Artificial Intelligence

Xiaoqing Zheng
zhengxq@fudan.edu.cn

Programs vs. Expert systems

Programs = Algorithms + Data Structures

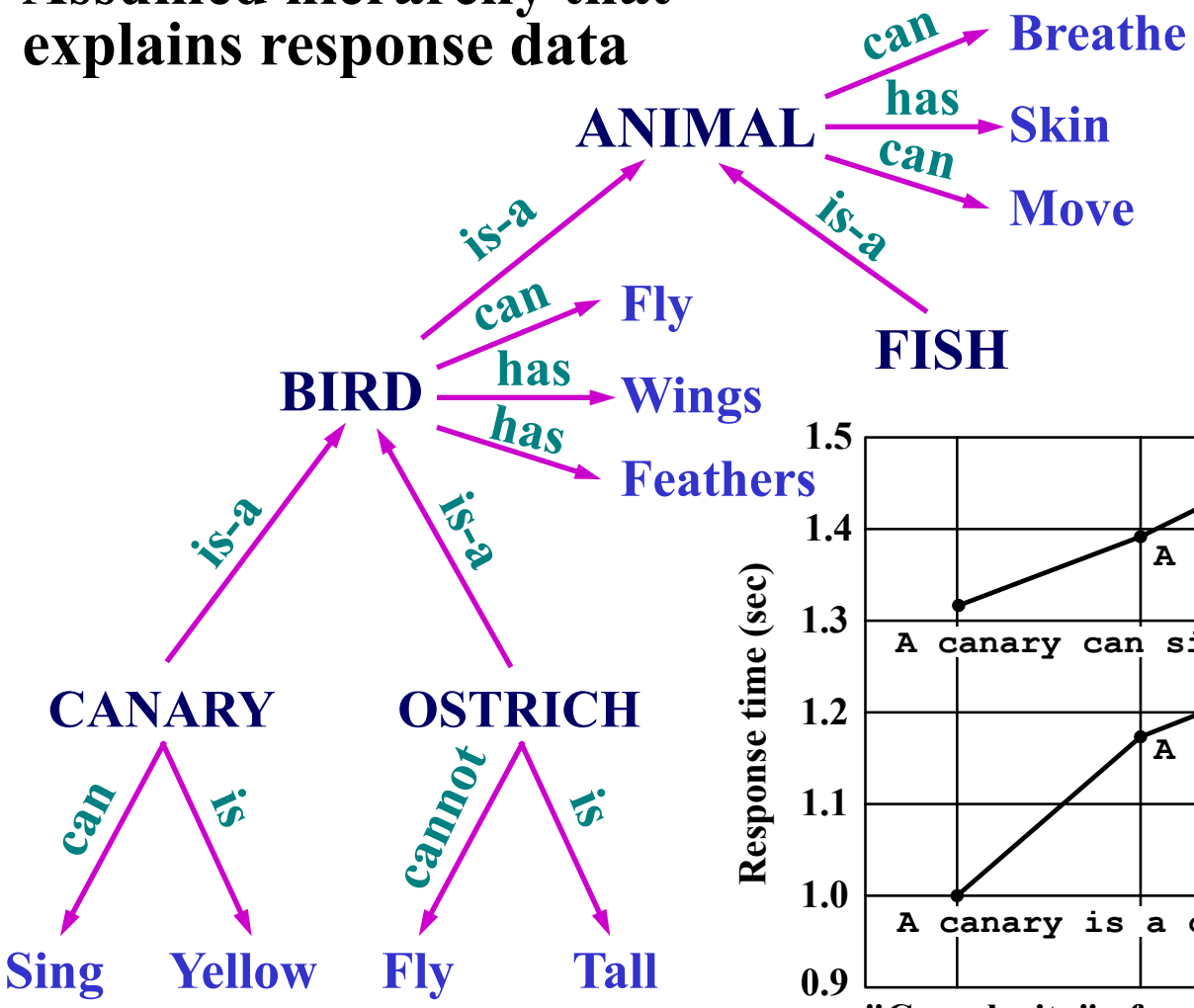
Expert Systems = Knowledge + Inference

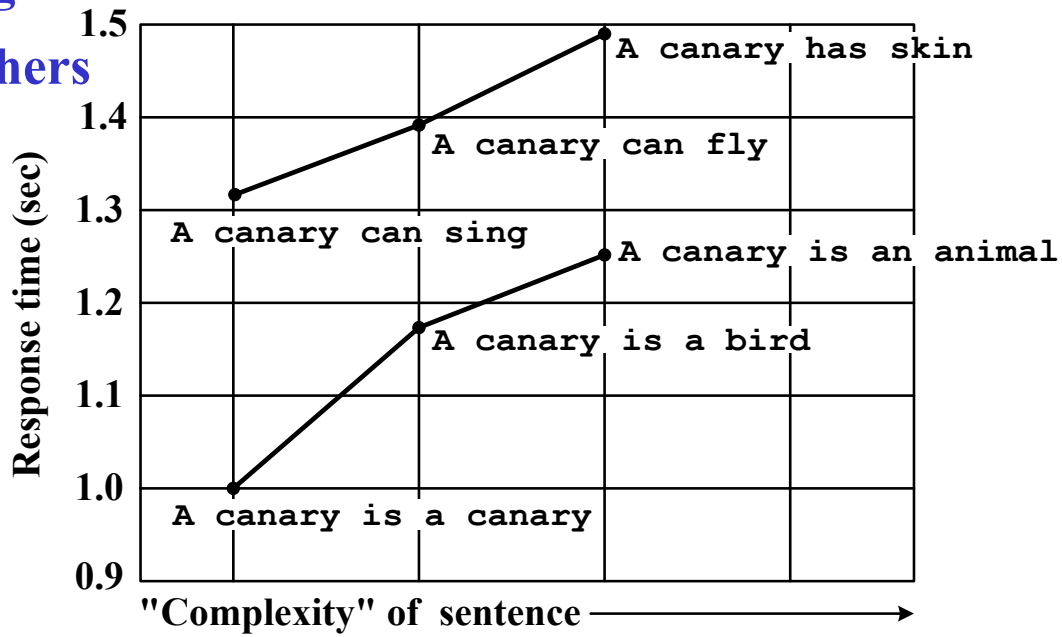
Knowledge representation

- ***Representation***, ***acquirement*** and ***use*** of knowledge are three main domain of research and application in artificial intelligent.
- Knowledge representation serving as a starting point or ***basis*** of the two later.

