Guelma University, Algeria
Computer Science Department
2ère Master STIC/ICST – UEF3

Knowledge Engineering Course

Chapter III
Knowledge Capture and Codification

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Outline

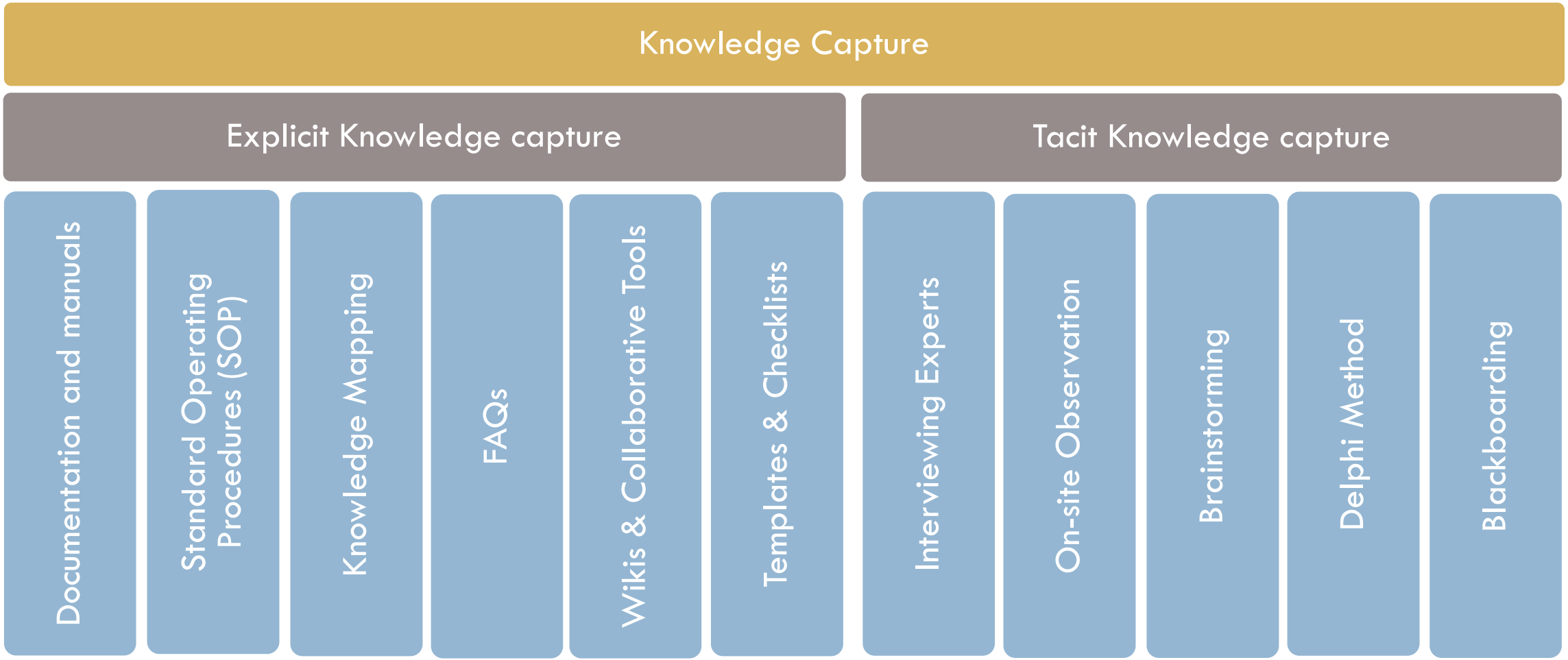
- What is Knowledge Capture?
- Methods for capturing explicit knowledge
- Methods for capturing tacit knowledge
- What is Knowledge Codification?
- Knowledge Codification Techniques

Knowledge Capture

What is Knowledge Capture?

- Knowledge capture is a structured and organized process that involves the systematic collection and documentation of knowledge.
- Knowledge capture concerns both explicit and tacit knowledge.
- Knowledge can be sourced from various channels within an organization: individuals, documents, databases, institutional memory, etc.
- Knowledge capture involves studying and understanding how experts acquire and apply their knowledge.
- The main objective of knowledge capture is to translate the expertise of experts into processes, procedures, or best practices that can be easily understood and adopted by others.
- The process of knowledge capture is iterative and dynamic. It involves updates, revisions, and improvements to keep the captured knowledge relevant and aligned with evolving organizational needs.

