Beamer presentation of Hunting Ontology

Knowledge Based Systems

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Competency questions

- How do we find an animal given its foot print?

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- What is the personal information of the hunter X?

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Competency questions

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- Check if X is a hunter.

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Competency questions

- How do we find an animal given its foot print?
- Get all hunters from country X.
- What are the calibers for each weapon?
- Which caliber is required to hunt animal Y?
- What are each animal's foot prints?
- What is the personal information of the hunter X?
- Check if X is a hunter.
- What are the foot-prints of all animals?

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Use cases

The fields in which the ontology can be applied:

- help hunters with information about weapons, animals and hunting experience
- help hunters with current legislature
- help people who try to buy a weapon and learn more about hunting

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Tboxes

In this project, we defined the following concepts regarding hunting domain: weapon, caliber, animal, country, terrain, foot-print, hunter, food.

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Tboxes

In this project, we defined the following concepts regarding hunting domain: weapon, caliber, animal, country, terrain, foot-print, hunter, food. A weapon is the most important concept from the hunting domain because it fulfills the hunting activity.

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Tboxes

(implies weapon (all has-caliber caliber)) - this concept implies that all weapons must have a caliber.

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Tboxes

(define-primitive-role has-foot-print :domain animal :range foot-print)
(implies animal(all has-foot-print foot-print)) - this implies that all animals must have a different foot-print model.

Tboxes

(define-primitive-role caliber-for-animal :domain caliber :range animal) - different animals require different calibers because some animals are smaller and they don't need a big sized caliber and other larger animals require caliber for their size. This role helps the hunter into choosing the optimal caliber for the animal which he is going to hunt.
(define-primitive-role terrain-for-animal :domain terrain :range animal :feature t) - because there are different types of animal species, these can not live in the same habitat (e.g. bear in the mountains, rabbit in plain). For this reason, we need this role to specify the habitat in which an animal can live and to help the hunter into where to go look for the wanted prey.
(define-concept Food (or grass honey)) - different animals eat different foods

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Tboxes

(define-primitive-role has-address :domain Hunter :range Country) - this is a sub-concept of the hunter.

Tboxes

The hunter is the main actor of our ontology. This concept can have name, address and age.
(instance Trif Hunter)
(attribute-filler Trif "Andrei" has-name)
(attribute-filler Trif 23 has-age)

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Tboxes

Here are all the roles that we use in our ontologies:
(define-primitive-role has-foot-print :domain animal :range foot-print)
(define-primitive-role caliber-for-animal :domain caliber :range animal)
(define-primitive-role caliber-for-foot-print :domain caliber :range foot-print)
(define-primitive-role terrain-for-animal :domain terrain :range animal :feature t)
(define-concrete-domain-attribute has-name :domain Hunter :type string)
(define-concrete-domain-attribute has-age :domain Hunter :type integer)
(define-primitive-role has-address :domain Hunter :range Country)
(define-primitive-role has-part :transitive t :inverse is-part-of :domain Food)
One role has a domain and a range, for example caliber-for-animal has domain caliber and range animal.

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ABoxes

In this section it is presented the ABox part of the ontology. The ABox is the component which refers to the instances through which the ontology has been populated and the different connections between them. Knowing this, in our ontology there are described the relations between weapons, calibers, animals, foot-prints etc. In Racer these instances are declared using the 'instance' key-word and for relations it is used the 'related' key-word. Relations refer to the concept of more instances being tied together.

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ABoxes

For the weapon concept we have the fallowing instances and relation:

Examples

(instance sniper weapon)
(instance shotgun weapon)
(instance pistol weapon)

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ABoxes

First we have 3 instances of weapon and these are sniper, pistol and shotgun. These 3 weapons each have a different caliber specified in the following 3 relations:

Examples

(related sniper cal365mm has-caliber)
(related shotgun cal66mm has-caliber)
(related pistol cal12mm has-caliber)

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ABoxes

Also the cal365mm, cal66mm and cal12mm are instances of the caliber concept.

Examples

(instance cal365mm caliber)
(instance cal66mm caliber)
(instance cal12mm caliber)

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ABoxes

The next 3 instances represent the animal imported into our ontology:

Examples

(instance bear animal)
(instance deer animal)
(instance rabbit animal)

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ABoxes

Here we have 3 animals bear, deer and rabbit. These instances are related with the caliber domain because we try to create a method through which we can get the optimal caliber for each animal.

Examples

(related cal365mm bear caliber-for-animal)
(related cal66mm deer caliber-for-animal)
(related cal12mm rabbit caliber-for-animal)

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ABoxes

Also deer-foot-print, bear-foot-print and rabbit-foot-print are all instances of foot-print concept.

