



Conceptual modelling in OWL

11th tutorial

Ontologies and Semantic Web

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Crash course Protégé

- Ontology editor supporting OWL
- Download from <http://protege.stanford.edu/> and install
- 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)
$C_1 \sqsubseteq C_2$ $C_1 \equiv C_2$ $C_1 \sqsubseteq \neg C_2$ $R_1 \sqsubseteq R_2$	C_1 SubClassOf C_2 C_1 EquivalentTo C_2 C_1 DisjointWith C_2 R_1 SubPropertyOf R_2
$\neg C$ $C_1 \sqcup C_2$ $C_1 \sqcap C_2$ $\exists R \cdot C$ $\forall R \cdot C$ $\exists R \cdot \{i\}$ $(\geq 2 R C)$ $(\leq 2 R C)$	not C C_1 or C_2 C_1 and C_2 R some C R only C R value $\{i\}$ R min 2 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 toolbar contains navigation and editing icons.

The 'Active ontology' tab is selected, showing the 'Ontology header' panel with the following information:

- Ontology IRI:** `http://www.co-ode.org/ontologies/pizza`
- Ontology Version IRI:** `http://www.co-ode.org/ontologies/pizza/2.0.0`

The 'Annotations' panel shows the following metadata:

- rdfs:label** [type: xsd:string]: pizza
- dc:title** [language: en]: pizza
- dc:description** [language: en]: An ontology about pizzas and their toppings. This is an example ontology that contains all constructs required for the various versions of the Pizza Tutorial run by Manchester University (see...

The 'Metrics' panel shows the following counts:

Metrics	
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

The 'Class axioms' panel shows the following counts:

Class axioms	
SubClassOf	259
EquivalentClasses	15

The 'Ontology prefixes' panel shows the following mappings:

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

The bottom status bar shows 'Git: master' and 'To use the reasoner click...'.

Classes

The screenshot shows the Protégé OWL editor interface. The top menu bar includes File, Edit, View, Reasoner, Tools, Refactor, Window, and Help. The address bar displays the URL: <http://www.co-ode.org/ontologies/pizza/2.0.0>. The breadcrumb trail indicates the current location: DomainThing > Food > Pizza > CheesyPizza. The active ontology is 'pizza'. The left pane shows the class hierarchy for 'CheesyPizza', which is a subclass of 'Pizza'. The right pane shows the annotations for 'CheesyPizza', including 'rdfs:label' in English and Portuguese, and 'skos:prefLabel' in English. The description of 'CheesyPizza' is shown as 'Equivalent To Pizza and (hasTopping some CheeseTopping)'. The bottom status bar indicates the Git repository is at the 'master' branch.

Object properties

Browser window showing the **pizza** ontology (<http://www.co-ode.org/ontologies/pizza/2.0.0>) in a web editor.

The interface displays the **Object property hierarchy: hasBase** and the **Description: hasBase** panel.

Object property hierarchy: hasBase

- owl:topObjectProperty
 - hasCountryOfOrigin
 - hasIngredient
 - hasBase**
 - hasTopping
 - hasSpiciness
 - isIngredientOf

Description: hasBase

- Equivalent To: +
- SubProperty Of: +
 - hasIngredient
- Inverse Of: +
 - isBaseOf
- Domains (intersection): +
 - Pizza
- Ranges (intersection): +
 - PizzaBase
- Disjoint With: +

Git: master

To use the reasoner click Reasoner

Data properties

The screenshot shows the Protege OWL editor interface. The top menu bar includes File, Edit, View, Reasoner, Tools, Refactor, Window, and Help. The address bar displays the URL for the 'pizza' ontology. The main workspace is divided into several panes:

- Left Pane:** Contains a tree view of the ontology. The 'Data properties' tab is selected, showing a hierarchy starting with 'owl:topDataProperty'. Below the tree are icons for adding, removing, and asserting properties.
- Right Pane:** Displays the configuration for the selected property, 'owl:topDataProperty'. It includes tabs for 'Annotations' and 'Usage'. The 'Usage' tab is active, showing a list of characteristics (Functional, Equivalent To, SubProperty Of, Domains (intersection), Ranges, Disjoint With) with plus signs next to them, indicating they can be added or modified.

