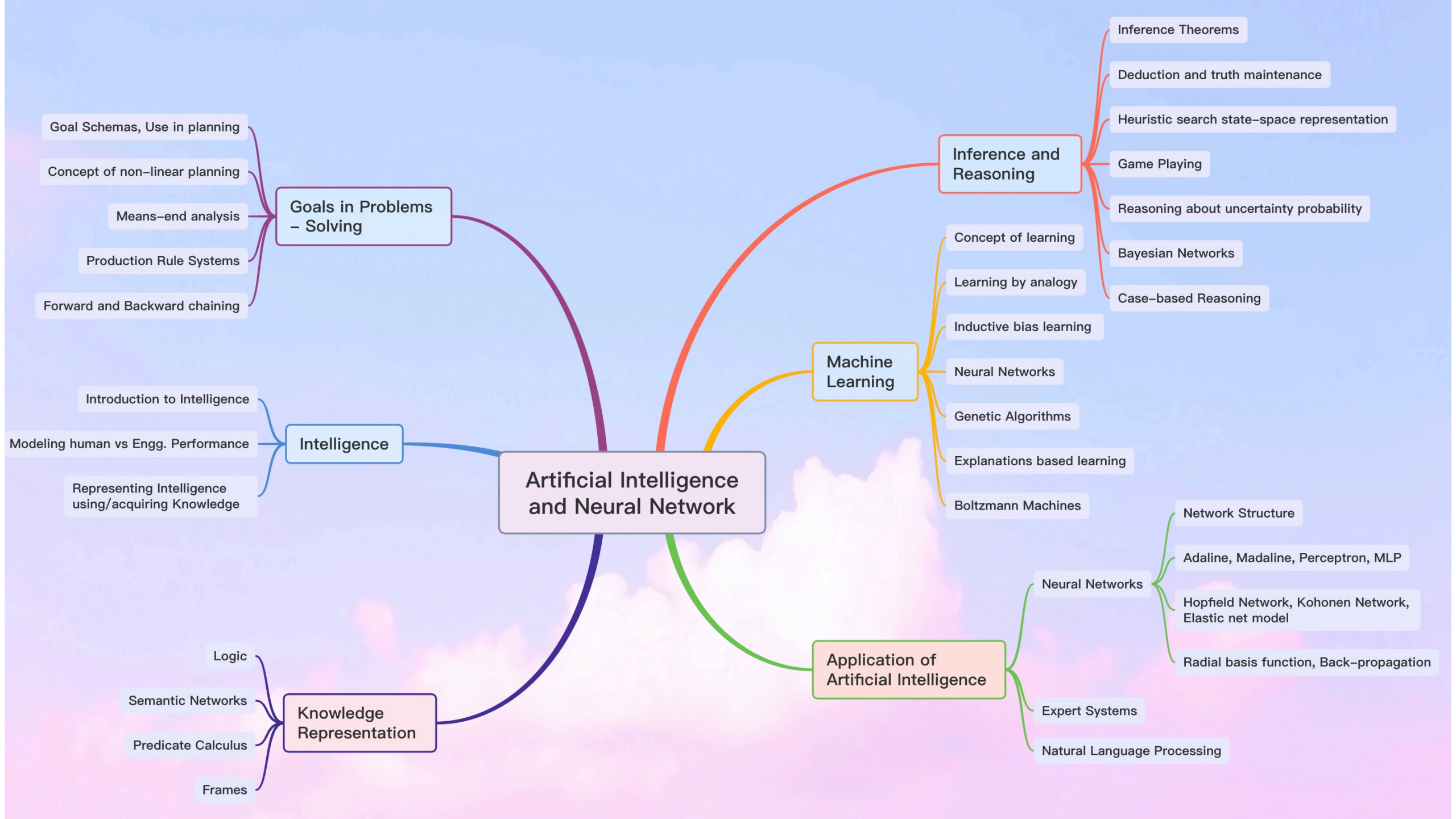
UNIT 3

Knowledge Representation


Artificial Intelligence and Neural Network
Goals in Problems – Solving
Goal Schemas, Use in planning
Concept of non–linear planning
Means–end analysis
Production Rule Systems
Forward and Backward chaining
Intelligence
Introduction to Intelligence
Modeling human vs Engg. Performance
Representing Intelligence using/acquiring Knowledge
Knowledge Representation
Logic
Semantic Networks
Predicate Calculus
Frames
Inference and Reasoning
Inference Theorems
Deduction and truth maintenance
Heuristic search state–space representation
Game Playing
Reasoning about uncertainty probability
Bayesian Networks
Case–based Reasoning
Machine Learning
Concept of learning
Learning by analogy
Inductive bias learning
Neural Networks
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Explanations based learning
Boltzmann Machines
Application of Artificial Intelligence
Neural Networks
Network Structure
Adaline, Madaline, Perceptron, MLP
Hopfield Network, Kohonen Network, Elastic net model
Radial basis function, Back–propagation
Expert Systems
Natural Language Processing