Examples

(instance deer-foot-print foot-print)
(instance bear-foot-print foot-print)
(instance rabbit-foot-print foot-print)

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Queries

- What are the calibers for each weapon?

```
(INDIVIDUAL-FILLERS SNIPER HAS-CALIBER) --> (CAL365MM)
(INDIVIDUAL-FILLERS PISTOL HAS-CALIBER) --> (CAL12MM)
(INDIVIDUAL-FILLERS SHOTGUN HAS-CALIBER) --> (CAL66MM)
```

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```

- Which caliber is required to hunt a bear?

```
(INDIVIDUAL-FILLERS BEAR (INV CALIBER-FOR-ANIMAL)) --> (CAL365MM)
```

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- What are the calibers for each weapon?

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(INDIVIDUAL-FILLERS SNIPER HAS-CALIBER) --> (CAL365MM)
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```

- Which caliber is required to hunt a bear?

```
(INDIVIDUAL-FILLERS BEAR (INV CALIBER-FOR-ANIMAL)) --> (CAL365MM)
```

- What are each animal's foot prints?

```
(INDIVIDUAL-FILLERS DEER HAS-FOOT-PRINT) --> (DEER-FOOT-PRINT)
(INDIVIDUAL-FILLERS BEAR HAS-FOOT-PRINT) --> (BEAR-FOOT-PRINT)
(INDIVIDUAL-FILLERS RABBIT HAS-FOOT-PRINT) --> (RABBIT-FOOT-PRINT)
```

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Queries

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(INDIVIDUAL-FILLERS SNIPER HAS-CALIBER) --> (CAL365MM)
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- Which caliber is required to hunt a bear?

```
(INDIVIDUAL-FILLERS BEAR (INV CALIBER-FOR-ANIMAL)) --> (CAL365MM)
```

- What are each animal's foot prints?

```
(INDIVIDUAL-FILLERS DEER HAS-FOOT-PRINT) --> (DEER-FOOT-PRINT)
(INDIVIDUAL-FILLERS BEAR HAS-FOOT-PRINT) --> (BEAR-FOOT-PRINT)
(INDIVIDUAL-FILLERS RABBIT HAS-FOOT-PRINT) --> (RABBIT-FOOT-PRINT)
```

- What is the required caliber given a foot-print?

```
(((RELATED CAL365MM BEAR-FOOT-PRINT CALIBER-FOR-FOOT-PRINT))
  ((RELATED CAL66MM DEER-FOOT-PRINT CALIBER-FOR-FOOT-PRINT))
  ((RELATED CAL12MM RABBIT-FOOT-PRINT CALIBER-FOR-FOOT-PRINT))))
```

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Rules

- What is Trif hunting?

```
;Ce vaneaza trif?
 (define-rule (Trif ?y animal-hunt )
    (and (Trif Hunter)
    (?y animal)
    (Trif ?z has-address)
    (?y ?z animal-has-country)))
 (run-all-rules)
```

- Rule result

```
(RUN-ALL-RULES) --> ((((RELATED TRIF DEER ANIMAL-HUNT))))
```

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Rules

- What weapon is Trif using?

```
;Ce arma foloseste
(define-rule (Trif ?t use-weapon )
    (and (Trif Hunter)
    (?y animal)
    (Trif ?z has-address)
    (?y ?z animal-has-country)
    (?x ?y caliber-for-animal)
    (?t ?x has-caliber)))
 (run-all-rules)
```

- Rule result

```
(RUN-ALL-RULES) --> ((((RELATED TRIF SHOTGUN USE-WEAPON))))
```

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DL-Learner Configuration

- We converted our hunting.racer file into an owl file called hunt.owl.

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DL-Learner Configuration

- We converted our hunting.racer file into an owl file called hunt.owl.
- Next, we downloaded the DLLearner 1.4.0 software from `https://dl-learner.org`. In the *examples* directory from DL-learner, we created a new file with the extension .conf and in this file we modified the prefix to match the .owl file generated in the previous step. To execute the .conf file, we ran the following command in the command prompt:
  bin/cli.bat examples/hunt.conf

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DL-Learner Results

- The software learns from examples and it generates a set of axioms. For positive examples, we used types of weapons which can be used in hunting sniper, shotgun and pistol and for negative examples, we used sling, bow and knife. The obtained result axioms are as following:

```
solutions:
1: weapon (pred. acc.: 100.00%, F-measure: 100.00%)
2: not (not-weapon) (pred. acc.: 100.00%, F-measure: 100.00%)
3: weapon or weapon (pred. acc.: 100.00%, F-measure: 100.00%)
4: weapon or not-weapon (pred. acc.: 100.00%, F-measure: 100.00%)
5: weapon or (not (not-weapon)) (pred. acc.: 100.00%, F-measure: 100.00%)
6: not-weapon or (not (not-weapon)) (pred. acc.: 100.00%, F-measure: 100.00%)
7: weapon or (not (not-weapon)) (pred. acc.: 100.00%, F-measure: 100.00%)
8: weapon and (not (weapon)) (pred. acc.: 100.00%, F-measure: 100.00%)
9: weapon and (not (not-weapon)) (pred. acc.: 100.00%, F-measure: 100.00%)
10: weapon or (hasCaliber some Thing) (pred. acc.: 100.00%, F-measure: 100.00%)
```

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Java API Configuration

- In order to populate the ontology with instances, we also used the JRacer API. This connects to the Racer server's ip address and to the port which can read the hunt.racer file to access the ontology.

