Cyc

What is Cyc?

- “The longest-lived artificial intelligence project…that spans the basic concepts and ‘rules of thumb’ about how the world works” –Wikipedia
- “A revolutionary AI platform with human reasoning, knowledge and logic” –Cycorp
- “A really large knowledge base/ontology” –Irina

What is Cyc?

- Started by Doug Lenat in 1984
- As of 2017, complete ontology contained:
  - >1.5 million terms
  - >24.5 million facts and rules
- Constructed by knowledge engineers
  - Thousands of person-hours
- Also includes an inference engine

Cyc syntax

- Sentences/facts generally take the form:

  `(<predicate> <arg1> … <argn>)`

- Predicates are camelCase (e.g. `performedBy`)
- Collections are CamelCase (e.g. `BookSeries`), sometimes with a hyphen (e.g. `Book-CW`)
- Functions are CamelCase, typically with “Fn” at the end

  (e.g. `MotherFn`)

Let’s try it

- Holmes is a cat.

```
(isa Holmes Cat)
```

- Watson is a doctor.

```
(isa Watson Doctor-Medical)
```

- Watson is married to Mary.

```
(spouse Watson Mary)
```

KB Concept Search

Possible completions for **married**

- Married (Collection)
- MarriedCouple (Collection)

- married (Entity)
- Married-TheWord (Entity)

Married
[type = Collection]:

NextKB (41590df90f0f)
/app/websketch/kb/

comment: An instance of PersonTypeByMaritalStatus . Each instance of Married is a Person who is married. In MainstreamAmericanCultureMt , Married is a specialization of HumanAdult .

MarriedCouple
[type = Collection]:

NextKB (41590df90f0f)
/app/websketch/kb/

comment: The collection of all pairs of people who are married to each other. A type of Couple-Romantic .

KB Concept Search

Possible completions for **spouse**

- Spouse-TheWord (Entity)
- spouseless (Entity)
- Spouseless-TheWord (Entity)
- spouses (Entity)

- spouse (Relation)

spouse

[type = Relation]:

NextKB (41590df90f0f)
/app/websketch/kb/

comment: (spouse PERSON1 PERSON2) means the two Persons PERSON1 and PERSON2 are married and committed to being permanent, lifelong partners. Cultures vary in whether such a couple must be of opposite genders, or may possibly belong to the same gender. Cultures also vary in whether a person is restricted to having only one cotemporal spouse.

spouse

[type = Relation]:

NextKB (41590df90f0f)
/app/websketch/kb/

comment: (spouse ... s PERSON1 and PERSON2 are married and committed to being permanent, lifelong partners. Cultures vary in whether such a couple mu... ossibly belong to the same gender. Cultures also vary in whether a person is restricted to having only one cotemporal spouse.

Human readable description

isa:

in Unive... CoexistingObjectsPredicate , DirectBinaryPredicate , FamilyRelationsConcept , FamilyRelationSlot , InterActorSl... mmetricBinaryPredicate , TerrorismOWLExportBinaryPredicate

in GeneralLexicon...

in TopicMt: Relati...

in UnitedStatesSocialLifeMt: InterExistingObjectPredicate

Collection membership

arity: 2

arg1Isa: HomoSapiens

arg2Isa: HomoSap...

Expected argument types

prettyString-Canonical:

in EnglishMt: "spous...

genlPreds:

in UniversalVoca... eRelatives , mate , relativesByMarriage

specPreds:

in UniversalVocabul...

Inheritance hierarchy

spouse
[type = Relation]:

NextKB (41590df90f0f)
/app/websketch/kb/

comment: (spouse PERSON1 PERSON2) means the two Persons PERSON1 and PERSON2 are married and committed to being permanent, lifelong partners. Cultures vary in whether such a couple must be of opposite genders, or may possibly belong to the same gender. Cultures also vary in whether a person is restricted to having only one cotemporal spouse.

