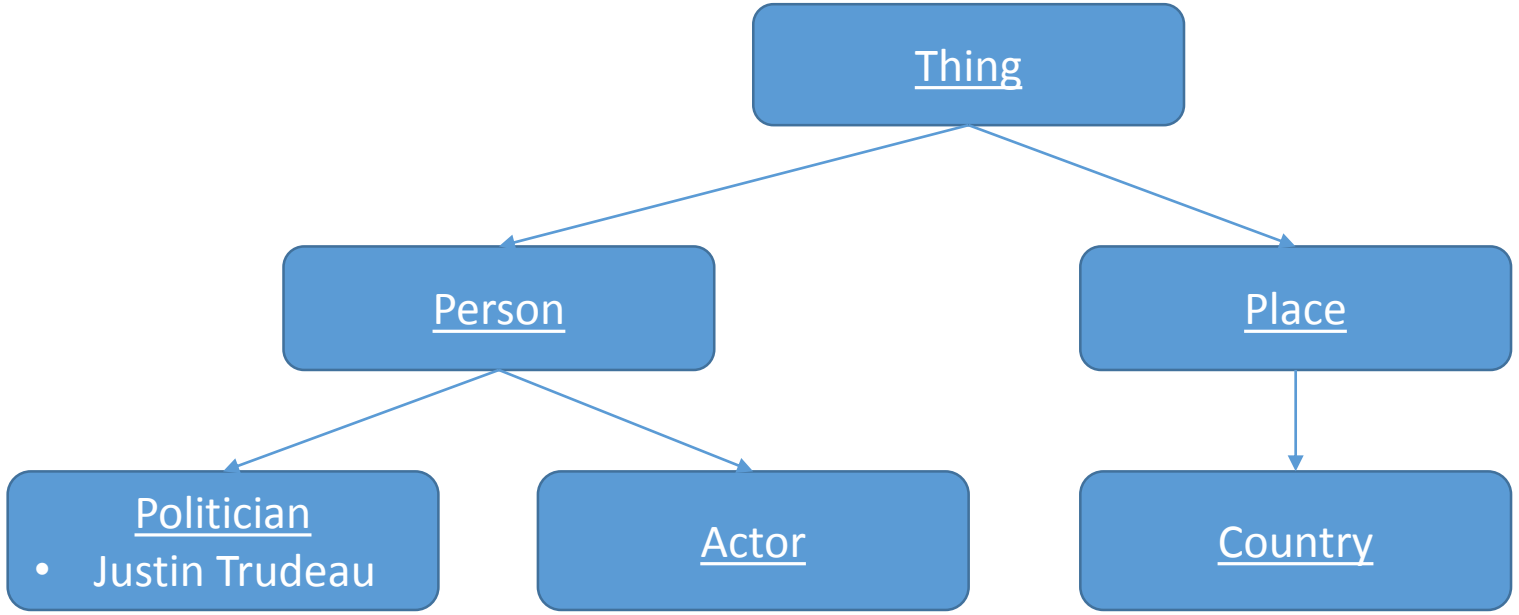
- Subjects are added to the hierarchy
- This process generates hierarchical clusters from the knowledge graph