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

Annotation properties

The screenshot shows the Protege OWL editor interface. The top menu bar includes File, Edit, View, Reasoner, Tools, Refactor, Window, and Help. The address bar displays the URL: `pizza (http://www.co-ode.org/ontologies/pizza/2.0.0)`. Below the menu bar, there are tabs for 'Active ontology', 'Entities', 'Individuals by class', and 'DL Query'. The main workspace is divided into two panes. The left pane, titled 'Annotation property hierarchy:', contains a list of annotation properties with expandable icons to their left. The right pane is currently empty and displays the text 'Nothing Selected'. The status bar at the bottom indicates 'Git: master' on the left and 'To use the reasoner click Reasoner' on the right.

Annotation property hierarchy:

- 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

Nothing Selected

Git: master

To use the reasoner click Reasoner

Datatypes

⌵ — □ pizza (http://www.co-ode.org/ontologies/pizza/2.0.0) : [/home/michal/Projects/Teaching/osw/2021-winter/tutorials/pizza...

File Edit View Reasoner Tools Refactor Window Help

< > 🍷 pizza (http://www.co-ode.org/ontologies/pizza/2.0.0) Search...

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

Annotation properties Datatypes Individuals
Classes Object properties Data properties

Datatypes: 🗑️ 🗑️

- 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

owl:topDataProperty — http://www.w3.org/2002/07/owl#topDataProperty

Nothing Selected

Git: master To use the reasoner click Reasoner

Individuals

pizza (http://www.co-ode.org/ontologies/pizza/2.0.0) : [/home/michal/Projects/Teaching/osw/2021-winter/tutorials/pizza...

File Edit View Reasoner Tools Refactor Window Help

pizza (http://www.co-ode.org/ontologies/pizza/2.0.0) Search...

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

Annotation properties Datatypes Individuals
Classes Object properties Data properties

