Negotiative Dialogue

Today Session Plan:

- Negotiation as conflict resolution
- Game-theoretical model of bargaining
- GT Model of mixed initiative
- Sidner's Formal language for negotiation
- Corpus analysis of negotiative dialogues

What is Negotiation?

"Negotiation can be considered the fundamental form of **dispute resolution**. Essentially it involves two or more parties working together to examine their interests and needs, and **working out a solution** that will give the best possible outcome to both sides. This can be done **cooperatively**, as it is in principled negotiation, or it can be done in a **competitive** way as is typical in distributive bargaining."

From:
Conflict Research Consortium, University of Colorado, USA:
http://www.colorado.edu/conflict/peace/treatment/negotn.htm

Negotiation Phases

- pre-negotiation analysis: exchange information about positions and preferences (it may be in agent's interest to either reveal or conceal preferences, etc.)

- negotiation: offers, counter-offers, arguments to persuade, threats

- post-settlement analysis: may result in re-negotiation or new negotiation of related issues

Negotiation Forms

- hard bargaining: adversarial, win-lose, competitive
- soft bargaining: concessive, effort to please

- **distributive bargaining**: dividing a limited amout of "stuff"
- **integrative bargaining (principled negotiation)**: with each other instead of against each other; interest-based conflict resolution; win-win
  - separate the people from the problem
  - negotiate about interests, not positions
  - invent options for mutual gain
  - insist on objective decision criteria
  - know your BATNA (best alternative to a negotiated agreement)

Game Theoretical Model of Bargaining

- In GT, agents are viewed as rational *utility maximizers* in *direct interaction*.
- GT models bargaining dialogue is a sequence of **offers** and **counter-offers**.
- GT enables to study
  - how agents evaluate offers
  - what strategies agents may employ
  - what strategies are likely to lead to desirable outcomes

- Basic concepts:
  - **Issues**: there is a set of negotiable topics/issues
  - **Values**: each issue has a value
  - **Offers**: an offer is a set of issues with values
  - **Utilities**: negotiators assign a utility value to each offer for evaluation

Game Theoretical Model of Bargaining

- negotiable offer: a negotiation can result in an offer acceptable to all sides if there is a pareto optimal offer which strictly dominates the status quo (or ‘no deal’ situation)

- strategy: a set of rules that enable a negotiator to predict a next move
  - nash equilibrium
  - perfect equilibrium
  - dominant strategy equilibrium

GT Model Applied to Travel Planning Dialogue

- Issues: journey attributes (e.g., cost, mode, origin, destination, time)
- Values: true, false (actual values of journey attributes are not considered subject of negotiation)
- Offers: possible offers are all combinations of journey attributes a included in database query
- Utility: $worth - cost$
  - offers which include destination are preferred
  - generally, offers with higher number of included attributes are preferred

Dialogue moves:

- propose, accept, reject (an attribute)
- make an offer (of a journey)

GT Model Applied to Travel Planning Dialogue

Example(s)

Formal Language for Negotiation

Sidner (1994):

- collaborative problem solving (establishing shared plans)
- negotiation in order to share and reach agreement on beliefs held by agents
- model the beliefs at each stage of communication
- additional structures: stacks for open beliefs and rejected beliefs
- dialogue moves defined as *messages*, specifying the changes to beliefs concerning a proposition (cf. plan operators with conditions and effects), plus operations on the stacks

Formal Language for Negotiation

Primitives:

- Propose For Accept: PFA(agt1, belief, agt2)
- Acknowledge Receipt: AR(agt1, belief, agt2)

- Reject: RJ(agt1, belief, agt2)
- Acknowledge Reject: ARJ(agt1, belief, agt2)

- Accept Proposal: AP(agt1, belief, agt2)

- Retract Proposal: RP(agt1, agt2, belief)
- Acknowledge Retracted Proposal: ARP(agt1, agt2, belief)

Formal Language for Negotiation

Composites:

- Counter: CO(agt1, belief1, agt2, belief2)
  PFA(agt1, belief2, agt2) + PFA(agt1, Supports((not belief1), belief2), agt2)
- Accept Other's Proposal: AOP(agt1, belief1, agt2, belief2)
  RP(agt1, agt2, belief2) + AP(agt1, agt2, belief1)
- Propose Replace: PR(agt1, belief1, agt2, belief2)
  RJ(agt1, belief2, agt2) + PFA(agt1, belief1, agt2)
- Propose Act: PA(agt1, agt2, action, context)
  PFA(agt1, Shoul-do(agt2, action, context), agt2)

Modelling Negotiation in Information-State Update Approach

Re-formulation Sidner's model:

- update rules for core negotiation moves
- update rules for acknowledgements (is there any difference from grounding?)

Adding Issues Under Negotiation:

- to capture intuition that neogtiation concerns simultaneously considered (open) alternatives
- straightforward modelling as questions and corresponding set of possible answers

Negotiative Dialogue Annotation

- COCONUT project
- Verbmobil project