TRANSFER LEARNING BASED ADAPTIVE AUTOMATED NEGOTIATING AGENT

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- Automated negotiation is a ubiquitous method for reaching agreement between industrial partners.
  - In many relevant real-world scenarios, **negotiations repeat with similar but not the same ufuns**.
- Historical negotiation traces are becoming available due to the increased pace of digitalization specially due to the pandemic.
- We propose a framework for incrementally learning and adapting an end-to-end negotiation policy based on historical negotiation traces.
  - We show that learning is **transferred** to related new situations.
  - The system adapts automatically to **changes in utility functions**.
  - **Outperforms** top GENIUS agents on ANAC domains by 6%.
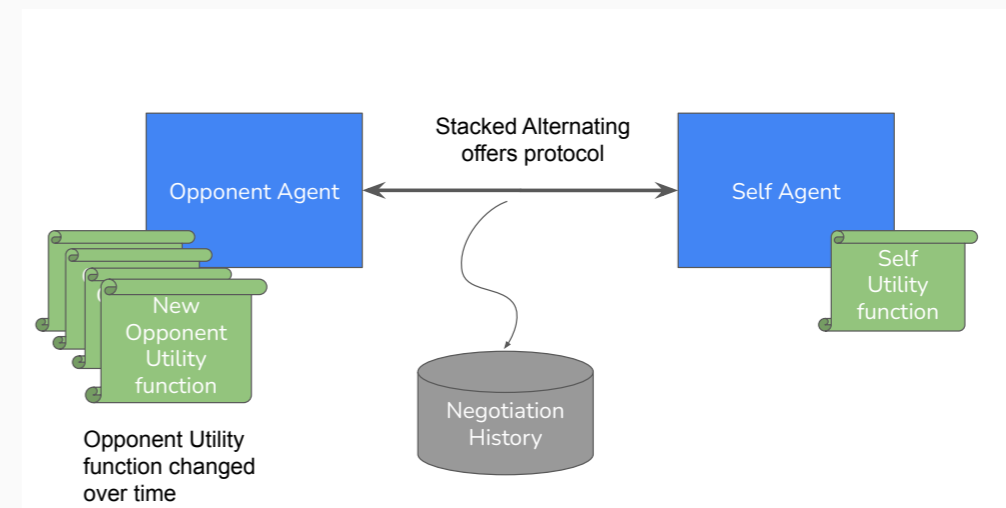
- Takes contextual information into account (e.g. season).
- Trains and adapts with few negotiation traces with no active opponent.
- Your best negotiator in → higher performance out.

