Knowledge Engineering Session 2:
Developing your Domain Ontology

A Simple Ontology Development Methodology

1. Determine the domain and scope of the ontology

2. Consider reusing existing ontologies

3. Enumerate terms in the ontology

4. Define the classes and the class hierarchy

5. Define the properties of classes (slots)

6. Define the facets of slots

7. Create instances

Step 1: Determine the Domain and Scope

What is the domain that the ontology will cover?

Road signs, as those used in the European Union.

For what are we going to use the ontology?

To know what kind of road sign we identify based on its properties, and what actions we need to take as an agent in traffic.

Who will use and maintain the ontology?

For example, (semi-)autonomous vehicles and their engineers.

Competency Questions

- What is the shape of 'danger warning' signs?

- Which road signs are relevant to pedestrians?

- How many roadsigns are depicted in image IMG_20230314_49094.jpg?

- Are there images containing a 'compulsory minimum speed' sign?

- What percentage of road signs depicted in the image repository are prohibitory signs?

- Is there any roadsign in the image repository that informs about a restriction applicable to lorries or other large vehicles?

- Is there any 'priority road' sign in the image repository?

- Which border colour do circle-shaped road signs have?

- Which images contain 'stop' signs?

- Is there an image containing both, a 'danger warning' sign and a 'prohibitory' sign?

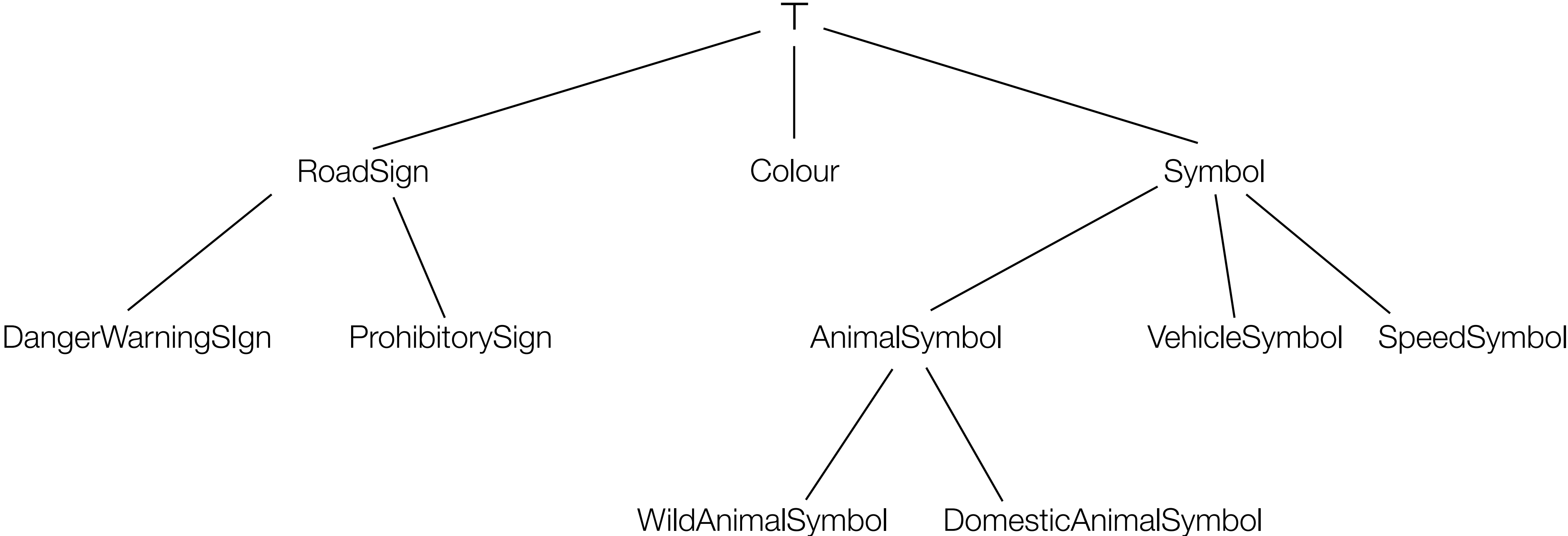- Which is the maxmium speed shown on most 'speed limit' signs?

Step 2: Consider Reusing Existing Ontologies

- **Vienna Convention on Road Signs and Signals** (uploaded on the Virtual Campus)

- Web search of "road sign ontology":

  - Iancu, Bogdan and Zamfiroiu, Alin (2015): **Automating the Process of Traffic Orientation Through Mobile Devices and Ontologies.** Published in: JADLeT Journal of Advanced Distributed Learning Technology , Vol. 3, No. 7 (July 2015): pp. 64-74.