Knowledge Capture Methods



Knowledge Capture

Explicit Knowledge

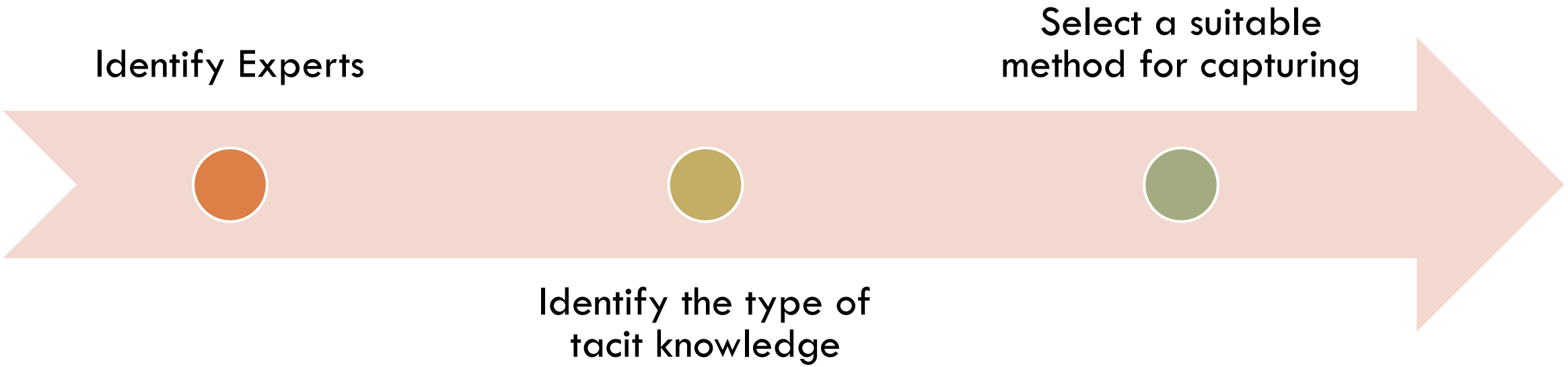
Explicit Knowledge Capture

- **Documentation and Manuals:** Create written documents, manuals, procedures, and guidelines that capture explicit knowledge in a structured and easily accessible format.
- **Standard Operating Procedures (SOPs):** Develop SOPs that outline step-by-step processes and workflows, enabling consistent execution of tasks.
- **Knowledge Mapping:** Create knowledge maps, concept maps, or mind maps that visually represent explicit knowledge relationships and concepts.
- **FAQs and Knowledge Bases:** Maintain Frequently Asked Questions (FAQs) that provide answers to common queries and capture explicit knowledge.
- **Wikis and Collaboration Tools:** Using wikis and collaboration platforms where employees can contribute and update explicit knowledge collaboratively.
- **Templates and Checklists:** Create templates and checklists that guide employees in completing tasks or projects using predefined knowledge.

Knowledge Capture

Tacit Knowledge

Process for capturing Tacit Knowledge



How to identify experts?

- Talk to people and begin with the senior managers, but don't limit yourself to only this group. It is important to talk to the people in the field and equally important to speak to a representative sample of organizational units. Ask people to answer two questions:
  - Who do you ask for help when you need it?
  - Who asks you for help?
- Look at employee profiles (LinkedIn ResearchGate, or Internal profiles): most people list their expertise in such platforms.
- Automated software applications also can help in identifying expertise by analyzing emails, publications authored by employees, and presentations, etc.
- Use a hybrid approach – a combination of all the three above mentioned techniques.

Expert indictors

- **Problem-Solving Skills:** Experts are skilled problem solvers who can address complex issues within their domain.
- **Experience:** Years of hands-on work or research can indicate a depth of knowledge and expertise.
- **Education:** Academic qualifications, degrees, and certifications relevant to the field can signal expertise.
- **Publications:** Experts may have published articles, books, research papers, or other scholarly materials related to their field.
- **Awards and Recognitions:** Awards, honors, and professional recognitions within the industry or field can highlight an individual's expertise and contributions.
- **Reputation:** Experts often have a strong reputation within their professional community. This can be assessed through surveys, peer reviews, or feedback from colleagues and peers.

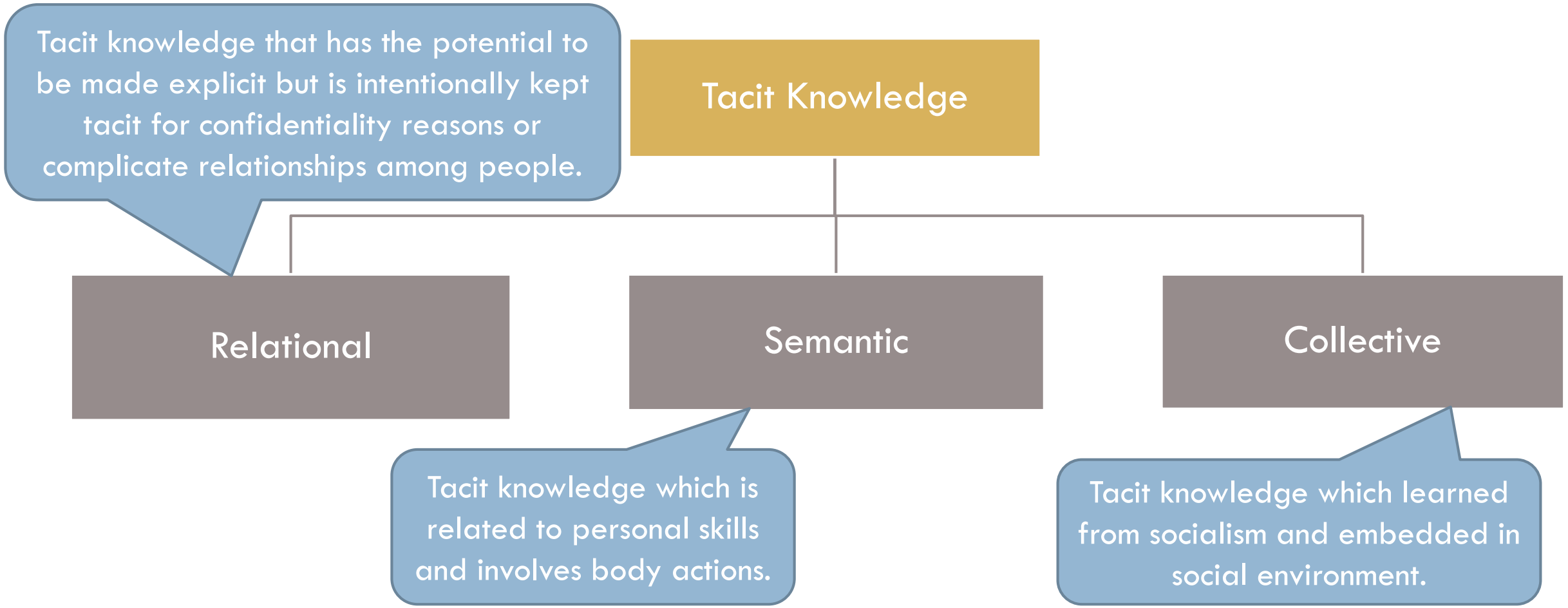
Experts Selection for Knowledge Capture

- Having in-depth knowledge and experience in the specific domain or subject matter relevant to the knowledge capture project.
- Experts that are knowing when to follow hunches and when to make exceptions.
- Consider experts who are open to new ideas and innovative approaches. Look for those who have demonstrated the ability to adapt to changing circumstances.
- Experts who have a track record of sharing their knowledge with colleagues and mentoring junior staff are often excellent candidates for knowledge capture.
- Have effective communication skills, including the ability to articulate and explain complex concepts, are essential for conveying knowledge to others.
- In diverse environments, it's important to consider an expert's ability to work with people from different cultural backgrounds.
- Willing to invest time and effort in contributing to the organization's knowledge base.

