



Conceptual modelling in OWL

7th tutorial

Ontologies and Semantic Web

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Crash course Protégé

- Ontology editor supporting OWL
- Download from <http://protege.stanford.edu/> and install (with Java 8 SE)
- Install Pellet Reasoner plug-in (info about reasoner here: <https://github.com/stardog-union/pellet>)
- Go to Preferences → Plugins and change the Plugin registry to <https://raw.githubusercontent.com/Complexible/pellet/master/protege/plugin/plugins.repository>. You will need to restart Protege before the repository change is taken into account (a Protege bug).



What is OWL?

<https://www.w3.org/TR/owl2-primer/>

Ontology language for Semantic Web. Provides **classes, properties, individuals and data values**. Can be combined with RDF information.

Supports description logics.

Description logics in OWL - terminology

DL	OWL
concept	class
role	Object property
Constant/individual	individual
theory	ontology
axiom	axiom

Description logics in OWL - Manchester syntax

description logics syntax	Manchester syntax (OWL in Protégé)
$C_1 \sqsubseteq C_2$	C_1 SubClassOf C_2
$C_1 \equiv C_2$	C_1 EquivalentTo C_2
$C_1 \sqsubseteq \neg C_2$	C_1 DisjointWith C_2
$R_1 \sqsubseteq R_2$	R_1 SubPropertyOf R_2
$\neg C$	not C
$C_1 \sqcup C_2$	C_1 or C_2
$C_1 \sqcap C_2$	C_1 and C_2
$\exists R \cdot C$	R some C
$\forall R \cdot C$	R only C
$\exists R \cdot \{i\}$	R value $\{i\}$
$(\geq 2 R C)$	R min 2 C
$(\leq 2 R C)$	R max 2 C
R^-	inverse R

- Download Pizza ontology from <https://protege.stanford.edu/ontologies/pizza/pizza.owl> (RDF/XML serialization)
- Open Protégé and open Pizza ontology in it

Tutorial in Protégé

The screenshot shows the Protégé interface with the Pizza ontology loaded. The title bar indicates the file path: `pizza (http://www.co-ode.org/ontologies/pizza/2.0.0) : [/home/michal/Projects/Teaching/osw...]`. The menu bar includes File, Edit, View, Reasoner, Tools, Refactor, Window, and Help. The search bar contains the text `pizza (http://www.co-ode.org/ontologies/pizza/2.0.0)`. The interface is divided into several panels:

- Ontology header:** Shows the **Ontology IRI** as `http://www.co-ode.org/ontologies/pizza` and the **Ontology Version IRI** as `http://www.co-ode.org/ontologies/pizza/2.0.0`.
- Annotations:** Lists three annotations:
 - `rdfs:label` [type: xsd:string] with the value `pizza`.
 - `dc:title` [language: en] with the value `pizza`.
 - `dc:description` [language: en] with the value `An ontology about pizzas and their toppings.`
- Ontology metrics:** A table showing various counts:

Metric	Count
Axiom	801
Logical axiom count	322
Declaration axioms count	120
Class count	100
Object property count	8
Data property count	0
Individual count	5
Annotation Property count	12
- Ontology prefixes:** A table showing the mapping of prefixes to their base URIs:

Prefix	Value
	<code>http://www.co-ode.org/ontologies/pizza/pizza.owl#</code>
<code>dc</code>	<code>http://purl.org/dc/elements/1.1/</code>
<code>owl</code>	<code>http://www.w3.org/2002/07/owl#</code>

Classes

The screenshot displays a web browser window with the URL `http://www.co-ode.org/ontologies/pizza/2.0.0`. The browser's address bar shows the path `DomainThing > Food > Pizza > CheesyPizza`. The main content area is divided into two panes:

- Left Pane (Class Hierarchy):** Shows a tree view of classes. The root is `owl:Thing`, which branches into `DomainThing`, `Country`, `Food`, `IceCream`, and `ValuePartition`. Under `Food`, there is a `Pizza` class, which is further divided into `CheesyPizza`, `InterestingPizza`, `MeatyPizza`, `NamedPizza`, `NonVegetarianPizza`, `ReallItalianPizza`, `SpicyPizza`, `SpicyPizzaEquivalent`, `ThinAndCrispyPizza`, `UnclosedPizza`, `VegetarianPizza`, `VegetarianPizza1`, and `VegetarianPizza2`. Below `Pizza` are `PizzaBase`, `DeepPanBase`, and `ThinAndCrispyBase`. Under `ValuePartition` is `Spiciness`, which includes `Hot`, `Medium`, and `Mild`. The `CheesyPizza` class is highlighted in blue.
- Right Pane (CheesyPizza Details):** Shows the details for the selected `CheesyPizza` class. It includes:
 - Annotations:** A list of annotations such as `rdfs:label [language: en] CheesyPizza`, `rdfs:label [language: pt] PizzaComQueijo`, and `skos:prefLabel [language: en] Cheesv Pizza`.
 - Description:** Shows the class's logical definition: `Equivalent To Pizza and (hasTopping some CheeseTopping)`.
 - SubClass Of:** Lists the superclass `PizzaBase` with the axiom `hasBase some PizzaBase`.
 - Other sections:** Includes sections for `SubClass Of (Anonymous Ancestor)`, `Instances`, and `Target for Key`.

At the bottom of the browser window, there is a status bar with the text `Git: master` on the left and `To use the reasoner click Reasoner` on the right.

Object properties

The screenshot displays the Protege web interface for editing the 'pizza' ontology. The browser address bar shows the URL: `http://www.co-ode.org/ontologies/pizza/2.0.0`. The interface includes a menu bar (File, Edit, View, Reasoner, Tools, Refactor, Window, Help) and a search bar. The main workspace is divided into several panels:

- Object property hierarchy: hasBase**: A tree view showing the hierarchy of object properties. The selected path is `owl:topObjectProperty` > `hasIngredient` > `hasBase`. Other properties shown include `hasCountryOfOrigin`, `hasTopping`, `hasSpiciness`, and `isIngredientOf`.
- Annotations: hasBase**: A panel for managing annotations for the selected property.
- Description: hasBase**: A panel showing the logical description of the property. It includes a list of characteristics (Functional, Inverse function, Transitive, Symmetric, Asymmetric, Reflexive, Irreflexive) and a list of logical relationships:
 - Equivalent To: `hasIngredient`
 - SubProperty Of: `isBaseOf`
 - Inverse Of: `isBaseOf`
 - Domains (intersection): `Pizza`
 - Ranges (intersection): `PizzaBase`
 - Disjoint With: (empty)

At the bottom of the interface, there is a status bar showing 'Git: master' and a note: 'To use the reasoner click Reasoner'.

Data properties

The screenshot shows the Protege OWL editor interface. The browser title is "pizza (http://www.co-ode.org/ontologies/pizza/2.0.0)". The menu bar includes File, Edit, View, Reasoner, Tools, Refactor, Window, and Help. The address bar shows the URL "pizza (http://www.co-ode.org/ontologies/pizza/2.0.0)".

The main workspace is divided into several panes:

- Left Pane:** Shows the "Data property hierarchy" for `owl:topDataProperty`. It includes a tree view with a plus icon, a minus icon, and a delete icon. The text "Asserted" is visible. Below the tree, the text `owl:topDataProperty` is displayed.
- Right Pane (Annotations):** Titled "Annotations: owl:topDataProperty", it shows a list of annotations with a plus icon to add new ones.
- Right Pane (Description):** Titled "Description: owl:topDataProperty", it contains a list of property characteristics with plus icons to add or modify them:
 - Functional
 - Equivalent To +
 - SubProperty Of +
 - Domains (intersection) +
 - Ranges +
 - Disjoint With +

At the bottom of the window, the status bar shows "Git: master" on the left and "To use the reasoner click Reasoner" on the right.