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Java API Configuration

- In order to populate the ontology with instances, we also used the JRacer API. This connects to the Racer server's ip address and to the port which can read the hunt.racer file to access the ontology.
- After the connection setup has been made we can create new instances and send them to our ontology. Next, we create instances for our most important concept and using the method *sendRaw* we send them to the ontology.

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Java API Configuration

- In order to populate the ontology with instances, we also used the JRacer API. This connects to the Racer server's ip address and to the port which can read the hunt.racer file to access the ontology.
- After the connection setup has been made we can create new instances and send them to our ontology. Next, we create instances for our most important concept and using the method *sendRaw* we send them to the ontology.
- After all our instances are sent to the ontology we can now execute a query to show that all are according to plan.

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Java API Results

- Here are all the results from the query. First are all concepts and after that are all instances of every important concept. As you can see at the sixth line, we can make a query to find the caliber of a specific weapon.

```
(TOP BOTTOM HAS-AGE HAS-NAME WEAPON TERRAIN ANIMAL MINIFISH CALIBER BAIT STORE HONY HUNTER GRASS FOOD COUNTRY FOOT-PRINT HAS-ADDRESS
(ELK MOOSE WOLF BEAR DEER RABBIT)
(CALIBER35MM CALIBER88MM CALIBER150MM CAL365MM CAL66MM CAL12MM)
(AK47 BOW DESERT_EAGLE SNIPER SHOTGUN PISTOL)
(MOUNTAIN FOREST PLAIN)
(CAL365MM)
(BEAR-FOOT-PRINT DEER-FOOT-PRINT RABBIT-FOOT-PRINT)
(RUSIA SUEDIA ROMANIA)
```

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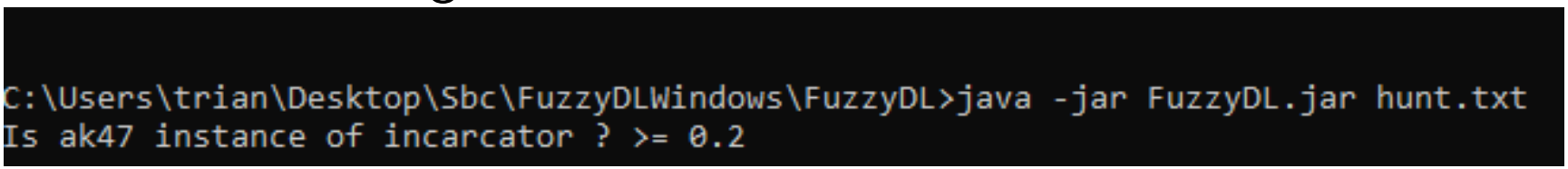
FDL Configuration and Testing

- We define four concepts which refer to a gun loader. *LowAmmo*, *AlmostFullAmmo*, *ammo10*, *LessThen15Bullets* and *incarcator* are our concepts. They are defined in the image below. Our goal was to determine if a gun loader is in one of the the 3 states, and for a loader with 12 bullets and being part of *LessThan15bullets* it is empty (0.2).
- For testing our fuzzy logic we open a cmd and in there we run our file, like in the image below.



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Partition Pattern

- Consider whether some set of subconcepts fully covers a concept.

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;Partition pattern;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(define-concept Food (or grass hony))

(disjoint grass hony)


;(concept-disjoint? iarba miere)
;(concept-parents iarba)
```

N-ary relations

- The aim is to model n-ary relations in an ontology, given that DL was designed to express binary relations.

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;N-ary relation pattern;;;;;;;;;;;;;;;;;;;;;;;;;;;;

( implies Hunter ( and ( some  propety-1 has-name)
                       ( some  propety-2 has-age)
                       ( some  propety-3 has-address)))


(define-concrete-domain-attribute has-name :domain Hunter :type string)
(define-concrete-domain-attribute has-age :domain Hunter :type integer)F
(define-primitive-role has-address :domain Hunter :range Country   )


(instance Trif Hunter)
(attribute-filler Trif "Andrei" has-name )
(attribute-filler Trif 23 has-age)
(related Trif Romania has-address)

;(concept-instances Hunter)
;(individual-fillers Trif has-address)
;(individual-told-attribute-value Trif has-age)
```

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PartOf

- This ODP aims to represent entities and their parts. The pattern exploits reasoning on transitive role has-part.

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;PartOf pattern;;;;;;;;;;;;;;;

( define-primitive-role has-part :transitive t :inverse is-part-of :domain Food)

( implies Store ( some has-part Bait ))
( implies Minifish ( some is-part-of Bait ))
( implies Minifish Food )

;(concept-subsumes? ( some is-part-of Bait ) Minifish )
```

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