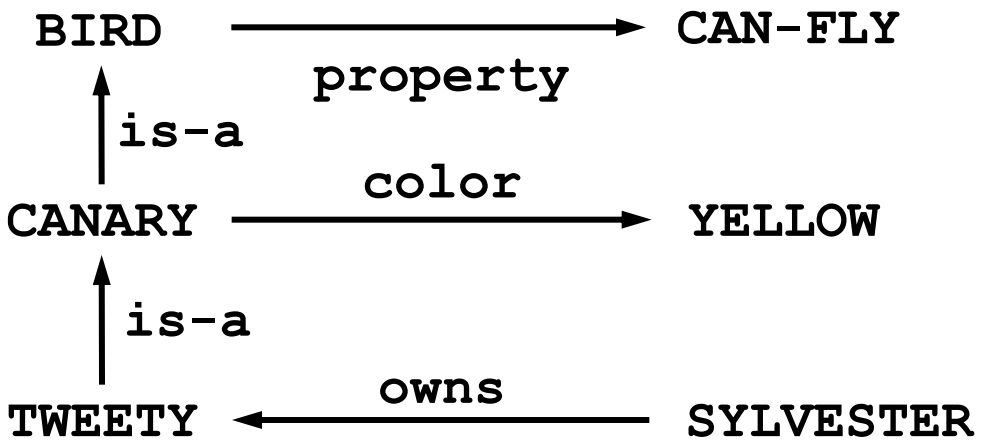
Psychological evidence

Assumed hierarchy that explains response data



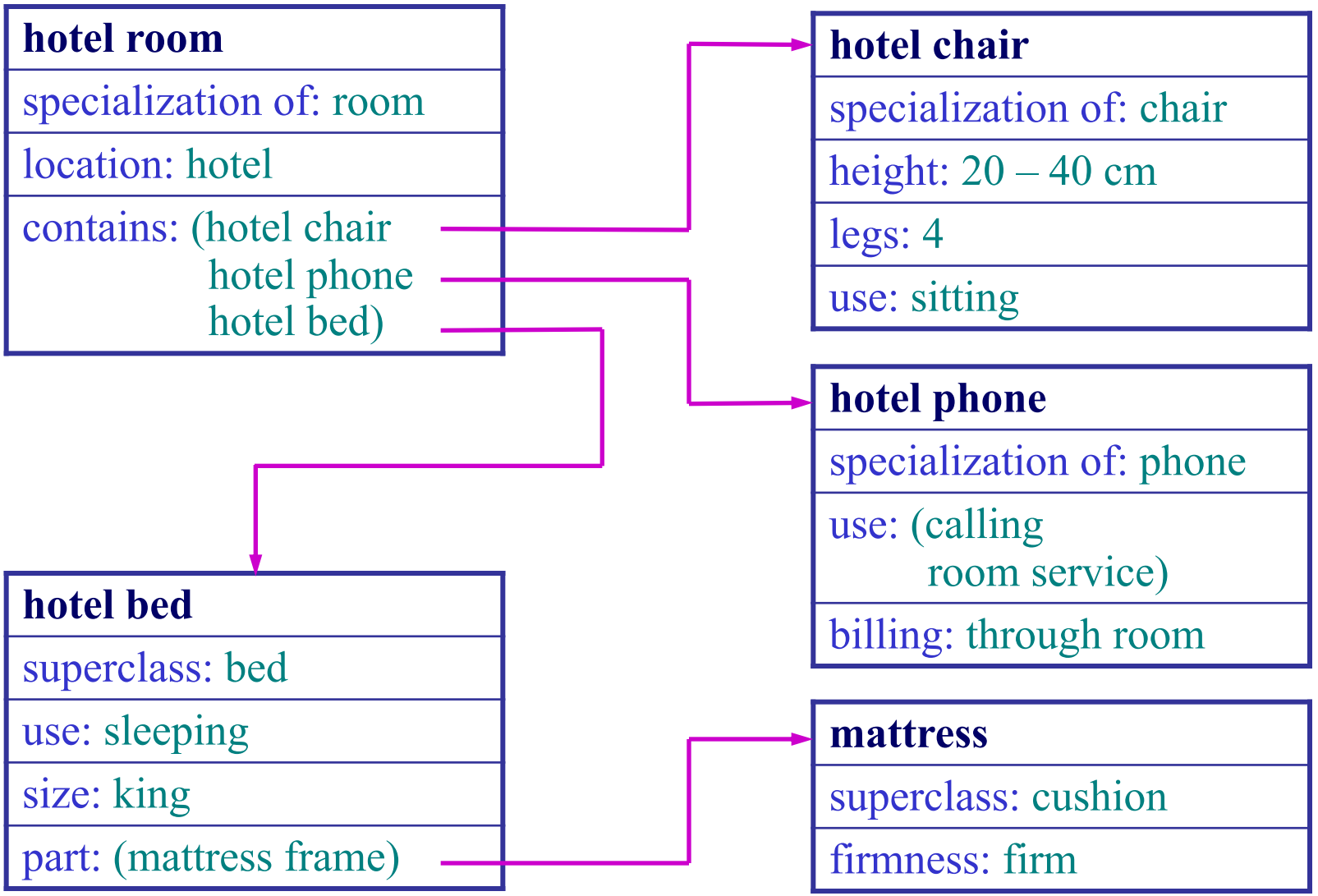


Inference in semantic networks



- CAN-FLY (CANARY)
- CAN-FLY (TWEETY)
- SYLVESTER owns Something that can fly
- TWEETY is YELLOW
- SYLVESTER owns a CANARY
- SYLVESTER owns a BIRD

Frame

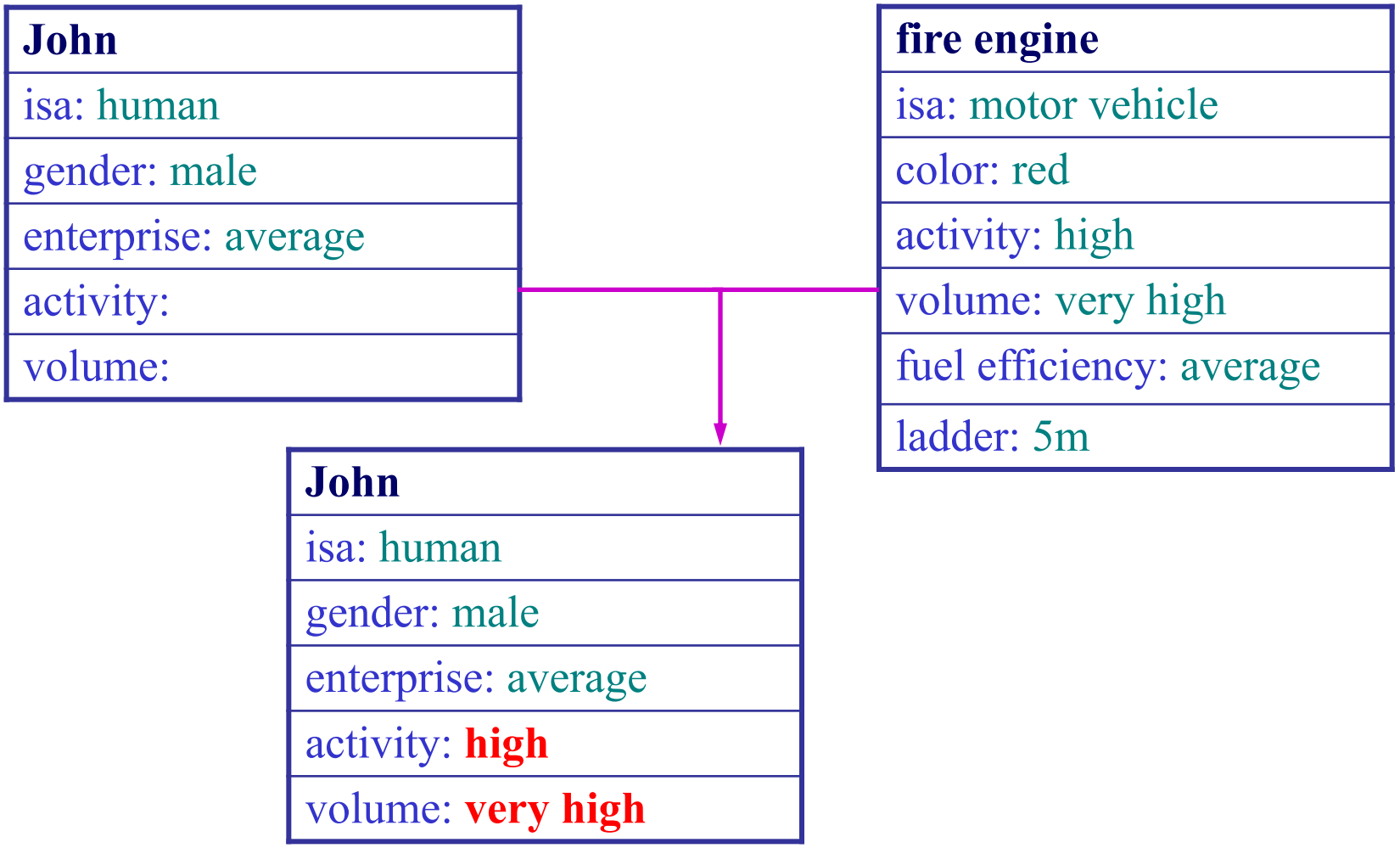

hotel room
specialization of: room
location: hotel
contains: (hotel chair
hotel phone
hotel bed)
hotel chair
specialization of: chair
height: 20 – 40 cm
legs: 4
use: sitting
hotel phone
specialization of: phone
use: (calling
room service)
billing: through room
hotel bed
superclass: bed
use: sleeping
size: king
part: (mattress frame)
mattress
superclass: cushion
firmness: firm

Types of slot

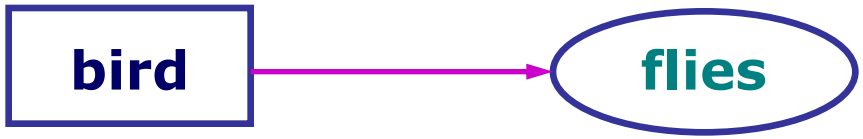
- Frame ***identification*** information.
- ***Relationship*** of this frame to other frames.
- Descriptors of ***requirements*** for a frame.
- ***Procedural*** information.
- Frame ***default*** information.
- ***New instance*** information.