Annotation properties

The screenshot shows a web browser window with the URL `http://www.co-ode.org/ontologies/pizza/2.0.0`. The browser's address bar and search bar both contain the same URL. The page title is "pizza (http://www.co-ode.org/ontologies/pizza/2.0.0)".

The interface includes a menu bar with "File", "Edit", "View", "Reasoner", "Tools", "Refactor", "Window", and "Help". Below the menu bar are tabs for "Active ontology", "Entities", "Individuals by class", and "DL Query".

There are two main panels. The left panel is titled "Annotation property hierarchy:" and contains a list of properties with expandable icons to their left:

- dc:description
- dc:title
- dcterms:contributor
- dcterms:license
- dcterms:provenance
- owl:backwardCompatibleWith
- owl:deprecated
- owl:incompatibleWith
- owl:priorVersion
- owl:versionInfo
- rdfs:comment
- rdfs:isDefinedBy
- rdfs:label
- rdfs:seeAlso
- skos:altLabel
- skos:definition
- skos:prefLabel

The right panel is titled "owl:topDataProperty — http://www.w3.org/2002/07/owl#topDataProperty" and contains a large grey box with the text "Nothing Selected".

At the bottom of the browser window, there is a status bar with "Git: master" on the left and "To use the reasoner click Reasoner" on the right.

Datatypes

The screenshot shows a web browser window with the URL `http://www.co-ode.org/ontologies/pizza/2.0.0`. The browser's address bar and search bar both contain the same URL. The page title is "pizza (http://www.co-ode.org/ontologies/pizza/2.0.0)".

The interface includes a menu bar with "File", "Edit", "View", "Reasoner", "Tools", "Refactor", "Window", and "Help". Below the menu bar is a navigation bar with tabs for "Active ontology", "Entities", "Individuals by class", and "DL Query".

The main content area has a tabbed interface with "Annotation properties", "Datatypes", and "Individuals". The "Datatypes" tab is active, showing a list of datatypes. The list includes:

- owl:rational
- owl:real
- rdf:PlainLiteral
- rdf:XMLLiteral
- rdfs:Literal
- xsd:anyURI
- xsd:base64Binary
- xsd:boolean
- xsd:byte
- xsd:dateTime
- xsd:dateTimeStamp
- xsd:decimal
- xsd:double
- xsd:float
- xsd:hexBinary
- xsd:int
- xsd:integer
- xsd:language
- xsd:long
- xsd:Name
- xsd:NCName
- xsd:negativeInteger
- xsd:NMTOKEN
- xsd:nonNegativeInteger
- xsd:nonPositiveInteger
- xsd:normalizedString
- xsd:positiveInteger

At the bottom of the list, there is a "Git: master" label. To the right of the datatypes list, there is a large, light gray rectangular area with the text "Nothing Selected" in the center. At the bottom right of the interface, there is a small text label: "To use the reasoner click Reasoner".

Individuals

Active ontology x Entities x Individuals by class x DL Query x

Annotation properties | Datatypes | Individuals
Classes | Object properties | Data properties

Individuals: Italy

- America
- England
- France
- Germany
- Italy**

Annotations: Italy

Annotations +

Description: Italy

Types +

- Country
- owl:Thing

Same Individual As +

Different Individuals +

- America, England, France, Germany

Property assertions: Italy

- Object property assertions +
- Data property assertions +
- Negative object property assertions +
- Negative data property assertions +