Single vs. Multiple Experts in Knowledge Capture

Single Expert	Multiple experts
Advantages	
Ideal for simple and restrictive domains.	Suitable for complex domains.
Enable easier conflict management.	Enable broader and more well-rounded knowledge base.
Faster knowledge capturing process.	Multiple experts can collaborate, validate each other's knowledge, and correct potential errors or biases.
Drawbacks	
Unsuitable for multi-disciplinary and complex domains.	Differences in opinions or approaches among experts can lead to conflicts and delays in knowledge capture.
Provide a narrow perspective, potentially missing out on diverse viewpoints and alternative solutions.	Process can take longer.

Types of Tacit Knowledge (Collins 2010)



Knowledge Capture Methods: Interviewing Experts (1/2)

- Often used in the early stages of tacit knowledge capture.
- Suitable for checking the validity of already acquire knowledge.
- Three types of interviews:
  - **Structured:** highly organized and follow a predetermined set of questions or topics.
  - **Unstructured:** open-ended and do not rely on a fixed set of questions. Instead, interviewers encourage interviewees to freely share their knowledge, experiences, and insights.
  - **Semi-structured:** combine structured and open-ended questions. While there is a predetermined list of topics or questions, interviewers have some flexibility to explore follow-up questions and probe for deeper insights.
- Three types of structured questions:
  - Multiple-choice questions.
  - Dichotomous questions.
  - Ranking scale questions.

Knowledge Capture Methods: Interviewing Experts (2/2)

- Recommended to do:
  - Show highly skills in communication, understanding and learning.
  - Prepare well for the interview.
  - Choose the appropriate location for holding the session. Their office is their comfort zone, and they will have easy access to their resources during the interviews.
  - Conduct separate interviews when multiple experts are required.
- Recommended not to do:
  - Don't convert the interview into an interrogation process.
  - Don't interrupt the expert.
  - Don't lose the control of the session.
  - Don't pretend that you understand an explanation when you actually don't.
  - Don't underestimate the expertise of the expert an any way.

Knowledge Capture Methods: On-site observation

- Allows individuals to directly observe and learn from the actions, behaviors, and practices of experts in a specific context → **More listening than talking**.
- Enables individuals to identify implicit knowledge by observing how experts naturally and effortlessly perform tasks, make decisions, or solve problems.
- Provides a deep and contextually rich understanding of how tasks or processes are performed within a particular environment.
- Observing experts in different situations or contexts can reveal how tacit knowledge adapts and varies based on circumstances.
- Allows for real-time feedback and interaction with experts. Observers can ask questions, seek clarification, and engage in discussions, fostering a dynamic learning process.
- Allows for cross-checking information obtained through observation with other sources, such as interviews or documentation.

Knowledge Capture Methods: Brainstorming

- Allows a group of people to meet and freely express their thoughts, experiences, and problem-solving approaches without judgements → **Unstructured approach to generate ideas**.
- Ruled for conducting effective brainstorming sessions:
  - Pay attention to everyone's ideas without any criticism, rather combine/improve ideas.
  - Encourage participants to share real-life stories, anecdotes, or examples from their experiences that illustrate their tacit knowledge in action.
  - Prompt participants to elaborate on their ideas, providing context, examples, and explanations to make their tacit knowledge more comprehensible to others.
  - As participants share their tacit knowledge, have a scribe or note-taker to record the ideas and insights in a structured manner.
  - Appoint a skilled facilitator to guide the brainstorming process.

Knowledge Capture Methods: Delphi Method

- The Delphi method is a structured and iterative approach used to capture tacit knowledge from a group of experts. It's suitable for dealing with complex or ambiguous issues that require the collective insights of knowledgeable individuals.
  1. Experts are asked individually to provide detailed responses to specific questions based on their tacit knowledge and experiences. Responses are collected and compiled without revealing the identity of the experts.
  2. The responses from the first round are analyzed, summarized, and synthesized. Common themes, patterns, and areas of agreement or disagreement are identified. The summarized feedback is then shared with the experts.
  3. Experts are provided with the summarized feedback and asked to review their initial responses and, if necessary, revise or refine their answers.
  4. The process of analysis, feedback is repeated as needed until a consensus or convergence of opinions is reached among the experts.

Knowledge Capture Methods: Blackboarding

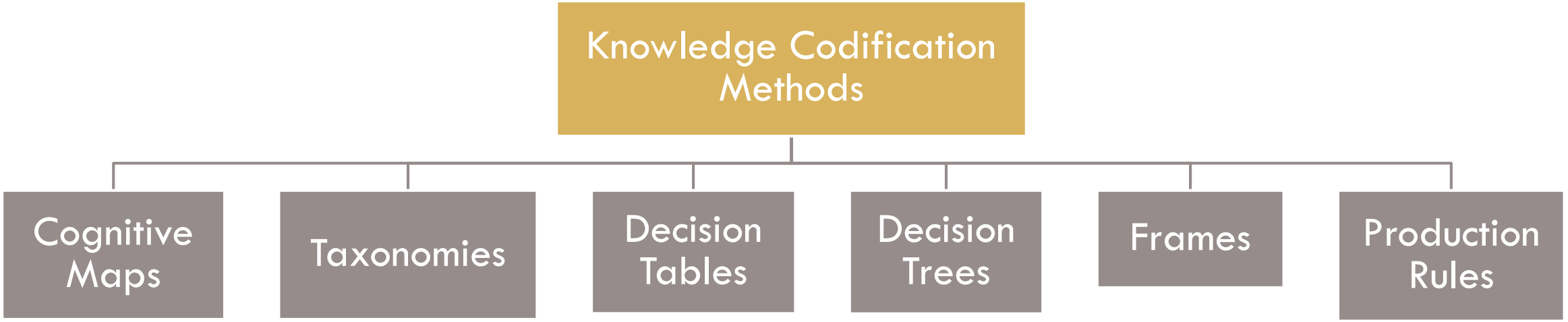
- Blackboarding is a collaborative method that visually represents complex problems or domains on a shared display, fostering the collective contribution of experts' tacit knowledge to solve problems or make decisions.
  1. Open discussion is encouraged among team members. Each expert contributes their tacit knowledge by discussing their insights, experiences, and potential solutions related to the problem.
  2. As the discussion progresses, experts can sketch diagrams, charts, or models on the blackboard to visually represent their ideas and insights. These visual elements help in making tacit knowledge more explicit.
  3. Team members revisit and refine the visual representation as new insights emerge during the discussion.
  4. Once the solution is reached, the outcome is captured, which includes the visual representation and any documented insights.

