Knowledge Representation and its methods

Syllabus

SECTION - B

Chapter 4

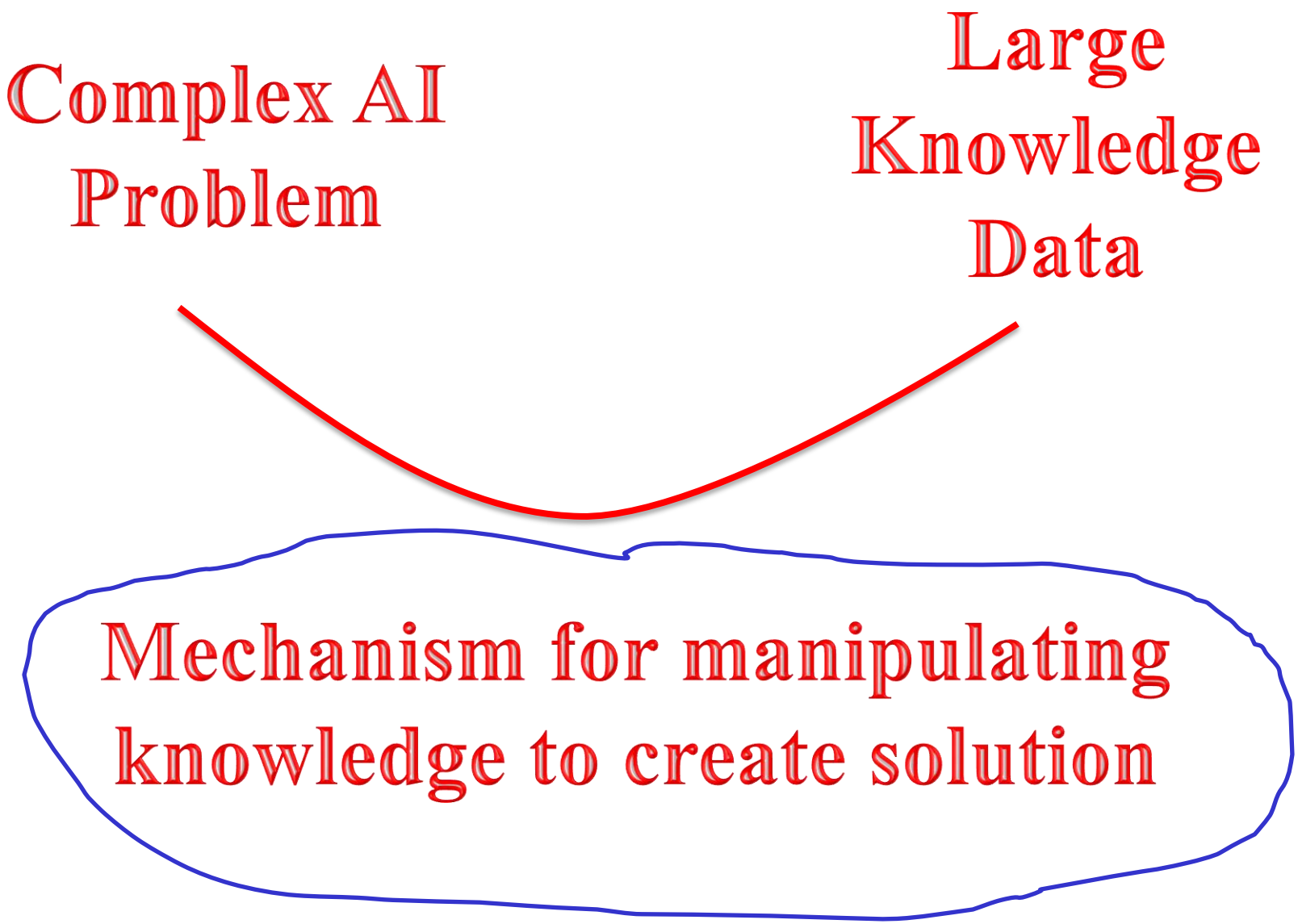
3. Knowledge Representation : Information and Knowledge, Knowledge Acquisition and Manipulation, Issues in knowledge representation,