isa:
in UniversalVocabularyMt: Analyst-PertinentConcept , CoexistingObjectsPredicate , DirectBinaryPredicate , FamilyRelationsConcept , FamilyRelationSlot , InterActorSlot , PersonalAssociationPredicate , SymmetricBinaryPredicate , TerrorismOWLExportBinaryPredicate
in GeneralLexiconMt: RelationalNounSlot
in TopicMt: Relationships-Social-Topic
in UnitedStatesSocialLifeMt: InterExistingObjectPredicate

arity: 2
arg1Isa: HomoSapiens
arg2Isa: HomoSapiens

prettyString-Canonical:
in EnglishMt: "spouse"

genlPreds:
in UniversalVocabularyMt: cohabitingFamilyMembers , coreRelatives , mate , relativesByMarriage

specPreds:
in UniversalVocabularyMt: husband , wife

0

Cat
[type = Collection]:

NextKB (41590df90f0f)
/app/websketch/kb/

comment: The collection of all members of the species Felis domesticus. Most members of this collection are DomesticCats , but feral cats are also included in this collection. Big cats, e.g., lions, ocelots, or tigers, are not members of this collection, although they are of its superset, FelidaeFamily .

isa:
in UniversalVocabularyMt: BiologicalSpecies , DomesticatedAnimalType , OrganismClassificationType

prettyString-Canonical:
in EnglishMt: "cat"

genls:
in UniversalVocabularyMt: FelisGenus
in WebSearchEnhancementMt: NonPersonAnimal

specs:
in BaseKB: (JuvenileFn Cat) , (SubcollectionOfWithRelationToTypeFn Cat on-Physical Bookcase)
in UniversalVocabularyMt: Cat , DomesticCat
in BiologyMt: (MaleFn Cat)
in BiologyVocabularyMt: (AdultFn Cat)

Cat

[type = Collection

NextKB (41590df90f0f)
/app/websketch/kb/

comment: The collection ...mesticus. Most members of this collection are DomesticCats , but feral cats are also included in this collection. Big cats, e.g., lions, ocelots, c... ...ection, although they are of its superset, FelidaeFamily .

Human readable description

isa:

in Uni... ...icatedAnimalType , OrganismClassificationType

Collection membership

prettyString-Canonica...

in EnglishMt: "ca...

genls:

in Universalv...

in WebSearchEnhan...

Inheritance hierarchy

specs:

in BaseKB: (JuvenileFn Cat) , (SubcollectionOfWithRelationToTypeFn Cat on-Physical Bookcase)
in UniversalVocabularyMt: Cat , DomesticCat
in BiologyMt: (MaleFn Cat)
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in BaseKB: (JuvenileFn Cat) , (SubcollectionOfWithRelationToTypeFn Cat on-Physical Bookcase)
in UniversalVocabularyMt: Cat , DomesticCat
in BiologyMt: (MaleFn Cat)
in BiologyVocabularyMt: (AdultFn Cat)

