Part 1. Organization

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Intended audience: Cognitive Science Bachelor
Type of course: Seminar
Intended language: English
Time of sessions: Thu 4:00 pm - 6:00 pm
Room: 01/EZ04

Purpose and Course Objectives:
The purpose of this course is to discuss and evaluate some major difficulties and constraints for introducing a knowledge representation formalism for different applications. Classical examples of such frameworks are natural language, FOL, Prolog, semantic nets, frames, KL-ONE, formal concept analysis, channel theory, situation calculus, situation theory, channel theory, tense logic, description logics etc. The choice is dependent on what we want to model: temporal reasoning, spatial reasoning, structural description of objects, context change, reasoning about reasoning, classical logical inferences, non-classical logical inferences, planning etc. Dependent on the interests of the participants we will examine some important frameworks that can be used for representing knowledge.

Requirements in order to pass the course:
- Presentation
- 3 assignments
- Final (take-home) exam
- Attendance and active participation

Grades: Grades are assessed on the basis of the performance concerning the presentation, the assignments, and the final examination. The presentation should be a 45-60 minutes talk, in order to provide enough time for discussion.
Criteria that can be important for assessing the performance of the presentations are:

- General impression
- Clarity
- Enthusiasm
- Usage of media
- Professionalism
- Response to questions

Each assignment (including the final exam) must be solved within two weeks. Late submission is generally not accepted. Exceptions of this rule are possible. The purpose of the assignments is to review the topics discussed in class.

The final examination is a take-home exam that must be completed in two weeks.

Grades will be calculated as follows: 30% performance in the presentation, 40% assignments, 30% final exam.

Part 2. Tentative Schedule

1. Introduction

1.1. Introduction (10.04.2003).
- Organization
- Discussion of the tentative schedule
- Preferences of students
- What is knowledge?
- Properties of knowledge

Readings: –
Speaker: Kai-Uwe Kühnberger

- Some philosophical remarks
- Distinctions that are relevant for AI
- Some classical problems of knowledge
- Properties of knowledge

Readings: [Bi93], [Sc91], [Pu81].

Objectives of this session: We will discuss classical philosophical distinctions of theories of knowledge as well as distinctions more relevant for AI applications. Furthermore, we will consider some puzzles of knowledge about knowledge and start with some first frameworks.

Speaker: Kai-Uwe Kühnberger
1.3. **Meeting canceled (24.04.2003).**

1.4. **Holiday (01.05.2003).**

2. **The First Frameworks**

2.1. **The Classical Frameworks (08.05.2003).**
   - Semantic nets, frames, and KL-ONE
   - Relation between semantic nets and DAGs
   - The logic of frames
   - Ontologies
   - Problems

   **Readings:** [Bi93], [Mi75], [Sh76], [Lu90].

   **Objectives of this session:** We will introduce several frameworks that are important for AI. Furthermore, we will examine advantages and disadvantages of these frameworks as well as their expressive power.

   **Speaker:** NN (Seminar paper)

   » First assignment

2.2. **Logical frameworks I (15.05.2003).**
   - Motivation of modal logic and epistemic logic
   - Possible world semantics
   - Some facts about modal logic and epistemic logic
   - Applications in multi-agent systems

   **Readings:** [DaMo93], [Ch80].

   **Objectives of this session:** In this session, we will use a tutorial given at the IJCAI-93 (International Joint Conference of Artificial Intelligence) to get a flavor of modal logic and epistemic logic.

   **Speaker:** NN (Seminar Paper)

2.3. **Logical Frameworks II: Knowledge about Knowledge (22.05.2003).**
   - Puzzles
   - Scenarios
   - Modal logic representation

   **Reading:** [BaMoSo99]

   **Objectives of this session:** In this session, we will examine in-depth puzzles of knowledge that can occur in multi-agent systems.

   **Speaker:** NN (Seminar Paper)

   » First assignment is due
   » Second assignment

3. **The Problem of Analogical Reasoning**

3.1. **Holiday (29.05.2003).**
3.2. Analogies and Anti-unification (05.06.2003).

- Analogies, similes, metaphors...
- Anti-unification: What is it?
- Applications in naïve physics
- Discussion of metaphorical expressions
- Applying anti-unification to metaphors

Readings: [GuKuSc03], [Bu02], [In92].

Objectives of this session: Starting with different types of analogies occurring in intelligence tests, literary texts, naïve physics etc. we will examine the theory of anti-unification and its applications to selected problem spaces. Furthermore we will try to apply anti-unification to metaphorical expressions of natural language.

Speaker: Kai-Uwe Kühnberger

3.3. Holiday (12.06.2003).

4. The Problem of Non-monotonicity

4.1. Answer sets and the preference of rules (19.06.2003).

- Answer sets
- Default logic
- Semantics and fixed point constructions
- Examples

Readings: [BrEi99]

Objectives of this session: An introduction to answer sets, fixed point constructions, and the semantics of logical programming languages will be given.

Speaker: NN (Seminar paper).

☞ Second assignment is due

☞ Third assignment

4.2. Logic programming with preferences (26.06.2003).

- Preferences of rules
- Constructing different fixed points (Wang, Delgrande, Brewka)
- A comparison of the frameworks

Readings: [ScWa01].

Objectives of this session: Using techniques of extended logic programming, default logic, and fixed points constructions, we will compare certain accounts towards a modeling of non-monotonic reasoning.

Speaker: NN (Seminar paper).
5. Selected Topics

5.1. Representing the flow of information I: Channels (03.07.2003).

- The crucial ideas of channel theory
- Classifications, infomorphisms, and coproducts
- Dynamics of information flow
- Applications

Readings: [BaSe97].

Objectives of this session: We will introduce the crucial ideas of a dynamic framework that enables us to model a variety of problems. The theory in question is called channel theory. It provides a framework that give a conceptually sound approach towards information flow.

Speaker: NN (Seminar Paper)

⇒ Final examination
⇒ Third assignment is due

5.2. Representing the flow of information II: Applications (10.07.2003).

- Dynamic changes of perspectives
- Modeling inferences
- Granularity

Readings: [BaSe97].

Objectives of this session: We will apply channel theory to particular domains perennially causing problems for classical accounts.

Speaker: NN (Seminar paper).

5.3. Final Discussion (17.07.2003).

- Conclusions

Readings: –

Speaker: Plenum discussion

⇒ Final examination is due

References


Knowledge Representation in AI with tutorial and examples on HTML, CSS, JavaScript, XHTML, Java, .Net, PHP, C, C++, Python, JSP, Spring, Bootstrap, jQuery, Interview Questions etc. Represenational Adequacy: It is the ability of the system to represent all kinds of knowledge needed in a specific domain. Inferential Adequacy: It is the ability of a knowledge representation system to manipulate the current stored knowledge so that newly gained knowledge could be added. Types of Knowledge Representation. Knowledge can be represented in different ways. The structuring of knowledge and how designers might view it, as well as the type of structures used internally are considered. Different knowledge representation techniques are. a. Logic. b. Semantic Network. It is a knowledge representation technique which consists of basic concepts and the relationship between them. As the name indicates, it tries to capture the concepts about the events and represents them in the form of a graph. Representing Knowledge Using Rules. Procedural Versus Declarative Knowledge, Forward Reasoning, 4. Backward Reasoning. Symbolic Reasoning, Under Uncertainty Artificial Neural Networks and Genetic Algorithms. 3. Neural Network Representation, Appropriate Problems for. Neural Network Learning, Perceptron’s, Multilayer Networks. Hours 04.