Knowledge Representation Methods, Propositional Logic and First Order Predicate Logic, Resolution Principle, Horn's Clauses, Semantic networks, Partitioned Semantic Nets, Frames, Scripts and Conceptual Dependencies

Chapter 5 - 10

Knowledge Representation Issues

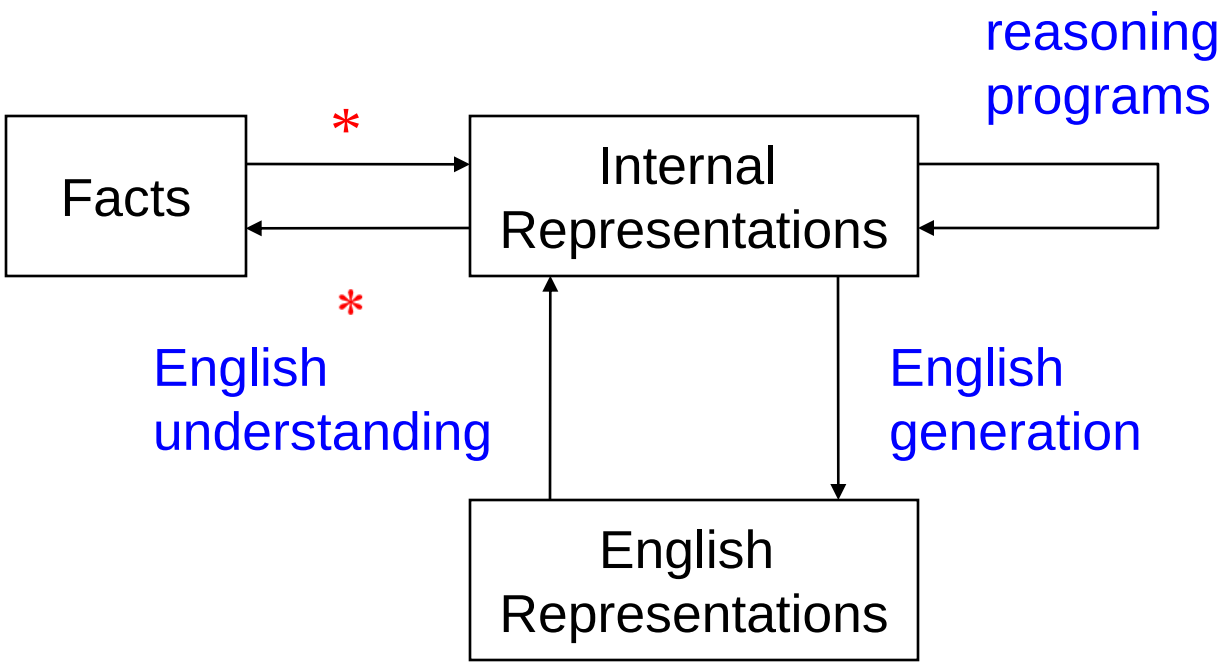
Chapter 4


Complex AI Problem
Large Knowledge Data
Mechanism for manipulating knowledge to create solution

