Dynamic Epistemic Logic

Study Notes

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Do not distribute, please send this link: https://github.com/frehburg/mol_DEL_notes

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1. Prompt

Prompt for generating summaries

Create a summary of the attached slides including the most important intuition, all mathematical formulas, relevant examples, and theorems, but no proofs. Pay special attention to the provided examples, their continuations and modifications.

Be concise and technical using expert vocabulary. Explain in a suitable manner for a master of Logic student familiar with the relevant background but unfamiliar with the discussed material as of yet. Write the summary in typst. The slides are attached. Only focus on content and leave out organizational information about the course. I am pasting all of this into my typst document where each lecture is a level two heading e.g. == Lecture 1, so subchapters have to be at the correct level, at least three e.g. === Core Intuitions and Definitions.

Important: Wrap the generated typst syntax summary in """ to make it copyable

Notable features of typst syntax:
1. if there is more than one letter in a name in typst math block then it needs to be wrapped in "".
2. to make text bold, wrap it in singular stars and to make it italic wrap it in underscores
3. If you are more used to different typesetting languages, typst always uses () as parentheses and only uses {} for set notation

Style guide:
1. do not include and [cite: x] in your output
2. I have defined custom functions to represent definitions, theorems ("theorem"), proofs ("proof"), examples ("example"), intuitions ("intuition"), warnings to watch out ("attention"), questions ("question") and calls to remember ("remember").
   - To define a new concept, call `#def("Name of Concept")[Definition body]`
   - For all others call `#box(title: "Title", style: "style-name")[Box body]`
   - Each box generates a tag @def-concept-name-hyphenated. Refer to any concept you reference back to always <def-concept-name-hyphenated>

2. Week 1

Session 2-1 (Lecture): Introduction: Motivation, Main Themes, Epistemic Puzzles

> **☰ Example: Multi-Agent Systems**
>
> 1. **Computation**: a network of communicating computers (e.g., the internet)
> 2. **Games**: players in a game (e.g., chess or poker)
> 3. **AI**: a team of robots exploring their environment and interacting with each other
> 4. **Cryptographic Communication**: agents ("principals") using a cryptographic protocol to communicate in private
> 5. **Economics**: transactions in a market
> 6. **Society**: social activities
> 7. **Politics**: diplomacy, war
> 8. **Science**: a community of scientists, engaged in creating theories about nature, making observations and performing experiments to test their theories

> **Def 1** (*Properties of Multi-Agent Systems*):
> - *dynamic*: Agents perform *actions* which change the system (via interaction)
> - *informational*: Agents acquire, store, process, and exchange *information* about each other and the environment

- *Evolving knowledge*: The knowledge an agent has may *change* in time, due to their or other players' actions
- Certain actions increase information
- *General rule*: players try to minimize their uncertainty and increase their knowledge.

> **Def 2** (*Knowledge*): Truthful information.

> **Def 3** (*Justified Belief*): Information that is plausible, well-justified, probable, but still possibly false.

> **Def 4** (*Belief Revision*): A sustained, dynamic, self-correcting, truth-taking action. True knowledge can only be recovered by effort.

> **Motto of Dynamic Epistemic Logic**
>
> *"The wise sees action and knowledge as one. They see truly."*
>
> (Bhagavad Gita, part of the epic poem Mahabharata)

> **Def 5** (*Uncertainty*): *Uncertainty* is a corollary of Knowledge (Def 2) or "imperfect information".

> **Def 6** (*Game of imperfect information*): A *game of imperfect information* conceals some information about other agents and or the environment from the agent: they only have a partial view of the situation.

- An agent may be *uncertain* (Def 5) about the real situation at a given time: they cannot *distinguish* between possible outcomes

Wrong Beliefs: Agents…
- … may acquire false "certainty"
- … causing them to "know" things that are not true
- Wrong beliefs are indistinguishable from true beliefs for an agent once they have become "certain" of it

> **Def 7** (*Distributed Knowledge*):

> **Ⅎ Theorem: Test theorem**
>
> If conditions a, b, c hold, then d.

> **Ⅎ Proof: Test theorem**
>
> Assume a, b, c. If you take an arbitrary e, it is clear that from a, c, e it follows that f. Taken together, b, f let us conclude d. □

Session 2-2 (Lecture): Main Themes, Puzzles, and Paradoxes Continued

Session 2-3 (Lecture): Single-Agent Epistemic-Doxastic Logics: Kripke Models

3. Week 2

Session 3-1 (Lecture): Multi-agent Models and Public Announcement Logic (PAL)

Session 3-2 (Lecture): PAL Continued

Session 3-3 (Lecture): Does this one even exist??

4. Week 3

Session 4-1 (Lecture): "Learnability" and "Knowability"

Session 4-2 (Lecture): Tutorial 1

Session 4-3 (Lecture): The problem of belief revision

5. Week 4

Session 5-1 (Lecture):

Session 5-2 (Lecture):

Session 5-3 (Lecture):

6. Week 5

Session 6-1 (Lecture):

Session 6-2 (Lecture):

Session 6-3 (Lecture):

7. Week 6

Session 7-1 (Lecture):

Session 7-2 (Lecture):

Session 7-3 (Lecture):

8. Week 7

Session 8-1 (Lecture):

Session 8-2 (Lecture):

Session 8-3 (Lecture):

9. Week 8

Session 9-1 (Lecture):

Session 9-2 (Lecture):

Session 9-3 (Lecture):