Knowledge Codification

What is Knowledge Codification?

- Knowledge codification is the process of converting tacit knowledge into explicit and structured forms, such as processes, databases, or manuals.
- Knowledge codification involves organizing and representing knowledge in, readable, comprehensive and useful formats.
- Codification makes knowledge more accessible, shareable, and transferable within organizations.
- Knowledge codification enhances organizational learning, decision-making, problem-solving, and innovation. It mitigates knowledge loss due to turnover.
- Challenges of knowledge codifications include ensuring their accuracy, readability and understandability, and relevance over time.
- Effective codification requires collaboration, feedback loops, and regular updates to keep knowledge repositories current and valuable.

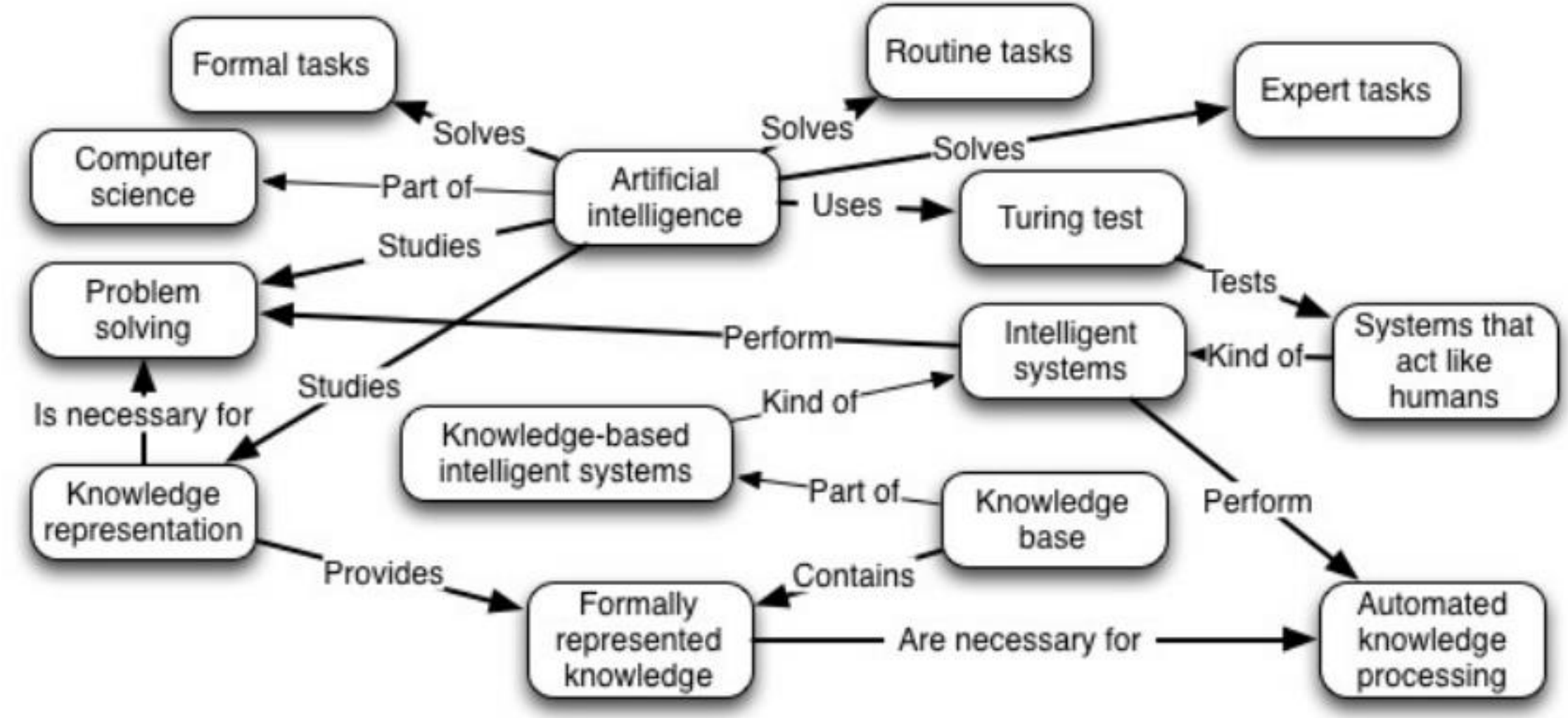
Knowledge Codification Techniques



Knowledge Codification Techniques: Cognitive Maps

- Graphical representations that depict the overall relationships between concepts or ideas. The nodes in a map represents the key concepts, and the links represent the interrelationships among the concepts.
- Provide a visual representation of complex knowledge structures and relationships within a domain. This visualization aids in understanding how different pieces of knowledge are interconnected.
- Helpful for problem-solving. They allow individuals to visually explore potential solutions and identify gaps or missing information.
- Can be used as a tool for validating knowledge. Experts and stakeholders can review the maps to ensure that the represented knowledge is accurate and up-to-date.

