

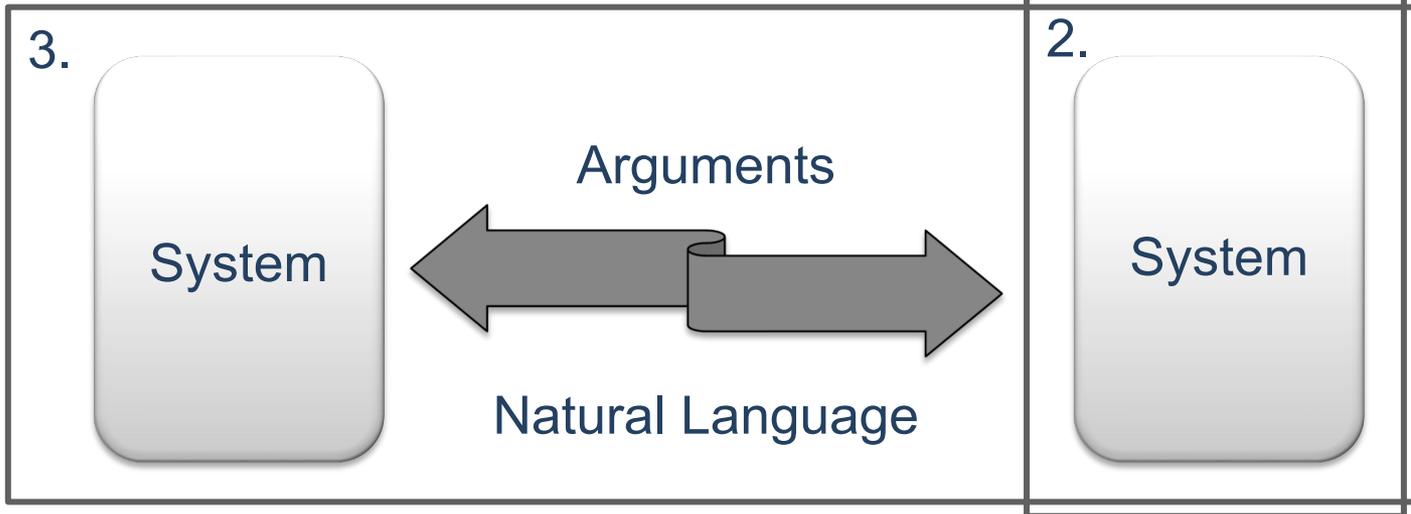


Utilizing Argument Mining Techniques for Argumentative Dialogue Systems

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Argumentative Dialogue System

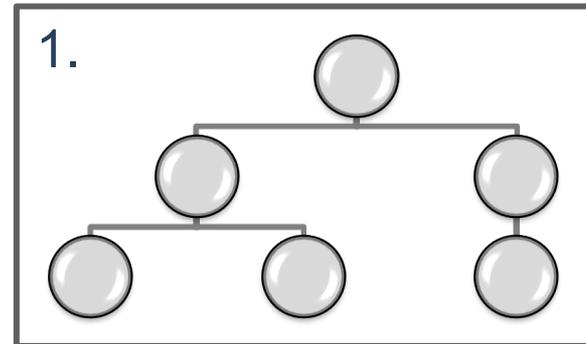
Argumentative System



Evaluation and Results



How to encode argument components and their relations in a practical way?



Argument Database

Part 1

ARGUMENT DATABASE

Background

Argument Mining

Aims at automatic extraction of argument structures from natural language sources.

Usually employed for analysis (argument quality, writing support, etc).

Approach: Utilize extracted argument structure in Argumentative Dialogue System.

Focus throughout this work on the annotation scheme of Stab and Gurevych.

