

Intelligent Tutor System : Making Local and Global Context Motivated Interventions

TEAM 2

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OUTLINE

- Background
- Research Problem
- Current Tutor Systems
- Earlier Work
- Our Approach
- Implementation and Results
- Future Work
- Summary



BACKGROUND

- Computer Supported Collaborative Learning is a pedagogical approach.
- In CSCL, better learning takes place via social interaction (McGrath, 1984)
- Involves using a computer or internet.



ILLUSTRATIVE EXAMPLE OF COLLABORATIVE LEARNING E-TUTOR SYSTEM

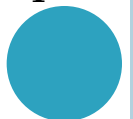
Group of students

421	hi anthony, & me either... what does hoitz mean?
413	nothing... for now
406	ooh, what's the point of this then.
TUTOR	joins the room
421	okay.. la la loopsy la la loopsy
TUTOR	Hi, my name is Sage. I'll be working with you in this activity. Take a minute to introduce yourselves.
413	idk its FOR SCIENCE
TUTOR	I won't tell you if you're right or wrong, but I'll give feedback as you discuss each problem as a team.
TUTOR	As a group, come up with a good scientific explanation for how these two parents could produce this litter of kittens.
421	so i guess we are trying to figure ou the traits of the parent cats. the orange one has the dominant trait for orange fur and it dominates over the cat with white fur so the possible gene combinations is Ff & ff or FF & ff
TUTOR	So, 421 - are you telling us that if both parents have the orange phenotype, it's still possible that some of the kittens will be white?
406	gene
421	F being the orange fur trait and f being the white fur trait
TUTOR	So, 421 - are you telling us that recessive genes aren't always expressed?
TUTOR	Any input from 406?
413	the white kitten is heterozygous and the orange one is homozygous domanint so there was no chance of a white kitten in there litter
TUTOR	So how is this about homozygous genotypes?
406	the orange cat is homozygous dominant.
421	no, they arent if the dominant trait is present in every outcome, there is no chance of the cats to come out with white fur

Role of E-Tutor

Posing a Question

Encouraging Participation



RESEARCH PROBLEM

- ❖ Making the ITS more socially aware of **when** to intervene in collaborative environment and **how**.
- ❖ Use a **state representation** of a conversation to do so.



EXAMPLES OF TUTOR INEFFECTIVENESS

TUTOR	<-- Here's the next problem...	07.19.15
TUTOR	What factors will affect these compounds' relative boiling points? How will the unla	07.19.26
TUTOR	Type 'ready' when you've finished discussing this.	07.19.35
S13	all of the molecules are the same in that they are in the same column, the only thing	07.19.59
S14	yep	07.20.14
S13	Si has the smallest while Sn has the largest. Do we agree?	07.20.14
S14	yes	07.20.17
TUTOR	Ok	07.20.18
S14	Ready	07.20.29
TUTOR	Thanks, S14.	07.20.31
S15	ready	07.20.32
S13	Ready	07.20.34
TUTOR	Thanks, S15.	07.20.35

Figure 1: Quick agreement of proposal without proper discussion.



EARLIER WORK

Work	Author/Year
Analyzes interaction processes to improve collaboration (DEGREE APPROACH)	Barros, B. e Verdejo, M. F, 2000
Collaborative Case Study System for Distance Learning	M. Rosatelli and J. A. Self , 2002
Seven Step Model for subjective/ case study type problems	Easton, 1982
Statistical Models for Topic Segmentation	Barros, B. e Verdejo, M. F, 2000
Learning to Detect Conversation Focus of Threaded Discussions	Jeffrey C. Reynar
Donghui Feng, Erin Shaw, Jihie Kim, Eduard Hovy	Learning to Detect Conversation Focus of Threaded Discussions
Dr. Carolyn P. Rosé & David Adamson	Coordinating Multi Dimensional Support in Collaborative Conversational Agents