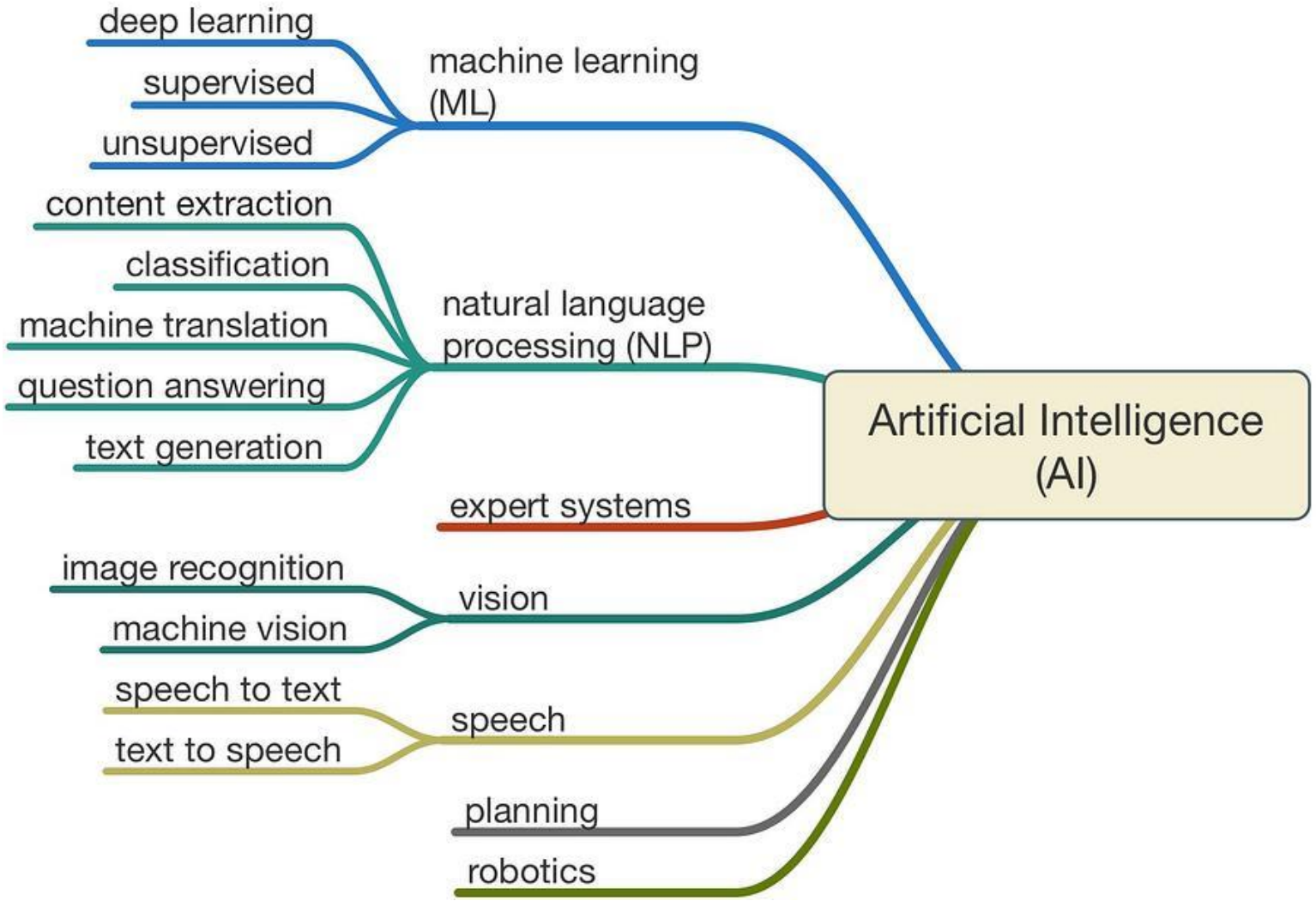
Knowledge Codification Techniques: Cognitive Maps Example (Strautmane 2014)



Knowledge Codification Techniques: Taxonomies

- Graphical and hierarchical structures or frameworks useful for classifying and categorizing information and knowledge.
- Provide a systematic way to organize and structure content where knowledge items can be categorized into specific categories based on their context, and relevance.
- Taxonomies make it easier to locate relevant knowledge, reducing search time and improving efficiency.
- Taxonomies help standardize the use of terminology and vocabulary within an organization. This consistency ensures that everyone uses the same terms and definitions, reducing confusion and improving communication.
- Taxonomies allow for cross-referencing knowledge items across different categories or topics. This helps in highlighting related content and promoting interdisciplinary knowledge exploration.
- Taxonomies are adaptable and can accommodate the growth of knowledge over time.