Stab, C., Gurevych, I.: Annotating argument components and relations in persuasive essays. In: COLING, pp. 1501–1510 (2014)

Annotation Scheme and Textual Source

Setup

Three different argument component types:
Major Claim, Claim, Premise

Two relations between the components:
Support and Attack

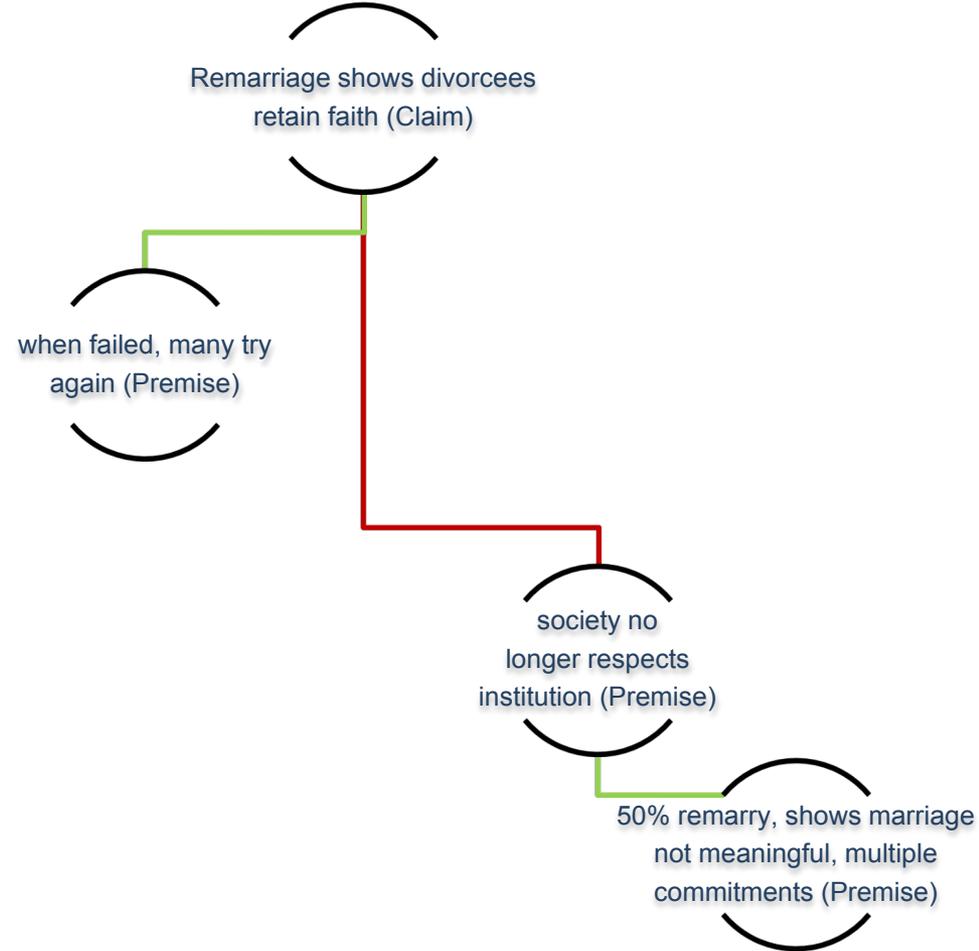
Applied on a debate from the debatabase of
idebate.org with the topic *marriage is an
outdated institution.*

Annotation of components, relations and
textual representation of components.

Example

The remarriage rate shows that even people who go through failed marriages retain faith in the institution of marriage.

- 50% of all divorcees in the UK go on to remarry. (National Office for Statistics 1999) This shows that, although their own marriage failed, they retain faith in the institution of marriage. The fact that, even when marriage has failed to work for them once, many people wish to give it another go shows that it is still meaningful to society. If an institution is so meaningful and relevant to modern society in this way, it cannot possibly be outdated.
- The fact that 50% of all divorcees (National Office for Statistics 1999) go on to remarry does not, as the opposition claims, show that marriage is a meaningful and relevant institution but quite the opposite. What this means is that a huge number of people vow to spend the rest of their life with another person, forsaking all others until death do them part, on multiple occasions. This does not show that society still has faith in marriage, it shows society no longer respects the institution of marriage.



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Part 2

THE ARGUMENTATIVE SYSTEM

Argumentative Dialogue System

Setup

Persuasive scenario (each side tries to convince the opponent of a certain point of view).