Step 2 Visualization



Justin Trudeau
Jim Carrey
Canada
Donald Trump
Wayne Gretzky
North America

Step 2 Visualization



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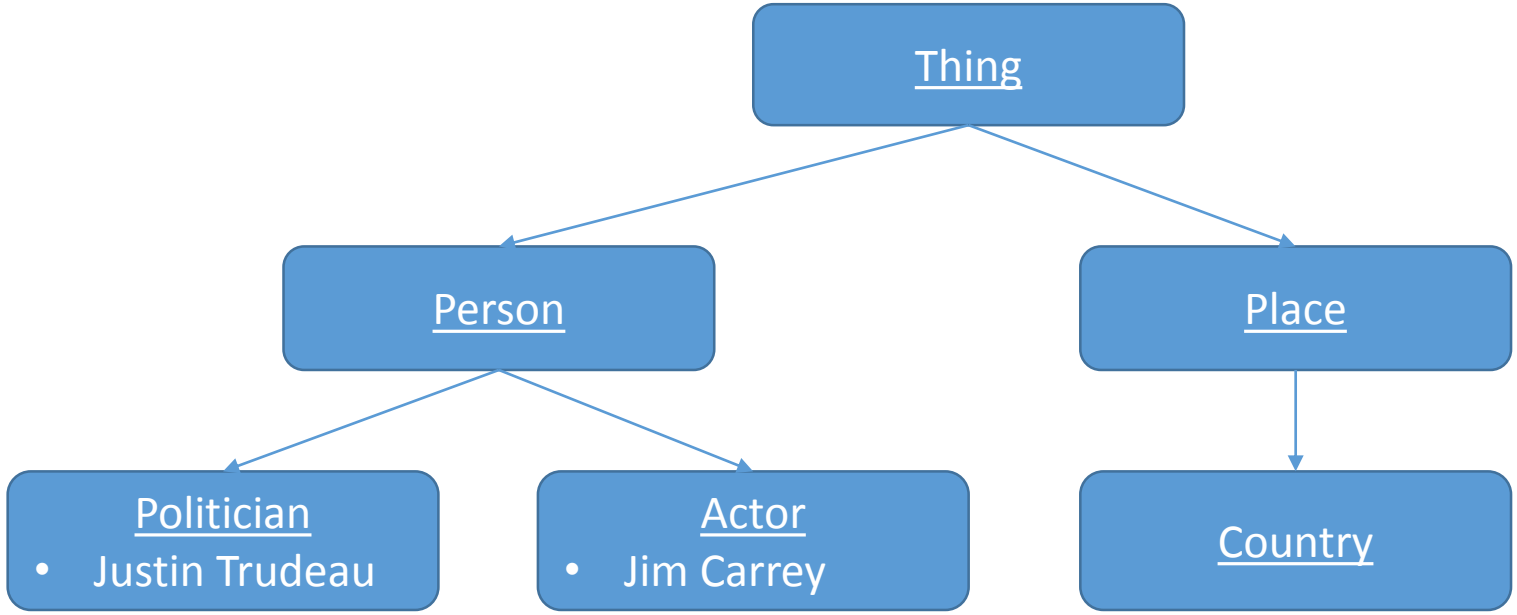

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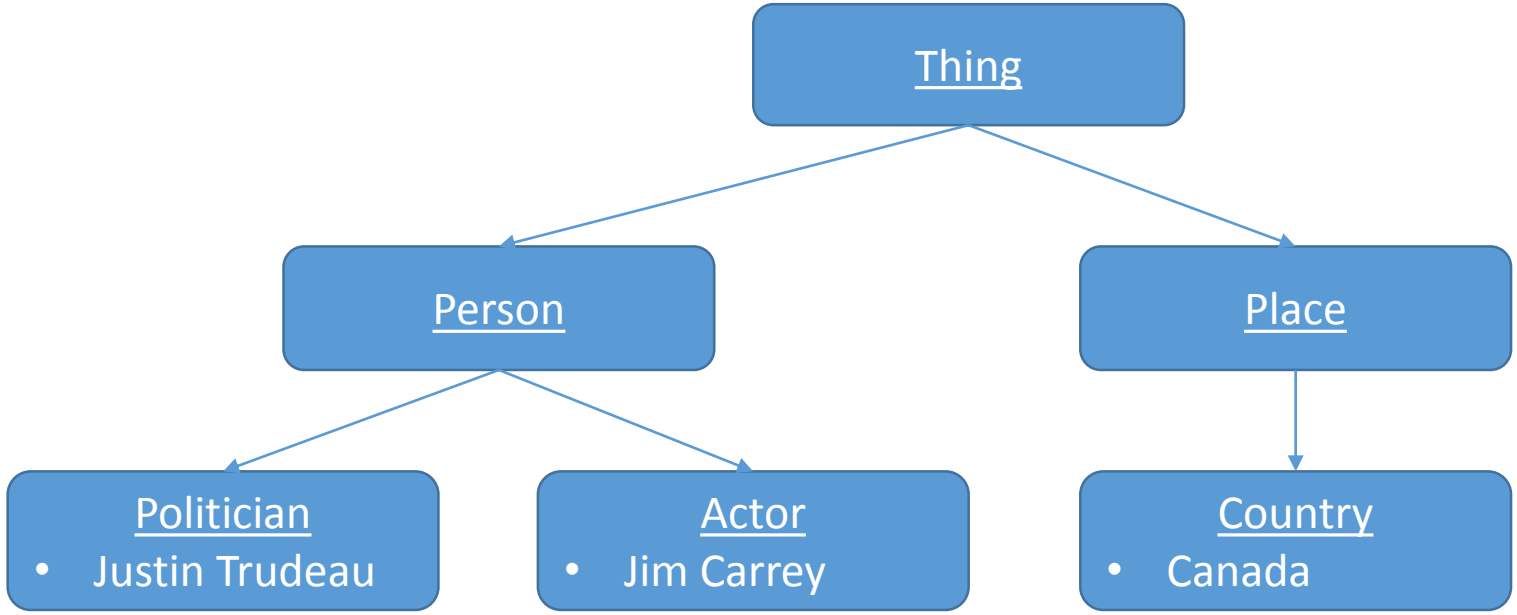