Individuals: Italy

Annotations: Italy

Annotations +

Italy — http://www.co-ode.org/ontologies/pizza/pizza.owl#Italy

Annotations Usage

Annotations: Italy

Annotations +

Description: Italy

Property assertions: Italy

Object property assertions +

Data property assertions +

Negative object property assertions +

Negative data property assertions +

Types +

Country owl:Thing

Same Individual As +

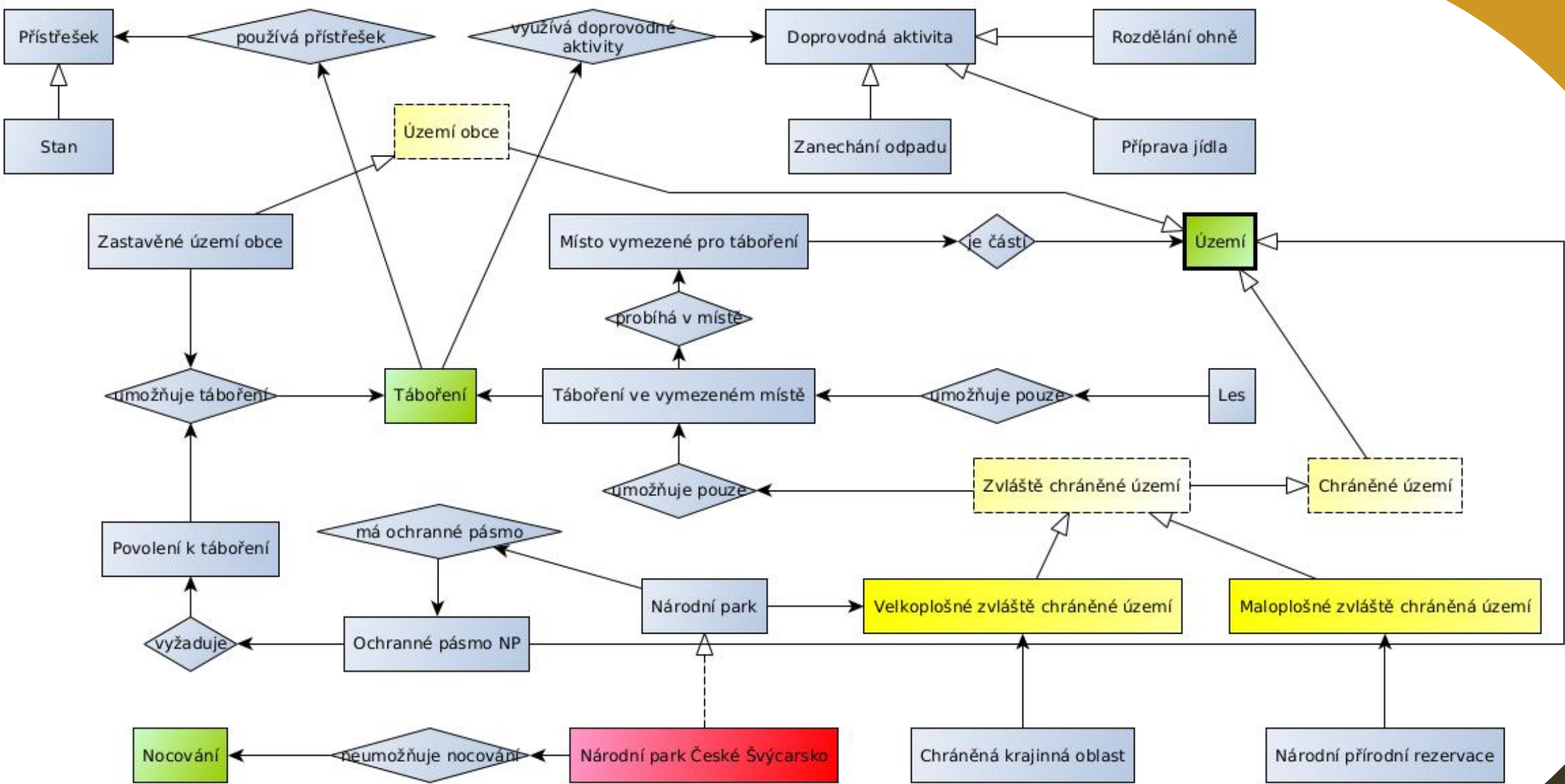
Different Individuals +

America, England, France, Germany

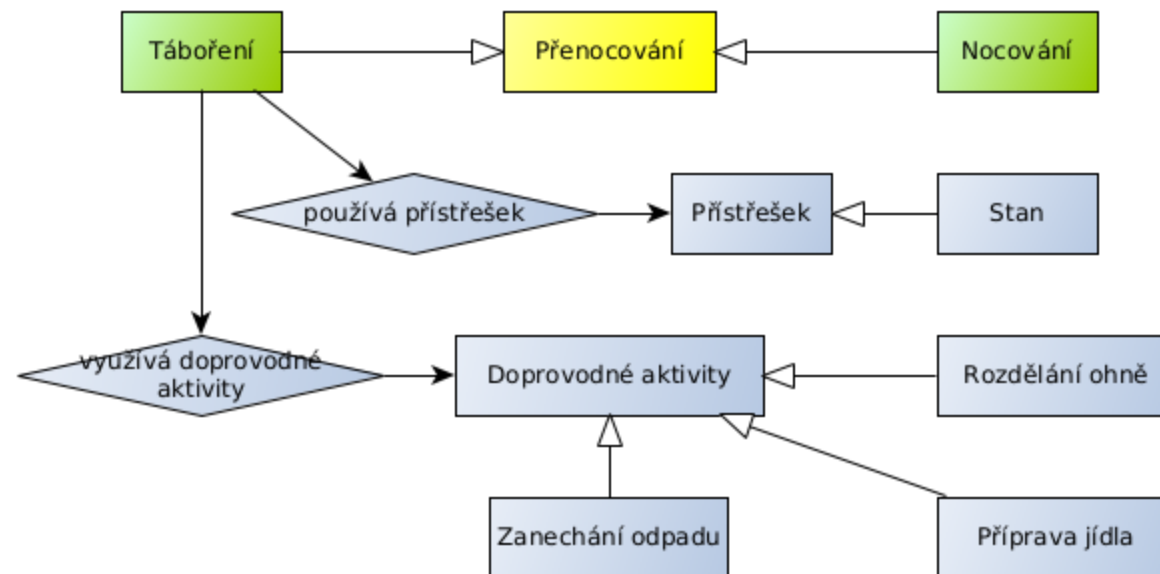
Git: master To use the reasoner click Reasoner



