Knowledge Representation In AI

AGENDA

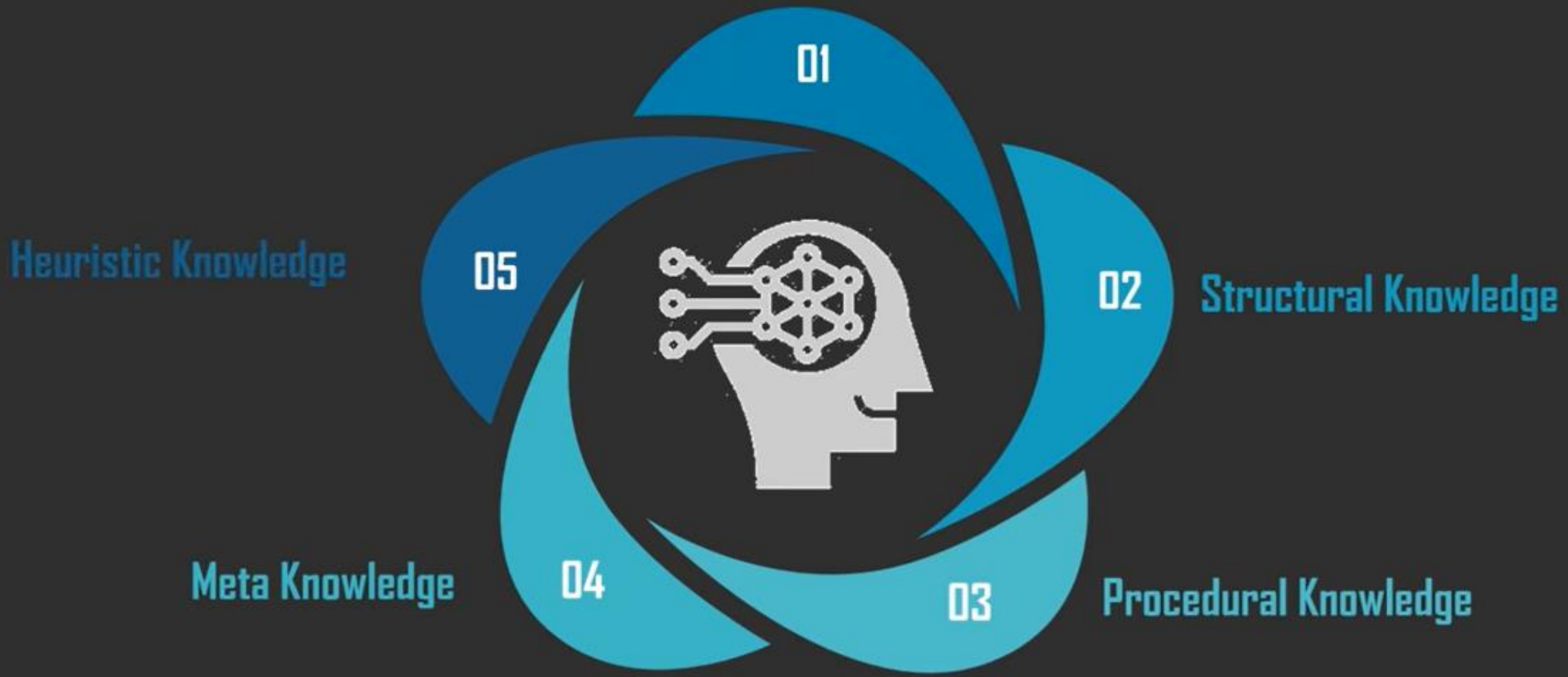
WHAT IS KNOWLEDGE REPRESENTATION?
DIFFERENT TYPES OF KNOWLEDGE
CYCLE OF KNOWLEDGE REPRESENTATION
RELATION BETWEEN KNOWLEDGE & INTELLIGENCE
TECHNIQUES OF KNOWLEDGE REPRESENTATION
REPRESENTATION REQUIREMENTS
APPROACHES WITH EXAMPLE

WHAT IS KNOWLEDGE REPRESENTATION?

Knowledge Representation and Reasoning (**KR, KRR**) represents information from the real world for a computer to understand and then utilize this knowledge to solve **complex real-life problems** like communicating with human beings in natural language.