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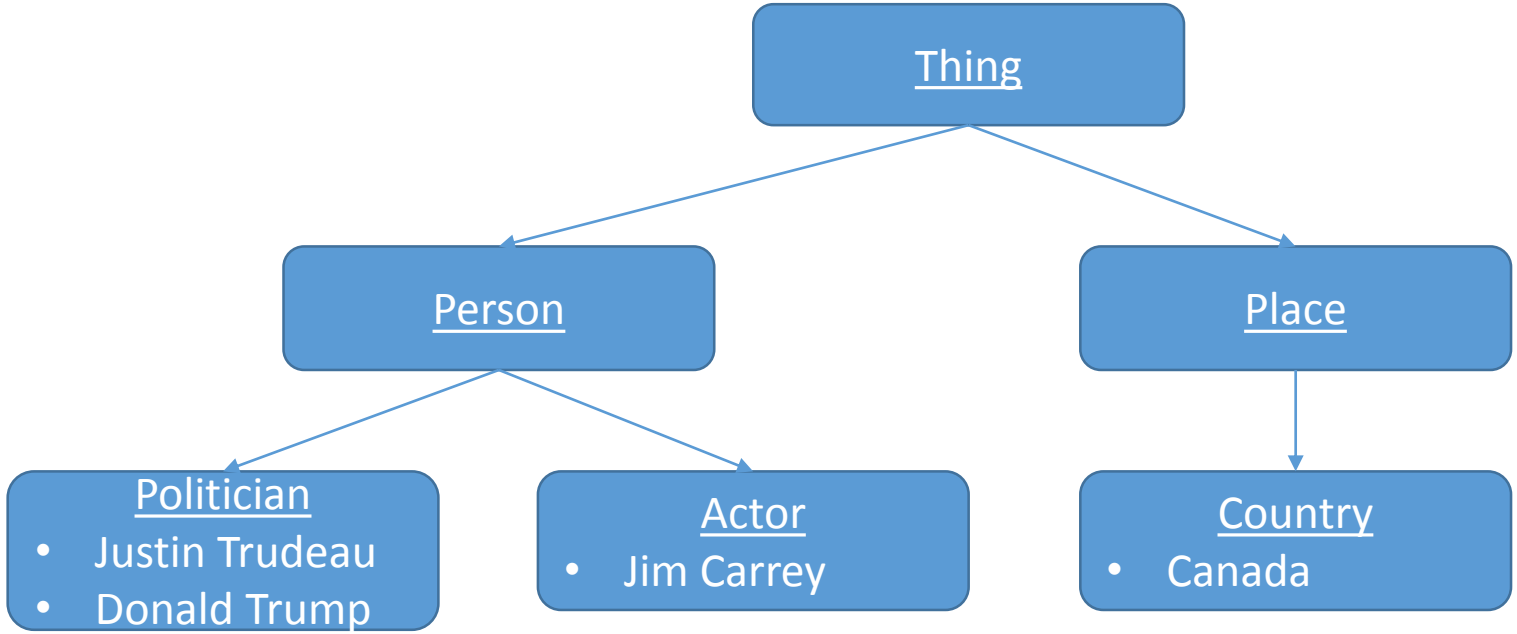
Step 2 Visualization