Git: master

To use the reasoner click Reasoner



OWL modeling of camping and oversleeping

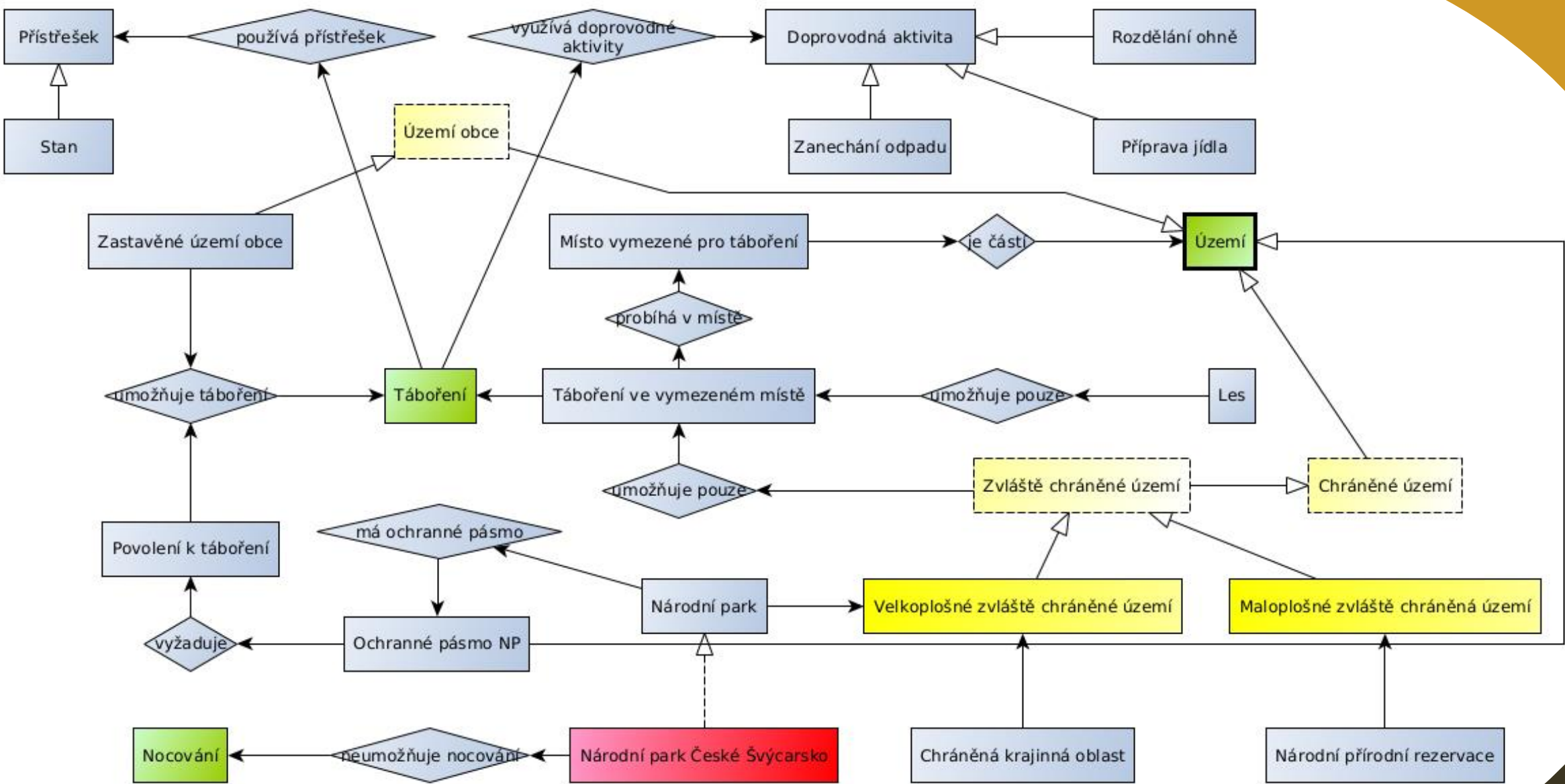
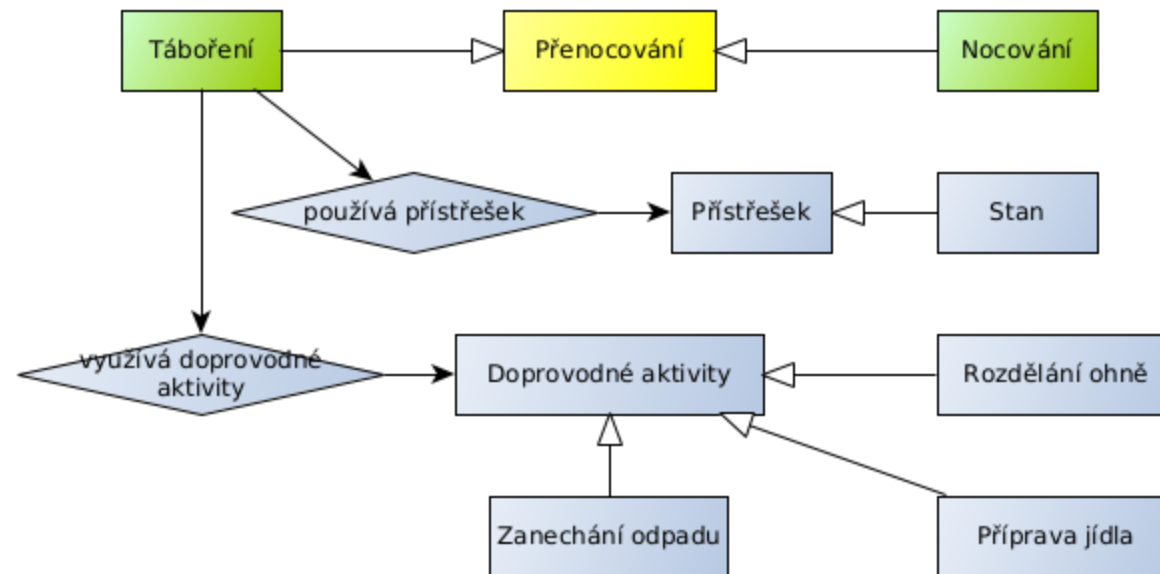