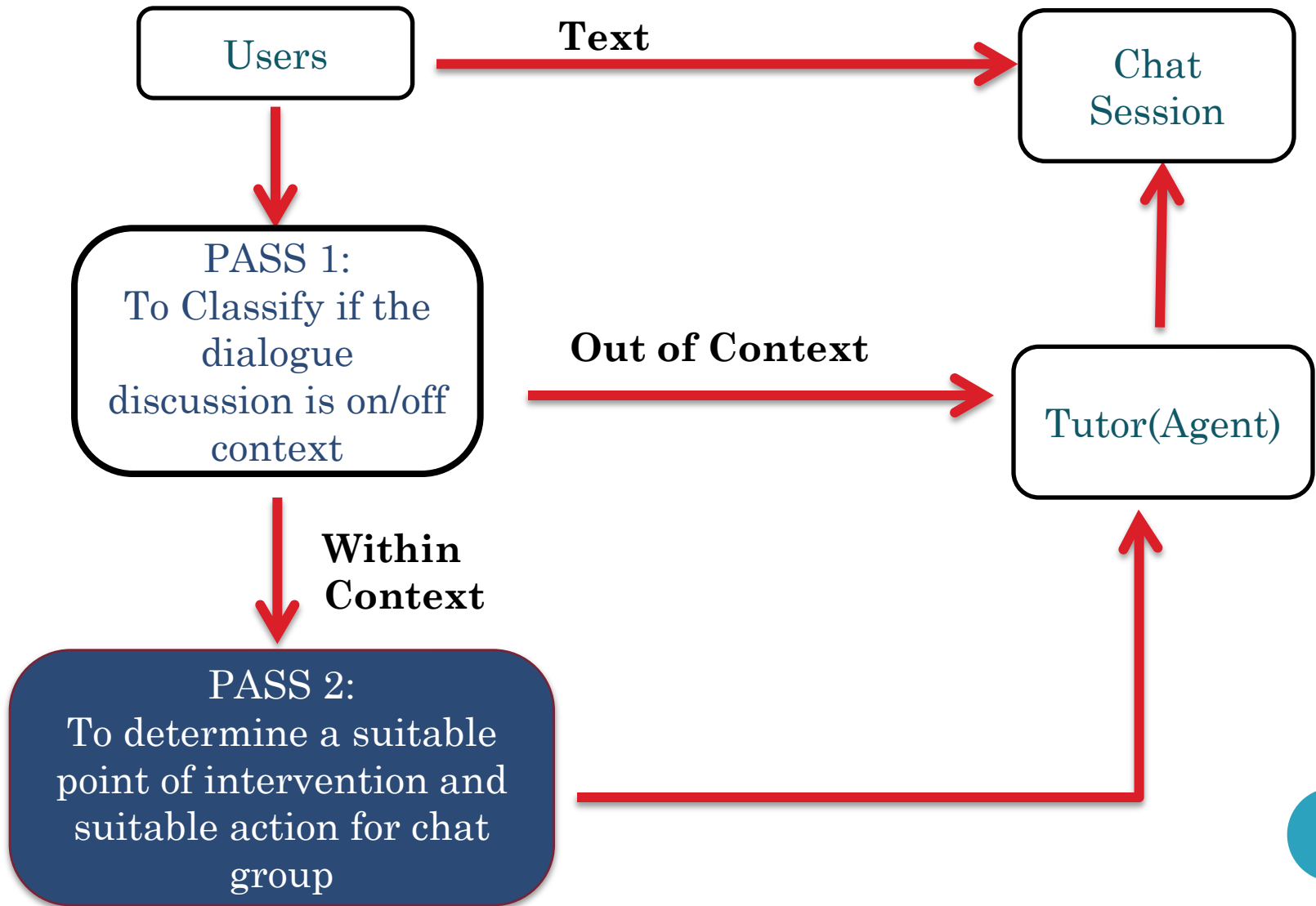
OUR APPROACH

- Monitoring only occurs in ontask conversations.
 - Filter Pass:

Uses frequency of domain specific jargon to identify deviations from topic over time and enforce focus.
 - Trigger Pass:
 - Categorize the conversations into **attributes** like proposal, question, doubt etc.
 - Conversation analysis using attributes at **two levels** :
 - Individual Level
 - Group Level
 - Depending on the trend of conversation, tutor steps in appropriately.