Representation and Mapping

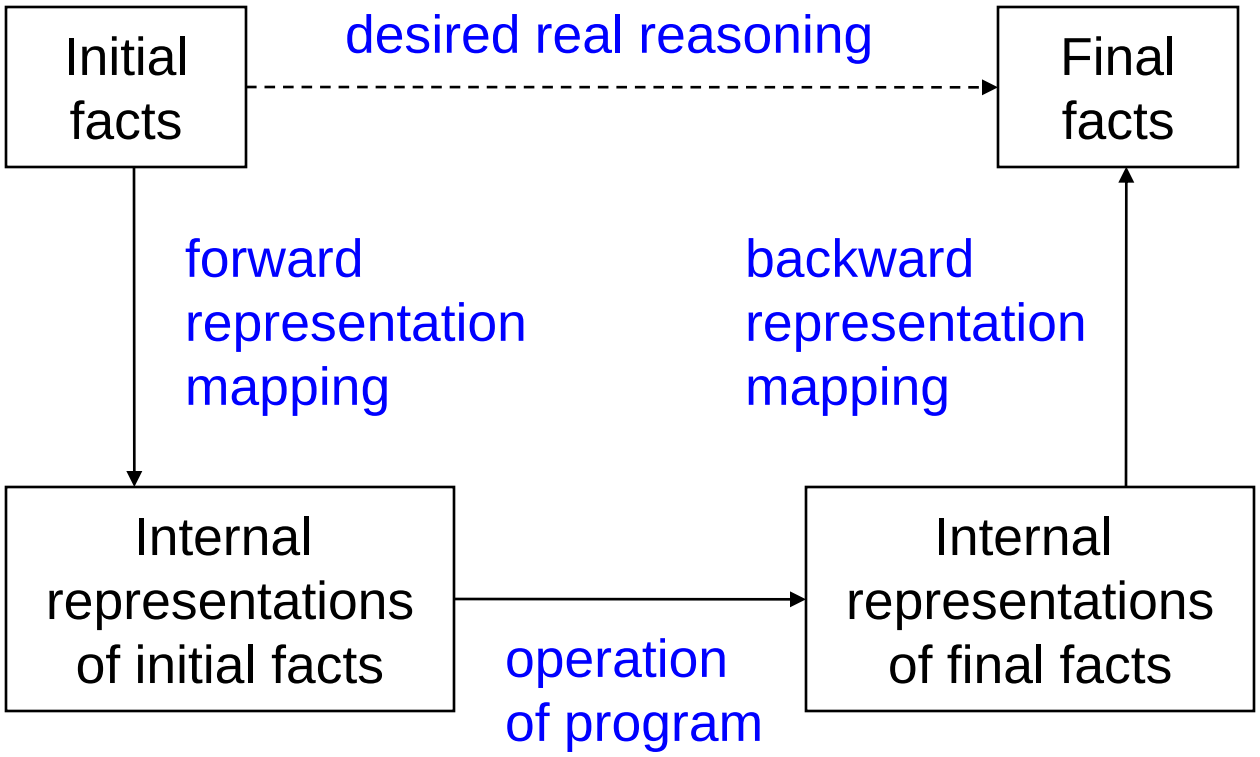
- Facts: (truth in relevant world) : things we want to represent.
- Representations of facts : (some chosen formalism): things we can manipulate.

Representation and Mapping



Representation Mappings

Representation and Mapping



Representation and Mapping

- Spot is a dog:
  - Dog(spot)
- Every dog has a tail:
  - \-/x:dog(x)→hastail(x)
- Spot has a tail:
  - Hastail(spot)

Representation and Mapping

- Spot is a dog

  dog(Spot)

- Every dog has a tail

  $\forall x$: dog(x) $\rightarrow$ hastail(x)

  hastail(Spot)

  Spot has a tail

Representation and Mapping

- Fact-representation mapping is not one-to-one.
- Each object in domain may map to several elements in range
- Several elements in range may map to same element

- Eg:
- (A) All dogs have tails.
- Represents: Every dog has atleast one tail and
- Each dog has several tails
- (B)Every dog has a tail
- Represents:Every dog has atleast one tail and
- There is a tail that every dog has.