Diagram illustrating the regulatory framework for camping (Táboření) in the Czech Republic, showing the relationship between various entities and activities.

Model this diagram in OWL



Classes and object properties

Annotation properties | Datatypes | Individuals
Classes | Object properties | Data properties

Class hierarchy: Nocování

- owl:Thing
 - Doprovodné aktivity
 - Zanechání odpadu
 - Příprava jídla
 - Rozdělení ohně
 - Přenocování
 - Nocování**
 - Táboření
 - Přístřešek
 - Tarp
 - Stan

Annotation properties | Datatypes | Individuals
Classes | Object properties | Data properties

Object property hierarchy: využívá doprovodné aktivity

- owl:topObjectProperty
 - využívá doprovodné aktivity**
 - probíhá s použitím přístřešku

využívá doprovodné aktivity — http://osw.felk.cvut.cz/medmicha/ont

Annotations | Usage

Annotations: využívá doprovodné aktivity

Annotations +
rdfs:label [language: cs]
využívá doprovodné aktivity

Char | Description: využívá doprovodné aktivity

- Functional
- Inverse function
- Transitive
- Symmetric
- Asymmetric
- Reflexive
- Irreflexive

Equivalent To +

SubProperty Of +

Inverse Of +

Domains (intersection) +
● Přenocování

Ranges (intersection) +
● 'Doprovodné aktivity'

Rules

☰ Táboření — <http://osw.felk.cvut.cz/medmicha/ontologies/táboření-a-nocování/tábo>