Architecture: Bird's Eye View



TRIGGER PASS

- ❖ Every chat conversation is categorized into following attributes:
 - **Comment** : Generic statement on an idea
 - EXAMPLE: I THINK....., I BELIEVE....., ANYWAYS.....ETC.
 - **Question** : subject pertaining questions
 - EXAMPLE: WHEN DO....., WHEN WILL....., HOW DOES.....ETC.
 - **Clarification** : Text that answers a question or elaboration.
 - EXAMPLE: TO CLARIFY...., TO ELABORATE...., I MEAN TO SAY.....ETC.
 - **Consensus/Agreement** : Concludes a discussion
 - EXAMPLE: I AGREE....., THAT'S FINE....., SOUNDS GOOD....ETC.
 - **Proposal** : Ideas being proposed or disagreements.
 - EXAMPLE: LET'S TRY....., SHALL WE....., I PROPOSE.....ETC.
 - **Doubt**: Depict confusion, conflict or similar sentences.
 - EXAMPLE: I DON'T KNOW....., I AM LOST....., IS THIS OKAY.....ETC.
- ❖ **Sentence Openers** would be used to identify the attributes.
 - Beginning of the sentence can only be one among the given set of above choices.
 - Simplicity of implementation.



STATES OF CONVERSATION

	Confusion	Initiative	Elaboration	Consensus
Proposal	-2	10	10	-5
Question	3	5	2	1
Doubt	10	3	1	0
Comment	0	4	2	0
Clarification	-1	2	8	8
Agreement	0	0	0	10

Figure 5: Weight distribution across states and attributes.

- ❖ States (confusion, initiative, elaboration and consensus) are used to evaluate the performance of the students (Beatriz Barros, Verdejo et al, 2000).
- ❖ **New attribute** DOUBT and new state CONFUSION were added.
- ❖ Individual analysis can be done by observing the frequency of the states in the conversation of a student.

GROUP ANALYSIS

- ❖ Analyzing the group conversation in terms of two variables:
 - Confusion
 - Consensus

Vectorial Representation of Attributes

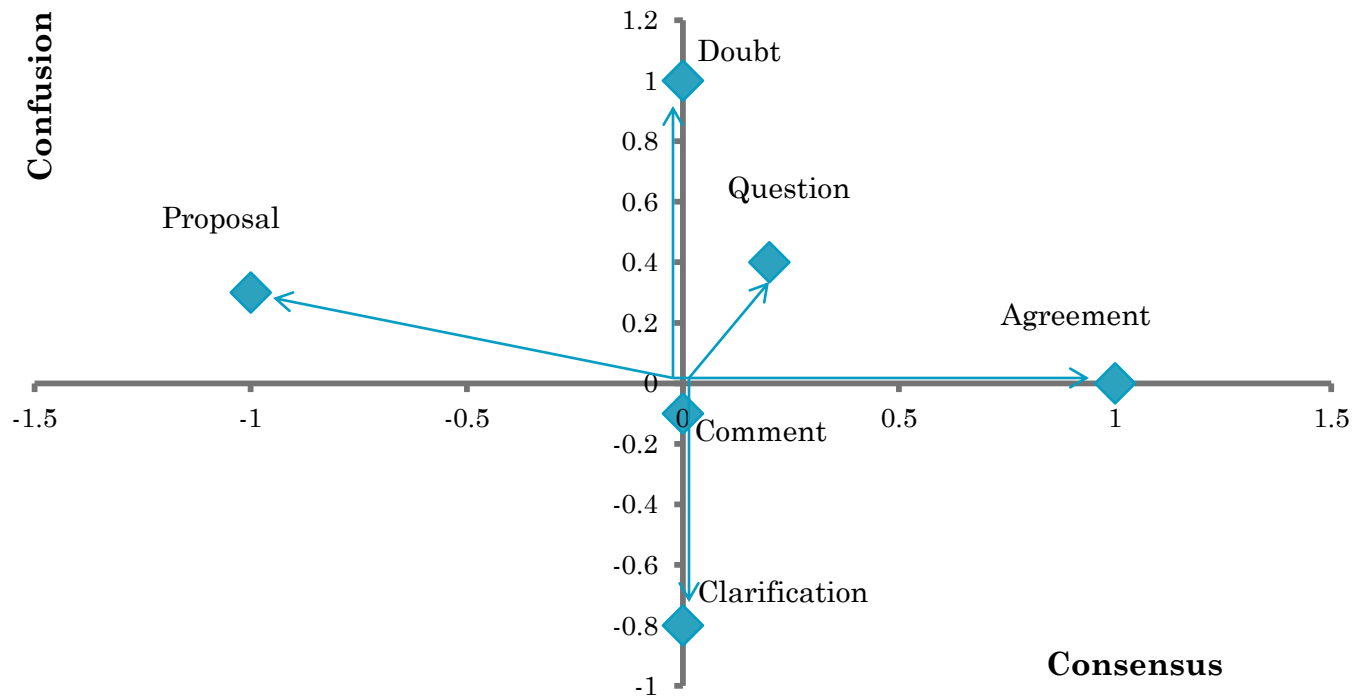


Figure 6: Distribution of Attribute Vectors for analysis of group conversation.



