Agents as sources of uncertainty

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Collaborators and works

- George Klir (Hierarchical Uncertainty Methatheory based upon modal logic)
- Boris Kovalerchuk (Agent Uncertainty Theory AUT)
- Chris Hinde (Active Set theory)
- Ngoc Thanh Nguyen (Structures,Conflicts and Consensus)

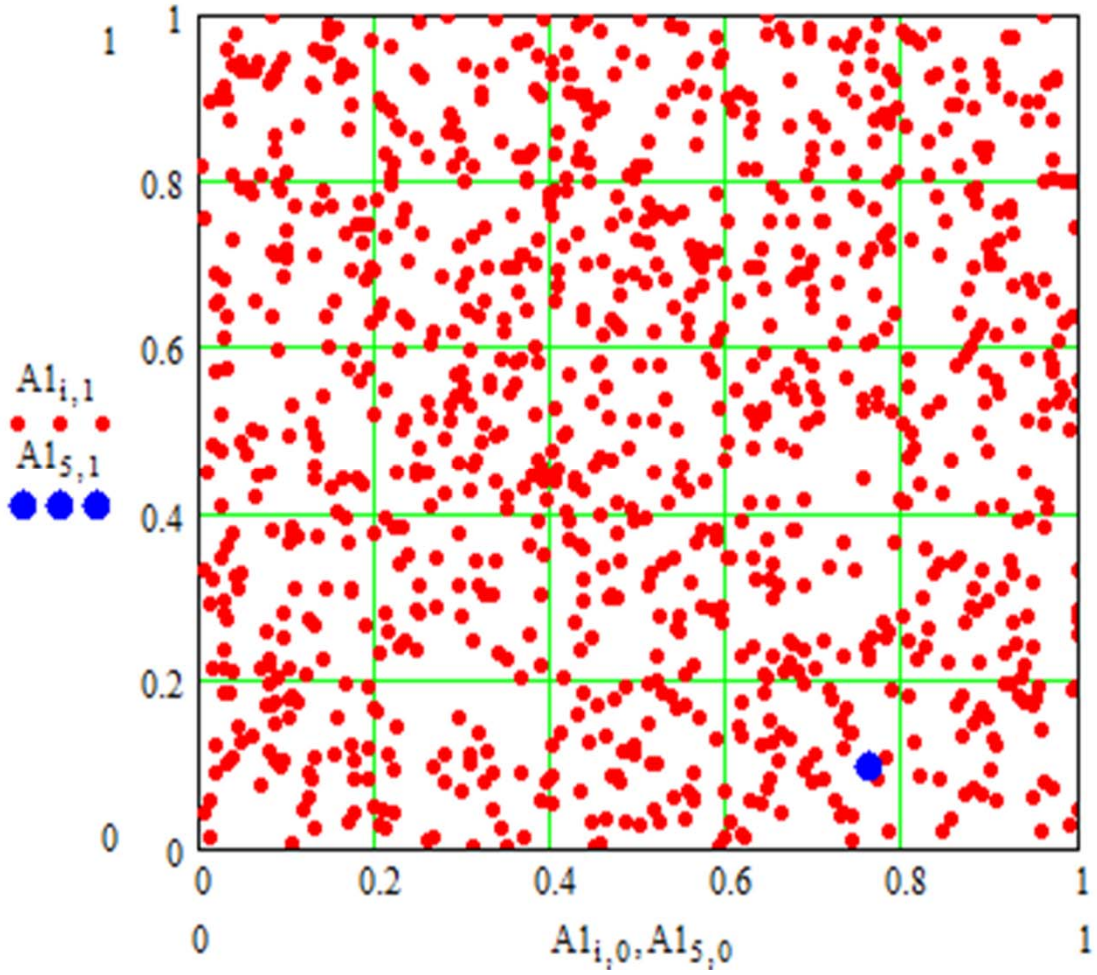
Epistemic Logic and Agents

- In epistemic Logic a value of a formula p at a world w can be linked to a set of all agents establishing p as true at w (Fitting)
- In modal logic we associate a set of modal logic operators with an agent which gives the logic value to the expression p for a set of worlds.