Knowledge Codification Techniques: Taxonomies Example



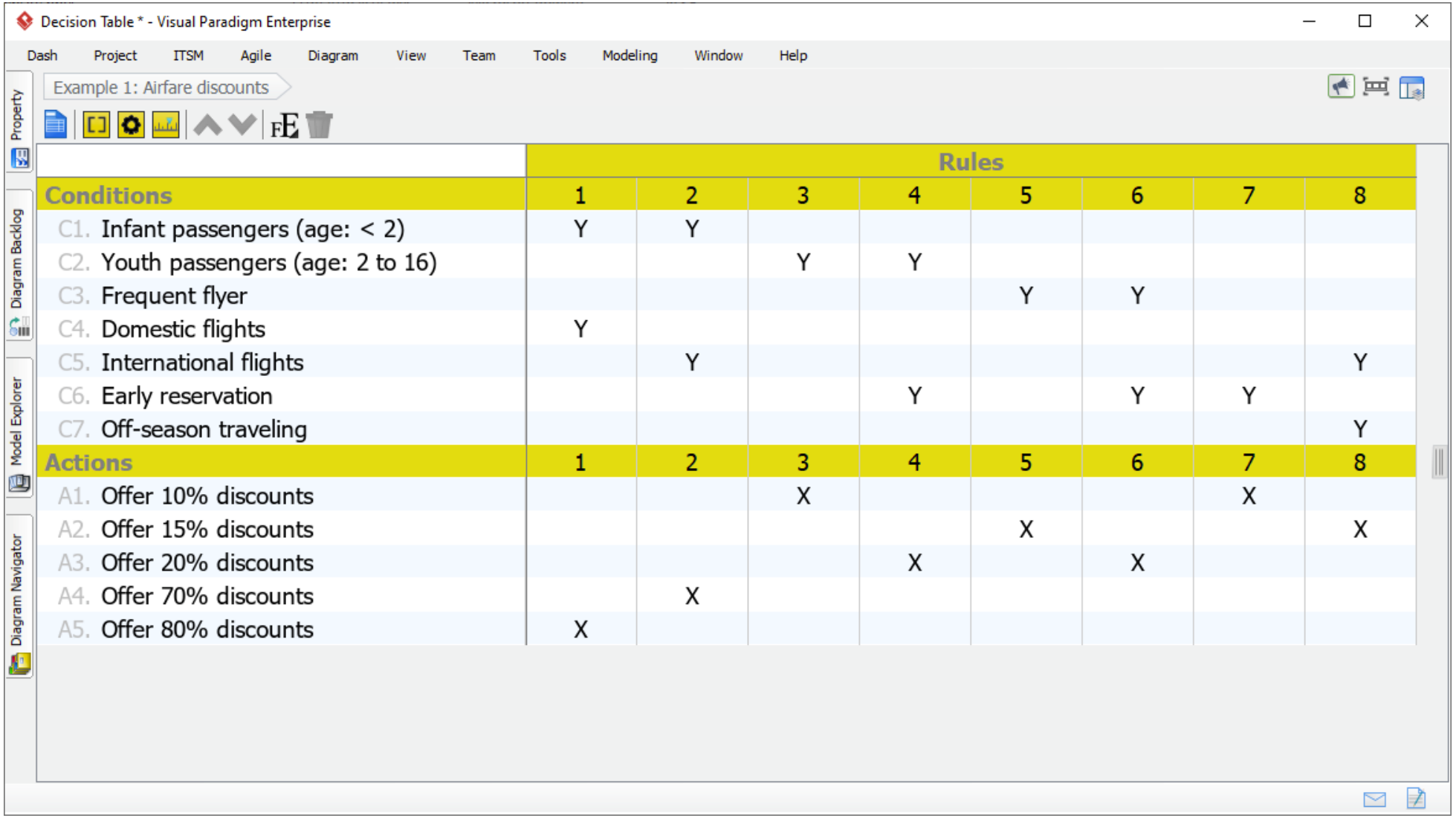
Knowledge Codification Techniques: Decision Tables

- Decision tables are useful means for codifying and organizing knowledge related to decision-making processes.
- Decision tables provide a structured format to represent decision logic. They consist of rows representing different combinations of conditions and columns representing possible decisions or actions. Each cell in the table contains the outcome or action associated with a specific combination of conditions.
- Decision tables serve as knowledge documentation tools, capturing the expertise of decision-makers. They document not only the decisions but also the rationale behind them and the conditions that influence them.
- Knowledge management systems use decision tables as a basis for automating decisions through decision support systems or business rules engines.

Knowledge Codification Techniques: Decision Tables

	Rules							
Conditions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Condition 1	Y	Y	Y	Y	N	N	N	N
Condition 2	Y	Y	N	N	Y	Y	N	N
Condition 3	Y	N	Y	N	Y	N	Y	N
Actions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Action 1	X		X					
Action 2							X	X
Action 3	X				X	X		
Action 4		X		X				