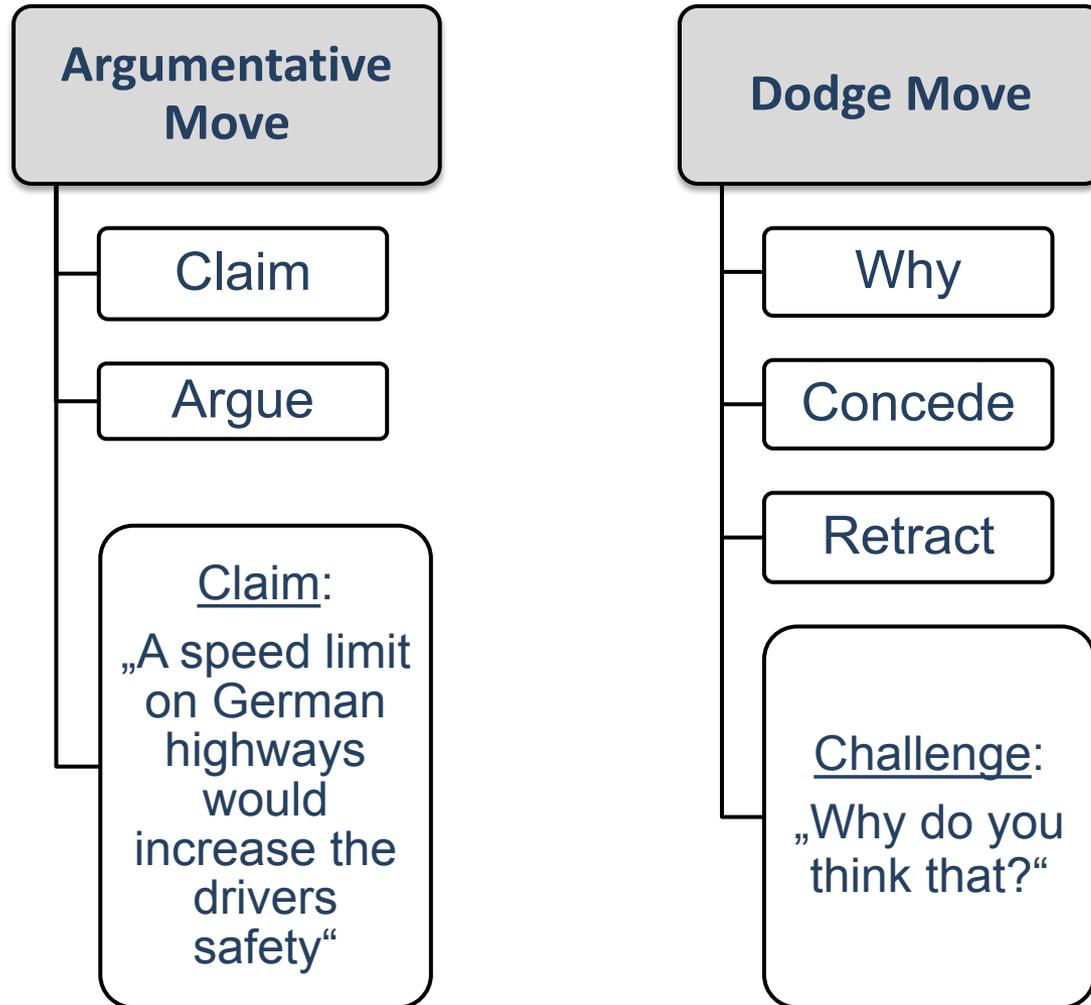
Formalization as Dialogue Game for argumentation or *Argument Game*.

Participants move in turns similar to a board game.

Rules are defined by a framework specific protocol.