Representation and Mapping

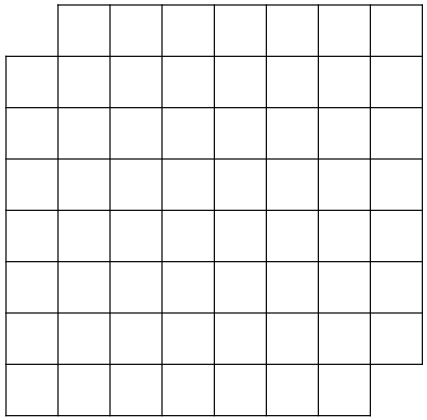
The Multilated Checkerboard Problem

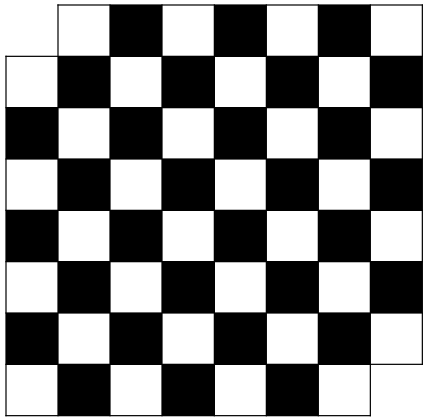
“Consider a normal checker board from which two squares, in opposite corners, have been removed.

The task is to cover all the remaining squares exactly with donimoes, each of which covers two squares. No overlapping, either of dominoes on top of each other or of dominoes over the boundary of the multilated board are allowed.

Can this task be done?”

Representation and Mapping





No. black squares
= 30

No. white square
= 32

Here's a concise expression of the idea.

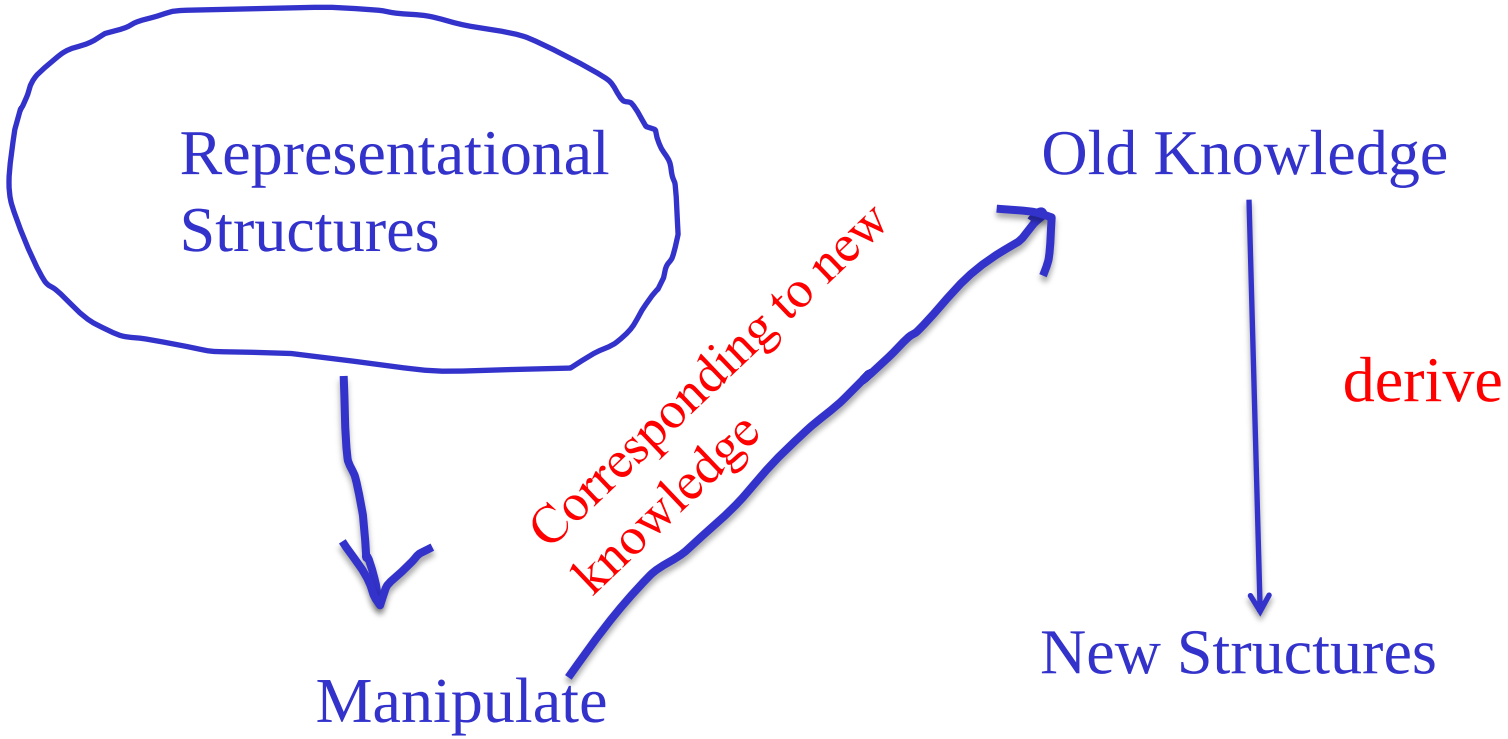
- A domino covers two squares of opposite color. For some people this will be enough. Others may require the additional sentence
- The two squares that have been removed are of the same color.