Knowledge Codification Techniques: Decision Tables Example

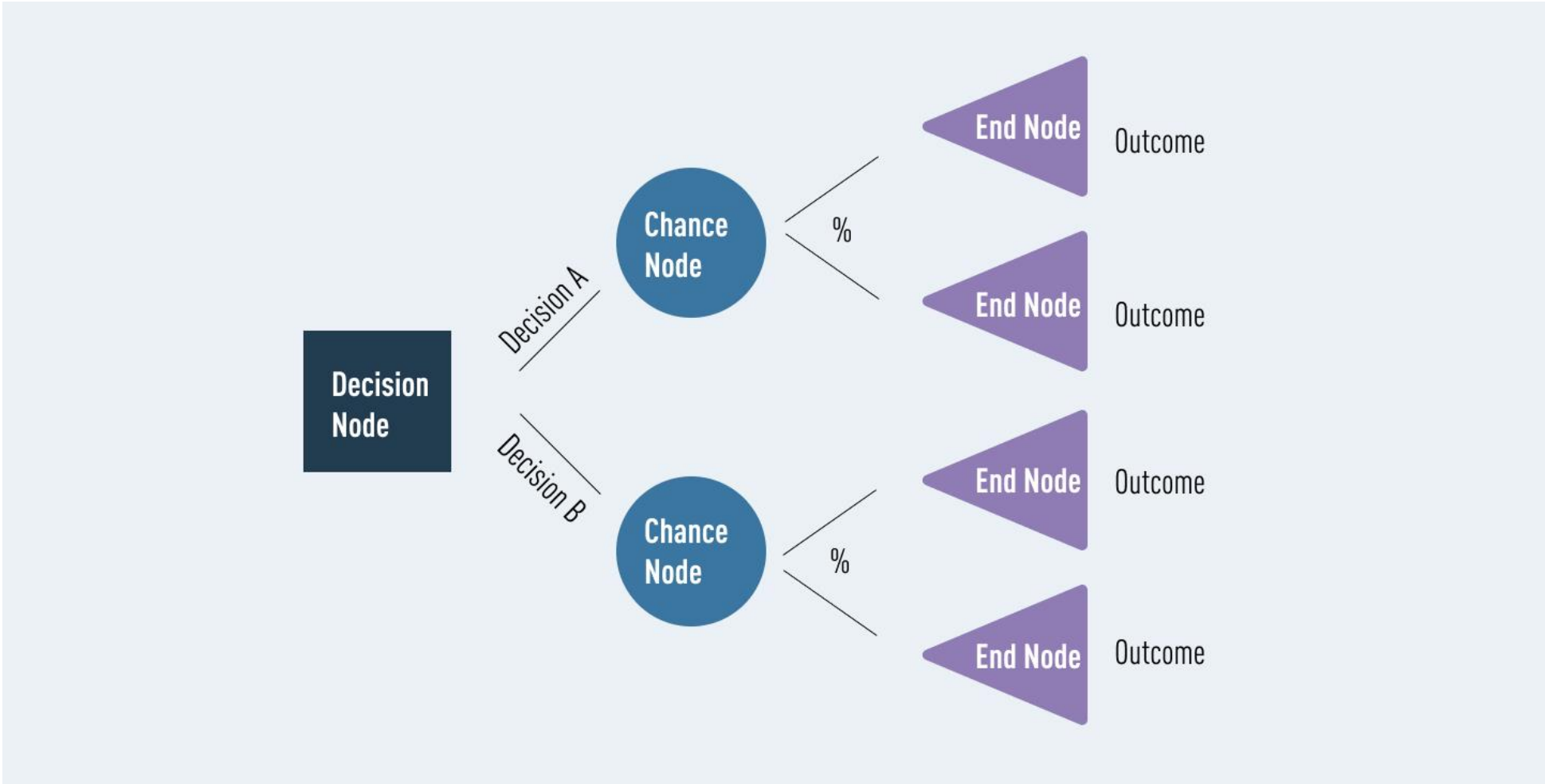


	Rules							
Conditions	1	2	3	4	5	6	7	8
C1. Infant passengers (age: < 2)	Y	Y						
C2. Youth passengers (age: 2 to 16)			Y	Y				
C3. Frequent flyer					Y	Y		
C4. Domestic flights	Y							
C5. International flights		Y						Y
C6. Early reservation				Y		Y	Y	
C7. Off-season traveling								Y
Actions	1	2	3	4	5	6	7	8
A1. Offer 10% discounts			X				X	
A2. Offer 15% discounts					X			X
A3. Offer 20% discounts				X		X		
A4. Offer 70% discounts		X						
A5. Offer 80% discounts	X							

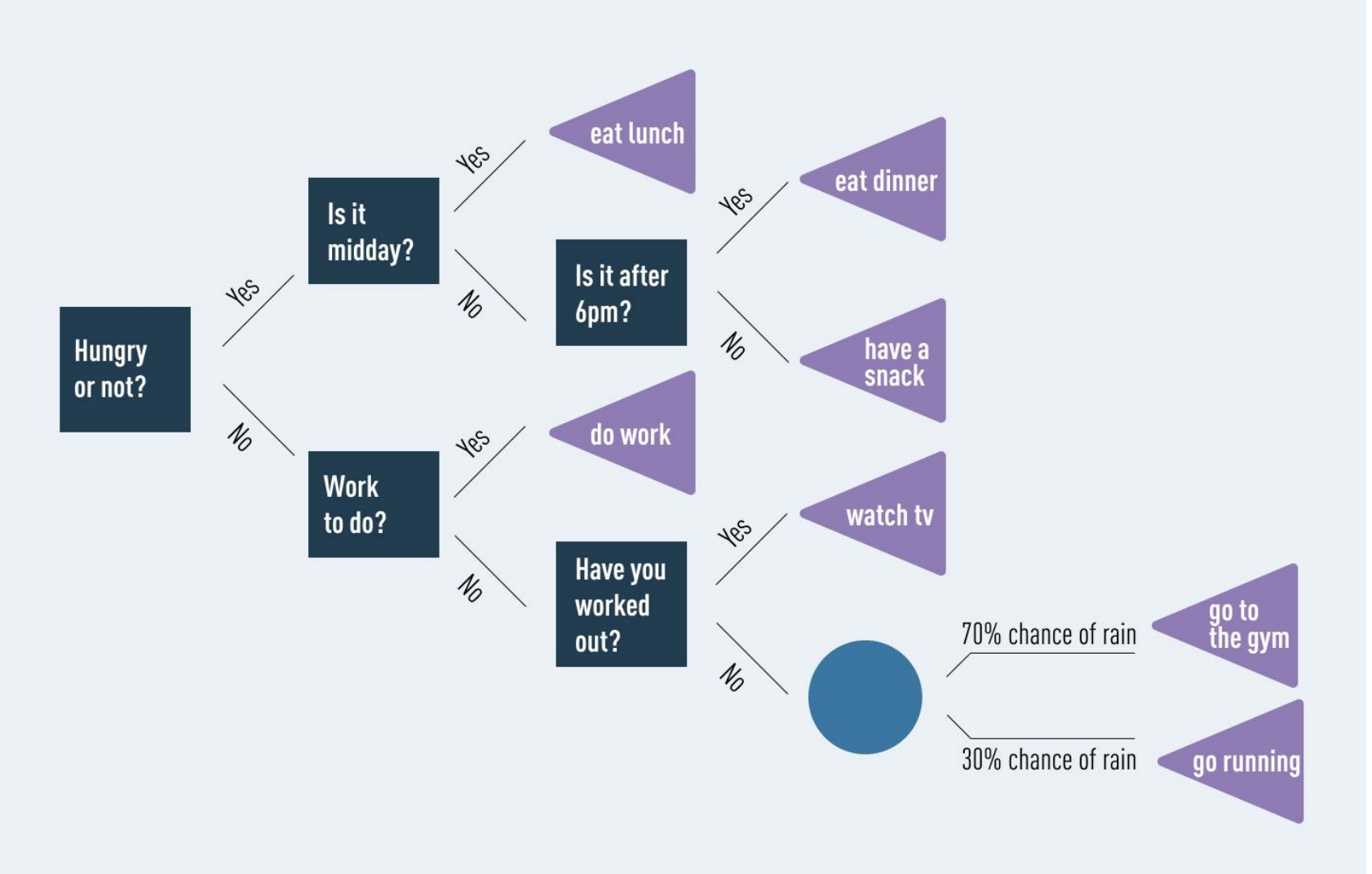
Knowledge Codification Techniques: Decision Trees

- Decision trees codify the decision-making logic and rules that experts follow in specific scenarios. They define the sequence of decisions, conditions, and actions that lead to particular outcomes or recommendations.
- Decision trees provide a structured and visual representation of knowledge by breaking down complex decision-making processes or knowledge domains into a series of decisions and outcomes. Each node in the tree represents a decision point or a condition.
- Decision trees can also be applied as problem-solving within KMS. Users can navigate decision trees to troubleshoot issues, diagnose problems, and arrive at solutions based on predefined knowledge.

