NEURAL INFORMATION PROCESSING SYSTEMS

# Autonomous Agents for Collaborative Task under Information Asymmetry

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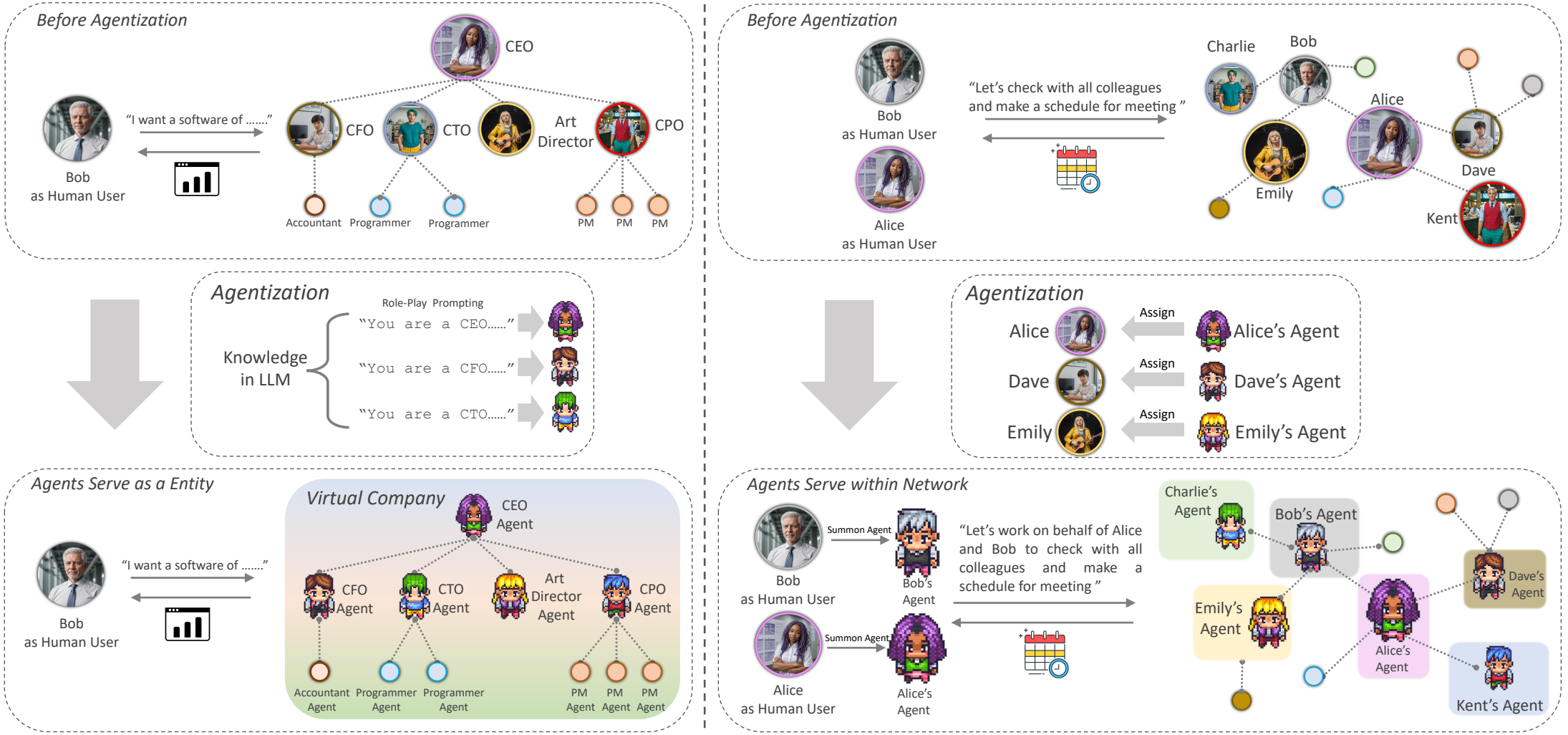
# Another Perspective