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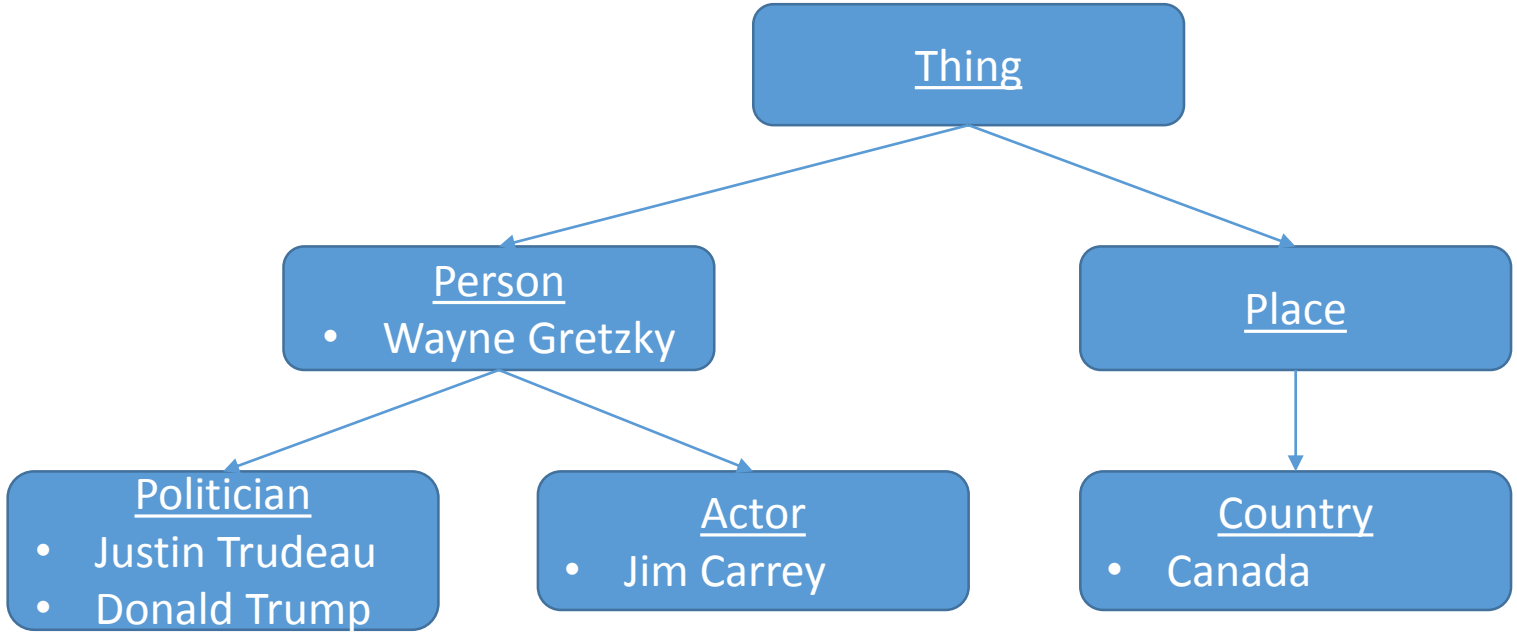
Step 2 Visualization