Knowledge Codification Techniques: Decision Tables



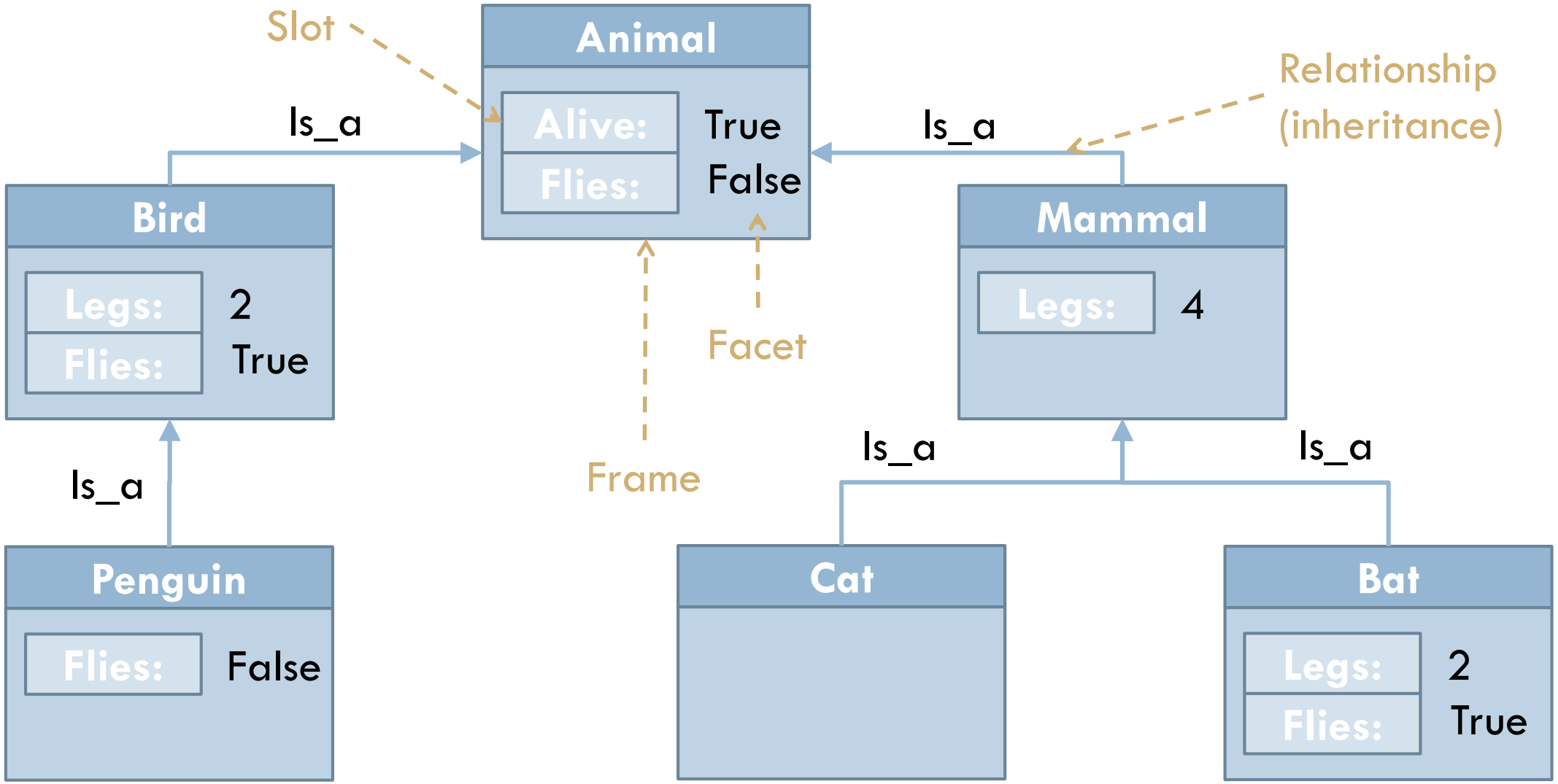
Knowledge Codification Techniques: Decision Tables Example



Knowledge Codification Techniques: Frames

- A single frame represent knowledge about a particular concept in one place where a collection of frames can capture and organize knowledge about different concepts in a hierarchical and structured manner.
- Similar to object oriented programming, frames are classes that define and represent various objects within a specific domain.
- A frame is defined as a collection of slots (attributes in OOP paradigm). Slots are used to store values (a.k.a. **facets**) where each slot describes a particular attribute.
- Frames can handle a combination of declarative (i.e., attributes) and operational knowledge (i.e., operations).
- Within a frame-based system, instances of concepts can be created. These instances represent specific occurrences or examples of the concept and inherit the attributes defined in the frame → When all the slots are filled, the frame is instantiated.

Knowledge Codification Techniques: Frames Example



Knowledge Codification Techniques: Production Rules

- Production rules encode knowledge in a structured format, typically in the form of **if-then** statements. These rules capture specific knowledge, facts, conditions, and actions.
- Production rules are used to codify decision-making knowledge. When a specific condition or set of conditions is met (the **if** part of the rule), the corresponding action (the **then** part of the rule) is executed.

IF Premise **THEN** Action

Knowledge Codification Techniques: Production Rules Example

- **IF** (at bus stop **AND** bus arrives) **THEN** (get into the bus)
- **IF** (on the bus **AND** paid **AND** empty seat) **THEN** (sit down)
- **IF** (on bus **AND** unpaid) **THEN** (pay charges)
- **IF** (bus arrives at destination) **THEN** (get down from the bus)