GROUP ANALYSIS

- We choose an initial situation relative to which the flow of conversation is being analyzed.
- To track the trends of the conversation, we add the attribute vector to the previous state.

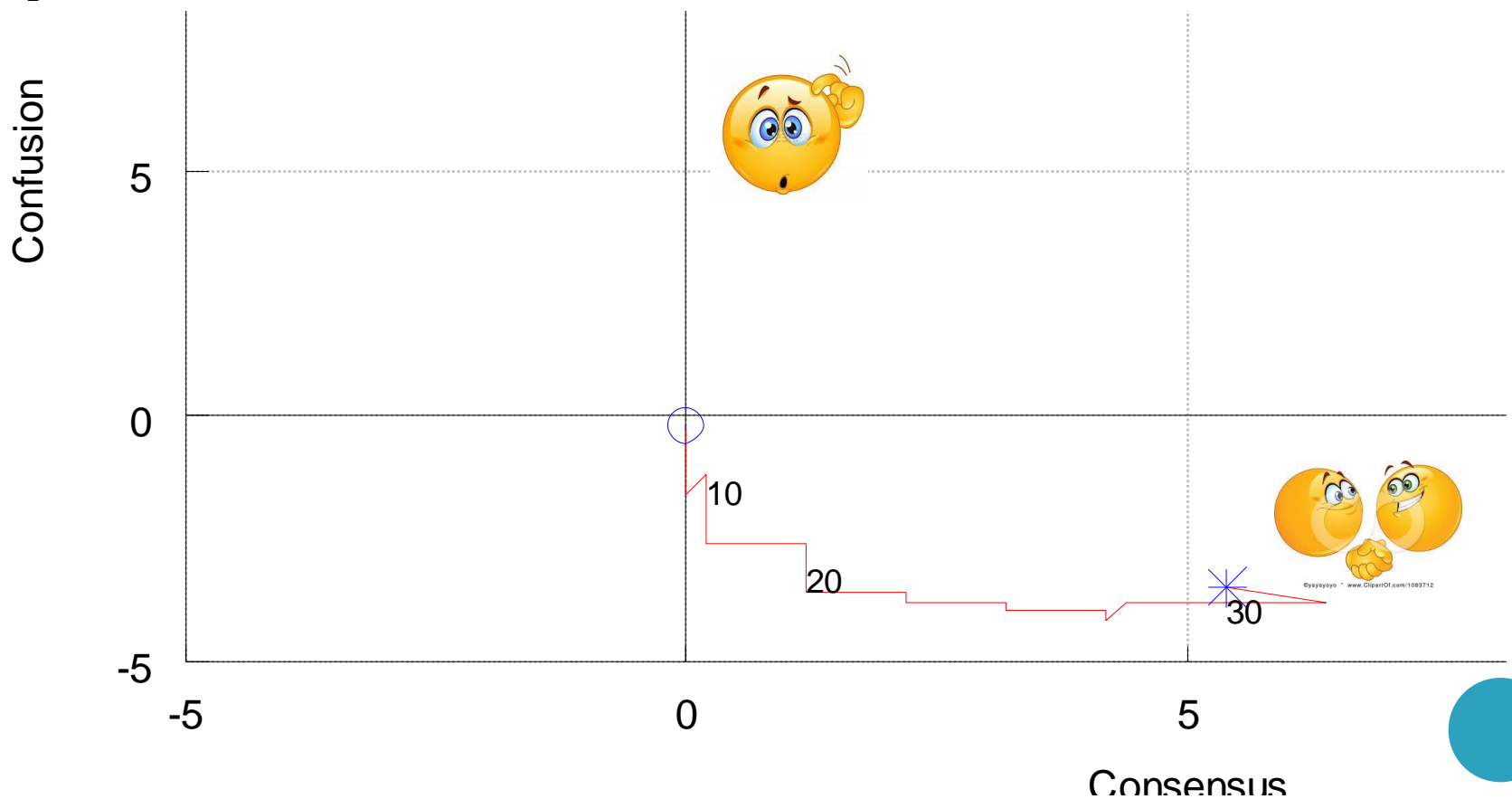


Figure 7: Group Trends for a conversation excerpt..