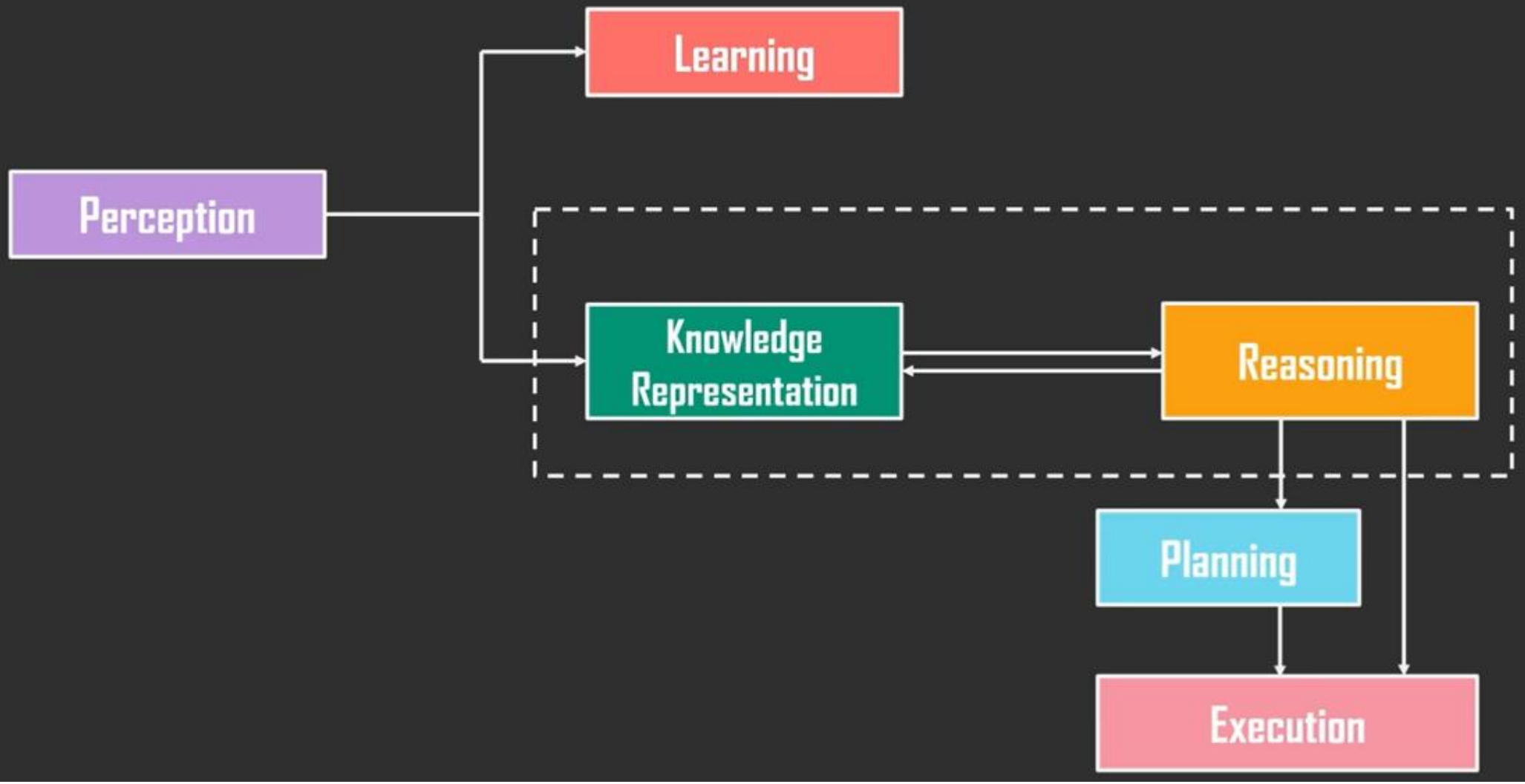
- Objects
- Events
- Performance
- Facts
- Meta-Knowledge
- Knowledge-Base

TYPES OF KNOWLEDGE



- **Declarative Knowledge** – It includes concepts, facts, and objects and expressed in a declarative sentence.
- **Structural Knowledge** – It is a basic problem-solving knowledge that describes the relationship between concepts and objects.
- **Procedural Knowledge** – This is responsible for knowing how to do something and includes rules, strategies, procedures, etc.
- **Meta Knowledge** – Meta Knowledge defines knowledge about other types of Knowledge.
- **Heuristic Knowledge** – This represents some expert knowledge in the field or subject.