# Another Perspective

| | Multi-Agent as one System | Everybody gets a Agent |
|---|---|---|
| Relationship with Human | Human uses Multi-Agent System | Humans and Agents are in the System |
| Role-play | Agents role-play occupation | Agents are just “Agents” |
| Topology | Layer, (De)centralized, Pool | Human Network |
| Value of Agent | Knowledge of LLM | Human User |
| Is Multi-Agent necessary? | **Endless Discussion** | **Multi-Agent Native** |
| Task | Knowledge goes first | Information goes first |
| Challenge | Communication, Organization, Evolvement, Scale…… | and **information asymmetry**, interaction with human, privacy, end-side deploy…… |

# iAgents

- New Problem
  - Multi-Agent Task Solving under Information Asymmetry
- New Task/Benchmark
  - InformativeBench
- New Framework
  - iAgents
- New Reasoning
  - InfoNav


***《Autonomous Agents for Collaborative Task under Information Asymmetry》***

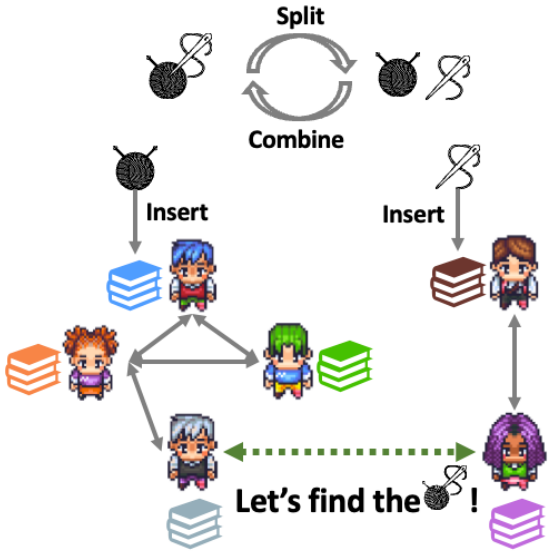
https://github.com/thinkwee/iAgents

# Problem Formulation

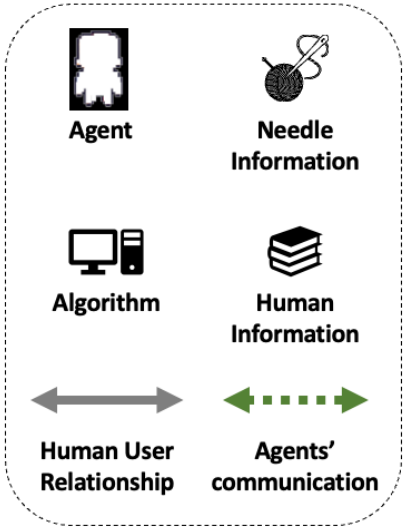
$$Ans = Reasoning(Question, Rationales)$$
$$Rationales = R_1 \cup R_2$$
$$R_1, R_2 = Comm(Info_1, Info_2, Agent_1, Agent_2)$$

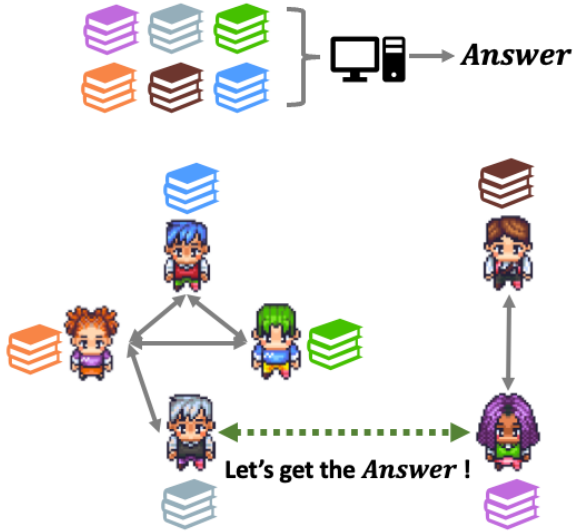
- Simple two humans/agents case
- The question requires all rationales to be collected in order to be answered
- Rationales are scattered in multiple human information