North America

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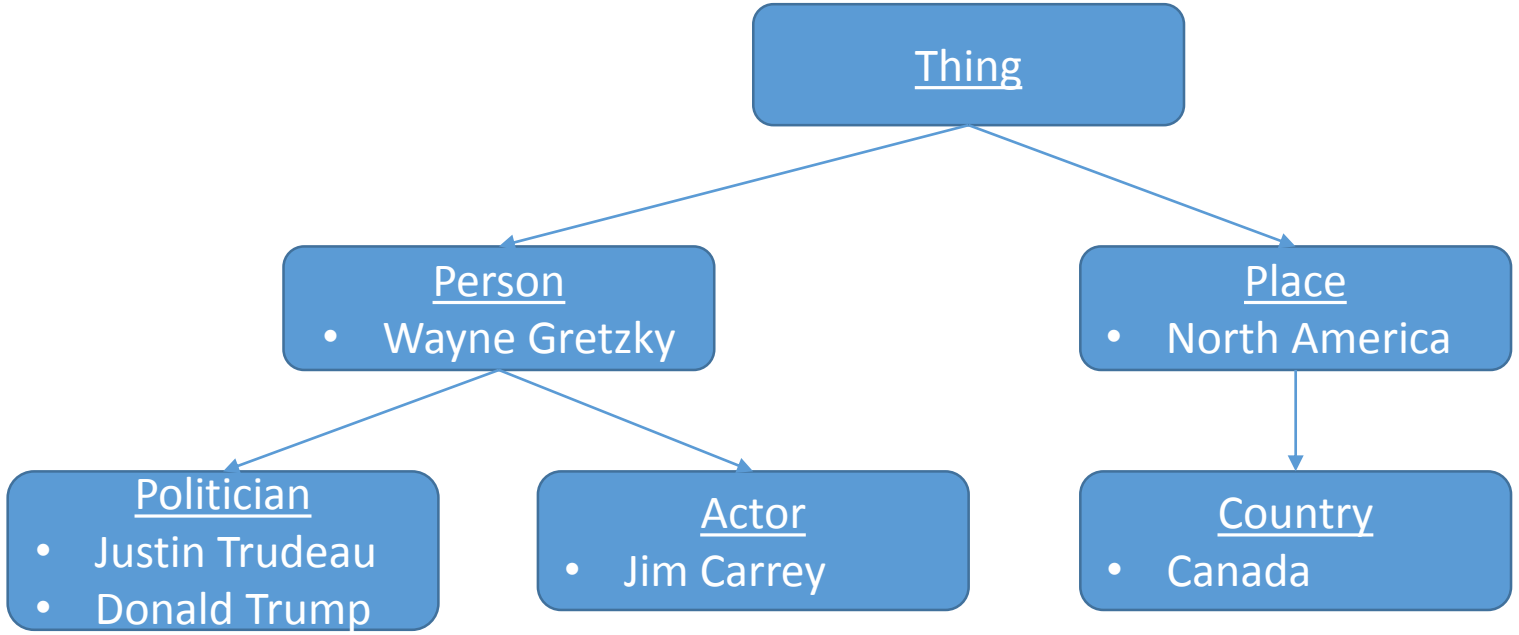
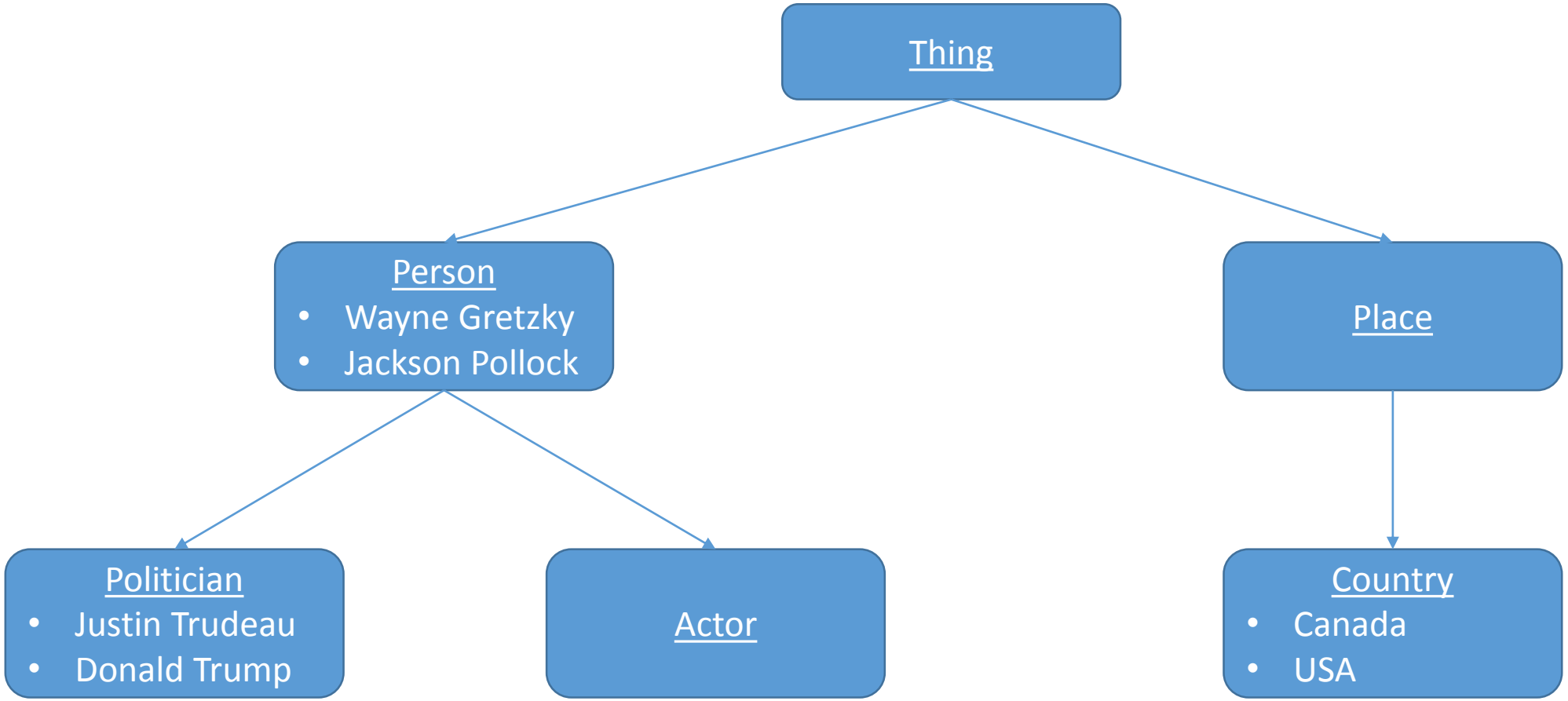