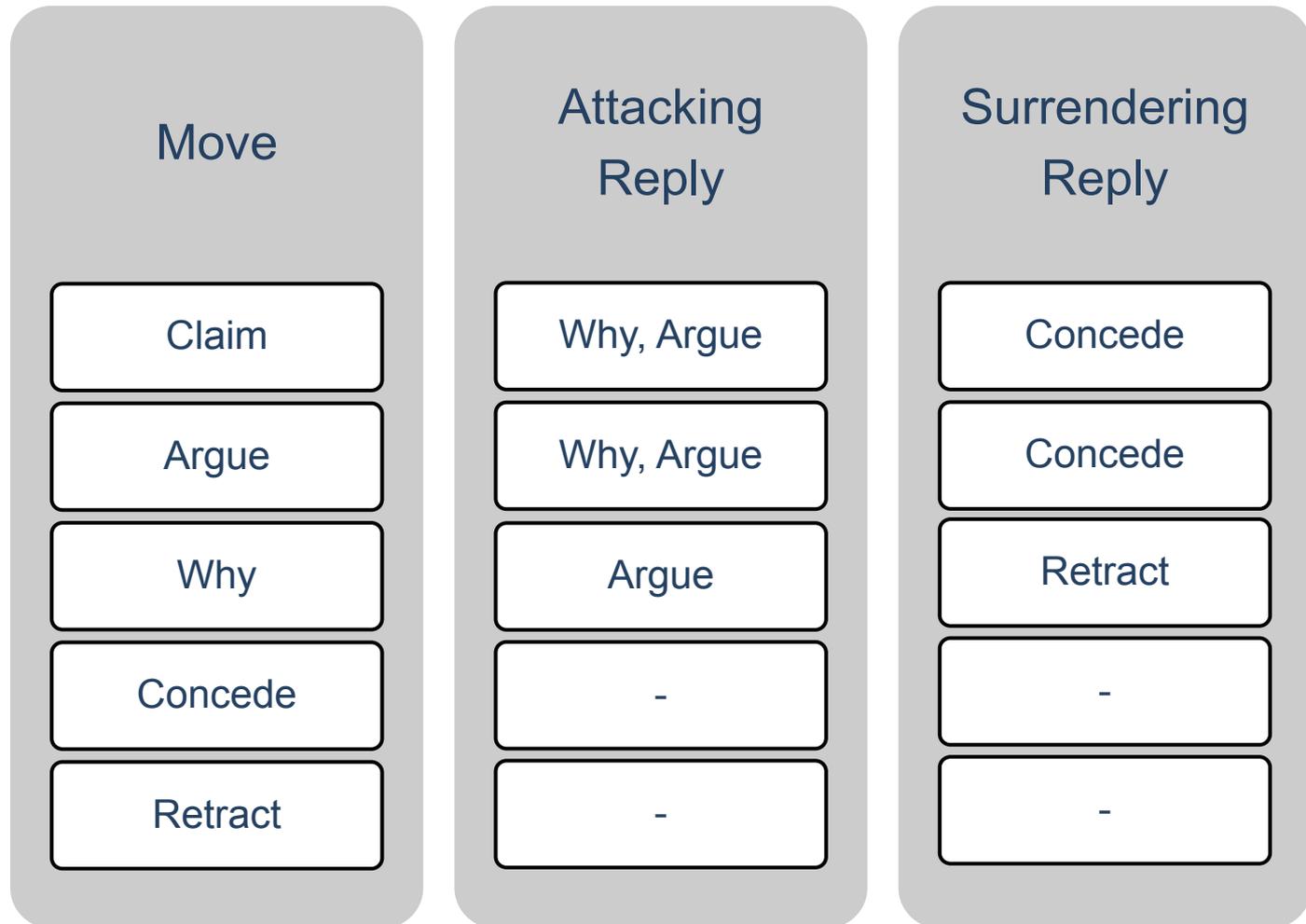
Prakken, Henry. "Coherence and flexibility in dialogue games for argumentation." *Journal of logic and computation* 15.6 (2005): 1009-1040.

Allowed Moves



Prakken, Henry. "On dialogue systems with speech acts, arguments, and counterarguments." *European Workshop on Logics in Artificial Intelligence*. Springer Berlin Heidelberg, 2000

Rules and Relations



Prakken, Henry. "On dialogue systems with speech acts, arguments, and counterarguments." *European Workshop on Logics in Artificial Intelligence*. Springer Berlin Heidelberg, 2000

System Strategy

Strategic Rules

Attack if possible.

If possible, attack
previous opponent
move.