Properties of good Knowledge Representation

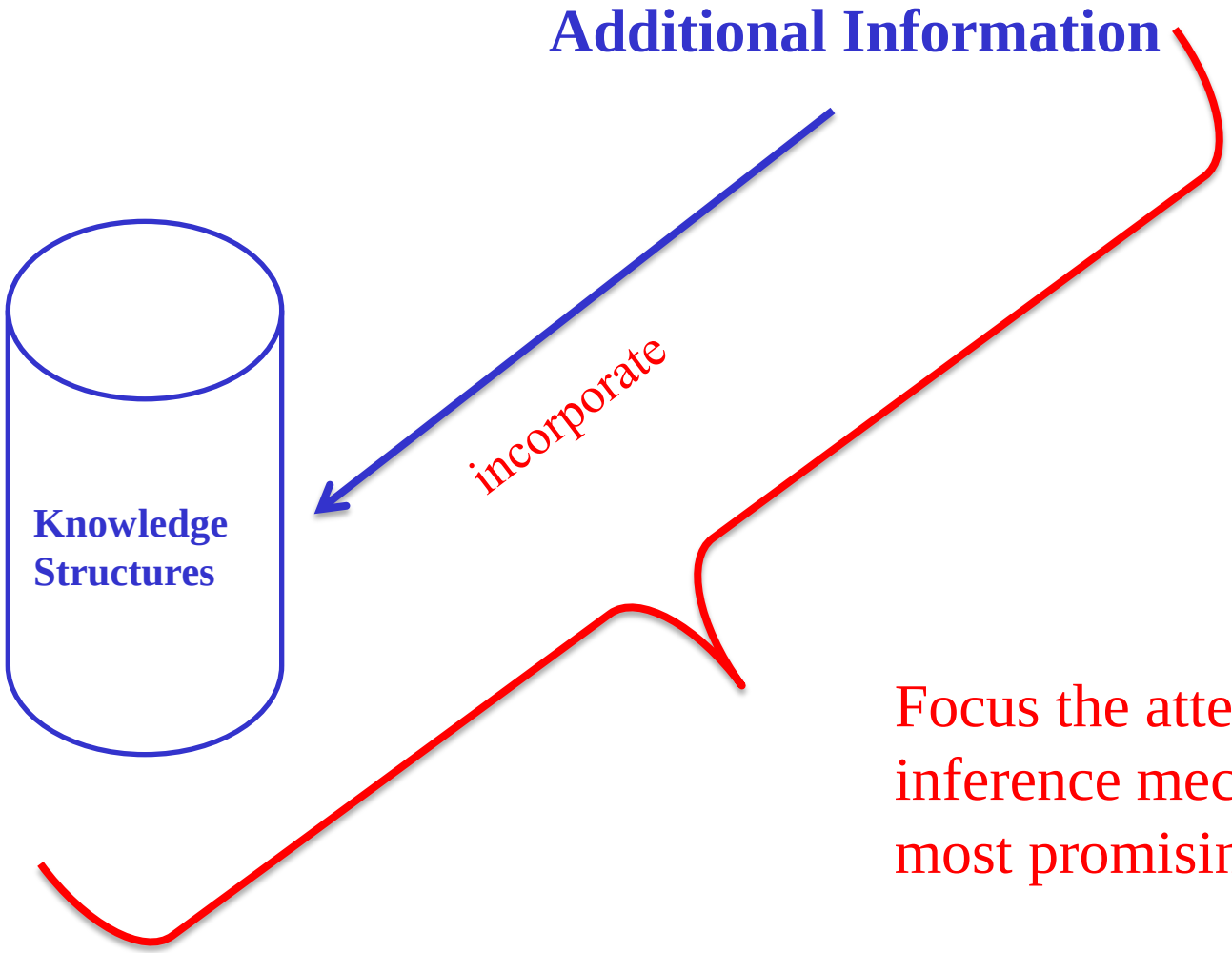
Representational adequacy – Ability to represent all kinds of knowledge that are needed in that domain

