



Introducing Dialogue-Act Framework for Multi-Agent LLM Negotiation



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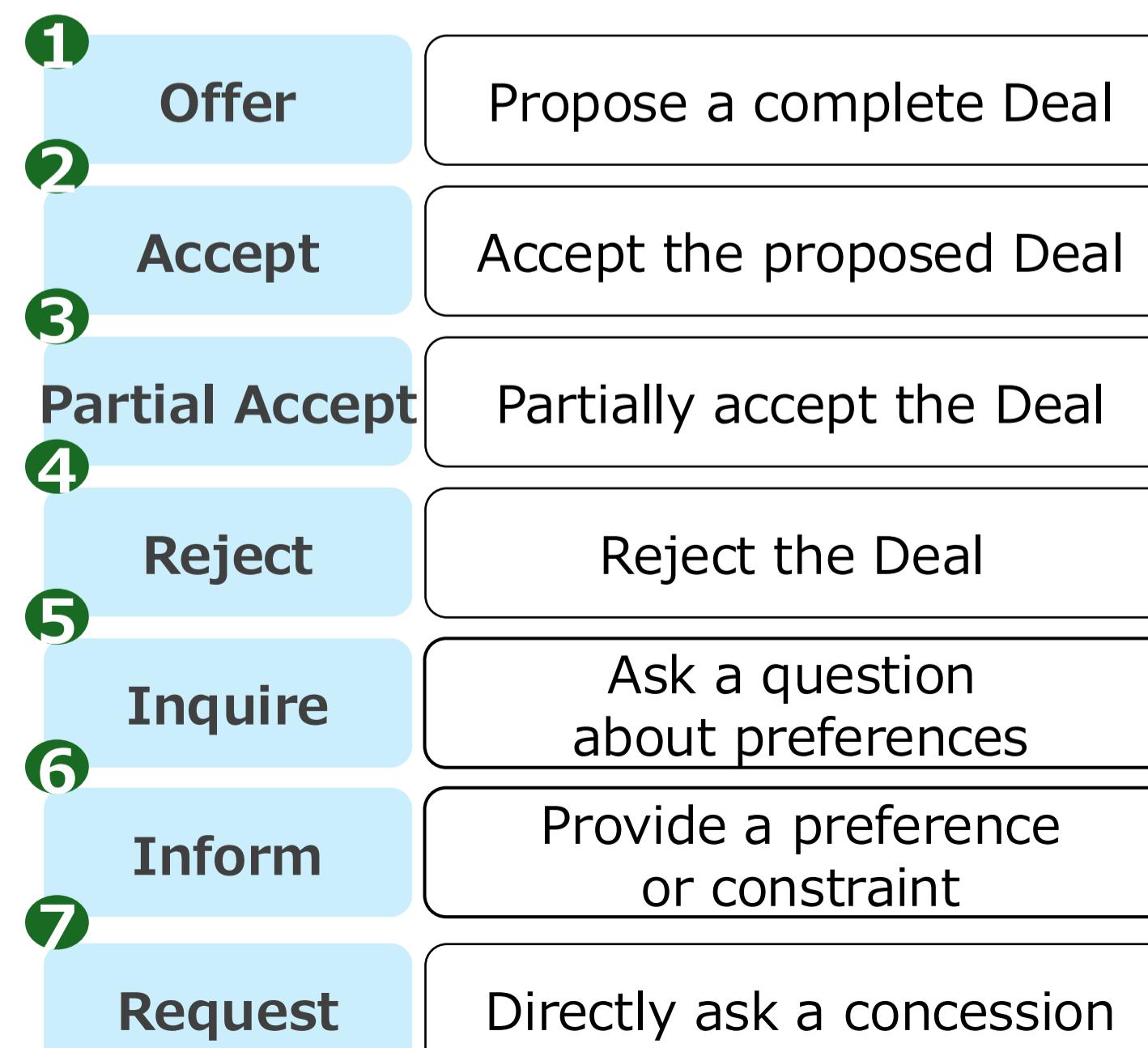
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Background & Motivation