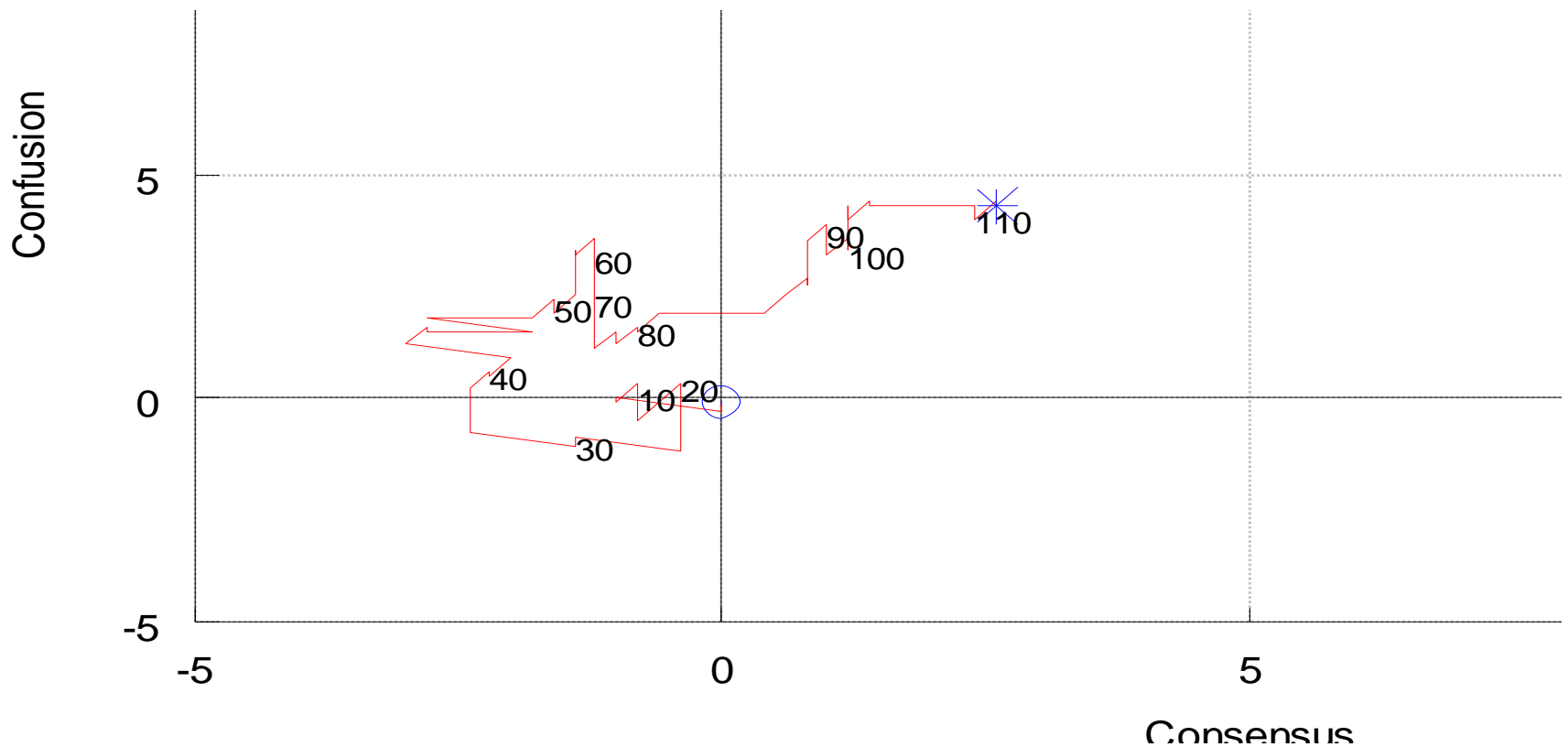
FUZZY MODEL FOR INTERVENTION

Confusion	Consensus	Number of turns	Tutor Action
High	Low	Few	Comment
High	Low	Many	Clarification
Low	High	Few	Proposals/ Elaborations
Low	High	Many	Move on

Figure 8: Distribution the type of intervention tutor should make.