- Inferential adequacy
- Inferential efficiency
- Acquisitional efficiency

Inferential Adequacy



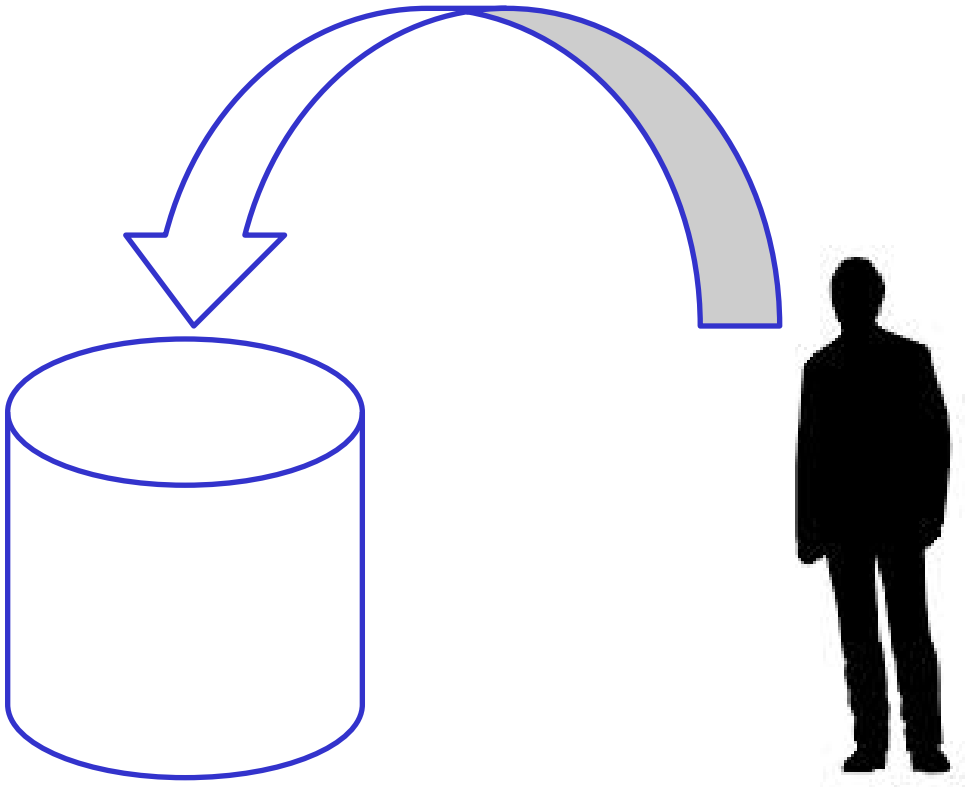
Inferential Efficiency



Focus the attention of inference mechanism in the most promising direction

Acquisitional Efficiency

Ability to acquire new information easily



Approaches to KR

Simple relational knowledge:

- Provides very weak inferential capabilities.
- May serve as the input to powerful inference engines.