Outline

- Representations and Mappings
- Approaches to Knowledge Representation
- Issues in Knowledge Representation
- Semantics Net
- Frames
- Conceptual Dependencies
- Scripts

Knowledge

- Data
- Information
- Knowledge

- Tacit Knowledge
- Recorded Knowledge

- Knowledge Engineering

Representations and Mappings

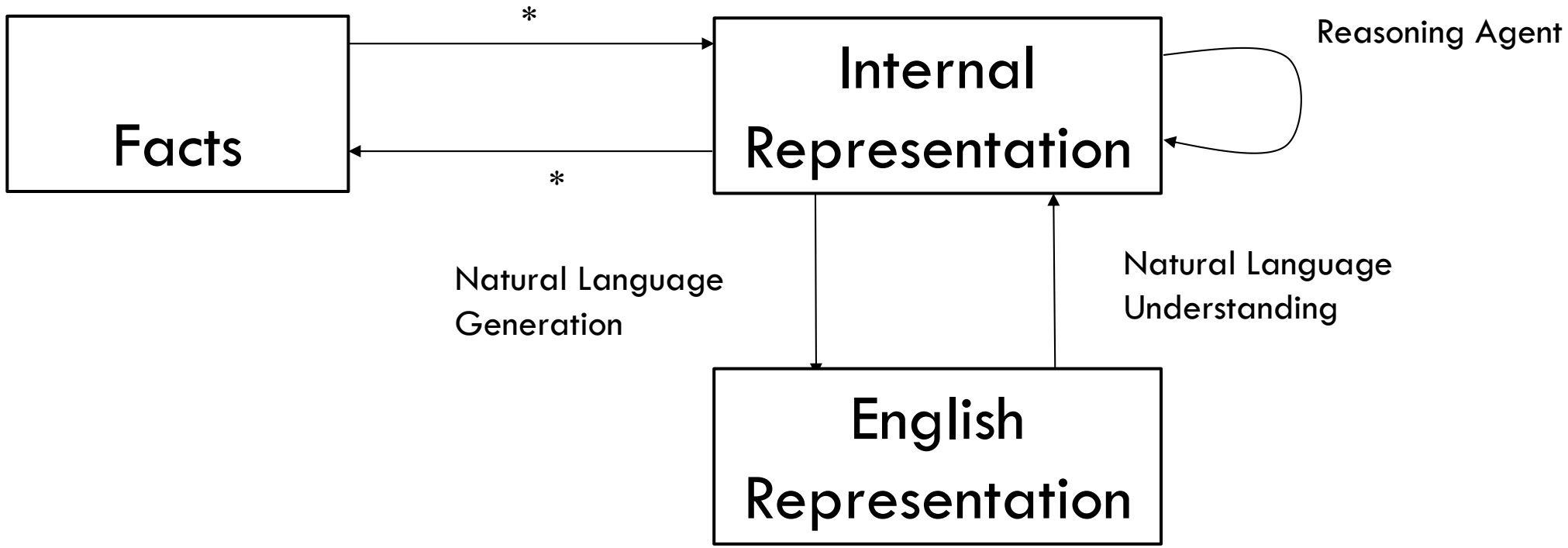
- Solving Complex Problems is guided by requirement of large amount of knowledge and some mechanisms to manipulate that knowledge and create the solution to the Problem
- For that knowledge is to be represented for which the following points are to be considered
  - Facts: that we want to represent, i.e. the truth in the representing world
  - Representation: in some formal way

Representations and Mappings

- For structuring these entities one way is to think at two levels:
  - The knowledge level
  - The symbol level
- At knowledge level facts are described
- At symbol level objects represented at knowledge level are defined in terms of symbols that can be manipulated by programs

Representations and Mappings (Reviewing)

Figure: Mapping Facts and Representation



Representations and Mappings

- Rather than thinking of one level on top of another, focusing on facts, representations and on the two way mappings that must exist between them is more important
- These links are called Representation Mappings
- Forward Representation Mapping maps facts to representations
- Backward Representation Mapping maps representations to facts

