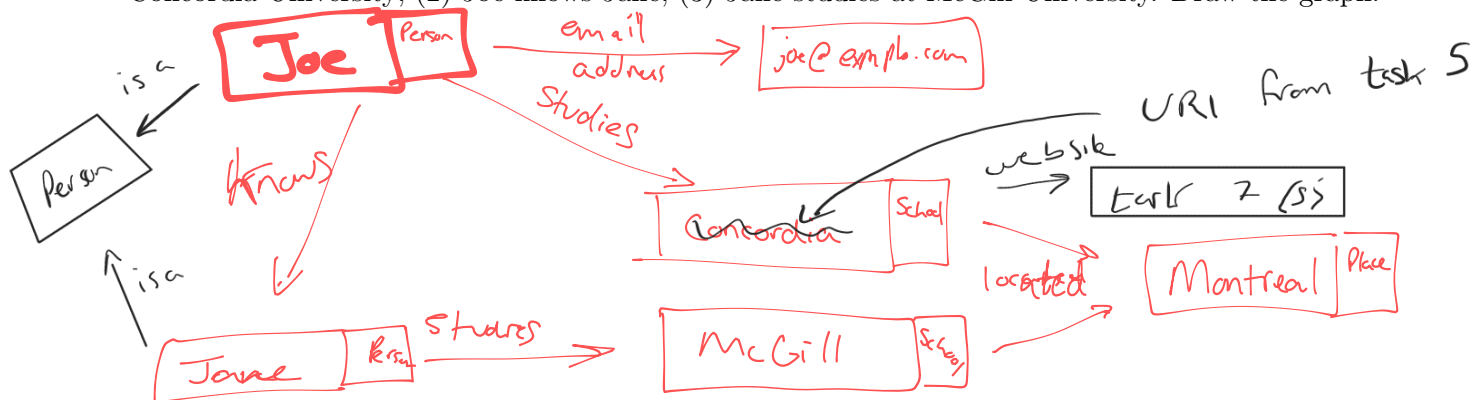# COMP 474/6741 Intelligent Systems (Winter 2024)

Worksheet #1: Knowledge Graphs

These are <u>active learning</u> exercises; work on them during the lecture in <u>teams of two!</u>

Task 1. We start by modeling some university-related knowledge in form of a *graph*: (1) Joe studies at Concordia University; (2) Joe knows Jane; (3) Jane studies at McGill University. Draw the graph:

Task 2. Let's add some additional knowledge: (4) Joe's email address is `joe@example.com`; (5) Concordia is located in Montreal; (6) McGill is located in Montreal. Add these to the graph above.

Task 3. Graphs can be represented as *triples* (and vice versa), consisting of

<center><subject> <predicate> <object></center>

Write the triples corresponding to the first three statements above:

1. 〈Joe〉 〈studies at〉 〈Concordia〉
2. 〈Joe〉 〈knows〉 〈Jane〉
3. 〈Jane〉 〈studies at〉 〈McGill〉

Task 4. Here's another triple: (*Joe, is a, Person*). Add it to the graph you drew in Task 1.

⌨ **Task 5.** So far, we defined everything in terms of natural language. That's not very useful for a knowledge base to be used in an intelligent system. Rather than writing *"Concordia"*, we will use a URI that points to a machine-readable description in the RDF *(Resource Description Framework)* format. Using your phone or laptop, look up (our) Concordia University in the open knowledge base *Wikidata* (https://wikidata.org):[1]

- URI: https://www.wikidata.org/wiki/Q326342

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[1] What you see in your browser is actually a human-readable web page obtained through a 303 redirect (from `/entity/...` to `/wiki/...`), not the raw RDF data that would be consumed by a program (`/entity/...`). The returned file format is determined by the extension, e.g., https://www.wikidata.org/wiki/Special:EntityData/Q326342.rdf for raw RDF data.

Task 6. Ok, now let's go back to the graph from Task 1. Replace the string "Concordia" with the URI you obtained in the previous step in your graph above. *Note:* To obtain a complete RDF graph, you'd have to continue replacing all subjects, predicates and objects (except literals) with URIs.

Task 7. Wikidata contains (among other information) the link to Concordia's *website*. Find the information and write it in form of a triple: `<s><P><o>`

- <http://www.concordia.ca> <website> <Concordia's website URI>

Now add this triple to the graph from Task 1.

Task 8. What about our Joe and Jane? Unlike some famous persons, we will most likely not find them in Wikidata (or any other public knowledge graph). However, an organization might have them in their own graph (for example, in Facebook, LinkedIn, or Concordia's student database). For this example, we simply name them with a URI like `http://example.org/joe` (likewise for Jane). How do we model the predicate that Joe *knows* Jane in a machine-readable way? The details will be the topic of the next lecture; for now simply use the URI `http://xmlns.com/foaf/0.1/knows`. Re-write the triple (2) from Task 1 using three URIs: RDF: `<s><p> <o>`

- <Joe URI> < URI> <Jane URI>

Observe how an intelligent agent can now learn more about each part of this triple simply by resolving the URI and reading the RDF data retrieved through it.

Task 9. Writing these full URIs (technically IRIs) is tiring (and uses up storage space). Using the following prefixes:

```
PREFIX foaf:  <http://xmlns.com/foaf/0.1/>
PREFIX user:  <http://example.org/>
```

re-write the triple from Task 8 using these namespaces:

- User:joe   foaf:Knows   User:jane

Task 10. Given the knowledge graph you constructed, can an intelligent agent answer the question *"Which city is Joe studying in?"* If yes, how (explain, step-by-step, using your graph)? If no, why not?

Yes, <Joe URI> <Studies at> <Concordia Uni URI>

<Concordia uni URI> <located> <MTL URI>

To learn more about the technical details of RDF, see the references provided in the lecture, in particular
https://www.w3.org/TR/rdf11-primer/