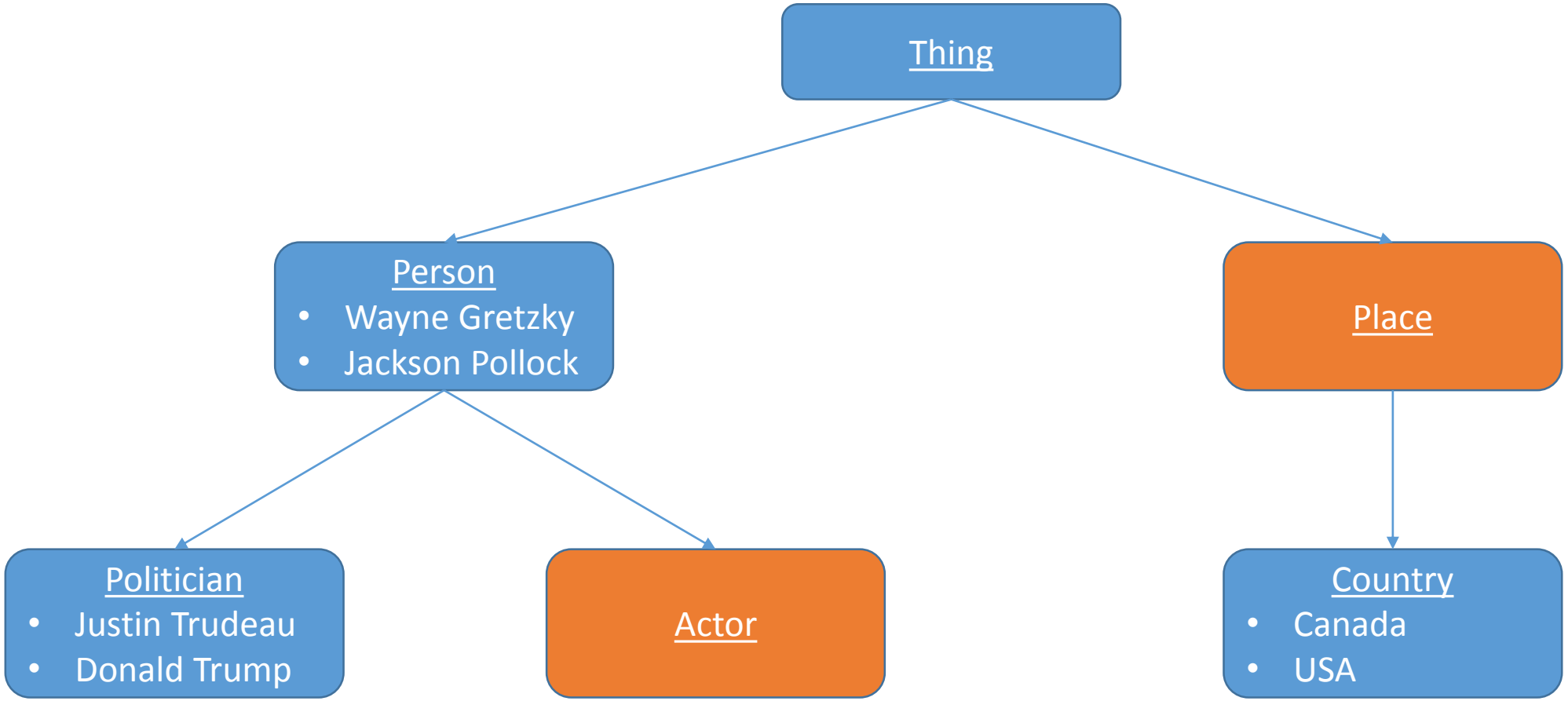
Step 3

- Prune the hierarchy by removing empty clusters and reattach orphaned clusters to next ancestor in line
- Root cluster is never removed