Uncertainty in logic is impossible

- Logic is the main instrument for any reasoning process.
- So any uncertainty stops human reasoning.
- How can we control and use uncertainty to solve human problems?
- Some solutions can be obtained by the fuzzy set theory , the rough set theory and other theories that deal with uncertainty.

Uncertainty in probability for red objects (copies of the blue object)



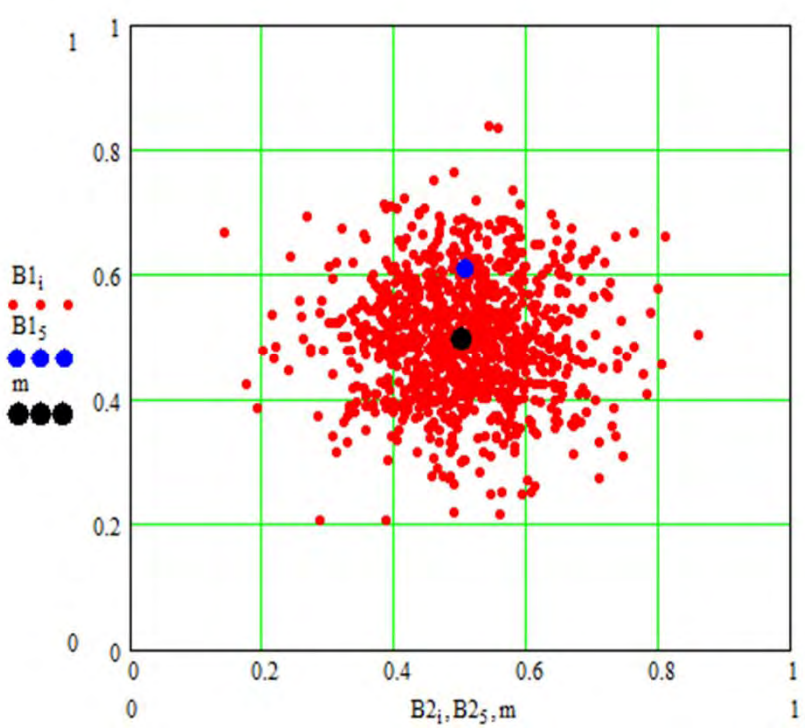
From local uncertainty (copies) to global certainty (number of copies)

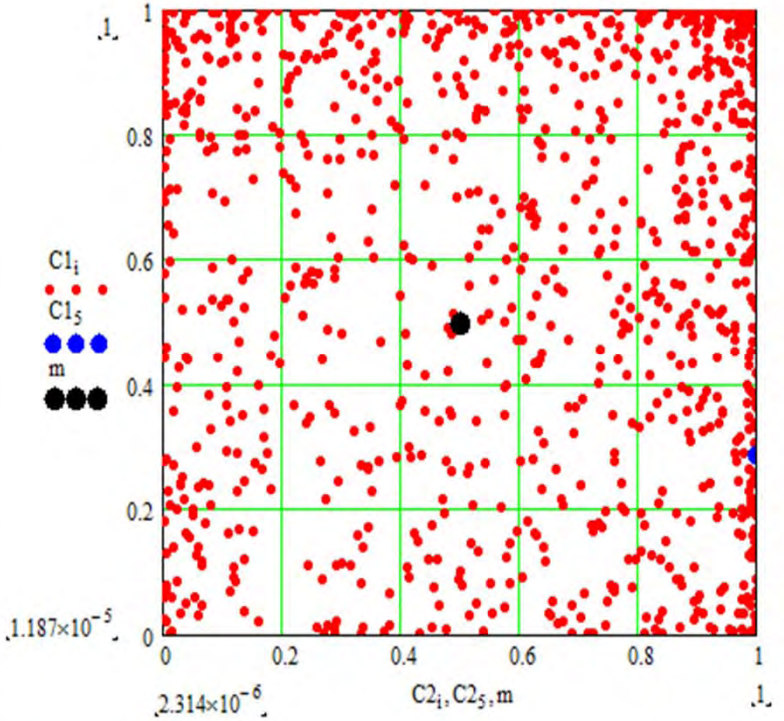
- In the classical probability the same object can have many copies with uncertainty. Here copies are not equal, but similar because we have no information how copies are different.
- Let all the objects be copies of one prototype object in a given state space. We can permute the copies without any change in the information. So we are interested not in the object itself, but in the number of copies in given states.