Inference in frame systems

John like a fire engine.

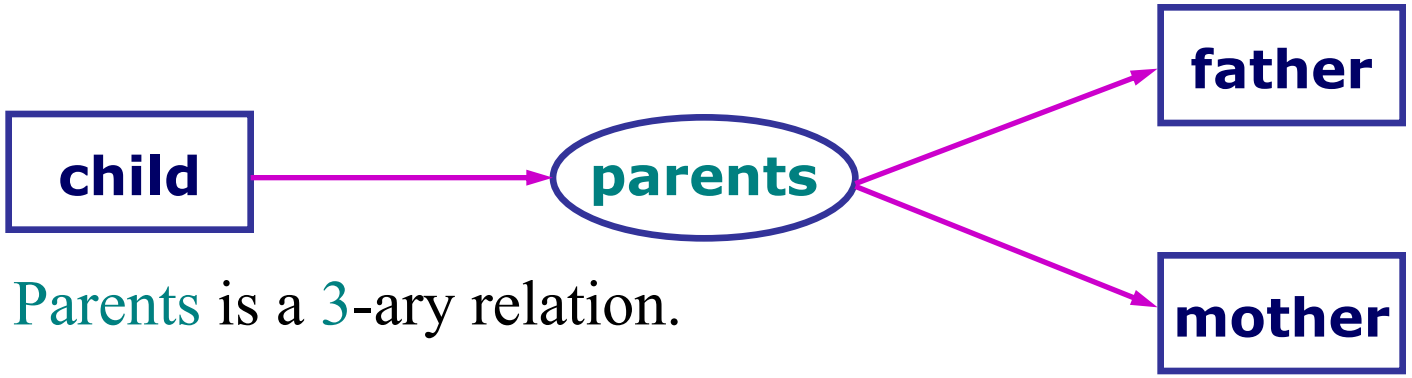


Conceptual graph



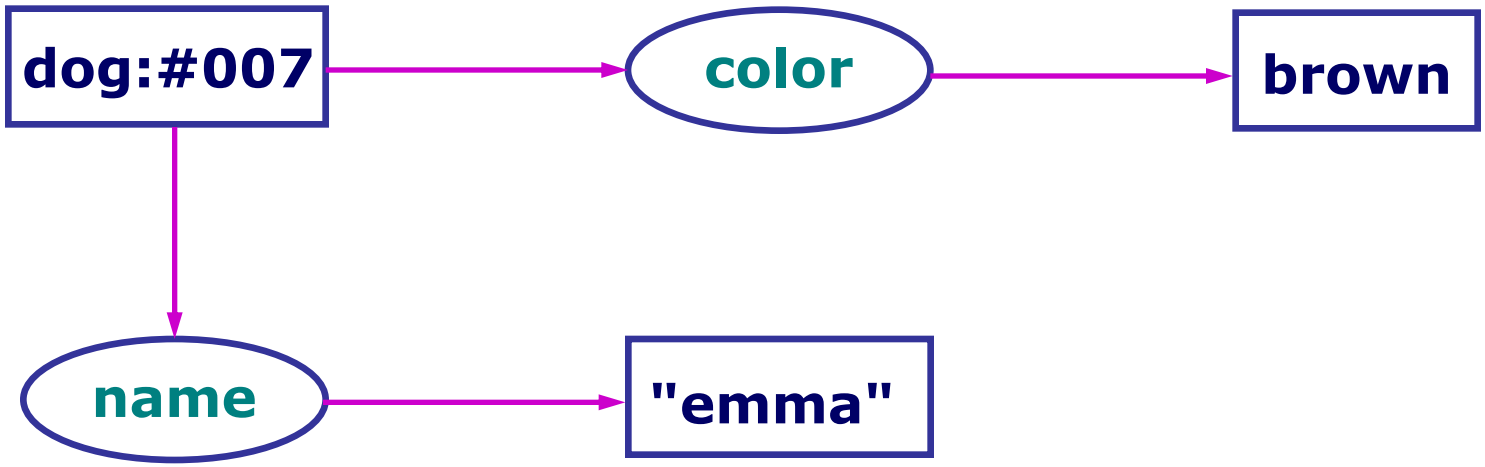
Files is a 1-ary relation.

Color is a 2-ary relation.



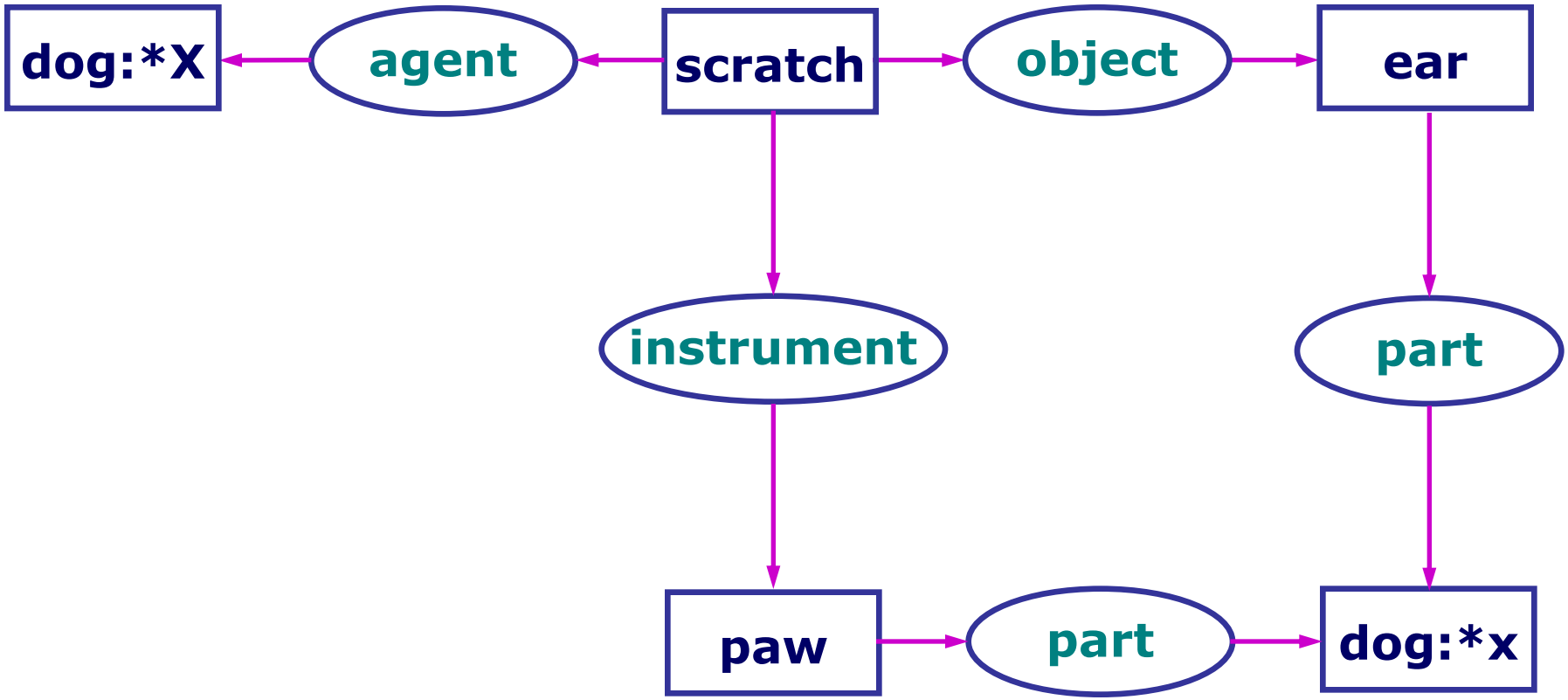
Parents is a 3-ary relation.