Proposed Framework
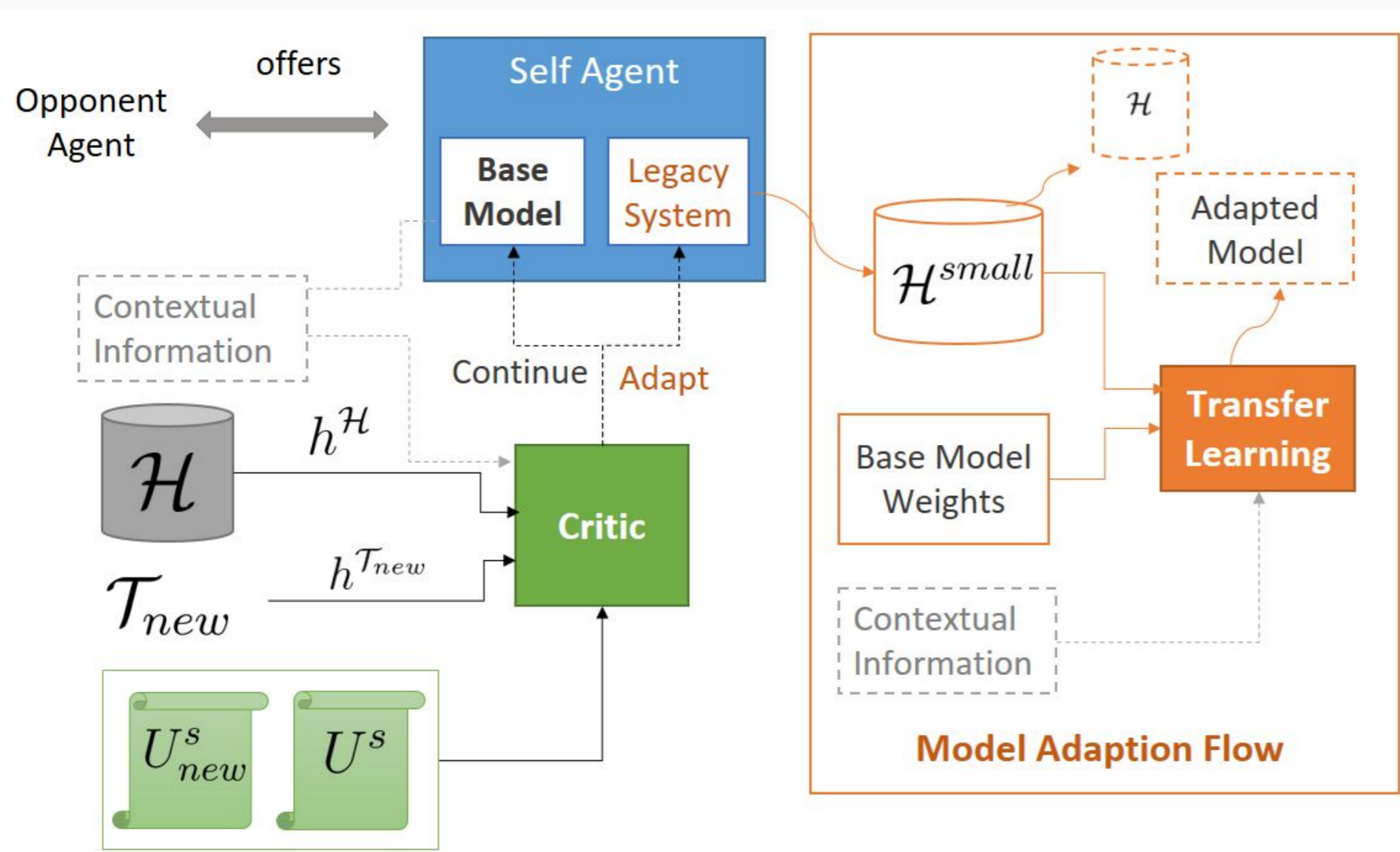
LegacySystem Top GENIUS Negotiator used for data collection during incremental improvement:
  - Atlas3, YX, Ponpoko, NTfT, ParsCat.

BaseModel An LSTM used to learn the negotiation policy.

Critic Decides when to adapt the BaseModel.

Base Model and Transfer Learning

- The BaseModel is trained using all available traces.
- Input and output encoding layers learn distances in the ufun space.
- A middle LSTM that *roughly* represents the strategy is not retrained.
- The Critic uses the LegacySytem to collect few (e.g. 10) extra traces when needed and triggers the transfer learning model.