Agent changes the space of the state reference

- Agent can change the reference of the state space and can move to a uniform distribution from a non uniform ditribution and reverse.
- AGENT’s action is to change the reference and the representation of the probability distri bution

Agent semantic action:
from non-homogeneous to homogeneous





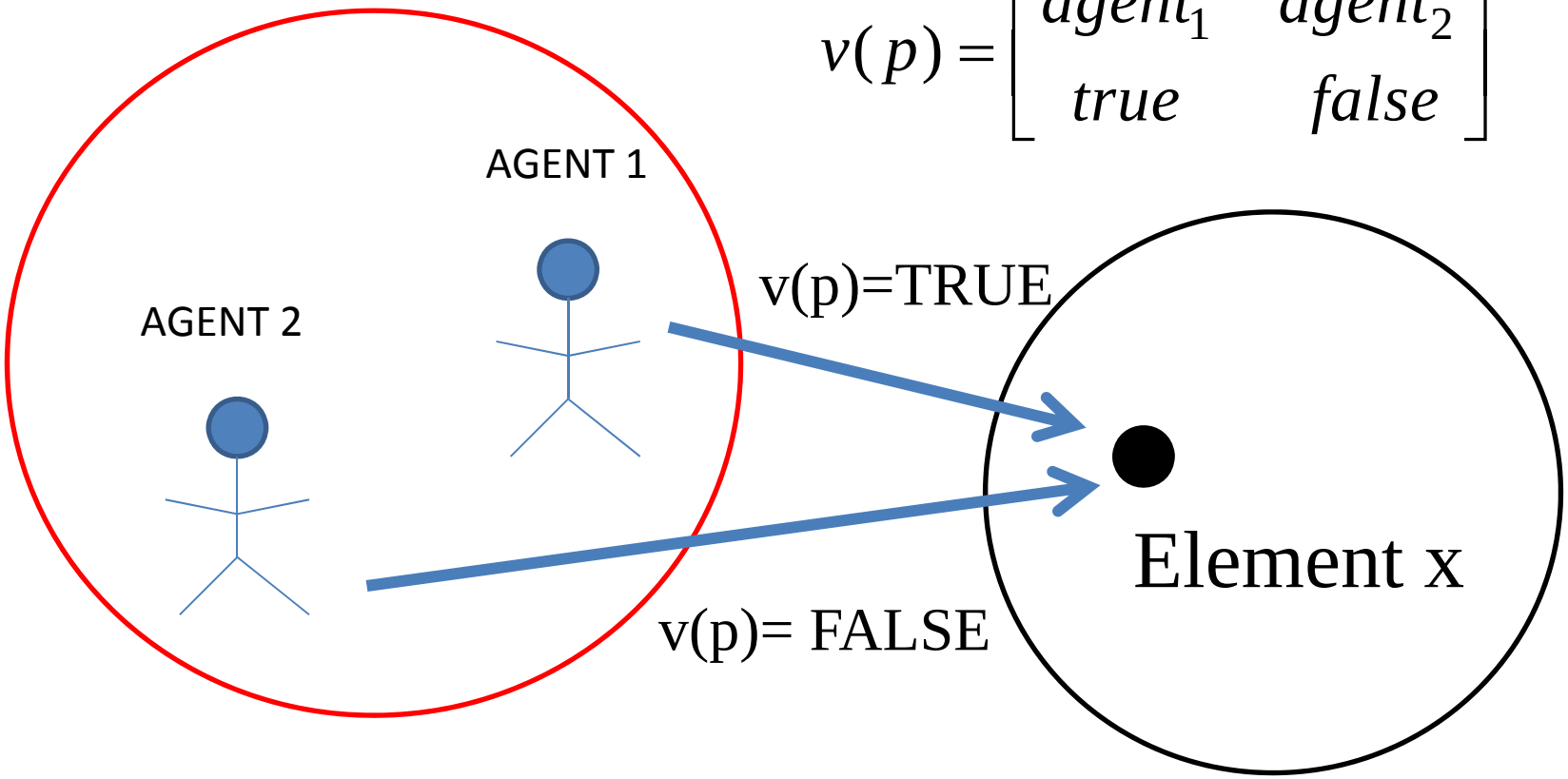
$$C1_i := \exp\left[-\left(\frac{B1_i - m}{d}\right)^2\right] \qquad C2_i := \exp\left[-\left(\frac{B2_i - m}{d}\right)^2\right]$$