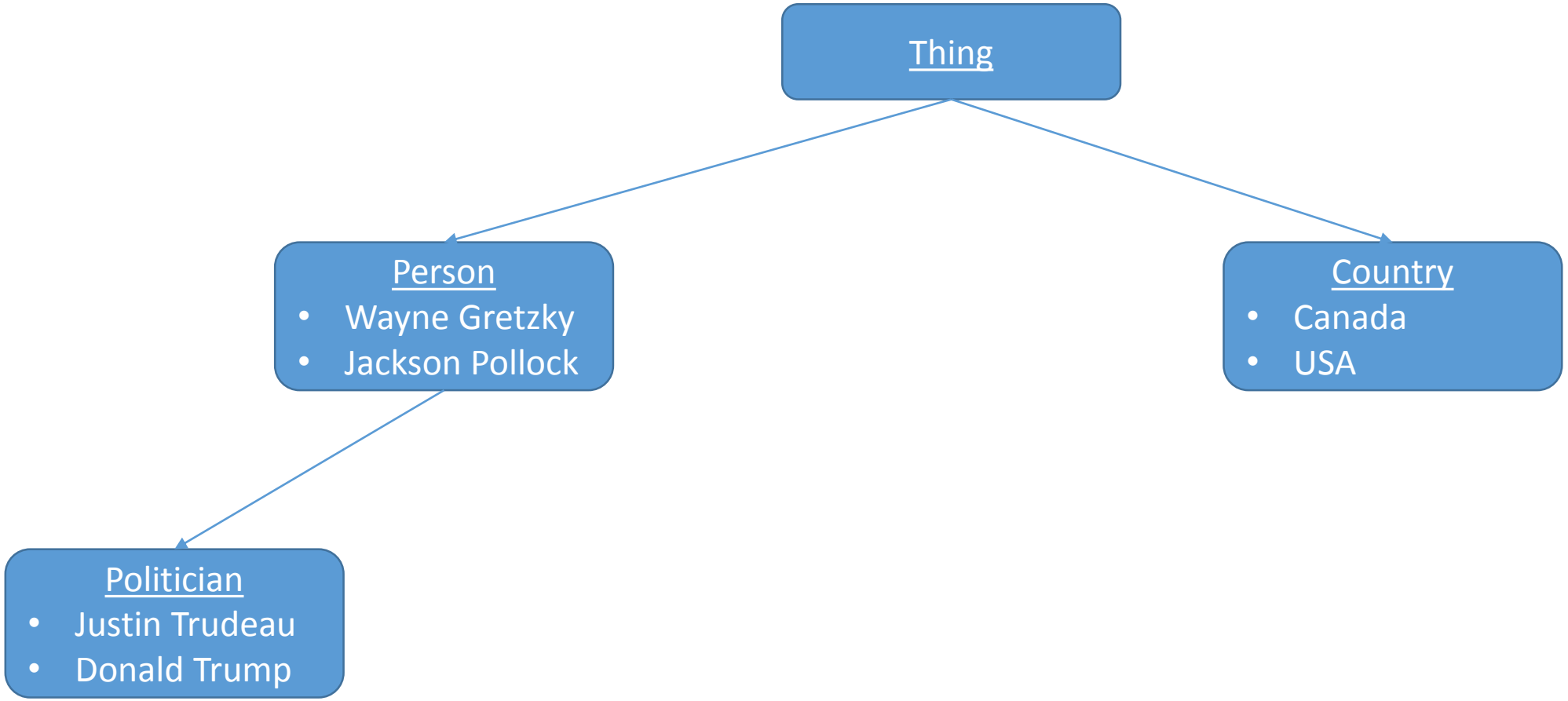
Step 3 Visualization



Step 3 Visualization



Step 3 Visualization



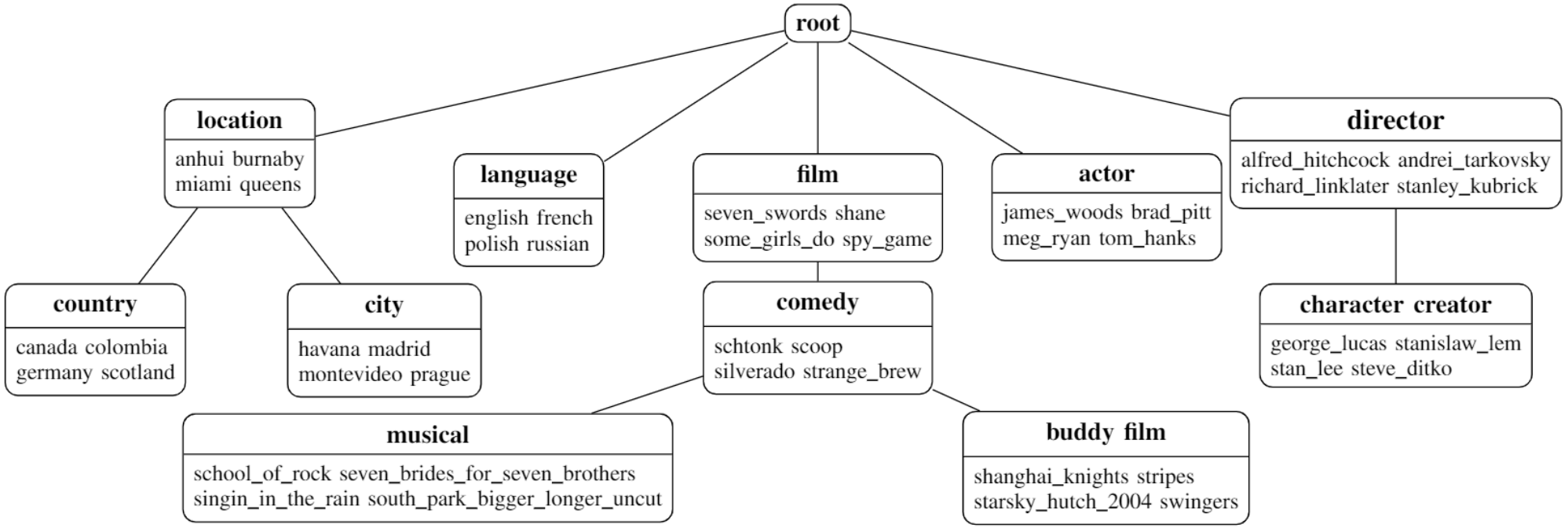
Evaluation

- We apply our method on three datasets:
  - IIMB (movies)
  - DBpedia (Wikipedia facts)
  - WordNet (English language)
- We use three metrics to measure performance: Hie-F1, Sub-F1, and Tag-F1.

Results

	Hie-F1	Sub-F1	Tag-F1
IIMB	0.4444	0.8905	0.7843