Annotations Usage

Annotations: Táboření

Annotations +

rdfs:label [language: cs] Táboření

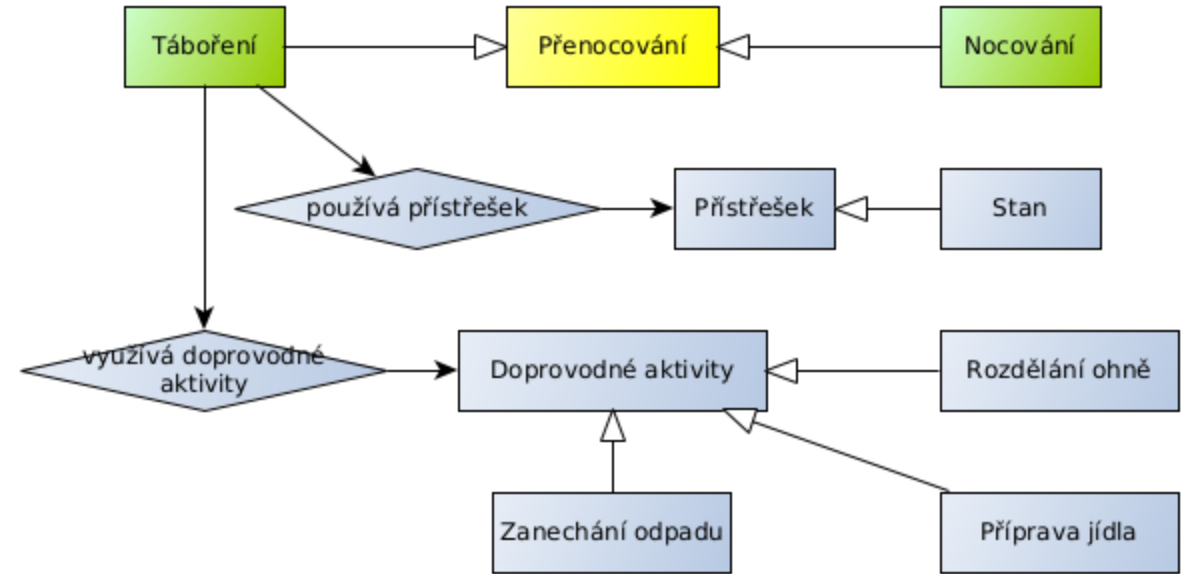
Description: Táboření

Equivalent To +

● ('probíhá s použitím přístřešku' some Přístřešek) or ('využívá doprovodné aktivity' some 'Doprovodné aktivity')

SubClass Of +

● Přenocování



Individuals

The image shows a screenshot of an ontology editor interface. The top navigation bar includes tabs for 'Annotation properties', 'Datatypes', and 'Individuals'. Below this, there are sub-tabs for 'Classes', 'Object properties', and 'Data properties'. The main content area is divided into several panels:

- Individuals: táboření_v_tisícáku**: A list of individual instances. Two are visible: 'oheň_v_tisícáku' and 'táboření_v_tisícáku', with the latter selected.
- Annotations: táboření_v_tisícáku**: A panel for viewing annotations on the selected individual, currently empty.
- Description: táboření_v_tisícáku**: A panel for the description of the selected individual, currently empty.
- Property assertions: táboření_v_tisícáku**: A panel for viewing property assertions on the selected individual. One assertion is visible: 'využívá doprovodné aktivity' with the value 'oheň_v_tisícáku'.
- Types**: A panel showing the type 'Přenocování' associated with the individual.
- Same Individual As**: A panel for viewing other individuals that are the same as the selected one, currently empty.

Reasoner

Annotation properties | Datatypes | Individuals
Classes | Object properties | Data properties

Individuals: táboření_v_tisícáku

◆ oheň_v_tisícáku
◆ táboření_v_tisícáku

☰ ◆ táboření_v_tisícáku — <http://osw.felk.cvut.cz/medmicha/ontologies/táboření-a->

Annotations | Usage

Annotations: táboření_v_tisícáku

Annotations +

Description: táboření_v_tisícáku

Types +

- Přenocování
- Táboření

Same Individual As +

Property assertions: táboření_v_tisícáku

Object property assertions +

- 'využívá doprovodné aktivity' oheň_v_tisícáku