Representation and Reasoning System

A Representation and Reasoning System (RRS) is made up of:

➤ **formal language:** specifies the legal sentences

➤ **semantics:** specifies the meaning of the symbols

➤ **reasoning theory or proof procedure:** nondeterministic specification of how an answer can be produced.

Implementation of an RRS

An implementation of an RRS consists of

➤ **language parser:** maps sentences of the language into data structures.

➤ **reasoning procedure:** implementation of reasoning theory + search strategy.

Note: the semantics aren't reflected in the implementation!

Using an RRS

1. Begin with a task domain.

2. Distinguish those things you want to talk about (the ontology).

3. Choose symbols in the computer to denote objects and relations.

4. Tell the system knowledge about the domain.

5. Ask the system questions.

Role of Semantics in an RRS

$in(alan, r123)$.
$part\_of(r123, cs\_building)$.
$in(X, Y) \leftarrow$
  $part\_of(Z, Y) \wedge$
  $in(X, Z)$.

alan
r123
r023
cs_building
$in(\bullet, \bullet)$
$part\_of(\bullet, \bullet)$
$person(\bullet)$
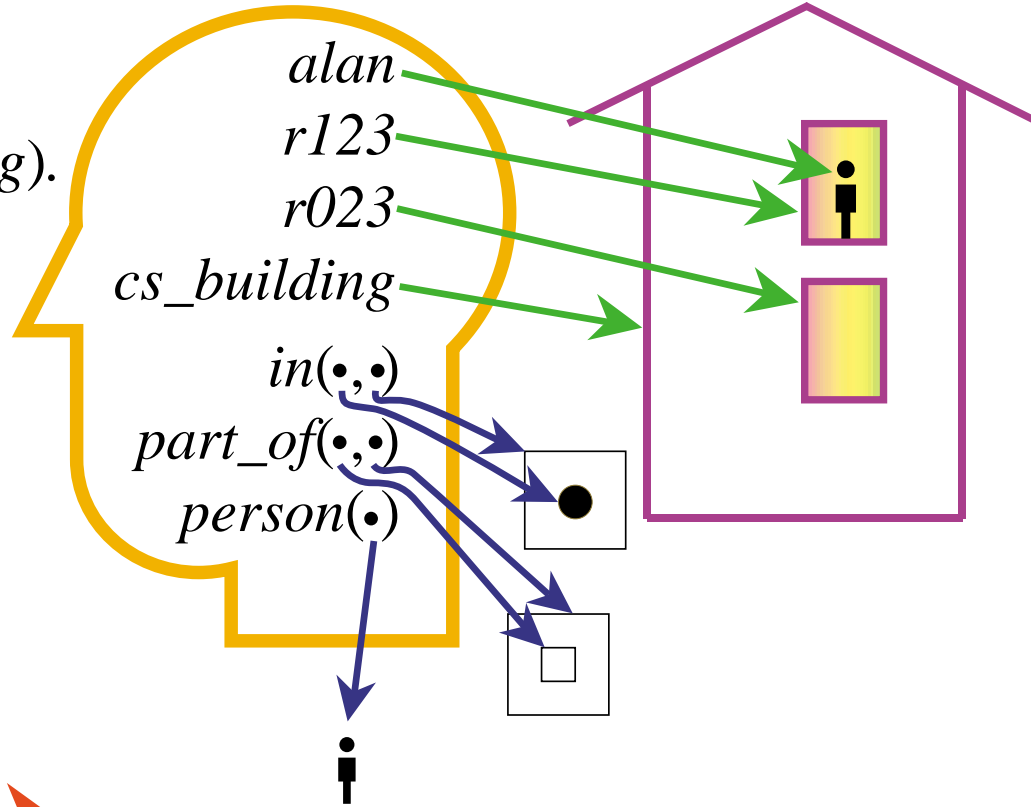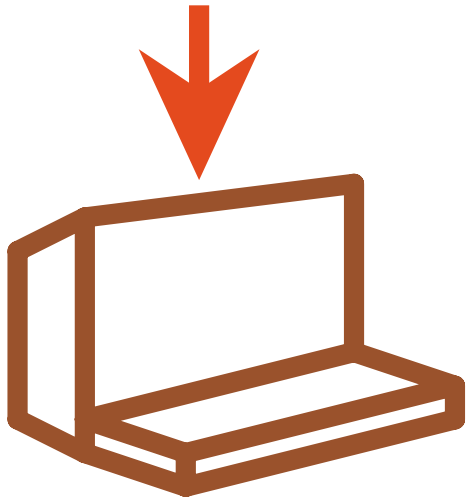
$in(alan, cs\_building)$

Simplifying Assumptions of Initial RRS

An agent's knowledge can be usefully described in terms of *individuals* and *relations* among individuals.

An agent's knowledge base consists of *definite* and *positive* statements.

The environment is *static*.

There are only a finite number of individuals of interest in the domain. Each individual can be given a unique name.

$\Longrightarrow$ Datalog

Syntax of Datalog

variable starts with upper-case letter.

constant starts with lower-case letter or is a sequence of digits (numeral).

predicate symbol starts with lower-case letter.

term is either a variable or a constant.

atomic symbol (atom) is of the form p or $p(t_1, \dots, t_n)$ where p is a predicate symbol and t_i are terms.

Syntax of Datalog (cont)

definite clause is either an atomic symbol (a fact) or of the form:

$$\underbrace{a}_{\text{head}} \quad \leftarrow \quad \underbrace{b_1 \wedge \cdots \wedge b_m}_{\text{body}}$$

where a and b_i are atomic symbols.

query is of the form $?b_1 \wedge \cdots \wedge b_m$.

knowledge base is a set of definite clauses.

Example Knowledge Base

$in(alan, R) \leftarrow$

$\quad teaches(alan, cs322) \wedge$

$\quad in(cs322, R).$

$grandfather(william, X) \leftarrow$

$\quad father(william, Y) \wedge$

$\quad parent(Y, X).$

$slithy(toves) \leftarrow$

$\quad mimsy \wedge borogroves \wedge$

$\quad outgrabe(mome, Raths).$