# InformativeBench




1) Needle-Oriented Task

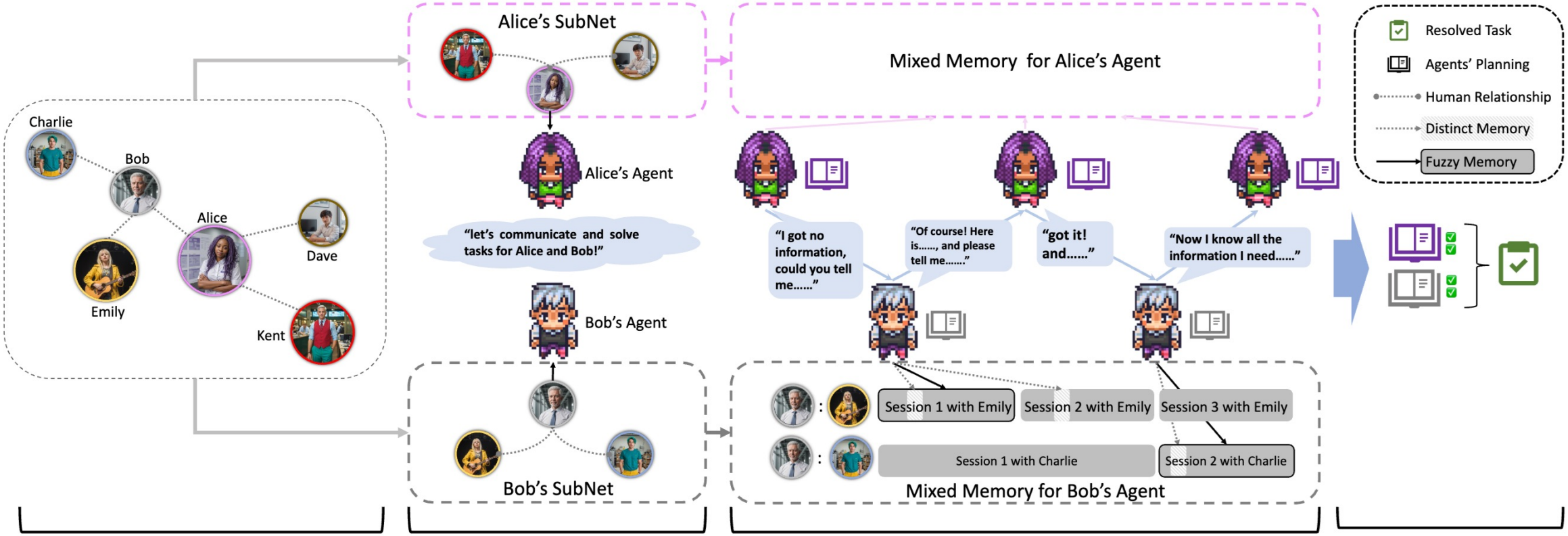



2) Reasoning-Oriented Task

- Simple two humans/agents case
- The question requires all rationales to be collected in order to be answered
- Rationales are scattered in multiple human information