Unique token: maker



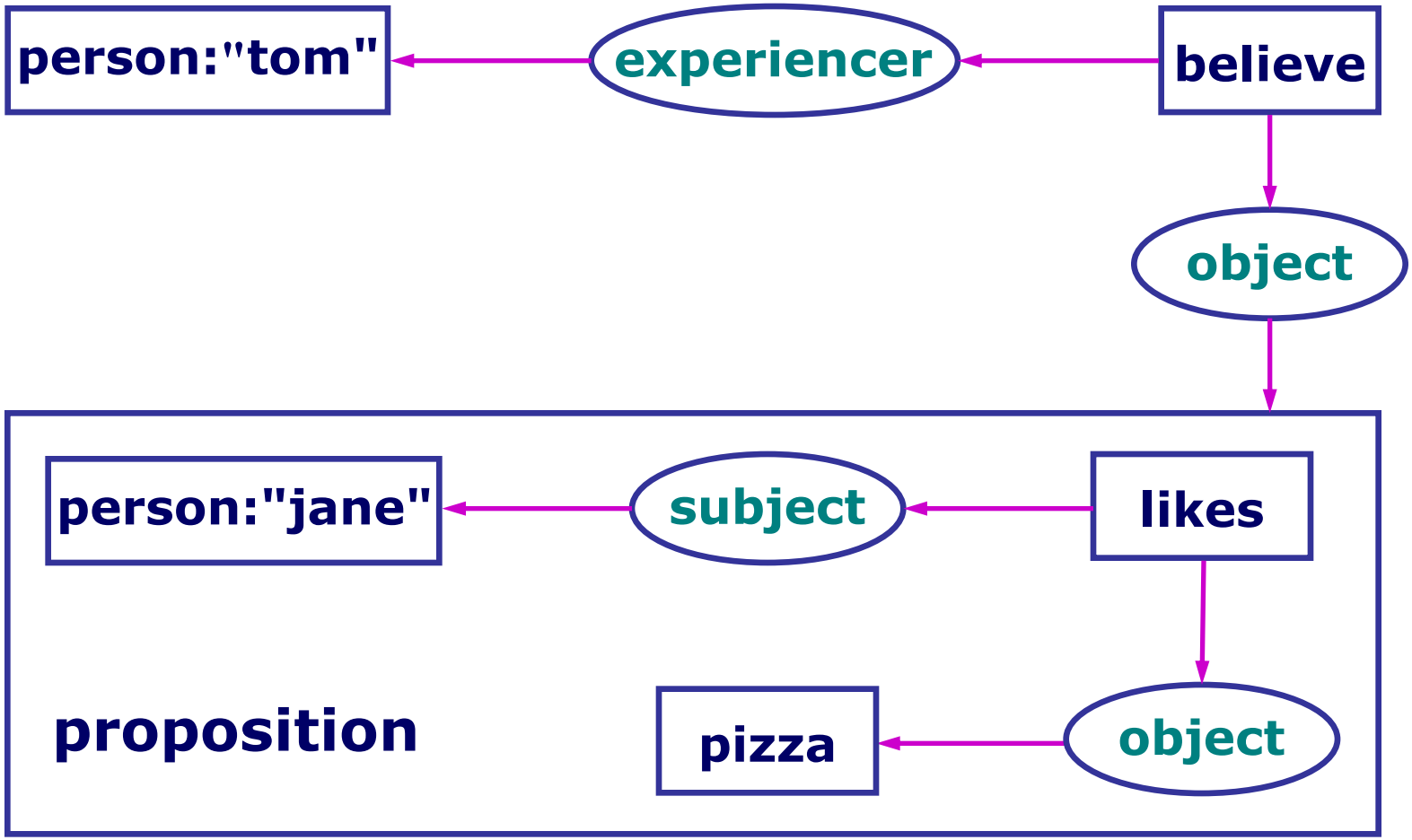
A dog name emma is brown.

Generic maker



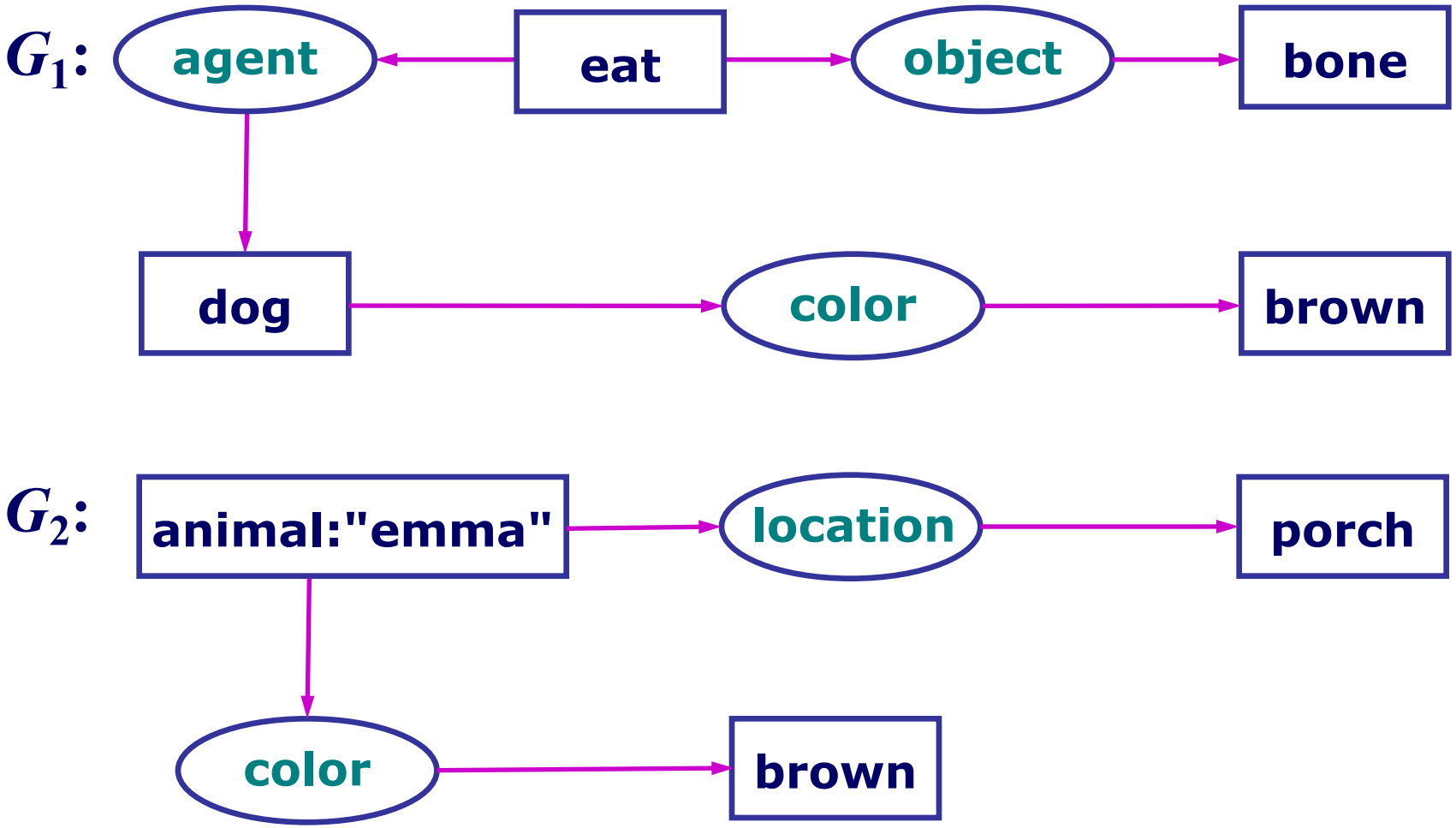
The dog scratches its ear with its paw.

