How Can AI Reason Your Character?

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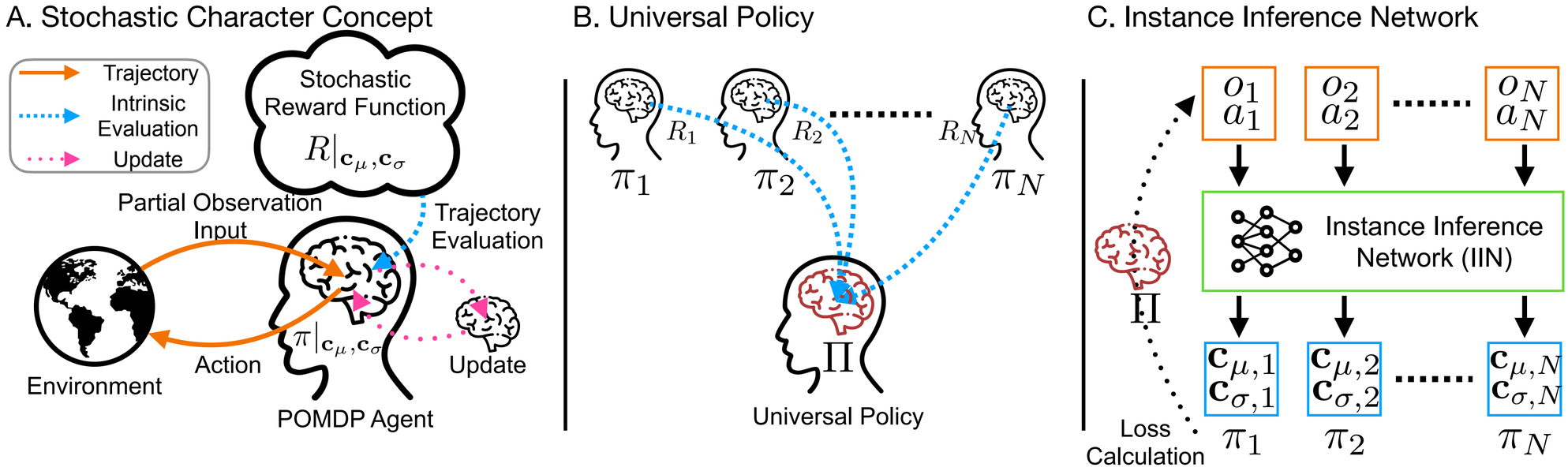
Motivation & Objectives

- **Inferring others' decision preferences** helps us to make an adaptive decision in the social context
- Endowing AI agents with this ability is essential for effective **human-AI and AI-AI collaboration**
  - Finding 1: Human character's stochasticity due to uncertainties → **Aim 1: Stochastic character**
  - Finding 2: Brain's inference ability to generate a character rapidly and update it gradually → **Aim 2: Instance inference**

Proposed Solution: Instance Inference to Stochastic Character



Aim 1: Stochastic Character in Reward

- Evaluate differently the **importance of each reward term**
- Make the behavioral pattern diversified

$$r_t = R(s_t, a_t, s_{t+1}; \mathbf{c}_\mu, \mathbf{c}_\sigma) = \sum_{n=1}^{N} c_n \mathcal{R}_n(s_t, a_t, s_{t+1})$$

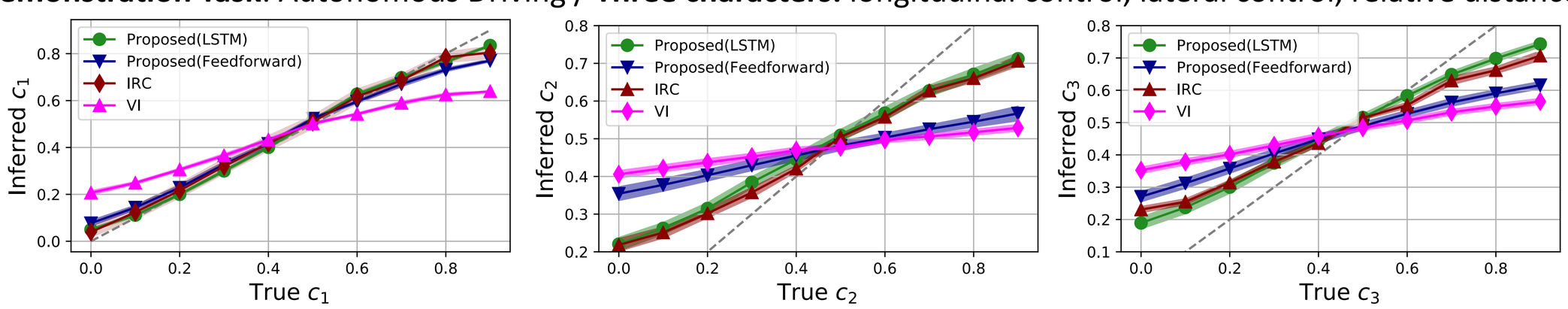
Aim 2: Instance Inference Network

- Infer the character by leveraging **the target's trajectory**
- **Update the inferred character** gradually using the RNN

$$\hat{\mathbf{c}}_\mu, \hat{\mathbf{c}}_\sigma = \arg\min_{\mathbf{c}_\mu,\mathbf{c}_\sigma} \mathcal{L}(f(\mathbf{c}; \mathbf{c}_\mu, \mathbf{c}_\sigma))$$

Simulation Results

Demonstration Task: Autonomous Driving / **Three characters:** longitudinal control, lateral control, relative distance



Benchmarking Algorithms:

- Inverse Rational Control (IRC): Monte Carlo estimation maximization-based approach → **High accuracy & High run-time**
- Variational Inference (VI): **Baseline** on inference task

Algorithm	Inference Accuracy			Run-Time
	l=10	l=100	l=200	
Proposed (LSTM)	0.9564 ±0.0017	0.9621 ±0.0007	0.9633 ±0.0006	0.006s
IRC	0.7874 ±0.0883	0.9441 ±0.0451	0.9604 ±0.0344	91.472s
Proposed (Feedforward)	0.9533 ±0.0019			0.003s
VI	0.8900 + ±0.0022			0.004s

The proposed solution **comprehensively outperforms in terms of the inference accuracy and the time-complexity**

Conclusion

- We have incorporated the stochastic character concept into reinforcement learning, specifically, the reward function
- Simulation results confirm that the proposed solution instantly infers character with the highest accuracy
- The proposed framework can serve as a helpful guide for achieving AI's social decision-making process