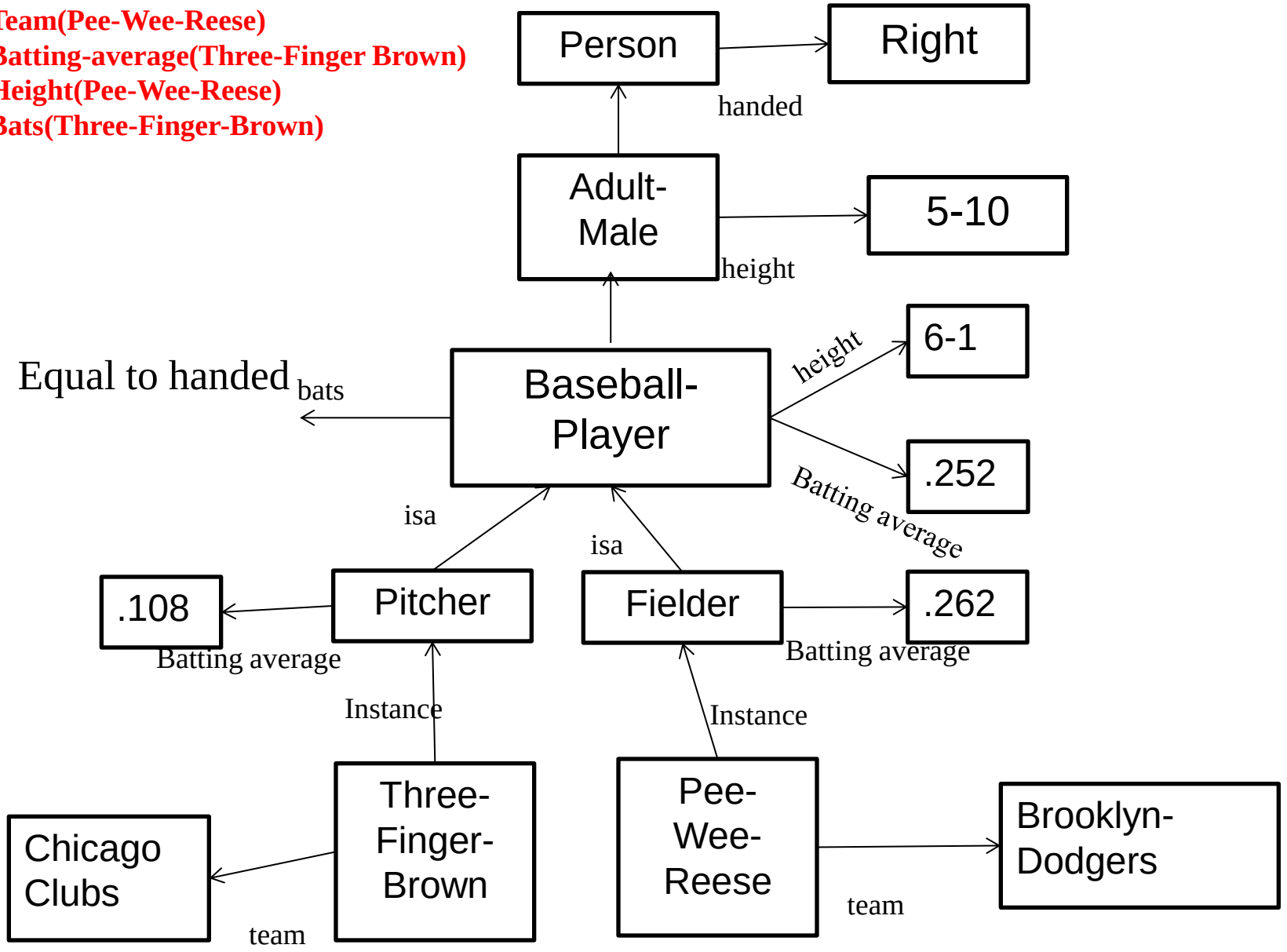
Player	Height	Weight	Bats-Throws
Hank Aaron	6-0	180	Right-Right
Willie Mays	5-10	170	Right-Right
Babe Ruth	6-2	215	Left-Left
Ted Williams	6-3	205	Left-Right
player_info(‘Hank Aaron’, ‘6-0’, 180, right-right)			

Approaches to KR

Inheritable knowledge:

- Objects are organized into classes and classes are organized in a generalization hierarchy.
- Inheritance is a powerful form of inference, but not adequate.
- Property Inheritance