Critic: Adaptation

- A binary classifier (Adapt?).
- Assumes either self or partner ufun can change.
- Uses the relative frequency of offers in the last few traces to decide wither the partner's ufun has changed.
- Trained using XGBoost with synthetic data.
  - During cold-start, the Wasserstein distance with an apprpriate threshold is also effective.
- Can accomodate changes is self ufun:
  - Uses Levenstein distance to measure the change between the new and old ufuns.
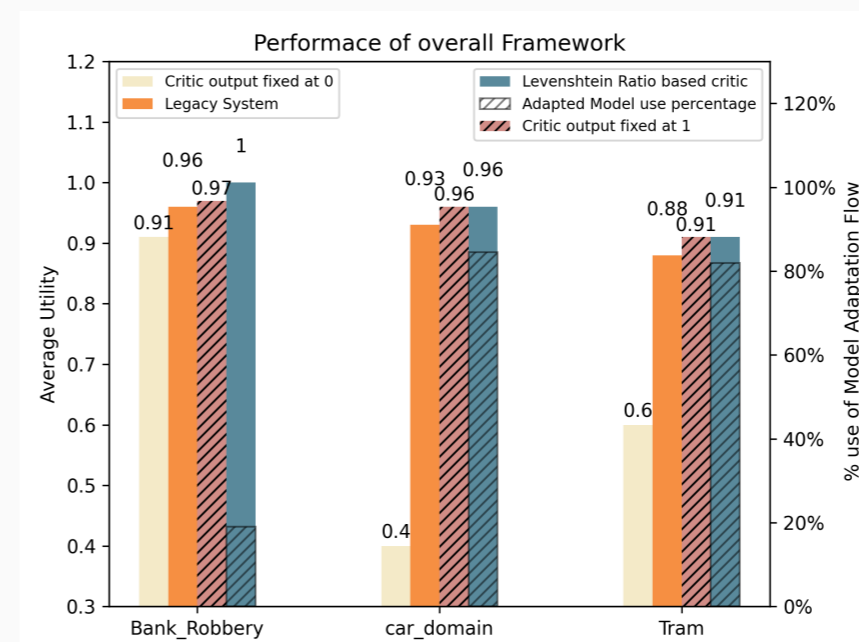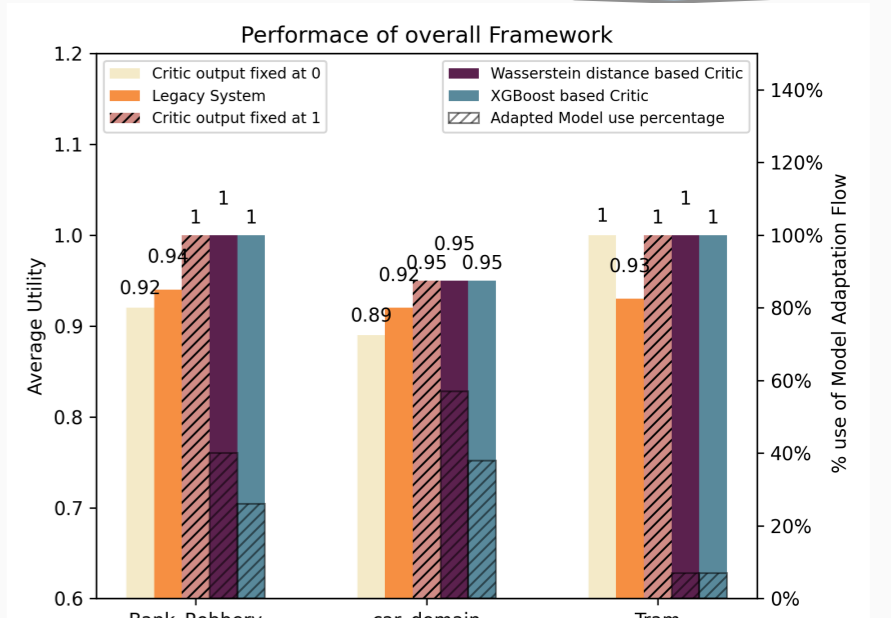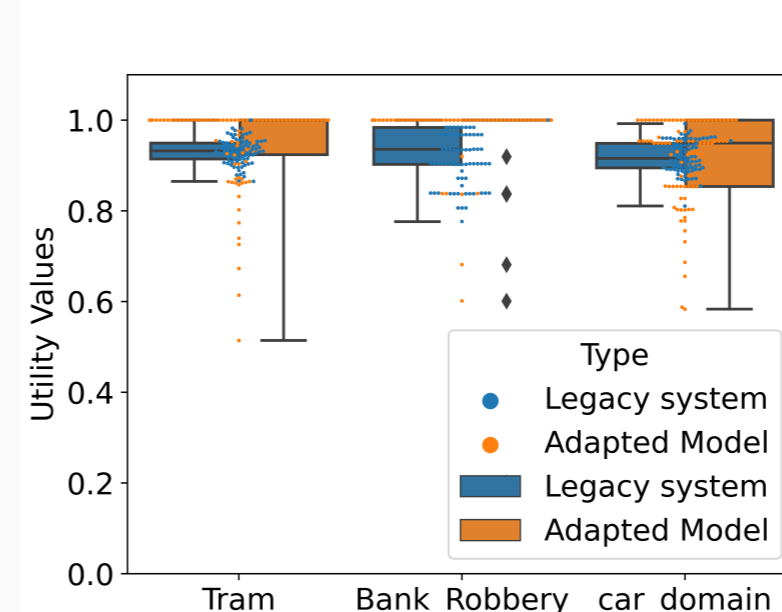
- Performance 6% ↑.
- Ablation: Critic is effective.
- XGBoost, Wasserstein distance are both effective but with different retraining rates.