CYCLE OF KNOWLEDGE REPRESENTATION



- The **Perception component** retrieves data or information from the environment. with the help of this component, you can retrieve data from the environment, find out the source of noises and check if the AI was damaged by anything. Also, it defines how to respond when any sense has been detected.
- Then, there is the **Learning Component** that learns from the captured data by the perception component. The goal is to build computers that can be taught instead of programming them. Learning focuses on the process of self-improvement. In order to learn new things, the system requires knowledge acquisition, inference, acquisition of heuristics, faster searches, etc.
- The main component in the cycle is **Knowledge Representation and Reasoning** which shows the human-like intelligence in the machines. Knowledge representation is all about understanding intelligence. Instead of trying to understand or build brains from the bottom up, its goal is to understand and build intelligent behavior from the top-down and focus on what an agent needs to know in order to behave intelligently. Also, it defines how automated reasoning procedures can make this knowledge available as needed.
- The **Planning and Execution** components depend on the analysis of knowledge representation and reasoning. Here, planning includes giving an initial state, finding their preconditions and effects, and a sequence of actions to achieve a state in which a particular goal holds. Now once the planning is completed, the final stage is the execution of the entire process.

RELATION BETWEEN KNOWLEDGE & INTELLIGENCE

Sensing

Knowledge

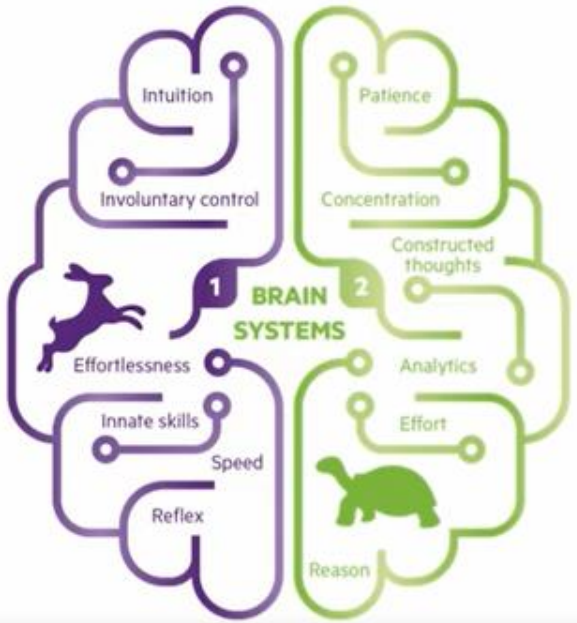
Decision Maker

Action

TECHNIQUES


Logical Representation
01
02
Semantic Network Representation
KR Techniques
Production Rules
04
03
Frame Representation

- **Logical Representation**
- Semantic Network Representation
- Frame Representation
- Production Rules



Logical representation is a language with some **definite rules** which deal with propositions and has no ambiguity in representation. It represents a conclusion based on various conditions and lays down some important **communication rules**.

Logical Representation

- Semantic Network Representation
- Frame Representation
- Production Rules

Syntax

- It decides how we can construct legal sentences in logic.
- It determines which symbol we can use in knowledge representation.
- Also, how to write those symbols.

Semantic

- Semantics are the rules by which we can interpret the sentence in the logic.
- It assigns a meaning to each sentence.

ADVANTAGES

- Logical representation helps to perform logical reasoning.
- This representation is the basis for the programming languages.

DISADVANTAGES

- Logical representations have some restrictions and are challenging to work with.
- This technique may not be very natural, and inference may not be very efficient.

- Logical Representation
- **Semantic Network Representation**
- Frame Representation
- Production Rules

Semantic networks work as an **alternative** of **predicate logic** for knowledge representation. In Semantic networks, you can represent your knowledge in the form of graphical networks. This network consists of nodes representing objects and arcs which describe the relationship between those objects.

01 **IS-A relation (Inheritance)**

02 **Kind-of-relation**

ADVANTAGES

- Semantic networks are a natural representation of knowledge.
- It conveys meaning in a transparent manner.
- These networks are simple and easy to understand.

DISADVANTAGES

- Semantic networks take more computational time at runtime.
- These are inadequate as they do not have any equivalent quantifiers.
- These networks are not intelligent and depend on the creator of the system.

- Logical Representation
- Semantic Network Representation
- **Frame Representation**
- Production Rules

A frame is a **record** like structure that consists of a **collection of attributes** and values to describe an entity in the world. These are the AI data structure that divides knowledge into substructures by representing stereotypes situations. It consists of a collection of slots and slot values of any type and size. Slots have names and values which are called facets.