Propositional concept

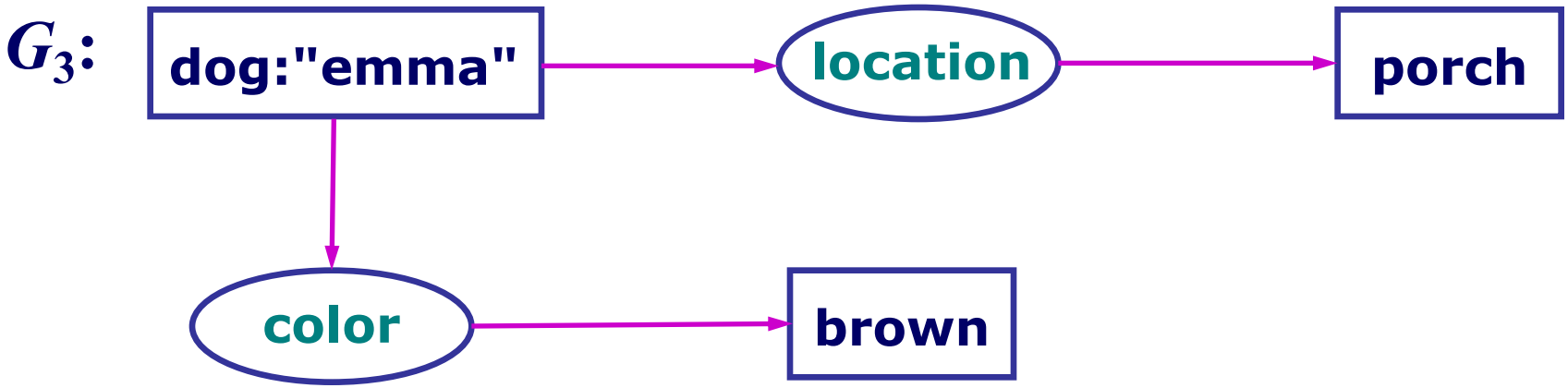


Tom believes that Jane likes pizza.

Inference in conceptual graphs

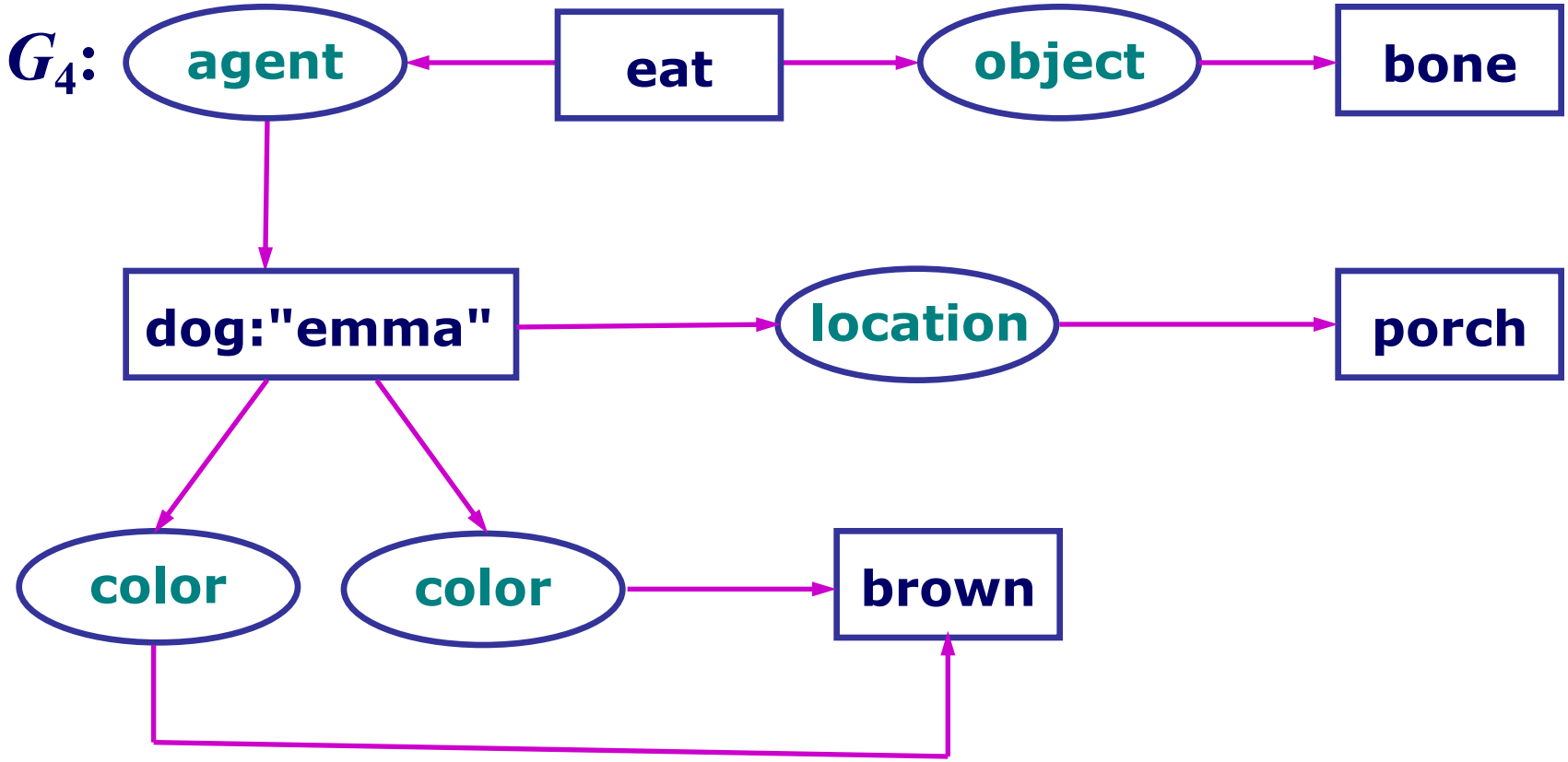


Restriction operation



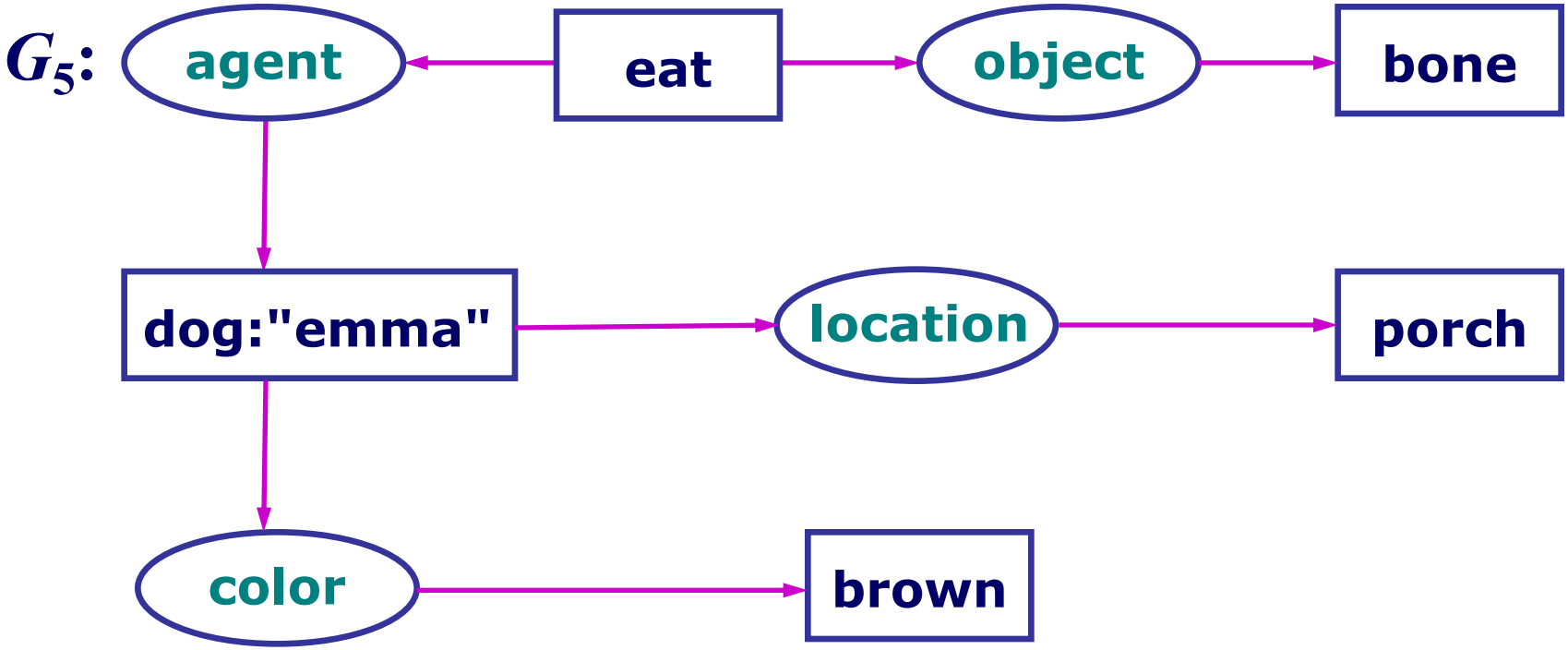
The ***restriction*** of G_2.

