Word Games

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3 Challenges

- Modular models
  - Dialogue model = local meaning representation - belief state - dialog act - utterance generation
  - Various works supervise particular parts then leave others to be implicitly learned through neural nets
  - Results in very task-specific architectures
  - Can we break down tasks to allow for more component sharing across different tasks, as well as semi-supervised learning?
- Less complicated meaning representations
  - Meaning representations vary in granularity
  - Can we learn a minimal task-specific subset of a meaning representation formalism?
- Adapting to partners
  - Partner model allows forward modeling, learned over a multiple round game or repeated games
  - Adapt opaque neural model or hierarchical bayesian model?

Natural Language Interaction

- Interaction (through language) is important
  - Cannot fully automate every task, i.e. task-oriented or information seeking dialogues require human input
  - Must handle diverse non-expert human input, although input may map to a low-dimensional manifold
  - High levels of ambiguity must be resolved via interaction
- Interaction (through language) is hard
  - Human input is expensive, so supervision is limited
  - In order to make certain problem aspects tractable, must make sacrifices in other areas (toy domain = out of distribution for pretrained models)
- What are the main challenges in interaction, and what are the tradeoffs of different approaches?

Types of Dialogue Games

- Task-oriented: Wizard of Oz (WoZ)
  - Tseng et al. (2019): Wizard obtains task from human then executes it.
- Deliberation / reference / signal
  - Udagawa and Aizawa (2019): Visual reference game with latent translated views. Each player gets a different petri dish view of the same underlying game board, and players must select the same object on the board.
- Information seeking / inquiry
  - Yu et al. (2019): WoZ-style answer providing where asker does not know exact question. Latent true question (to all), WoZ must answer
- Persuasion / negotiation
  - Lewis et al. (2017): Negotiation over an observed set of item with latent utilities for each agent.

Types of Dialogue Games

In all cases, the game can be (indirectly) solved by resolving a latent variable

- When is this tractable, and why do no new methods do this?
- New (ie basically all) methods rely on supervision
- If they do not, it is because the game has a trivial solution

Types of Dialogue Games: Latent goals and strategy

What are the latent variables in each type?

- Task-oriented
  - Latent task slots
- Deliberation / reference / signal
  - Varies per game
- Information seeking / inquiry
  - Infer true question, find answer
- Persuasion / negotiation
  - Infer utilities, exploit

Types of Dialogue Games: Latent goals and strategy

- Tasks must be interesting enough so that latent quantities cannot be inferred with a single utterance, reducing them to single turn games
  - High degree of ambiguity / distractors or large number of slots to fill (combinatorial)
- Break down latent quantities and use heuristics to make assumptions on structure
  - For example, choosing an ordering of WoZ slots: When choosing a restaurant, first figure out time, then cuisine, and finally price
  - Will likely remain task-specific
- What other parts can we learn?

Belief State Tracking

- The incremental inference procedure is known as belief state tracking (BST)
- Local semantics are aggregated into belief state, which informs high-level strategic decisions
- Seems difficult to learn language, high level strategy, belief state updating, and low level parsing at the same time
- Ablate how structure influences each of these

Language Games

- Games offer a testbed for the development of methods
  - Allow designers to control difficulty and simplicity
- Allowing interaction through language increases the population of players

Meaning reps

- In full generality, this problem is often encountered in hierarchical RL
  - Less bleak in the language gamesetting
  - Games are often very simple and can be constrained to small horizons, for example He He engineered a parser and policy that basically solves the negotiation task
- Many text-specific meaning representations (MR) to choose from
  - Many are too complex
  - Can we leverage existing MRs to learn a minimal task-specific representation that balances utility and expressivity?

Contributions

- Under a unified Bayesian game perspective of dialog games, present formulations for different classes of dialogs: signaling, negotation?
- Provide pipelined variational Bayesian framework for learning to play dialog games from offline data, with and without granular annotations
- Good results

Tasks

- Task-oriented dialogue: Multi-WoZ
- Negotation: Deal-or-no-deal
- Reference: OneCommon
- Information-Seeking: Birds

Citations I

Lewis, M., Yarats, D., Dauphin, Y. N., Parikh, D., and Batra, D. (2017). Deal or no deal? end-to-end learning for negotiation dialogues. *CoRR*, abs/1706.05125.

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