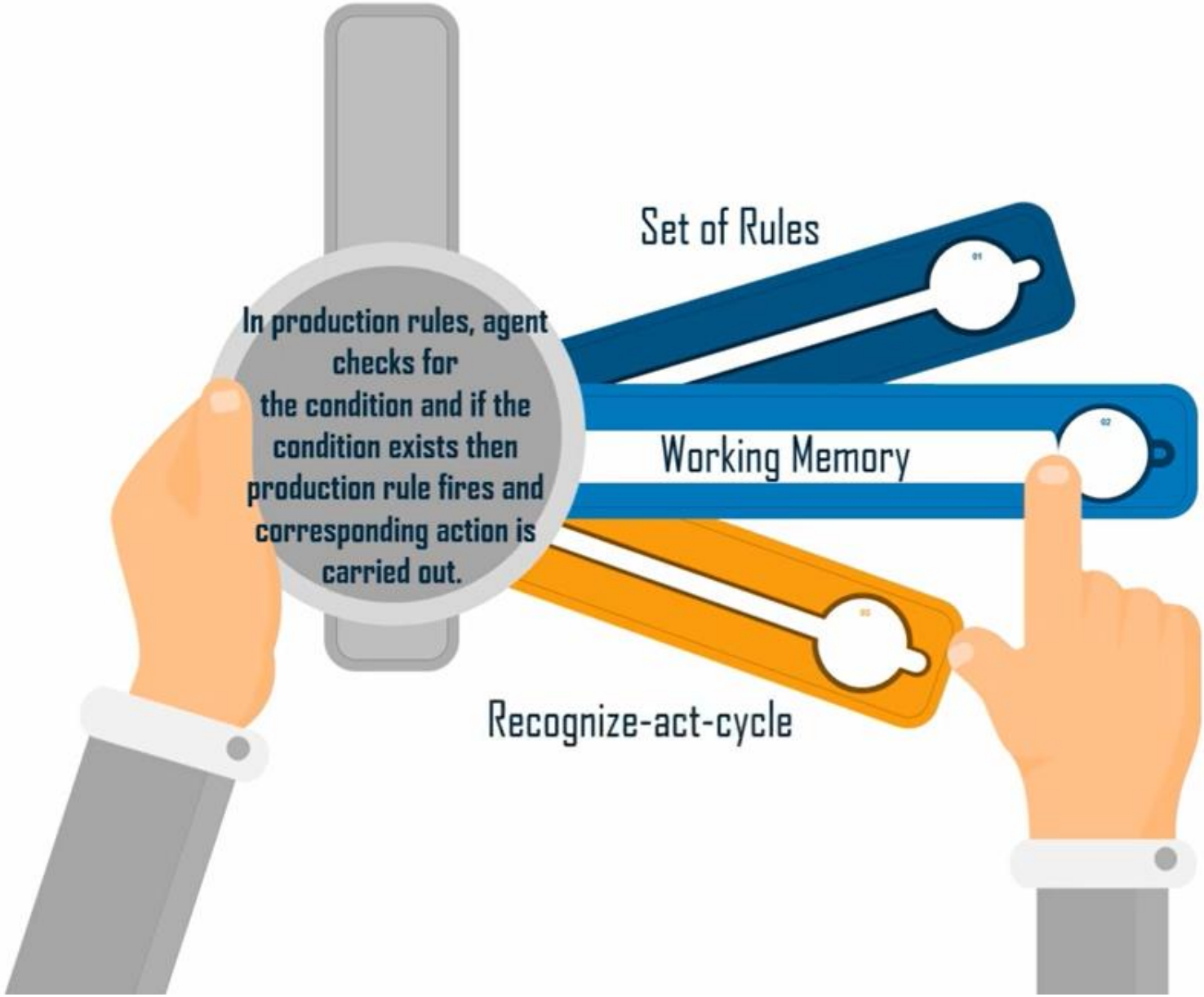
ADVANTAGES

- It makes the programming easier by grouping the related data.
- Frame representation is easy to understand and visualize.
- It is very easy to add slots for new attributes and relations.
- Also, it is easy to include default data and search for missing values.

DISADVANTAGES

- In frame system inference, the mechanism cannot be easily processed.
- The inference mechanism cannot be smoothly proceeded by frame representation.
- It has a very generalized approach.

- Logical Representation
- Semantic Network Representation
- Frame Representation
- **Production Rules**



ADVANTAGES

- The production rules are expressed in natural language.
- The production rules are highly modular and can be easily removed or modified.

DISADVANTAGES

- It does not exhibit any learning capabilities and does not store the result of the problem for future uses.
- During the execution of the program, many rules may be active. Thus, rule-based production systems are inefficient.