IMPLEMENTATION AND RESULTS



- Case Description:
 - Work setting – High school Bio class.
 - Tutor – Not making relevant comments
 - Group Response – Was unable to understand the system and rushed towards conclusion in the end.



IMPLEMENTATION AND RESULTS

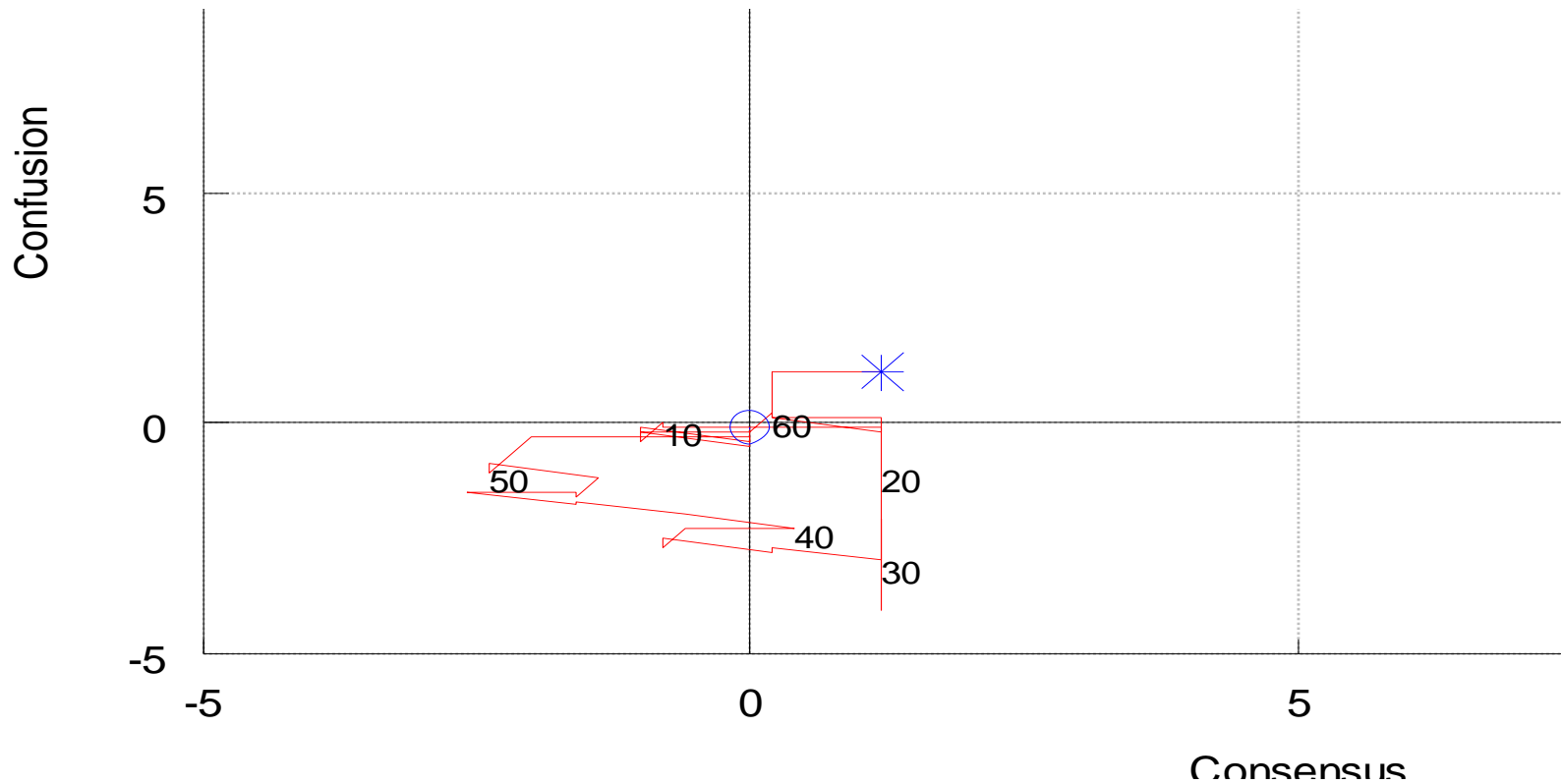
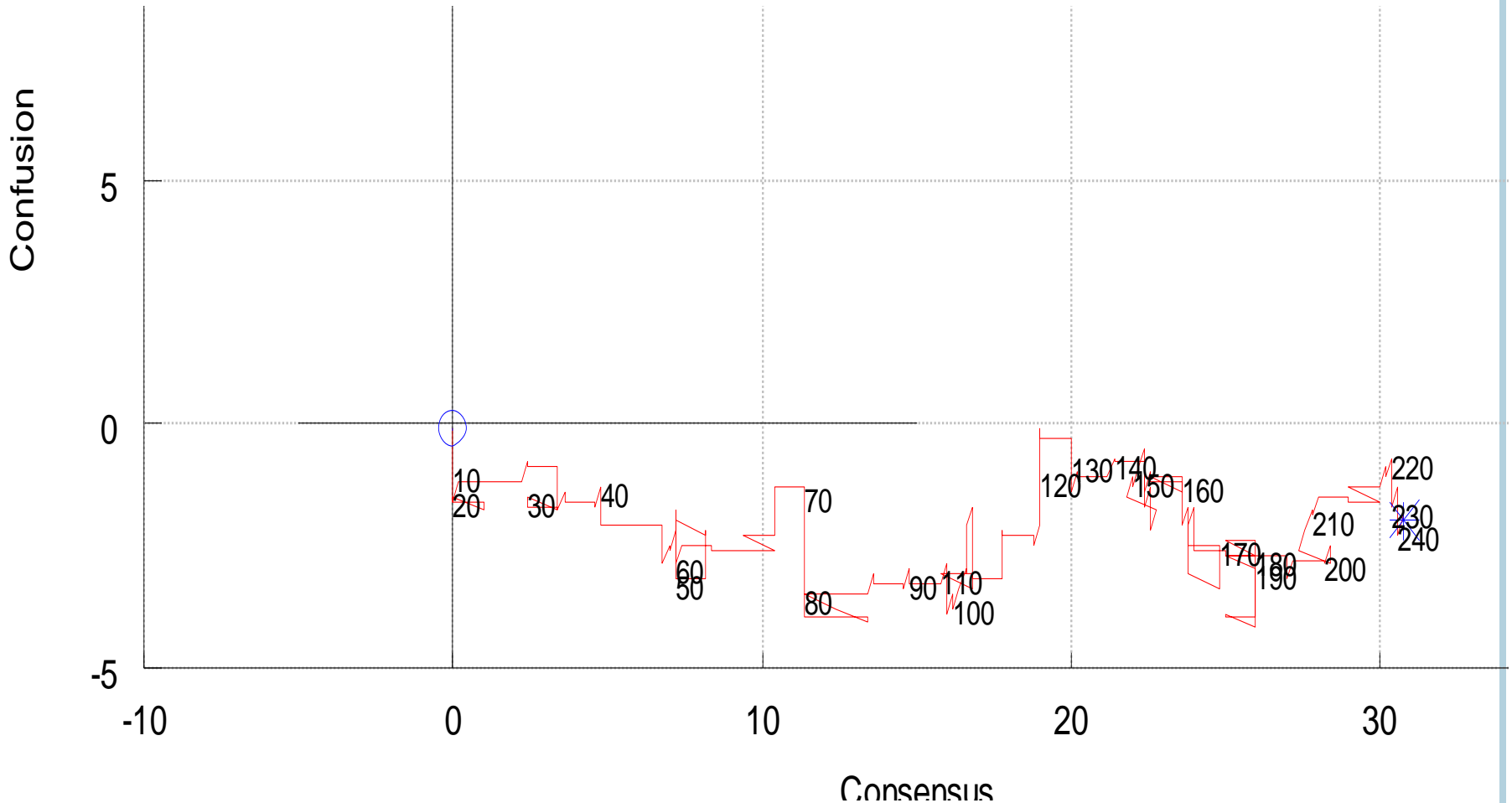