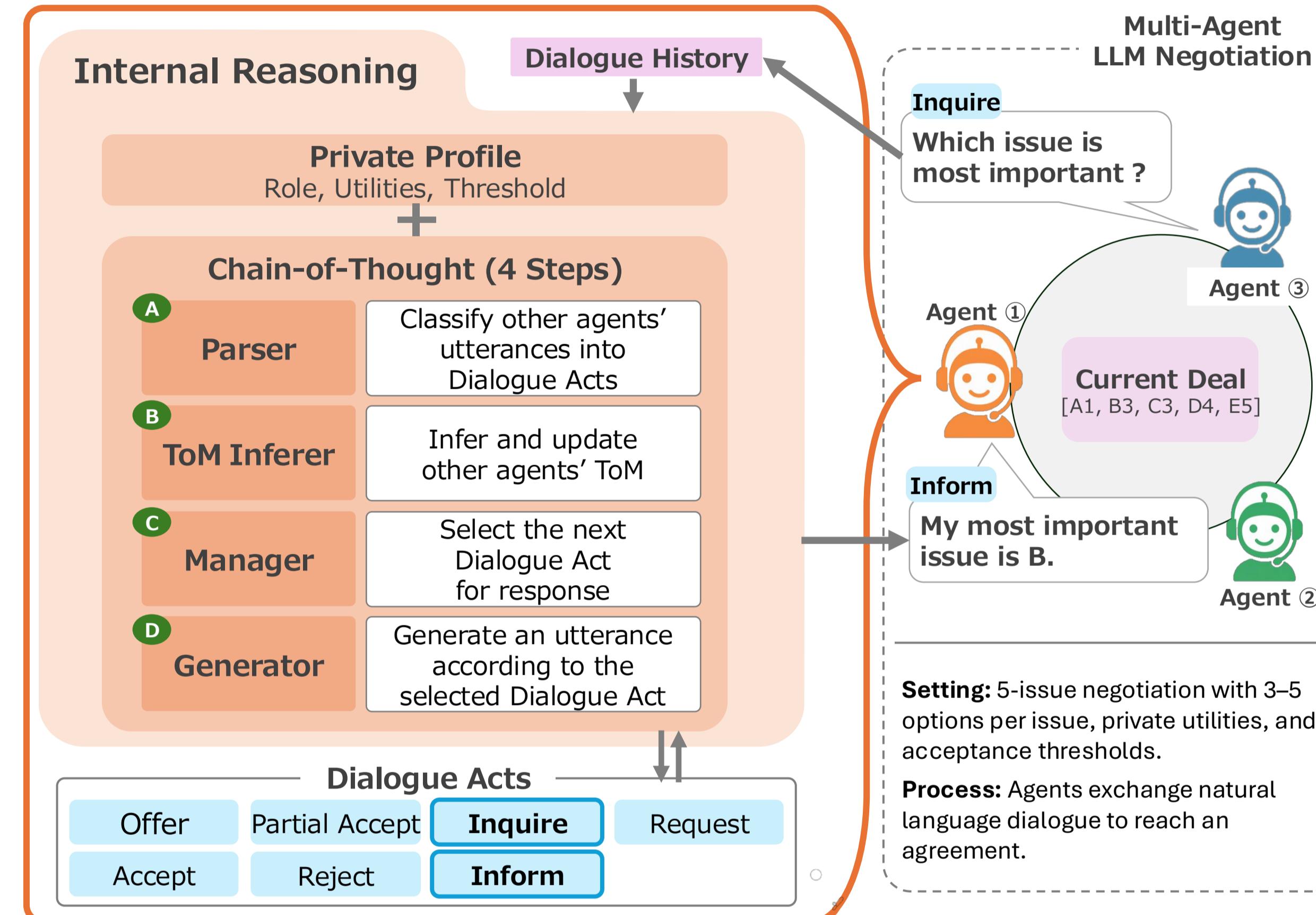
- **Negotiation** is a challenging testbed for **multi-agent coordination**.
- Resolving preference conflicts requires strategic reasoning and **Theory of Mind**.
- We propose a Dialogue-Act framework that enables **explicit preference exchange** in natural language.
- **Big picture:** enabling human-like negotiation via belief-guided language.

Dialogue Acts

- Dialogue Acts make **negotiation intent** explicit during interaction.
- Utterances are structured into acts such as Offer, Inquire, and Inform.
- This enables explicit **preference exchange** and reasoning.

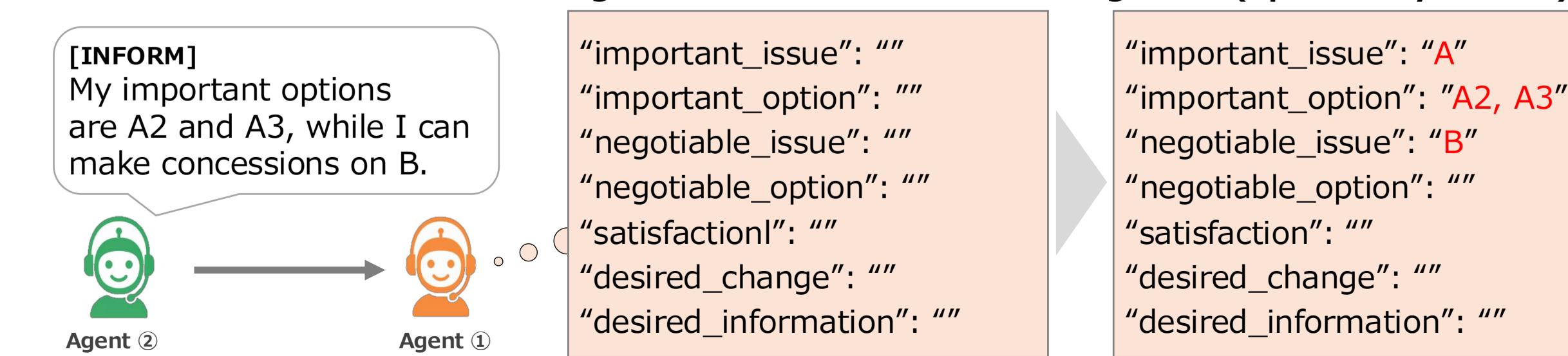


Framework Overview



ToM State & Updates

- Agents maintain an explicit, JSON-like **first-order ToM state** during internal reasoning.
- The state is **incrementally updated** from others' utterances (especially Inform and Request) and referenced during action selection.



- Agents generate their next response to others via a **4-step CoT reasoning**.
- A) Parser:** Converts an utterance into a Dialogue Act.
- B) ToM Inferer:** Updates ToM beliefs about others.
- C) Manager:** Chooses the next Dialogue Act based on ToM beliefs and profile.
- D) Generator:** Produces natural language output for the selected act.

Results

- Natural language interaction enables more **efficient agreement formation** compared to offer-only interaction.



Future Directions

- Improving **agreement quality** (e.g., Pareto optimality, Nash product).
- **Higher-order ToM** for modeling others' reasoning, enabling more deliberate negotiation actions (with cost concerns).
- **Strategic use of ToM** for guiding action selection.