OWL modeling of camping and oversleeping



Model this diagram in OWL

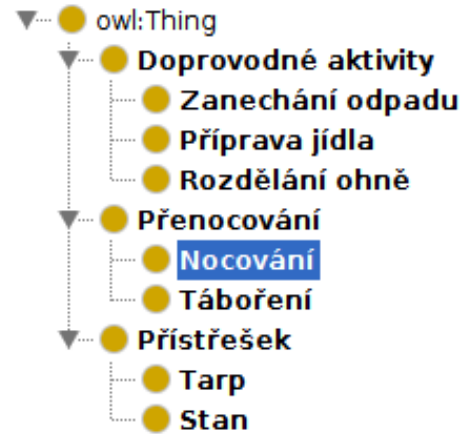


Classes and object properties

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

Class hierarchy: Nocování

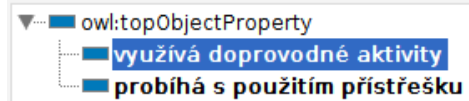
Asserted



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

Object property hierarchy: využívá doprovodn

Asserted



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

Annotations Usage

Annotations: Táboření

Annotations +

rdfs:label [language: cs]
Táboření

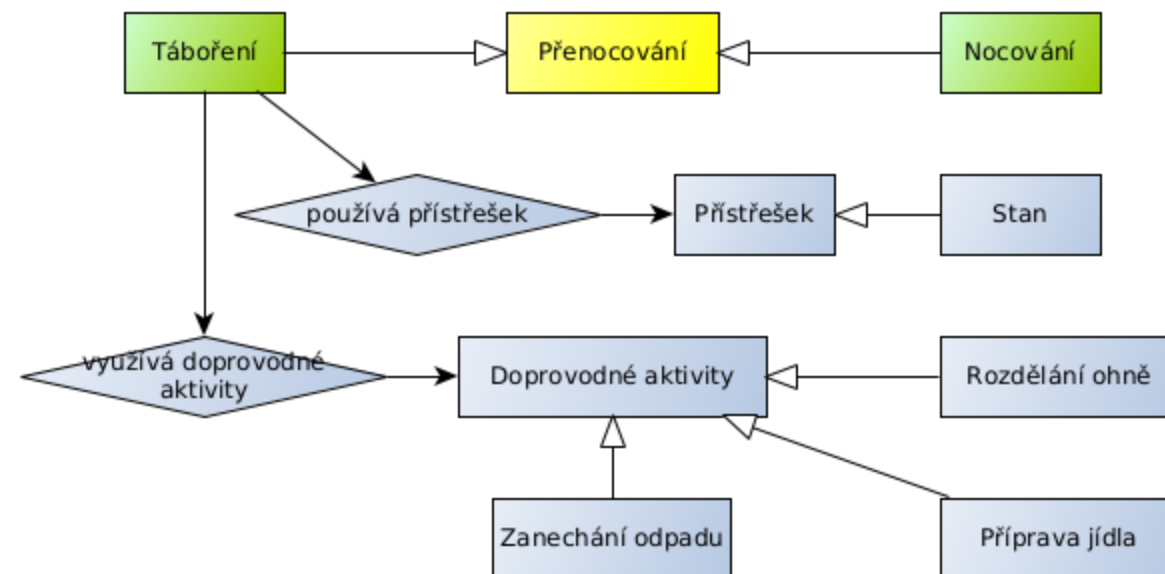
Description: Táboření

Equivalent To +

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

SubClass Of +

● Přenocování



Individuals

The screenshot displays a web-based ontology editor interface. The top navigation bar includes tabs for 'Annotation properties', 'Datatypes', 'Individuals', 'Classes', 'Object properties', and 'Data properties'. The 'Individuals' tab is active, showing a list of individuals for the class 'táboření_v_tisícáku'. The list includes 'oheň_v_tisícáku' and 'táboření_v_tisícáku', with the latter selected. The right-hand pane shows the details for the selected individual 'táboření_v_tisícáku'. It includes a title bar with the individual's name and URI, and tabs for 'Annotations' and 'Usage'. The 'Annotations' tab is active, showing a list of annotations. Below this, there are sections for 'Description: táboření_v_tisícáku' and 'Property assertions: táboření_v_tisícáku'. The 'Description' section shows a list of types, including 'Přenocování'. The 'Property assertions' section shows a list of object property assertions, including 'využívá doprovodné aktivity'.

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

Individuals: táboření_v_tisícáku

Annotations | Usage

Annotations: táboření_v_tisícáku

Annotations +

Description: táboření_v_tisícáku

Property assertions: táboření_v_tisícáku

Types +

Přenocování

Same Individual As +

Object property assertions +

'využívá doprovodné aktivity' oheň_v_tisícáku

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

Property assertions: táboření_v_tisícáku

Types +

- Přenocování
- ☰ Táboření

Same Individual As +

Object property assertions +

- 'využívá doprovodné aktivity' oheň_v_tisícáku