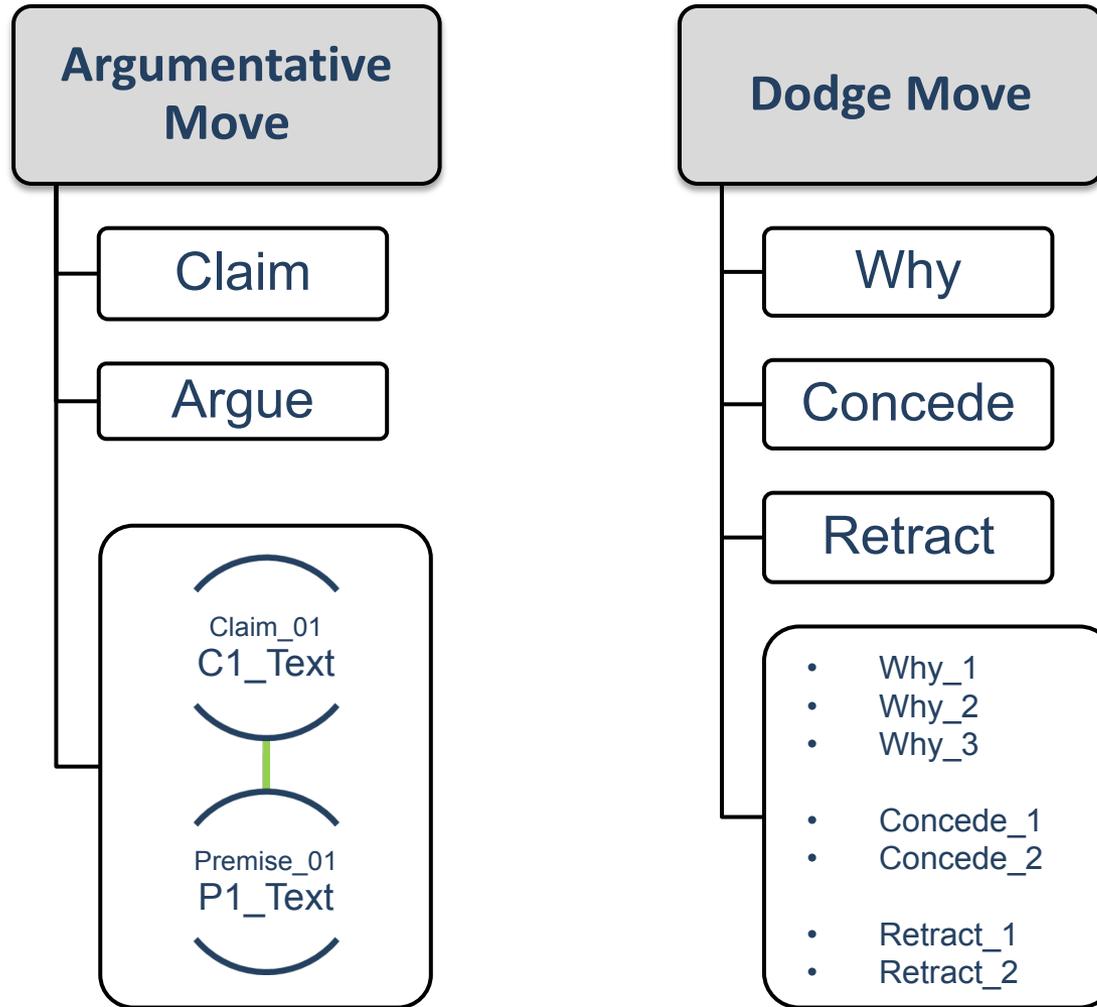
Prefer *argue* moves
over *why* moves.

If no attack is possible, surrender. If
possible, surrender to the latest
opponents move.

Choose random between equally rated
choices.

Amgoud, Leila, and Simon Parsons. "Agent dialogues with conflicting preferences." *International Workshop on Agent Theories, Architectures, and Languages*. Springer, Berlin, Heidelberg, 2001.

Natural Language Generation (Template)



Natural Language Generation

Additional (Random) Phrases...

...to indicate a topic switch.

...to clarify the referenced move in the case
of a topic switch.

...to express disagreement.

”Well, maybe we can come back to this point later.
You said earlier: Marriage no longer leads to a stable or permanent relationship.
I’m not sure I understand what you’re getting at.”

Part 3

EVALUATION AND RESULTS

Evaluation and Results

Setup

Comparison of artificial dialogues with dialogues created by humans using the same textual source.

Comparison was done via online survey (clickworker.com) with 122 participants from the UK.

Each participant was shown one randomly selected dialogue (artificial or human), resulting in a splitting of 54 (artificial) to 68 (human).

Each participant had to rate a set of 10 statements regarding the strategy, logical consistency and naturalness of the dialogue on a scale from 1 (strongly disagree) to 5 (strongly agree).

Evaluation and Results

Questions/Statements

I was not convinced by Bob/Alice and how he/she presented his/her case.

It was always clear which previous utterance Bob/Alice addressed in his/her turn.

The arguments presented by Alice/Bob are logically consistent responses to the utterances they refer to.

Alice's/Bob's line of argumentation is not logically consistent.