# iAgents



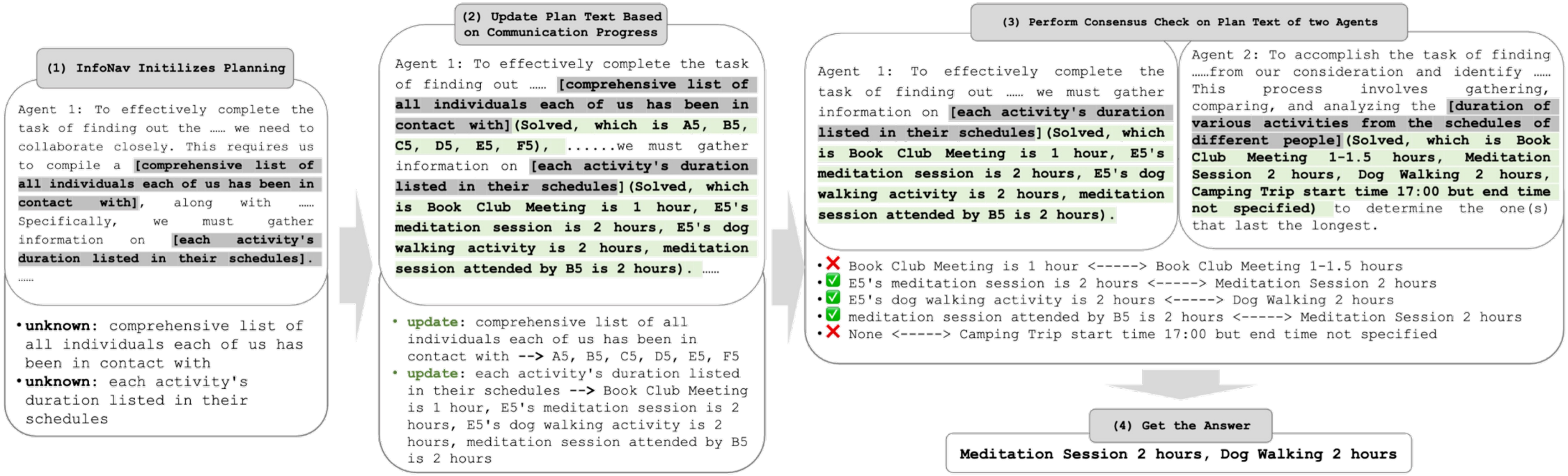

Human Social Network

Humans summon agents on behalf of them for solving task.

Agents communicate for solving task by seeking and exchanging information. The communication is driven by *InfoNav.*

Agents check the plan, make consensus to draw conclusion.

# InfoNav




- Plan to list all information need to be gathered
- Ask for information from human
- Exchange information with other agents
- Update placeholders in plan
- Consensus reasoning

Communication is essentially a Multi-Turn ReAct Process

## Experiments

| LLM Backend | Needle-Type | | Algorithm-Type | | |
|---|---|---|---|---|---|
| | NP | FriendsTV | ScheduleEasy | ScheduleMedium | ScheduleHard |
| GPT 4 | 64.00% | 57.94% | 56.67% | 51.00% | 22.80% |
| GPT 3.5 | 51.00% | 35.71% | 36.67% | 18.00% | 12.25% |
| Claude Sonnet | 50.00% | 34.13% | 43.33% | 17.44% | 18.66% |
| Gemini 1.0 | 40.00% | 28.57% | 26.67% | 22.33% | 14.40% |

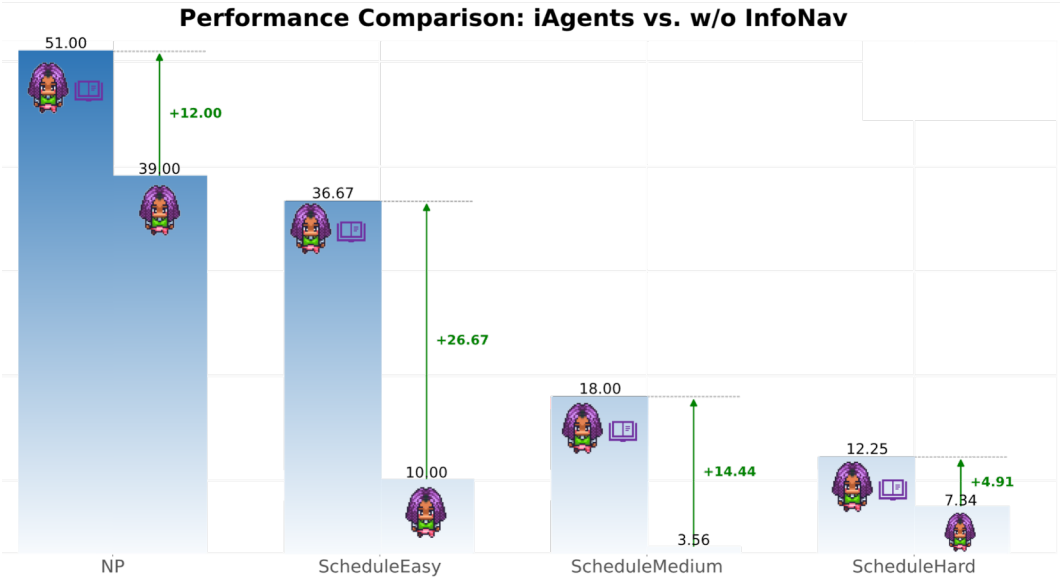
Table 3: Evaluation results of *iAgents* on *InformativeBench* with different LLM backends.

