

# Modeliranje z DL

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# DL in FOL

- Izražali bomo nekatere gradnike ostalih podatkovnih modelov z DL in FOL
- Pogledali si bomo:
  - Semantične mreže
  - Objekte in razrede
  - Attribute (lastnosti) objektov
  - Omejevanje lastnosti objektov
  - Entitete in razmerja

# Objects: classes

Oseba	
Ime:	[String]
naslov:	[String]
izbral:	[Predmet]

$$\{x \mid \text{Student}(x)\} =$$
$$\{x \mid \text{Person}(x) \wedge (\exists y.\text{NAME}(x,y) \wedge \text{String}(y)) \wedge$$
$$((\exists z.\text{ADDRESS}(x,z) \wedge \text{String}(z)) \wedge$$
$$((\exists w.\text{ENROLLED}(x,w) \wedge \text{Course}(w)))\}$$

Student = Person  $\sqcap$   
     $\exists$ NAME.String  $\sqcap$   
     $\exists$ ADDRESS.String  $\sqcap$   
     $\exists$ ENROLLED.Course

# Objects: instances

s1: Student	
Ime:	“Janez”
naslov:	“Kosovelova...”
izbral:	cs415

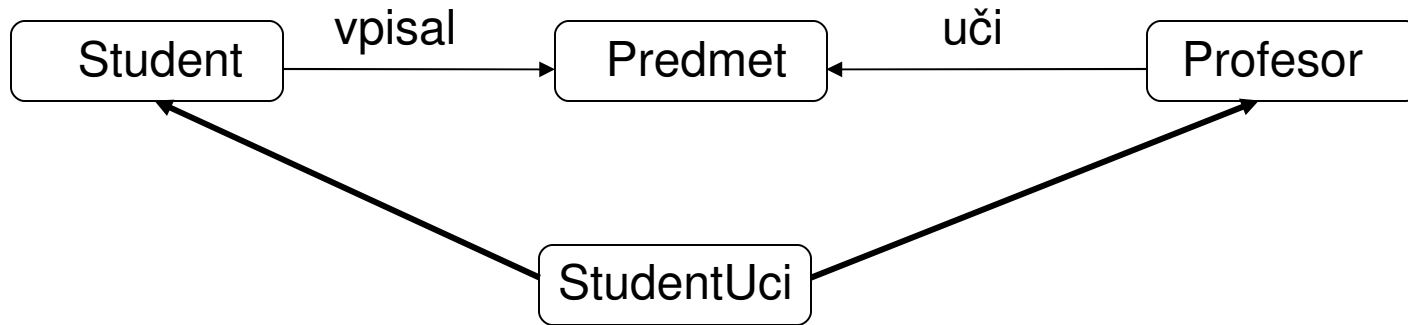
Student(s1)  $\wedge$

NAME(s1, "janez")  $\wedge$  String("janez")  $\wedge$

ADDRESS(s1, "kosovelova")  $\wedge$  String("kosovelova")  $\wedge$

ENROLLED(s1, cs415)  $\wedge$  Course(cs415)

# Semantične mreže



$\forall x. \text{Student}(x) \rightarrow$   
     $\exists y. \text{VPISAL}(x,y) \wedge \text{Predmet}(y)$   
 $\forall x. \text{Profesor}(x) \rightarrow$   
     $\exists y. \text{UČI}(x,y) \wedge \text{Predmet}(y)$   
 $\forall x. \text{StudentUci}(x) \rightarrow$   
     $\text{Student}(x) \wedge \text{Profesor}(x)$

$\text{Student} \sqsubseteq \exists \text{VPISAL}.\text{Predmet}$   
 $\text{Profesor} \sqsubseteq \exists \text{UČI}.\text{Predmet}$   
 $\text{StudentUci} \sqsubseteq \text{Student}$   
 $\text{StudentUci} \sqsubseteq \text{Profesor}$

# Kvantifikacija



- $\text{Žaba} \sqsubseteq \exists \text{BARVA.Zelena}$   
Vsaka žaba je tudi zelena.
- $\text{Žaba} \sqsubseteq \forall \text{BARVA.Zelena}$   
Vsaka žaba je samo zelena.

# Kvantifikacija: eksistenčna



Vsaka žaba je tudi zelena,.

Žaba  $\sqsubseteq$   $\exists$ BARVA.Zelena

$\forall x. \text{Žaba}(x) \rightarrow \exists y. (\text{BARVA}(x,y) \wedge \text{Zelena}(y))$

*Naloga:* Je to model?

Žaba(oskar)

BARVA(zelena)

BARVA(oskar,zelena)

BARVA(rdeča)

BARVA(oskar,rdeča)

# Kvantifikacija: univerzalna



Vsaka žaba je samo zelena,.