Join operation



The ***join*** of G_2 and G_3.

Simplify operation



The ***simplify*** of G_4.

The limits of relational technology

The limits of relational technology

28 intelligence databases
connected across
17 US intelligence agencies
over 5 years
totally missed …

The limits of relational technology

Relational power rule:

The full power of relational technology applies to semantically homogeneous relational databases

Databases tend to be mutually semantically heterogeneous hence lack a basis for guarantees for data integration for

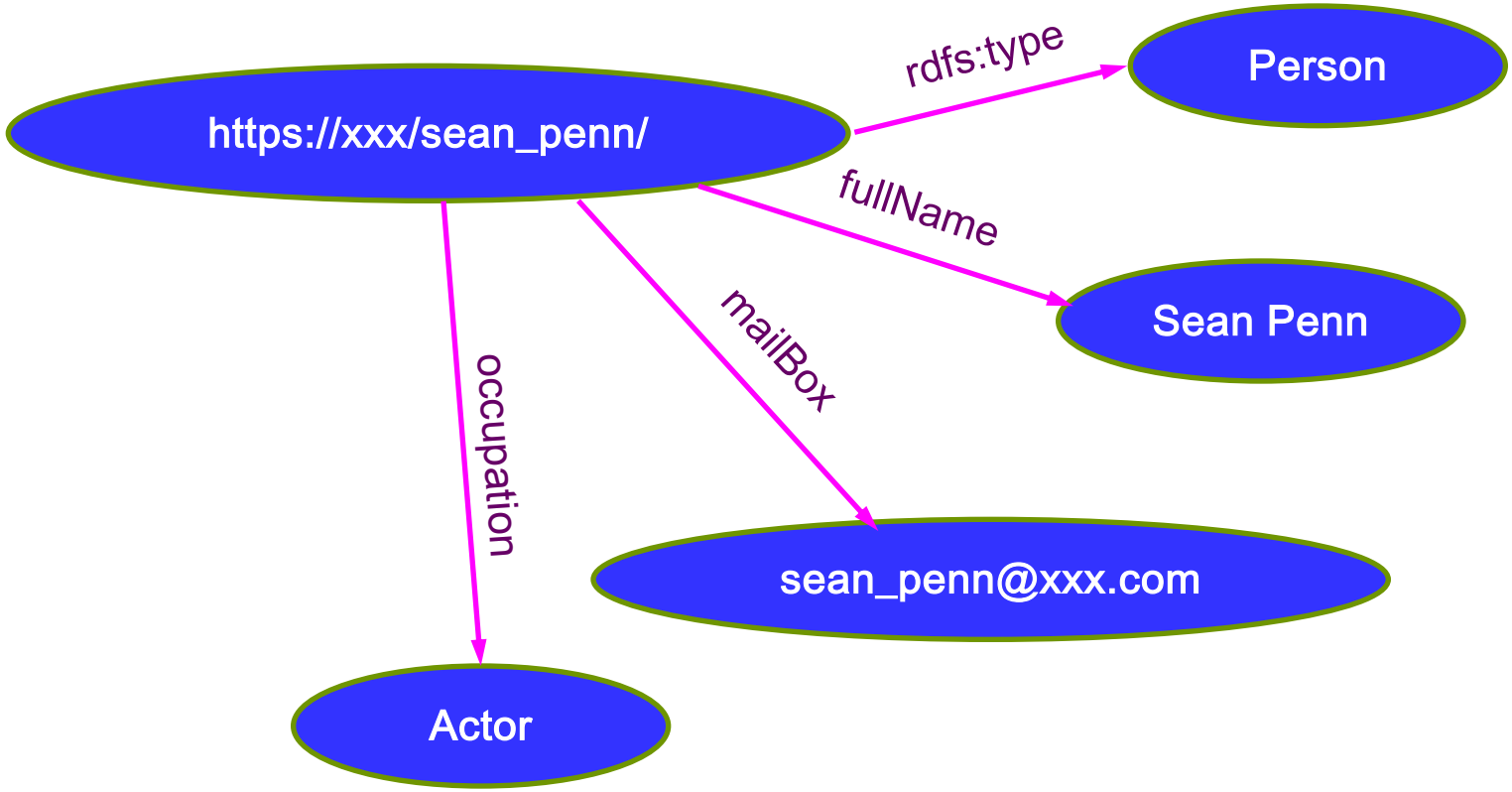
Correctness

Efficient design, development, execution

Relational assumptions

- **Updatable views**
- **Global Schema**
- **Single Version of Truth**

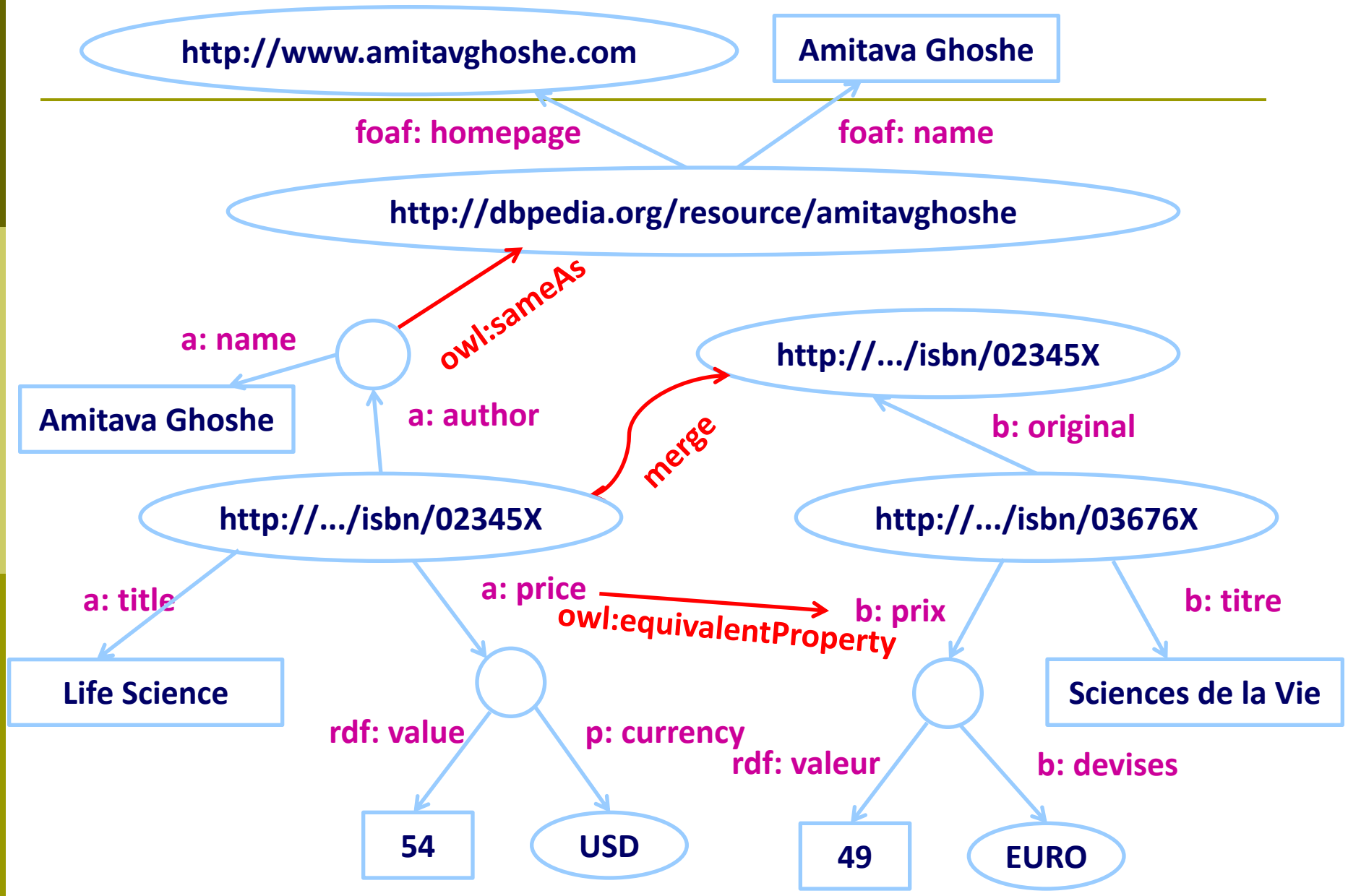
Triples in knowledge graph



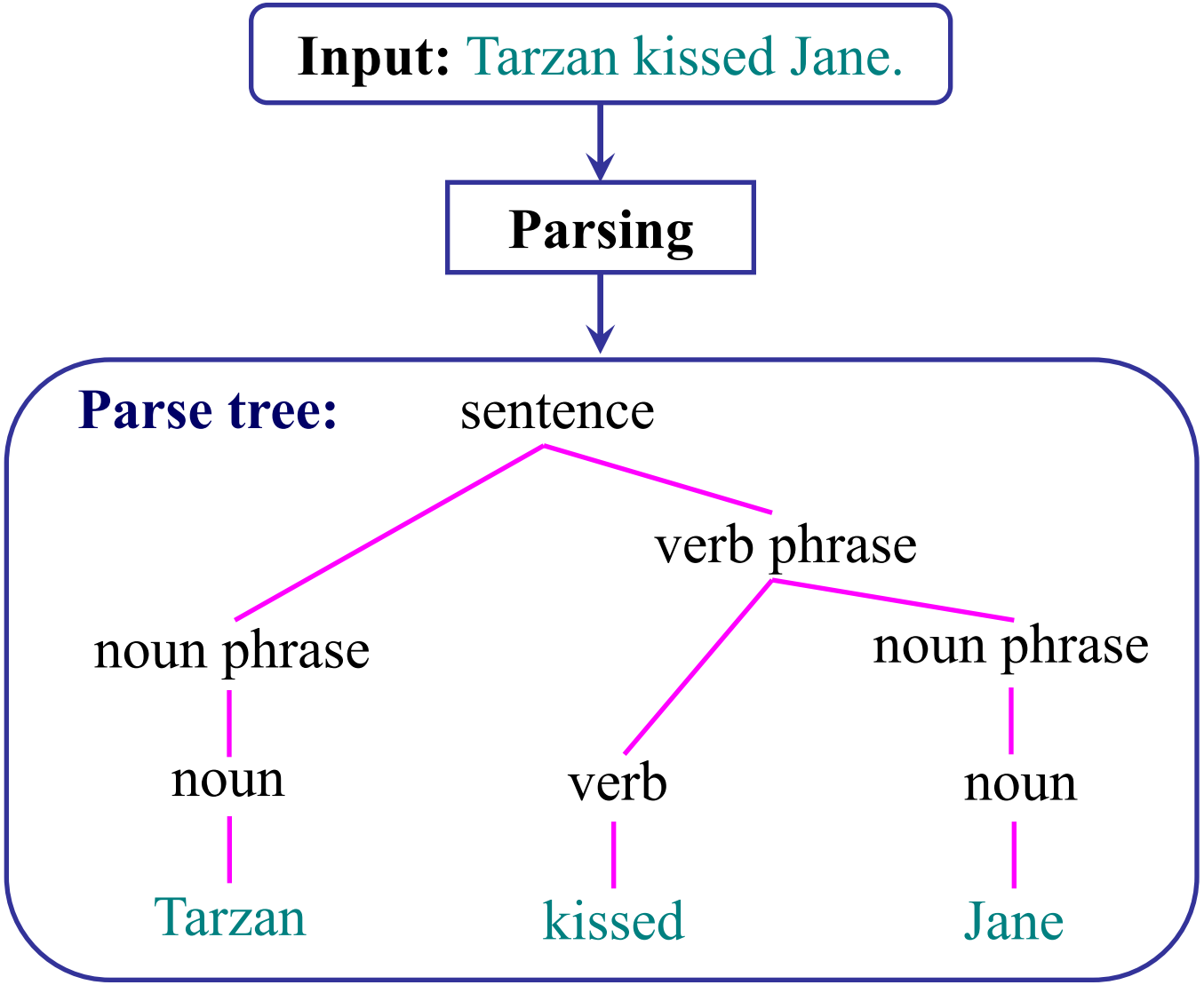
https://xxx/sean_penn

rdfs:type Person ;
fullName "Sean Penn" ;
mailbox. "sean_penn@xxx.com" ;
occupation "Actor" .

