

Course Outline for NASSLLI'03

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1 Description:

This course is addressed both to students interested in the informational aspects of the semantics and pragmatics of dialogues in natural language, and to the ones interested in the dynamics of knowledge, beliefs and rationality in game theory and in multi-agent systems. It explores applications of dynamic-epistemic logic to the analysis of information exchanges, of the role of beliefs and belief-changing actions, and of rationality in such dialogue games.

As such, the course may be considered as a continuation of the course on *Dynamic Epistemic Logic* taught by Larry Moss at NASSLLI'02, dealing with an extension of the logics presented there, together with applications to dialogue games and puzzles. But the course is nevertheless introductory, being mostly self-contained, and requiring only some familiarity with the standard modal logic formalism and semantics (although surely some prior contact with dynamic logic or Hoare logic would be very helpful).

I present a general setting for logics of "epistemic programs", and isolate a subfragment dealing with *communication actions*. These include *announcements* of different types (public or private, secure or not from interception by outsiders etc.), *queries* of the corresponding types, complex *dialogues*, *communication strategies* etc. I analyze some examples, discuss various desirable properties of dialogues (normalcy, responsiveness, publicity, appropriateness of questions) and define interesting types of dialogue strategies which break these assumptions, but which still prove to be "useful" in "solving the puzzle" (or "winning the information game"): rhetorical questions, cheating questions, Socratic dialogues (such as in the Muddy Children Puzzle), cheating by impersonation (such as in the so-called "man-in-the-middle" attack against cryptographic protocols), or simply announcements which pre-empt any suitable answer of the opponent by making

"unlearnable-iff-true" predictions (such as in the famous Surprise Examination Paradox).

Next, I analyze more generally the "usefulness" of a dialogue strategy, in terms of Nash equilibria of the corresponding game. This is an idea coming from the work of Robert van Rooij on the pragmatics of dialogues and on the usefulness of questions, but here is a *formal logical account* which incorporates this idea. I define the main game-theoretic notions ("best response", "Nash equilibrium") needed here, and I show how to characterize them for dialogue games using our logic, and to check that the above unorthodox communication strategies are indeed "useful" in this sense in the corresponding games.