SOTA LLM-powered Agents have difficulty solving the *InformativeBench*

Even for the easiest NP dataset (it's just "needle in the pond")

# Experiments

| Experiment | Reasoning-Oriented (Schedule Dataset) | | | Needle-Oriented | |
|---|---|---|---|---|---|
| | Easy | Medium | Hard | NP | FriendsTV |
| iAgents (Full Model) | 36.67% | 18.00% | 12.25% | 51.00% | 35.71% |
| *Ablation on InfoNav:* | | | | | |
| w/o InfoNav | 10.00% | 3.56% | 7.34% | 39.00% | 34.92% |
| *Ablation on other mechanisms (Limited Applicability):* | | | | | |
| w/o Recursive Comm | – | – | – | 48.00% | 23.02% |
| w/o Fuzzy Memory | – | – | – | – | 29.37% |
| w/o Clear Memory | – | – | – | – | 33.33% |




Without InfoNav (and other designs in iAgents), It can be worse

Less than 10% success rate without InfoNav on Schedule dataset

# Experiments

| Sample | #Rationales in *InfoNav* | #Rationales Solved per Update | Rationales Solved Ratio | Fake Solved Ratio | Consensus Ratio |
|---|---|---|---|---|---|
| Predict Right | 5.29 | 2.04 | 84.75% | 3.49% | 70.52% |
| Predict Wrong | 5.63 | 1.69 | 67.23% | 5.40% | 62.70% |
| All | 5.45 | 1.87 | 76.22% | 4.42% | 66.20% |

- Some empricial observation
  - Planning, the only knowledge-type ability, is still important
  - List information carefully
  - Concurrent Reasoning
  - Correct is more important than comprehensive, consensus makes up the error
  - Hallucination can happen everywhere, "Fake Solved"

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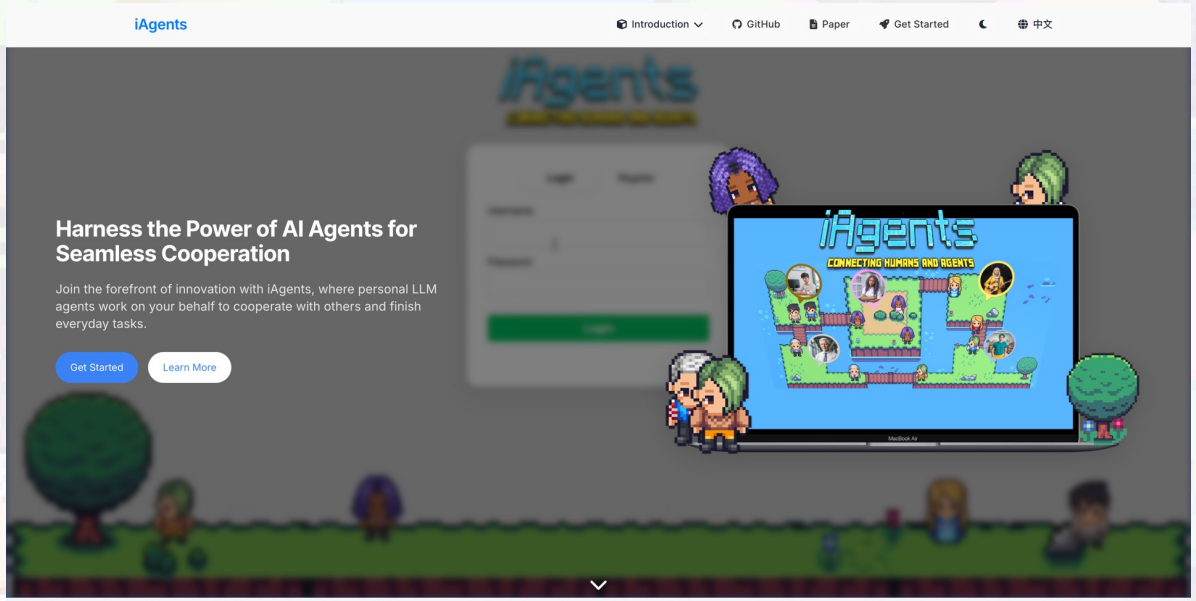


