

# **Mixed Initiative**

Nigel Kilmer

# Walker & Whittaker (1990)

- Natural human conversation is:
  - Bidirectional: information flows both ways
  - Mixed-initiative: both participants at times take the conversational lead and volunteer information
- Dialog systems that are not mixed-initiative:
  - Allocate control to one participant
  - Assume a passive listener
  - Don't allow users to participate in the reasoning process or ask questions
  - Have difficulty with fragmentary utterances that refer to the system's previous response

# Walker & Whittaker (1990)

- Examined four sets of dialogs, including advisory dialogs (ADs) and task-oriented dialogs (TODs).
- Propose control rules that can be used to find the boundaries between discourse segments, where segments are controlled by alternating participants.

# Walker & Whittaker (1990)

- Utterance types:
  - Assertions - declaratives used to state facts.  
Includes yes/no responses.
  - Commands - utterances intended to instigate action.  
Includes suggestions.
  - Questions - utterances intended to elicit information.
  - Prompts - utterances which express no propositional content, including checkbacks.

# Walker & Whittaker (1990)

- Control rules:
  - Assertion - controller is the speaker, unless the assertion was a response to a question
  - Command - controller is the speaker
  - Question - controller is the speaker
  - Prompt - control passes to or remains with the hearer

# Walker & Whittaker (1990)

## Abdication Example

E: "And they are, in your gen you'll find that they've relocated into the labelled common area"  
(ASSERT - E control)

C: "That's right." (PROMPT - E control)

E: "Yeah" (PROMPT - E abdicates control)

*CONTROL SHIFT TO C*

C: "I've got two in there. There are two of them." (ASSERT - C control)

E: "Right" (PROMPT - C control)

C: "And there's another one which is % RESA" (ASSERT - C control)

E: "OK um" (PROMPT - C control)

C: "VS" (ASSERT- C control)

E: "Right" (PROMPT - C control)

C: "Mm" (PROMPT - C abdicates control)

*CONTROL SHIFT TO E*

E: "Right and you haven't got - I assume you haven't got local labelled common with those labels"  
(QUESTION - E control)

# Walker & Whittaker (1990)

- Types of segment boundaries associated with control rules:
  - Abdication - controller produces a prompt, gives control to the hearer
  - Repetition/Summary - controller produces a redundant utterance which indicates that they have no new information to contribute and passes control to the hearer
  - Interruption - non-controller seizes control with an assertion, command, or question not in response to a previous question by the controller

# Walker & Whittaker (1990)

- As interruptions are allowed, the non-controller can seize control at any point in the discourse.
- Controllers are in control because the other participant allows it in order to collaborate.



# Walker & Whittaker (1990)

- Examined the distribution of anaphora across and within control segment boundaries.
- Anaphor classes:
  - 3rd person - it, they, he, she, etc.
  - One/some - one of them, one of those, some, etc.
  - Deictic - this, that, in reference to NPs
  - Event - this, that, it, in reference to VPs or clauses/sentences

# Walker & Whittaker (1990)

- The distribution of anaphora suggests that certain control segments are in a hierarchical relationship.
- When control shift occurs due to an interruption, there are often coreferential anaphora before and after the interruption control segment.

# Walker & Whittaker (1990)

- Since interruptions imply that the interrupting participant has an issue of some sort with the previous controller's utterance, anaphora that reference events or objects from the previous control segment are more common than if control is switched for another reason.
- Anaphora that refer to events are commonly used during planning and are frequently used across control boundaries to refer to ideas or propositions of the other participant.

# Walker & Whittaker (1990)

- When does an interruption occur?
  - Information quality - if the listener believes that the speaker has provided an untrue or ambiguous utterance, or that the speaker is missing relevant information, an interruption should occur.
  - Plan quality - if the listener believes that the course of action proposed by the speaker is counterproductive or irrelevant to their goals, or ambiguous, an interruption should occur.

# Walker & Whittaker (1990)

- Advisory dialogs vs. task-oriented dialogs
  - Expert controls the dialog in 55% of segments in ADs, 91% of segments in TODs
    - In ADs, the non-expert participant must communicate details of their situation to the expert.
  - Control shift is an interruption for 37% of segments in ADs, 58% of segments in TODs
    - Interruptions seem to be more important in TOD structure as the non-expert must indicate when there is a problem with the instructions of the expert.

# English and Heeman (2005)

- Approaches for creation of a dialog policy:
  - Hand-craft the policy
  - Use an iterative Wizard-of-Oz approach
  - Determine a policy from a human-human corpus
- When there is no corpus and human involvement needs to be minimized, reinforcement learning using two dialog agents may be an option.

# English and Heeman (2005)

- Task:
  - Two participants attempt to decide on 5 pieces of furniture to include in a room.
  - Furniture pieces have scores.
  - Participants have (initially) secret constraints that also have scores.
  - The goal is to maximize the score of furniture in the room while minimizing the scores of violated constraints.

# English and Heeman (2005)

- Dialog agents can perform these actions:
  - Propose
  - Accept
  - Reject
  - Inform (about a constraint)
  - Release turn
- Agents have internal state space that keeps track of the state of current proposals, violated constraints, and whether the agent can improve on the current proposal.



# English and Heeman (2005)

- Multiple runs through the task are performed to tune the dialog policies of the agents (sequences of dialog actions, expected response actions, etc.) to maximize the objective function
- Objective function:
  - $o(S, L) = w_1 S - w_2 L$
  - $S$  = solution quality (determined by a human)
  - $L$  = dialog length
  - $w_1$  and  $w_2$  are positive weights

# English and Heeman (2005)

- Since the agents are initially inexperienced, a high degree of randomness is used in coming up with a dialog policy.
- As the agents mature, the learning algorithm pays more attention to the dialog actions of the other agent in shaping dialog policy.
- Found a lack of convergence - with similar starting parameters and weights for the objective function, resulting dialog policies can vary in effectiveness.

# English and Heeman (2005)

- Best-performing pairs of trained dialog agents are chosen.
- When trained agents are put into dialog with handcrafted agents, the resulting dialog is better than the baseline for handcrafted agents that do not use mixed initiative, but worse for handcrafted agents that do.

# Chu-Carroll and Brown (1997)

- Task initiative vs. dialog initiative:
  - Rather than tracking only a single type of control through the dialog, distinguish between two types.
  - Task initiative is held by the participant who is actively proposing ideas for the collaboration process.
  - Dialog initiative is held by the participant who has immediate control of the conversation. It is possible to take dialog initiative but not task initiative, such as if a participant interrupts the other to point out a problem with the previous utterance but expects the other participant to continue guiding the dialog.

# Chu-Carroll and Brown (1997)

- Determined various cues for transfer of each type of initiative:
  - Explicit requests to take over or give both types of initiative (e.g. "Any suggestions?" "Let me handle this one.")
  - Questions can transfer dialog initiative only, as an answer is expected from the other participant
  - Utterances that point out the invalidity of the previous utterance can either transfer dialog initiative only or both types of initiative, depending on whether the speaker provides an alternative or not

Questions?