Agents: from local semantic uncertainty to global semantic certainty

- How is it possible to have copies of the logic value TRUE for the same proposition p? The classical logic has only one TRUE.
- But if TRUE value is the agent's evaluation we can have different types of TRUE for different states of agents. All the different types of TRUE are all similar, but not equal.
- This is a situation with POSSIBLE SEMANTIC CONFLICTS because any agent is free to say that p is true or false.

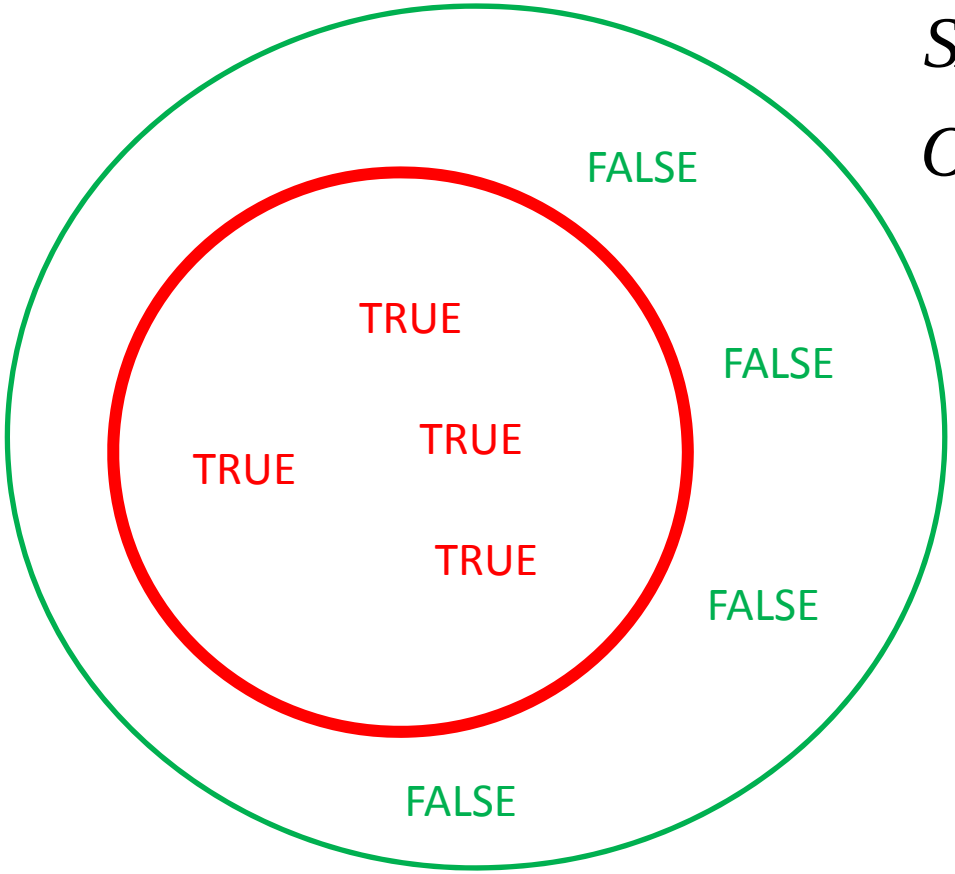
p = “x belongs to A “

$$v(p) = \begin{bmatrix} agent_1 & agent_2 \\ true & false \end{bmatrix}$$



ACTIVE SET OF AGENTS AND CONFLICT

In active set TRUE and FALSE are not objects, but evaluations by AGENTS



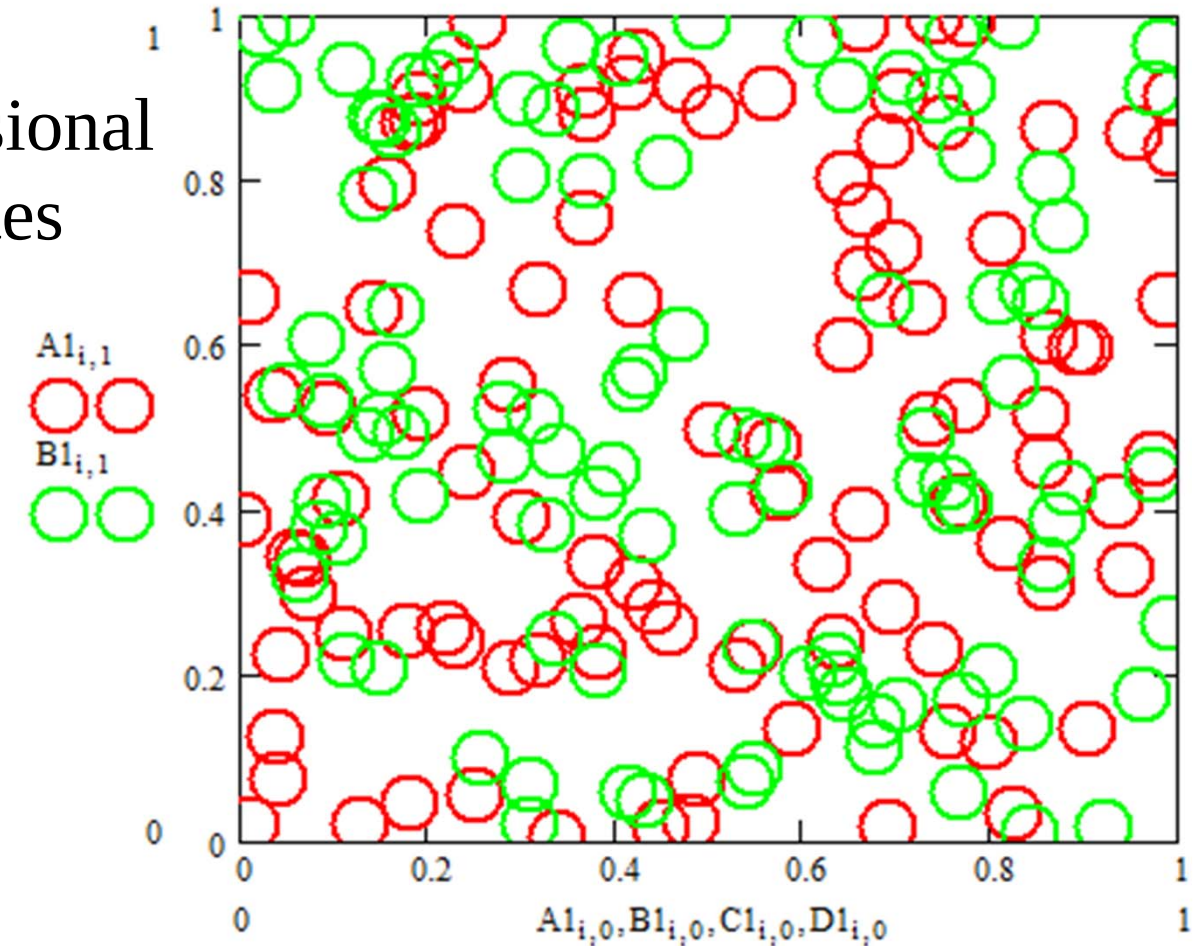
SEMANTIC FREE AGENTS