Žaba  $\sqsubseteq \forall \text{BARVA}. \text{Zelena}$

$\forall x. \text{Žaba}(x) \rightarrow \forall y. (\text{BARVA}(x, y) \wedge \text{Zelena}(y))$

**Naloga:** je to model?

Žaba(oskar), BARVA(zelena),

BARVA(oskar, zelena)

BARVA(rdeča),

BARVA(oskar, rdeča)



# Primer ontologije

- Avtor: Peter F. Patel-Schneider
- Majhna OWL ontologija
  - Ljudje in njihovi ljubljenci (people&pets: pp)
- Primer bomo prepisali tudi v OWL

# Primer: Terminologija

bone  $\sqsubseteq$  T

brain  $\sqsubseteq$  T

white+thing  $\sqsubseteq$  T

plant  $\sqsubseteq$  T

grass  $\sqsubseteq$  plant

tree  $\sqsubseteq$  plant

leaf  $\sqsubseteq$   $\forall$ part\_of.tree

male  $\sqsubseteq$  T

female  $\sqsubseteq$  T

young  $\sqsubseteq$  T

adult  $\sqsubseteq$  T

elderly  $\sqsubseteq$  adult

pet  $\sqsubseteq$   $\exists$ is\_pet\_of.T

animal  $\sqsubseteq$   $\exists$ eats.T

vegetarian  $\equiv$  animal  $\cap$

$\forall$ eats. $\neg$ animal  $\cap$

$\forall$ eats. $\neg$ ( $\exists$ part\_of.animal)

duck  $\sqsubseteq$  animal

cat  $\sqsubseteq$  animal

tiger  $\sqsubseteq$  animal

dog  $\sqsubseteq$   $\exists$ eats.bone

sheep  $\sqsubseteq$  animal  $\cap$

$\forall$ eats.grass

giraffe  $\sqsubseteq$  animal  $\cap$   $\forall$ eats.leaf

cow  $\sqsubseteq$  vegetarian

mad+cow  $\equiv$  cow  $\cap$   $\exists$ eats.

(brain  $\cap$   $\exists$ part\_of.sheep)

# Primer: Terminologija

mad+cow  $\equiv$  cow  $\sqcap$   $\exists$ eats.  
(brain  $\sqcap$   $\exists$ part\_of.sheep)

person  $\sqsubseteq$  animal

kid  $\equiv$  young  $\sqcap$  person

man  $\equiv$  person  $\sqcap$  male  $\sqcap$  adult

woman  $\equiv$  female  $\sqcap$  person  $\sqcap$   
adult

old+lady  $\equiv$  elderly  $\sqcap$  female  $\sqcap$   
person

old+lady  $\sqsubseteq$   $\forall$ has\_pet.cat  $\sqcap$   
 $\exists$ has\_pet.animal

grownup  $\equiv$  person  $\sqcap$  adult

animal+lover  $\equiv$  person  $\sqcap$   
 $>3$ has\_pet

pet+owner  $\equiv$   
 $\exists$ has\_pet.animal  $\sqcap$  person

cat+liker  $\equiv$   $\exists$ likes.cat  $\sqcap$   
person

cat+owner  $\equiv$  person  $\sqcap$   
 $\exists$ has\_pet.cat

dog+liker  $\equiv$   $\exists$ likes.dog  $\sqcap$   
person

dog+owner  $\equiv$   $\exists$ has\_pet.dog  
 $\sqcap$  person

# Primer: Aksiomi

$\text{dog} \sqcap \text{cat} \sqsubseteq \perp$

$\text{young} \sqcap \text{adult} \sqsubseteq \perp$

$(\text{animal} \sqcup \exists \text{part\_of}.\text{animal}) \sqcap (\text{plant} \sqcup \exists \text{part\_of}.\text{plant}) \sqsubseteq \perp$

# Primer: Lastnosti

$\exists \text{likes.T} \sqsubseteq \text{T}$

$\exists \text{eaten\_by.T} \sqsubseteq \text{T}$

$\exists \text{eats.animal} \sqsubseteq \text{T}$

( $\text{eats} \equiv \text{eaten\_by}^{-1}$ )

$\exists \text{works\_for.T} \sqsubseteq \text{T}$

$\exists \text{has\_parent.T} \sqsubseteq \text{T}$

$\exists \text{has\_father.man} \sqsubseteq \text{T}$

$\exists \text{has\_mother.woman} \sqsubseteq \text{T}$

$\exists \text{has\_child.T} \sqsubseteq \text{T}$

$\exists \text{has\_pet.animal} \sqsubseteq \text{T}$   
( $\text{domain}=\text{animal}$ )

$\exists \text{is\_pet\_of.T} \sqsubseteq \text{T}$

( $\text{is\_pet\_of} \equiv \text{has\_pet}^{-1}$ )

$\exists \text{part\_of.T} \sqsubseteq \text{T}$

$\exists \text{has\_part.T} \sqsubseteq \text{T}$

( $\text{has\_part} \equiv \text{part\_of}^{-1}$ )

$\text{has\_mother} \sqsubseteq \text{has\_parent}$

$\text{has\_pet} \sqsubseteq \text{likes}$

$\text{has\_father} \sqsubseteq \text{has\_parent}$

# Primer: Individualni objekti

```
Thing(Tom)
duck(Dewey)
duck(Huey)
duck(Louie)
dog(Fido)
cow(Flossie)
tiger(Fluffy)
dog(Rex)
is_pet_of(Rex,Mick)
cat(Tibbs)
person(Kevin)
person(Fred)
has_pet(Fred,Tibbs)
person(Joe)
has_pet(Joe,Fido)
male(Mick)
male(Minnie)
female(Minnie)
has_pet(Minnie,Tom))
person(Walt)
has_pet(Walt,Huey)
has_pet(Walt,Louie)
has_pet(Walt,Dewey)
```