Representations and Mappings

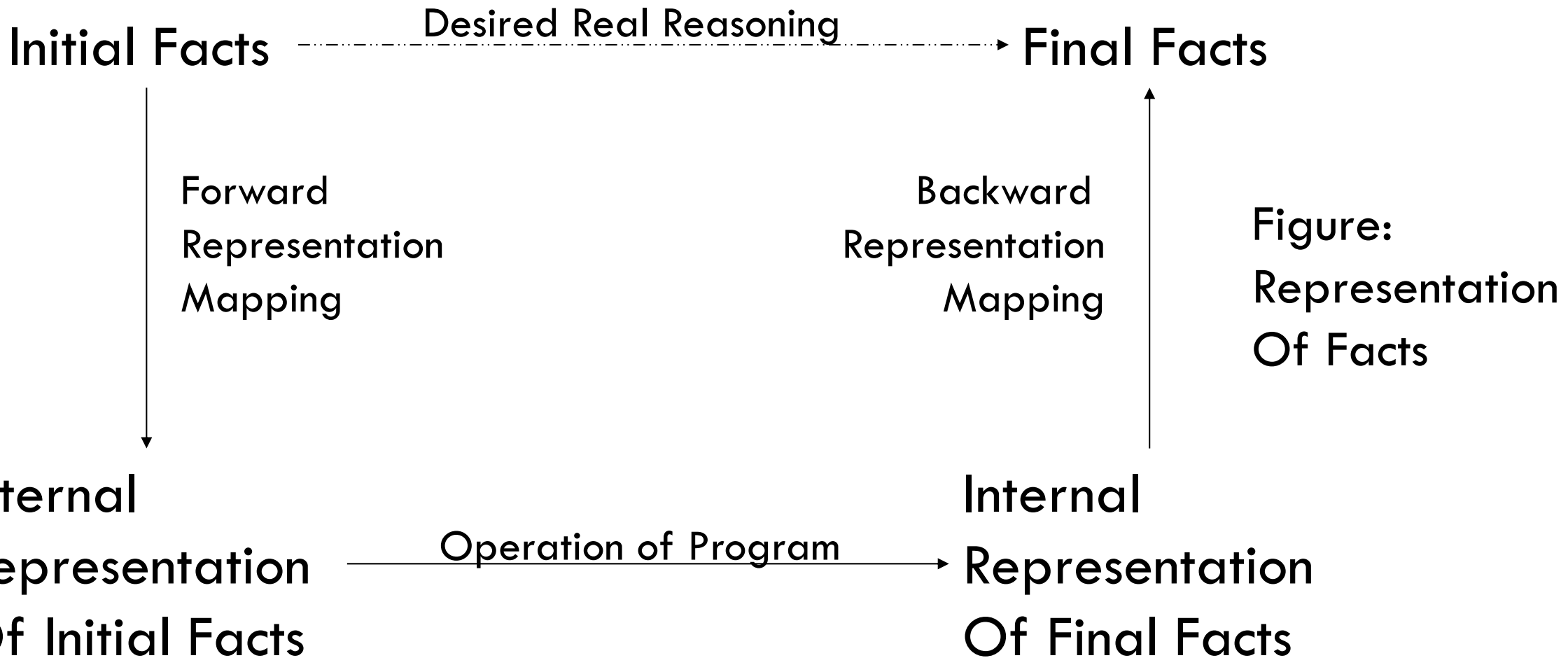


Figure: Representation Of Facts

Approaches to Knowledge Representation

For a good system following four properties are must

- Representational Adequacy: Ability to represent all kind of knowledge that are needed in the domain
- Inferential Adequacy: Ability to manipulate the representational structure in such a way as to derive new structures corresponding to new knowledge inferred from old
- Inferential Efficiency: Ability to incorporate into the knowledge structure additional information that can be used to focus the attention of the inference mechanism in the most promising direction
- Acquisitional Efficiency: Ability to acquire new information easily

Knowledge Representation: Types

- Simple Relational Knowledge
  - The simplest way to represent declarative facts is as a set of relations of the same sort used in database system
- Inheritable Knowledge
  - Structure must be designed to correspond to the inference mechanism that are desired
- Inferential Knowledge
  - Represents knowledge as formal logic
  - Based on reasoning from facts or from other inferential knowledge
  - Useless unless there is also an inference procedure that can exploit it
- Procedural (Imperative) Knowledge
  - Knowledge exercised in the performance of some task
  - Processed by an intelligent agent

Issues in Knowledge Representation

- Are any attributes of objects so basic that they have been occurred in almost every problem domain?
- Are there any important relationships that exist among attributes of objects
- At what level should knowledge be represented?
- How should sets of objects be represented?
- How can relevant parts be accessed when they are needed?