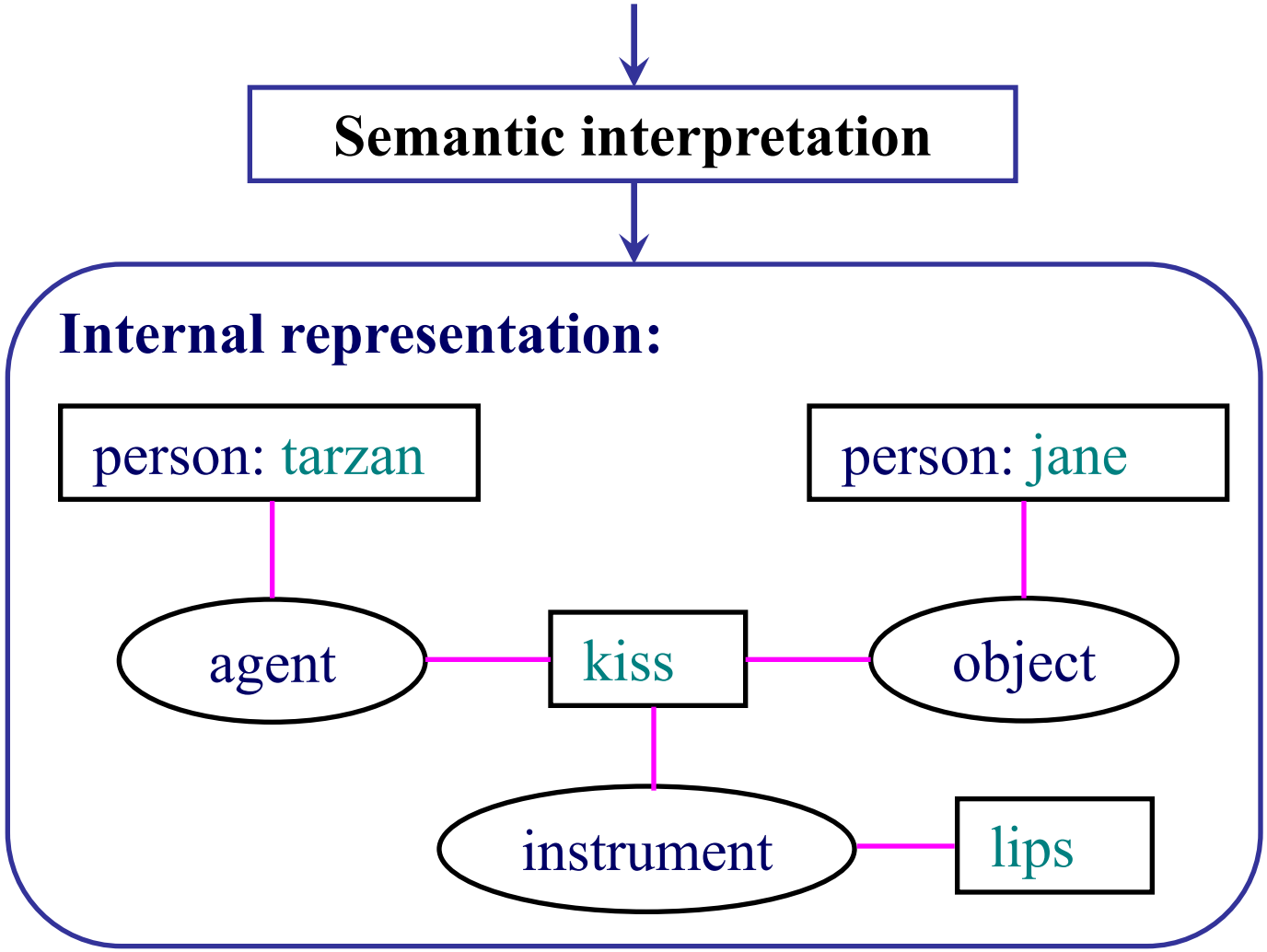
SELECT ?author ?titre ?homepage



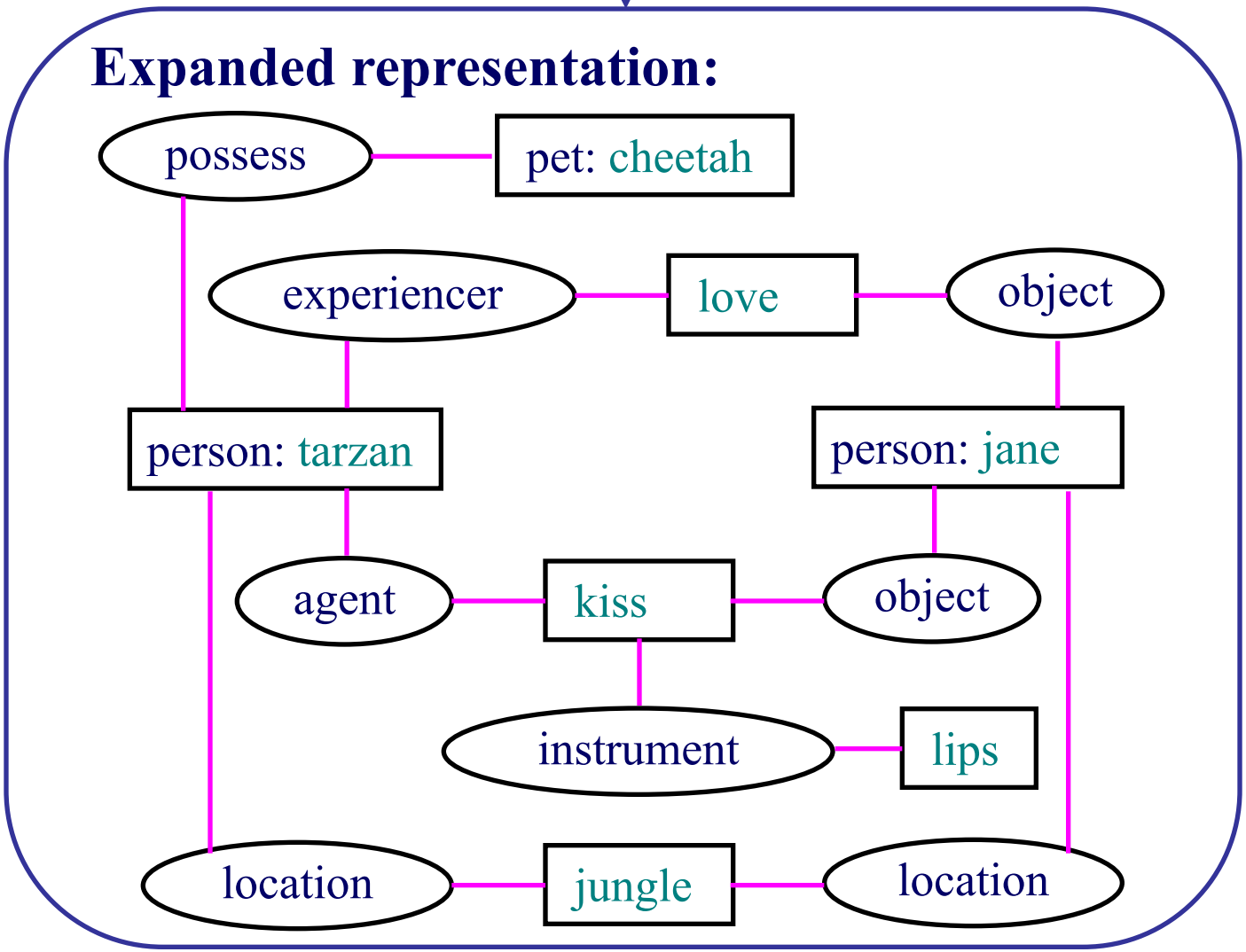
Stages


Input: Tarzan kissed Jane.
Parsing
Parse tree:
sentence
noun phrase
verb phrase
noun phrase
noun
verb
noun
Tarzan
kissed
Jane

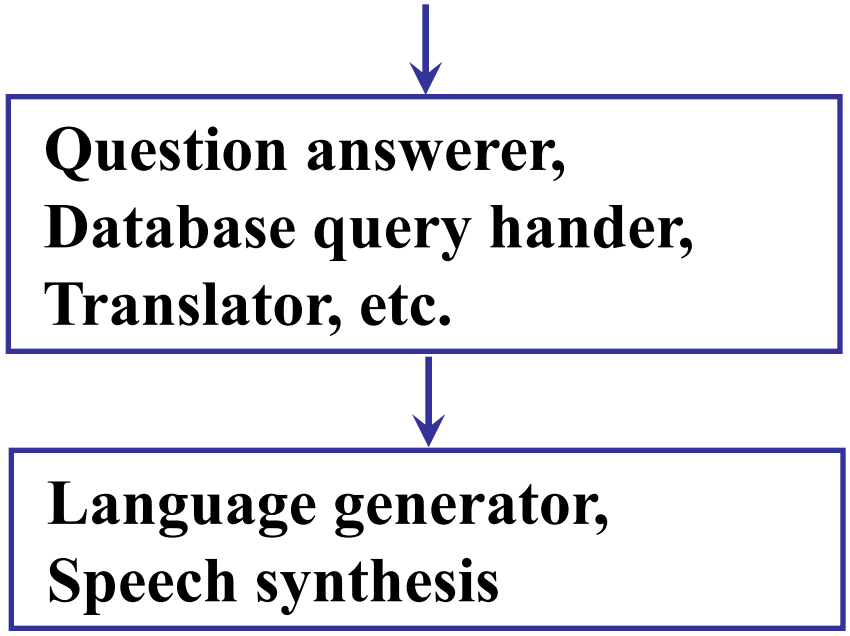
Stages


Semantic interpretation
Internal representation:
person: tarzan
person: jane
agent
kiss
object
instrument
lips

Contextual / world knowledge interpretation



Stages


Question answerer,
Database query hander,
Translator, etc.
Language generator,
Speech synthesis

Others

- ***Logics***: ***propositional***, ***first-order***, ***description***, ***modal***
- ***Production rule***
- ***Artificial neural network***
- ***Decision table***
- ***Knowledge Petri net***
- ***Script***
- ***Bayesian network***
- ***Object-attribute-value triples***
- ***Neurules***
- ***Language field theory***
- ***...***

Any question?

Xiaoqing Zheng
Fudan University