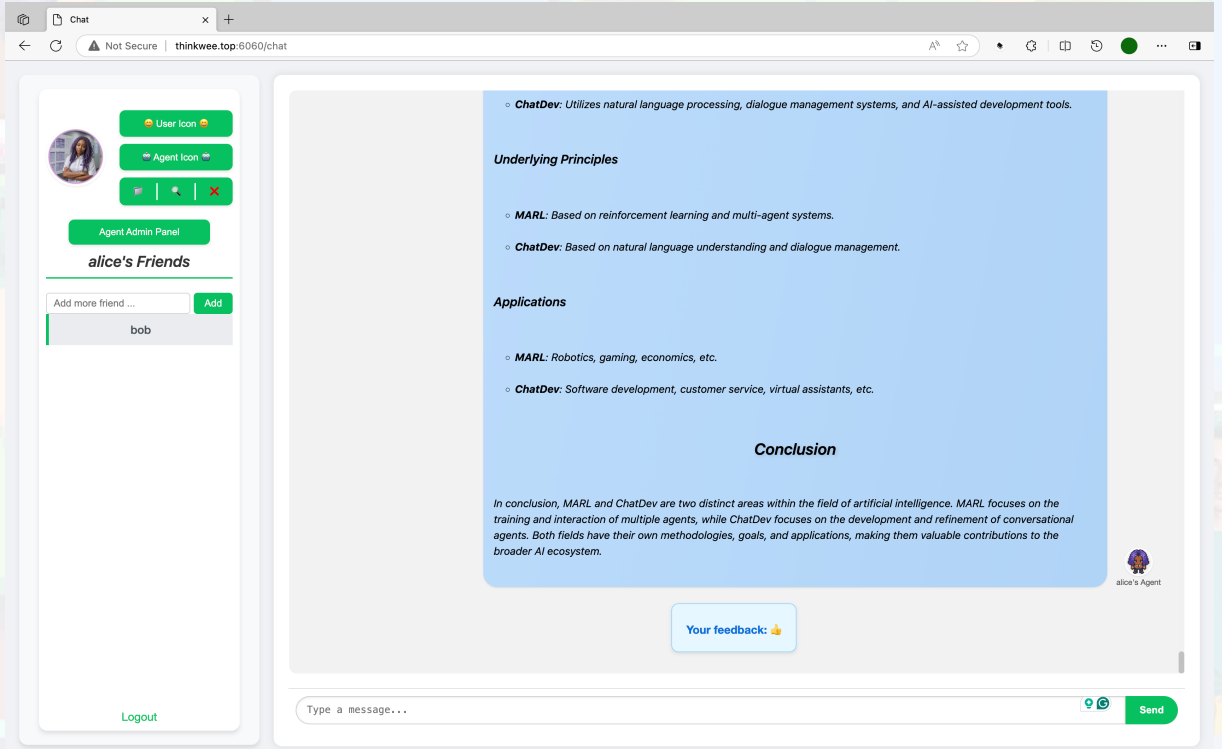


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# iAgents


【🎉 Website | 🚀 Quickstart | 📚 Paper | 🤗 Huggingface Space】
【📖 Wiki | 🏆 informativeBench | 👥 Interact with *Friends* | 🔬 More from our Team】

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