DBpedia	0.8627	0.9659	0.9603
WordNet	0.6579	0.9212	0.8998

IIMB Results Excerpt



Summary

- Method for performing hierarchical clustering on knowledge graph subjects
- Source code and experimental results available at www.github.com/mpietrasik/smich
- Feel free to email me about specifics at pietrasi@ualberta.ca

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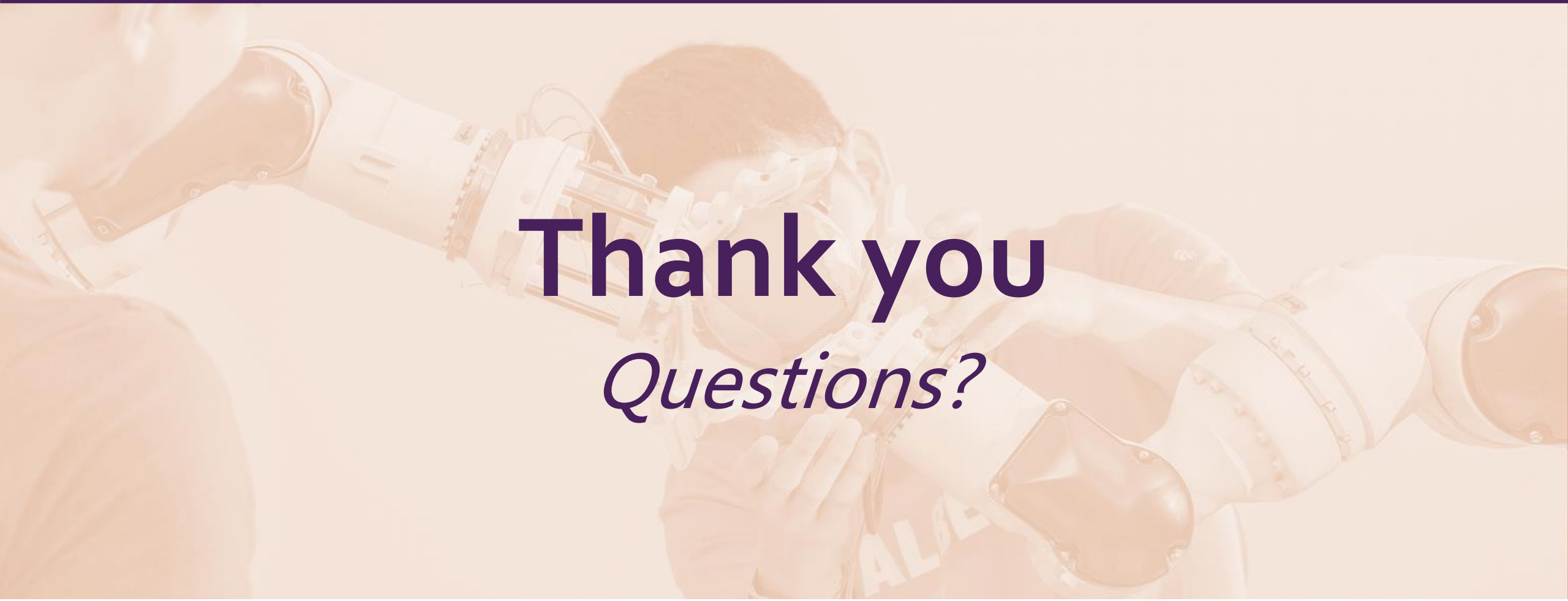

Thank you

Questions?