OR ACTIVE SET OF AGENTS

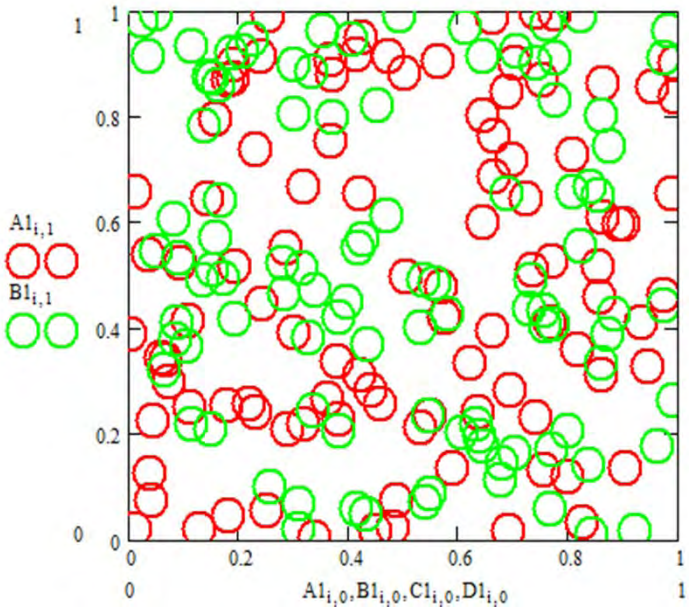
$$v(p)=\begin{bmatrix} a_1 & a_2 & a_3 & a_4 & a_5 & a_6 & a_7 & a_8 \\ True & True & False & False & True & False & True & False \end{bmatrix}$$

200 AGENTS 100 true (red) and 100 false (green) for the same “p”

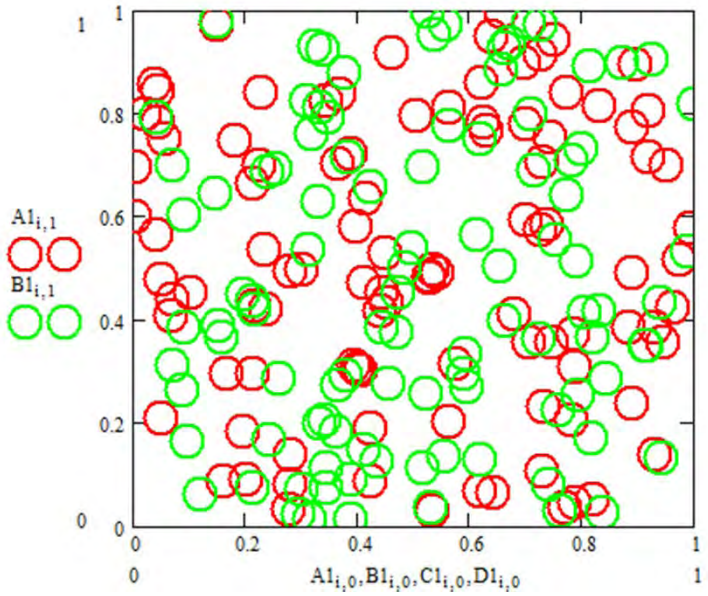
Two-dimensional space of states for agents



Logic operation OR between active sets



OR



Paradoxes create semantic uncertainty

- Suppose there is a town with just one barber, who is a male. In this town, every man keeps himself clean-shaven, and he does so by doing exactly one of two things:
- Shaving himself, or going to the barber. Another way to state this is: The barber shaves only those men in town who do not shave themselves.

Paradox as semantic uncertainty

- Pose the paradoxical question:
- **Who shaves the barber?**
- If the barber **does shave himself, then the barber (himself)** ***must not shave himself.***
- If the barber **does not shave himself, then he (the barber)** ***must shave himself.***
- ***The sentence "must shave himself" is TRUE and FALSE from two different points of view.***

Conflict as a paradox and consensus as a solution of the paradox

- If two or more agents are in a semantic conflict, we cannot decide if a sentence is TRUE or FALSE as in the paradox.
- Now we can solve the paradox and the semantic conflict
  - by introducing many-valued logic computation and
  - by using many-valued logic to obtain the consensus.
- We can also generate special fuzzy logic with particular logic operations with agents.