  - Kim, J.E., Henson, C., Huang, K., Tran, T.A., Lin, WY. (2021). **Accelerating Road Sign Ground Truth Construction with Knowledge Graph and Machine Learning.** In: Arai, K. (eds) Intelligent Computing. Lecture Notes in Networks and Systems, vol 284. Springer, Cham. https://doi.org/10.1007/978-3-030-80126-7_25
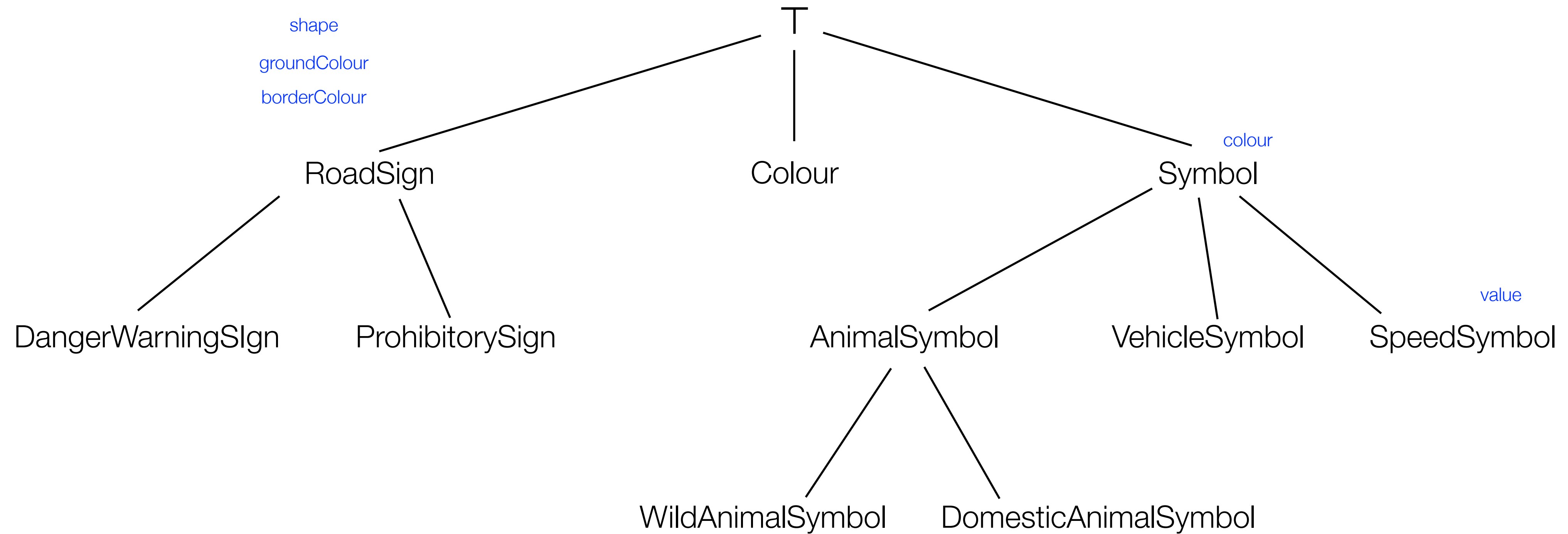
- **https://señalesdetrafico.com/**

- **….**

Step 3: Enumerate Important Terms

- road sign, danger warning sign, prohibitory sign, mandatory sign, …

- ground colour, border colour, shape, symbol

- white, red, blue, black, … triangle, circle, rectangle, …

- pedestrian crossing, horizontal bar, compulsory speed limit, priority road

- pedestrian, bicycle, car, lorry, motor vehicle,

- …

Step 4: Define the Classes and the Hierarchy

Step 5: Define the Properties of Classes (slots)

shape
groundColour
borderColour

⊤

RoadSign

Colour

Symbol   colour

DangerWarningSIgn

ProhibitorySign

AnimalSymbol

VehicleSymbol

SpeedSymbol   value

WildAnimalSymbol

DomesticAnimalSymbol

Step 6: Define the Facets of the Slots

- **Slot-value type:** determines the **range of the property**

  - *data types*: string, boolean, integer, float, enumerated, ...
  - *classes*: Colour, Shape, Symbol, ...

- **Slot cardinality**

  - *single cardinality* (at most one value): …
  - *multiple cardinality* (any number of values): property "symbol" of class "RoadSign"
  - *required* (at least one value)
    ‣ required single (exactly one value): property "shape" of class "RoadSign" (functional)
    ‣ required multiple (any number of values, but at least one): property "symbolColour" of class "Symbol"

  - *arbitrary minimum and maximum cardinality*

Step 7: Create Instances

Submission

- A link to the open data repository of the domain of your choice

- A list of at least ten varied competency questions (more ar welcome!)

- The OWL file with the class hierarchy, all properties (object properties and data properties), and all individuals as developed with Protégé using e.g. the 101 Ontology Development methodology to cover the competency questions (you can also suggest additional competency questions)

- Submission via the Virtual Campus (https://cv.uab.cat) by 23rd March at 23:59 h.