REPRESENTATION REQUIREMENTS

01 REPRESENTATIONAL ACURACY

02 INFERENTIAL ADEQUACY

03 INFERENTIAL EFFICIENCY

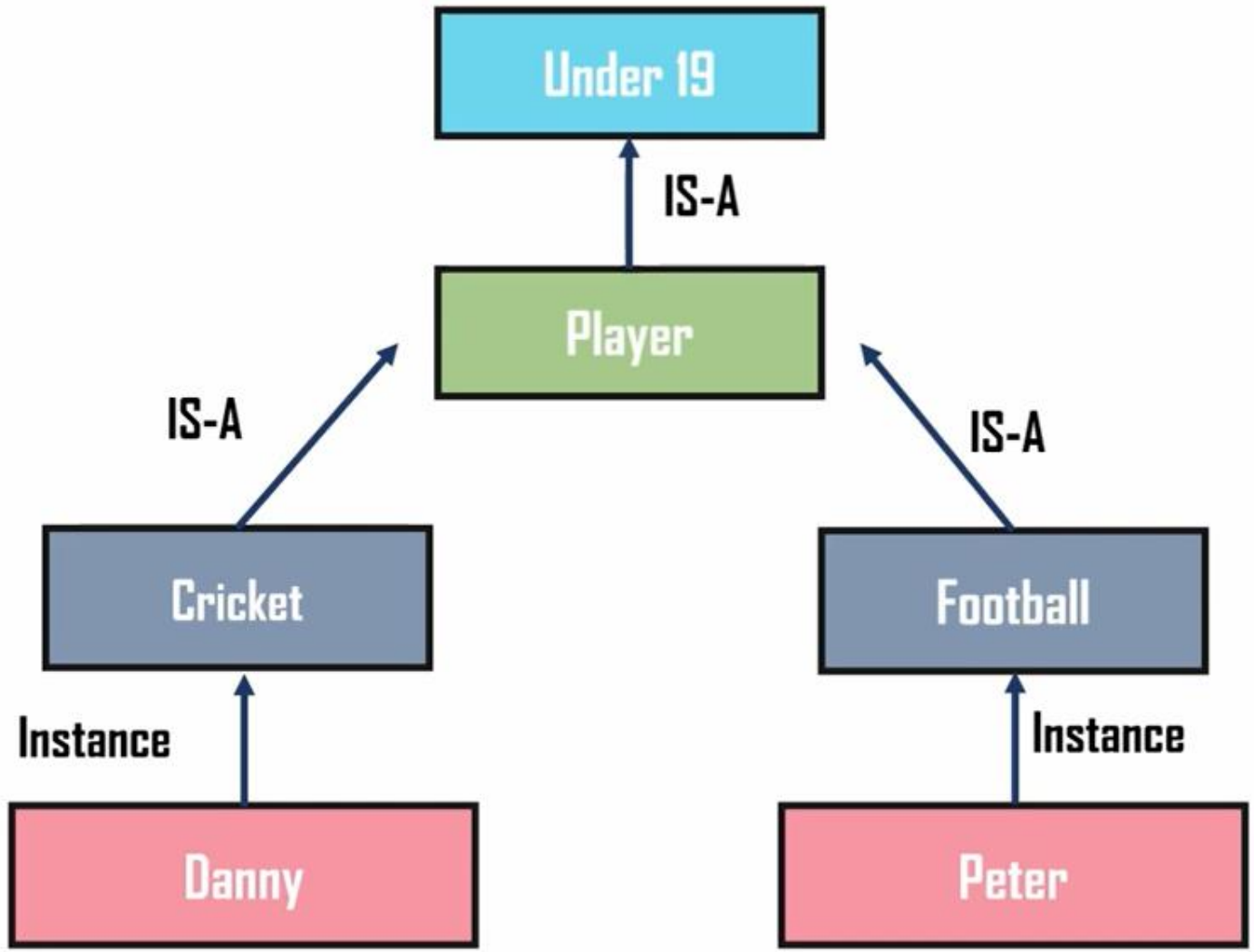
04 ACQUISITIONAL EFFICIENCY

- **Representational Accuracy:** It should represent all kinds of required knowledge.
- **Inferential Adequacy**: It should be able to manipulate the representational structures to produce new knowledge corresponding to the existing structure.
- **Inferential Efficiency**: The ability to direct the inferential knowledge mechanism into the most productive directions by storing appropriate guides.
- **Acquisitional efficiency**: The ability to acquire new knowledge easily using automatic methods.

Simple Relational Knowledge

Name	Age	Emp ID
John	25	100071
Amanda	23	100056
Sam	27	100042

Inheritable Knowledge



Inferential Knowledge

Statement 01	John is a cricketer
Statement 02	All cricketers are athletes

Cricketer(John)

∀x = Cricketer (x) ———-> Athlete (x)s