Collections: isa vs. genls

`(isa Cat BiologicalSpecies)`
`(isa Holmes Cat)`

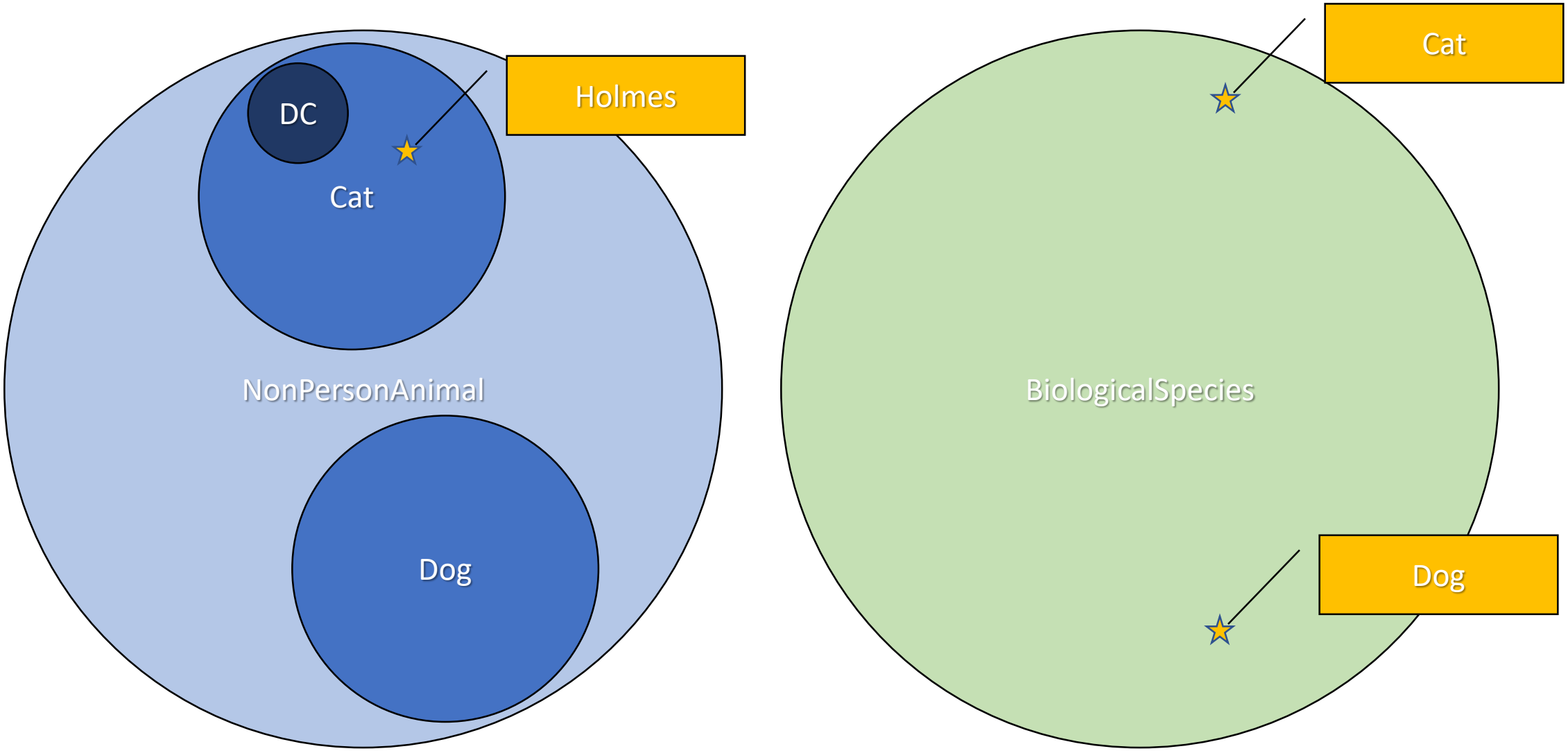
- Analogous to set membership
- Not transitive
  - Holmes is **not** a BiologicalSpecies

`(genls Cat NonPersonAnimal)`
`(genls DomesticCat Cat)`

- Analogous to subset
- Transitive
  - DomesticCat **is** a subset of NonPersonAnimal

Some notes:

- genls and spec are inverse predicates
  - `(spec Cat DomesticCat)` **==** `(genls DomesticCat Cat)`
- isa **does** transfer through genls
  - `(isa Holmes NonPersonAnimal)` is true


DC
Holmes
Cat
NonPersonAnimal
Dog
Cat
BiologicalSpecies
Dog

Pop quiz

```
(isa SaltFatAcidHeat CookBook)
(genls CookBook Book-CW)
```

a. `(isa SaltFatAcidHeat Book-CW)`

b. `(genls SaltFatAcidHeat Book-CW)`

c. `(isa CookBook Book-CW)`

d. None of the above

Pop quiz

```
(genls CookBook Book-CW)
(genls Book-CW PropositionalConceptualWork)
```

a. `(isa CookBook PropositionalConceptualWork)`

b. `(genls PropositionalConceptualWork CookBook)`

c. `(genls CookBook PropositionalConceptualWork)`

d. None of the above

Pop quiz

```
(isa SaltFatAcidHeat CookBook)
(isa CookBook ObjectType)
```

a. `(isa SaltFatAcidHeat ObjectType)`

b. `(genls SaltFatAcidHeat ObjectType)`

c. `(genls CookBook ObjectType)`

d. None of the above

Activity: Exploring Cyc

- Repeat the activity from last class using the Cyc ontology
- But first…

Choosing a scope

Activity: Exploring Cyc

- If necessary, rescope your application from last time
- What concepts and facts do you need in order to explore this domain?
- What concepts and facts are available in Cyc?
- How are they organized?
- What's missing?
- What are the pros and cons of using Cyc vs. the ontology you looked at on Thursday?