- **Team(Pee-Wee-Reese)**
- **Batting-average(Three-Finger Brown)**
- **Height(Pee-Wee-Reese)**
- **Bats(Three-Finger-Brown)**



Algorithm: Property inheritance

1. Find o in knowledge base
2. If there is a value there for attribute A,report that value.
3. Otherwise see if there is a value for attribute instance. if not then fail.
4. Otherwise move to the node corresponding to that value and look for a value for attribute A.if one is found report it.
5. Otherwise,do until there is no value for the “isa” attribute or until an answer is found:

(a)Get the value of the isa attribute and move to that node.

(b)See if there is a value for the attribute A.if there is,report it.

Approaches to KR

Inferential knowledge:

- Facts represented in a logical form, which facilitates reasoning.(like first order predicate logic)
- An inference engine is required--(inference procedure to exploit this knowledge in backward and forward form , one such procedure is resolution).

Approaches to KR

Procedural knowledge:

- Static and Declarartive Facts
- How to do it and when.
- Most common way is by coe (like LISP Programming)
- May have inferential efficiency, but no inferential adequacy and acquisitional efficiency.

Issues in Knowledge Representation

1. Are any attributes of object so basic that they occur in almost every problem domain
2. Are there any important relationships that exist among attributes of objects?
3. At what level should knowledge be represented ?Is there a good set of primitives into which knowledge can be broken down ? Is it helpful to use such primitives
4. How Should set of objects be represented?
5. Can a large amount of knowledge stored in a database, how can relevant parts be accessed when they are needed?

1. Important Attributes

- Instance
- Isa

} support property inheritance

(Class membership and class inclusion)

2. Relationship among Attributes

- Inverses

(binary relationships, symmetric relationship)

- Existence in an isa hierarchy

(attributes and specialization of attributes)

- Techniques for reasoning about values

(information about type of the value,

Constraints on value,

Rules for computing values when needed backward rules or if-needed rules,

Rules that describes action that could be taken –forward rules or if-added rules)

- Single-valued attributes

(specific and unique value,

Introduce explicit notation for temporal interval, If new value is asserted then replace old value, Provide no explicit support)

3. Choosing the Granularity of Representation

- High-level facts may not be adequate for inference.
- Low-level primitives may require a lot of storage.

eg : John spotted sue

Spotted(agent(John))

Object(Sue)

Who spotted Sue?

Did John see Sue?

Spotted(x,y)-> saw(x,y)

Saw(agent(John),Object(Sue), timespan(briefly))

Assignment

- Arguments against the use of low level primitives

4.Representing Set of Objects

Represent set of object

- By name
- Object and its elements may be having same attributes or different

State definition of a set and its element

- List the members (Extensional definition) {earth}
- Intensional Definition: Provide a rule that when a particular object is evaluated, returns true or false depending on whether the element is in the list or not
- {x:sun-planet(x)^human-inhabited(x)}
- Extensional and intensional def may not correspond one to one

5.Finding the right Structures as needed

John went to mehfil last night. He ordered rare steak, paid his bill and left

Did John eat dinner last night?

5.Finding the right Structures as needed

- Locating appropriate knowledge structures that have been stored in memory.
- To have access to right structures for describing particular situation ,it is necessary to solve all particular problems
- How to perform an initial selection of the most appropriate structure
- How to find a better structure if the one chosen initially turns out not to be appropriate
- What to do if none of the available structures if appropriate.
- When to create and remember a new structure.

Selecting an initial structure

Three approaches

- Index the structure directly by significant english words.
- Each major concept as pointer to all of the structures in which it might be involved.
- Locate one major clue in the problem description and use it as initial structure.

Revising the choice when necessary

Select the fragments of the current structure that do correspond to that situation and match them against candidate alternatives.

Make an excuse for current structure failure and continue to use it.

Refer to specific stored links between structures to suggest new direction in which to explore

If knowledge structures are stored in isa hierarchy , traverse upward until a structure is found that is sufficiently general and does not conflict with the concept.