It was difficult to follow the line of argumentation throughout the debate.

The whole debate is natural and intuitive.

Evaluation and Results

Technical Details

Comparison of the Median for each question/statement (ordinal scale).

Compared distributions with Mann-Whitney-U test.

Significant difference for $p \leq 0.05$ (5%).

Focus on questions assessing the logical consistency of argumentation.

Results

| | Agent | Human | p |
|------------------------|------------|------------|-------------------------------|
| Strat. Bob | 3.0 | 2.5 | 0.11 |
| Strat. Alice | 3.0 | 3.0 | 0.26 |
| Prev. Bob | 4.0 | 4.0 | 0.06 |
| Prev. Alice | 4.0 | 4.0 | 0.29 |
| Arg. Bob | 4.0 | 4.0 | 0.02 |
| Arg. Alice | 3.5 | 4.0 | ≤ 0.01 |
| Arg. line Bob | 2.0 | 2.0 | 0.72 |
| Arg. line Alice | 2.0 | 2.0 | 0.05 |
| Arg. line diff. | 3.0 | 2.0 | ≤ 0.01 |
| Nat. and int. | 2.0 | 4.0 | ≤ 0.01 |

Arg Bob/Alice: The arguments presented by Alice/Bob are logically consistent responses to the utterances they refer to.

Arg. line Bob/Alice: Alice's/Bob's line of argumentation is not logically consistent.

Exemplary Dialogues

Alice: Marriage is an outdated institution.

Bob: Why do you think that?

Alice: The frequency and accessibility of divorce undermines the entire purpose of marriage.

Bob: Could you please elaborate?

Alice: Marriage no longer leads to a stable or permanent relationship.

Bob: That's not a valid point. The purpose of marriage is not an eternal, unrelenting union, whether it is wanted or not.

Alice: Marriage is an outdated institution.

Bob: Could you be more specific?

Alice: According to the Office for National Statistics the average age, in the UK, to get married is approximately 30 years old. Life expectancy in the UK is approximately 80 years. This means the average marriage expects people to commit to maintain a certain way of life for a period that is longer than they have actually been alive. This goes hand in hand with the rise of social acceptability of people having more than one life partner in their life to show that either marriage is an unreasonable expectation of someone or a meaningless charade that is not actually expected to be maintained.

Bob: This argument only works under the assumption that we live in a society where divorce does not exist. If a person enters into a marriage without full awareness of what they have committed to and later need to get out of that marriage, they are free to. Being able to leave a marriage, though, does not make marriage a meaningless charade, as you claim. It is still more difficult to leave a marriage than it is to leave a non-marital committed relationship and so it makes a big difference.

Conclusion

Argumentative Dialogue System...

...utilizes argument structures extracted by means of argument mining techniques.

...formalizes the interaction as Dialogue Game for argumentation.

...was evaluated in a user study that compared artificial with human generated dialogues.

Outlook

Future Work

Integrate existing data/corpora and extend the dialogues to additional topics.

Optimize the dialogue strategy of the system by means of Reinforcement Learning.

Interaction with real users.

Many thanks for your attention!
Any questions?

Reinforcement Learning - Dialogue

Alice: Marriage is an outdated institution. (*Claim*)

Bob: The remarriage rate shows that even people who go through failed marriages retain faith in the institution of marriage. (*Argue*)

Alice: Could you be more specific? (*Why?*)

Bob: Even when marriage has failed to work for them once, many people wish to give it another go. (*Argue*)

Alice: I concede. I'm still thinking about something you mentioned earlier. You said: The remarriage rate shows that even people who go through failed marriages retain faith in the institution of marriage. But I think: Society no longer respects the institution of marriage. (*Concede + Argue*)

Bob: Could you be more specific? (*Why?*)

Alice: The fact that 50% of all divorcees, according to the National Office for Statistics in 1999, go on to remarry does not, as you claim, show that marriage is a meaningful and relevant institution but quite the opposite. What this means is that a huge number of people vow to spend the rest of their life with another person, forsaking all others until death do them part, on multiple occasions. (*Argue*)

Bob: Could you please elaborate? (*Why?*)

Alice: I take that back. You said earlier that the remarriage rate shows that even people who go through failed marriages retain faith in the institution of marriage. You've got a point there." (*Retract + Concede*)