Turn in on Canvas for participation points

- Assignment: Cyc Exploration
- Any format is fine
  - Take a picture and upload that if you did it on paper
- Only need to turn in one per group
  - Make sure all group member names are in the doc OR in a comment to the exercise

Defining new concepts

- SherlockHolmes (the fictional character)
- BookCharacter (the collection)
- characterInBookCW (the predicate/relation)
- BookCWAboutCharacterFn (the function)

Defining new concepts

- SherlockHolmes (the fictional character)

```
(isa SherlockHolmes FictionalCharacter)

(comment SherlockHolmes "The eccentric detective in
     Arthur Conan Doyle's short stories")
```

- BookCharacter
- characterInBookCW
- BookCWAboutCharacterFn (the function)

Defining new concepts

- SherlockHolmes (the fictional character)
- BookCharacter

```
(isa BookCharacter FirstOrderCollection)
(genls BookCharacter FictionalCharacter)
(comment BookCharacter "The collection of all book
     characters")
```

- characterInBookCW
- BookCWAboutCharacterFn (the function)

Defining new concepts

- SherlockHolmes (the fictional character)
- BookCharacter
- characterInBookCW

```
(isa characterInBookCW BinaryPredicate)
(genlPreds characterInBookCW characterInCW)
(arity characterInBookCW 2)
(arg1Isa characterInBookCW BookCharacter)
(arg2Isa characterInBookCW Book-CW)
(comment characterInBookCW “A relation connecting a
character to the book they belong in”)
```

- BookCWAboutCharacterFn (the function)

Defining new concepts

- SherlockHolmes (the fictional character)
- BookCharacter
- characterInBookCW
- BookCWAboutCharacterFn (the function)

```
(isa BookCWAboutCharacterFn CollectionDenotingFunction)
(arity BookCWAboutCharacterFn 1)
(resultIsa BookCWAboutCharacterFn Collection)
(resultGenl BookCWAboutCharacterFn Book-CW)
(comment BookCWAboutCharacterFn “The collection of all
     instances of Book-CW about character”)
```

Representing sentences

- Holmes is a cat.

```
(isa Holmes Cat)
```

- Watson is married to Mary.

```
(spouse Watson Mary)
```

- Watson is a biographer.

```
(isa Watson Biographer)
```

- Watson is Holmes’s biographer.

Watson is Holmes’s biographer.

```
(creatorOfCW Watson (BiographyFn Holmes))
```

Watson is Holmes’s biographer.

~~(creatorOfCW Watson (BiographyFn Holmes))~~

```
(isa biography123 (BiographyFn Holmes))
(creatorOfCW Watson biography123)
```

Consider

- Willie teaches.
- Willie teaches at 2pm.
- Willie teaches EECS371 at 2pm.
- Willie teaches EECS371 at 2pm at Northwestern.
- Willie teaches EECS371 in Tech LR2 at 2pm at Northwestern.
- Etc.

Willie teaches.

```
(isa teach123 TeachingACourse)
(instructor teach123 Willie)
```

Willie teaches at 2pm.

```
(isa teach123 TeachingACourse)
(instructor teach123 Willie)
(timeOfDayOfEvent teach123 TimeOfDay-2PM)
```

(genls TeachingACourse Event)
so
(isa teach123 Event)

CycL practice

- Maria is a student.
- Maria studies computer science.
- Maria studies at the library.
- Maria reads *Knowledge Representation & Reasoning*.
- Maria reads *Knowledge Representation & Reasoning* at the library on Tuesday.

Turn in on Canvas for participation points

- Assignment: CycL Practice
- Any format is fine
  - Take a picture and upload that if you did it on paper
- Only need to turn in one per group
  - Make sure all group member names are in the doc OR in a comment to the exercise

For next time:

- HW 2 due before class
- Read Chapters 3-5 of SW2O