Semantic Networks

- Other than descriptive logic, the major system designed to organise and for reasoning
- Evolved from existential graphs, called the logic of the future
- Existential graphs uses a graphical notation of nodes and arcs
- Semantic networks provide for certain kinds of sentences is often more convenient but if we strip away the human interface issues, the underlying concept persist with objects, relations, quantification and so on

Semantic Networks

- Many variant of semantic net are available now a days
- Semantic nets are capable of representing individual objects, categories of objects and relationships among those objects
- A typical graphical notation displays object or categories names in ovals or boxes and connects them with labelled arcs
- Suitable for implementing inheritance and object oriented concepts
- Inverse Links: Example→ Brother of (x, y) = Has brother (y, x)

Semantic Networks

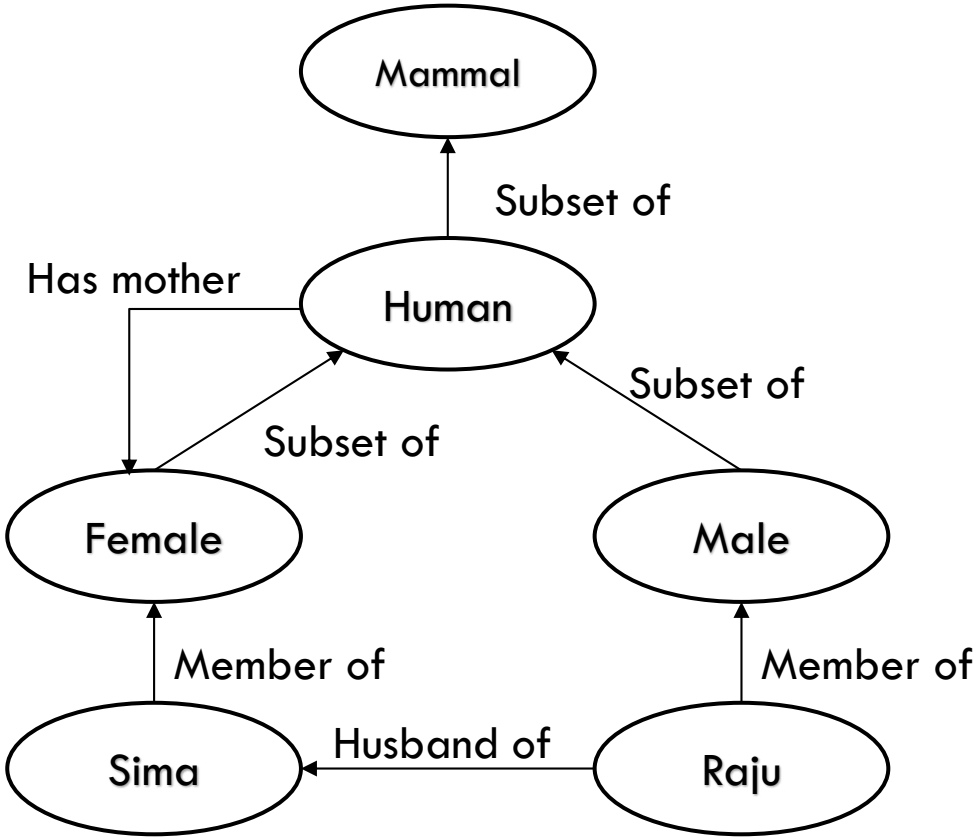


Figure: Semantic Network Example

Frames

- A frame is a collection of attributes (slots) and associated values and possibly constraints on values that describe some entity in the world.
- Frame system is build on a set of frames that are connected to each other by the virtue of fact that the value of an attribute of one frame may be another frame
- Generally, Frames are based on set theory

Frames

Example:

Human

Isa: Mammal

Cardinality: 6000000000

*Legs: 2

Male

Isa: Human

Cardinality: 4000000000

*Hair: Short

Scripts

- A script is a structure that is used to describe the sequence of events in a particular context
- It consists of a set of slots
- Each slot is associated with some information describing the kind of values a slot may contain as well as a default value to be used if no other information is available
- Script seems to be similar to frames but these have more detailed information
- For example: refer to Page Number 286, Artificial Intelligence, Rich and Knight.

References

- Russell, S. and Norvig, P., 2011, Artificial Intelligence: A Modern Approach, Pearson, India.
- Rich, E. and Knight, K., 2004, Artificial Intelligence, Tata McGraw hill, India.

Thank You

Any Queries?