Figure 10: Another conversation excerpt from another in the similar setting.



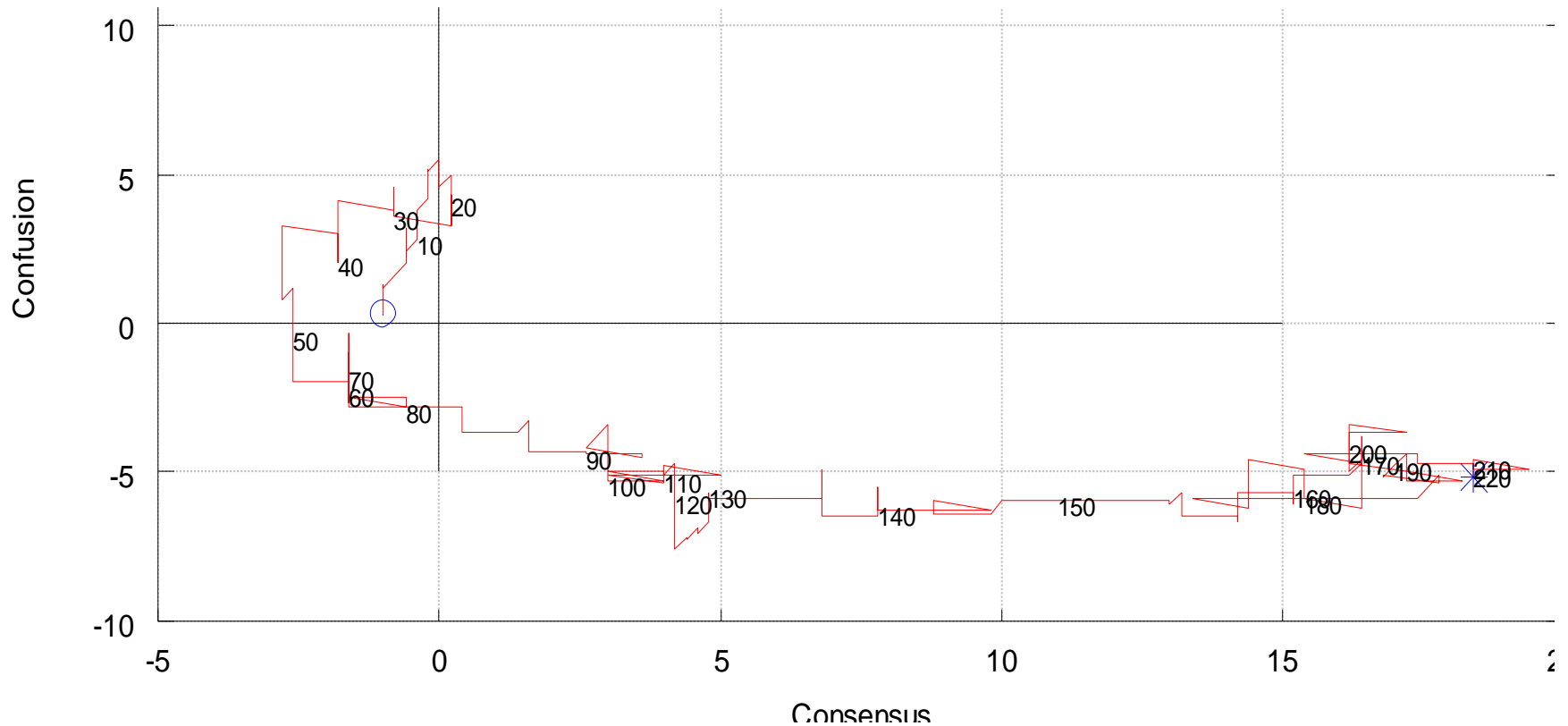
IMPLEMENTATION AND RESULTS



- Case Description:
 - Work setting – Undergraduate Students of Thermodynamics Class.
 - Tutor – More responsive tutor (asking for elaboration and questions)
 - Group Response – Discussion trend followed by the group.



IMPLEMENTATION AND RESULTS



- Case Description:
 - Work setting – Graduate Chemistry Students.
 - Tutor – Intervenes only to ask questions.



FUTURE IMPROVEMENTS

- The weights assigned for newly created class should be determined through some data mining techniques like reinforcement learning.
- Weights can be adaptive to more adequately react to local context.
- Model can be verified on larger corpus of chat data, using pre and post tests to do so.



SUMMARY

- Identified problems with existing ITS systems. (Lack of responsiveness, local context, unnecessary interventions etc.)
- Proposed 2 pass architecture:
 - First Pass : Maintaining conversation focus, for 2nd pass to function within correct context
 - Second Pass : Tracking global trends, detecting when to intervene and how.
- Developed a 2-D state representation method to model a conversation as a transition through states, in 2nd pass.
- Demonstrated how it takes care of existing problems :
 - global context (tracking state transitions over long time on 2-D graph)
 - Detecting when to intervene and what type of intervention is required (fuzzy model)
- Presented results and possible future developments.



THANK YOU!!!

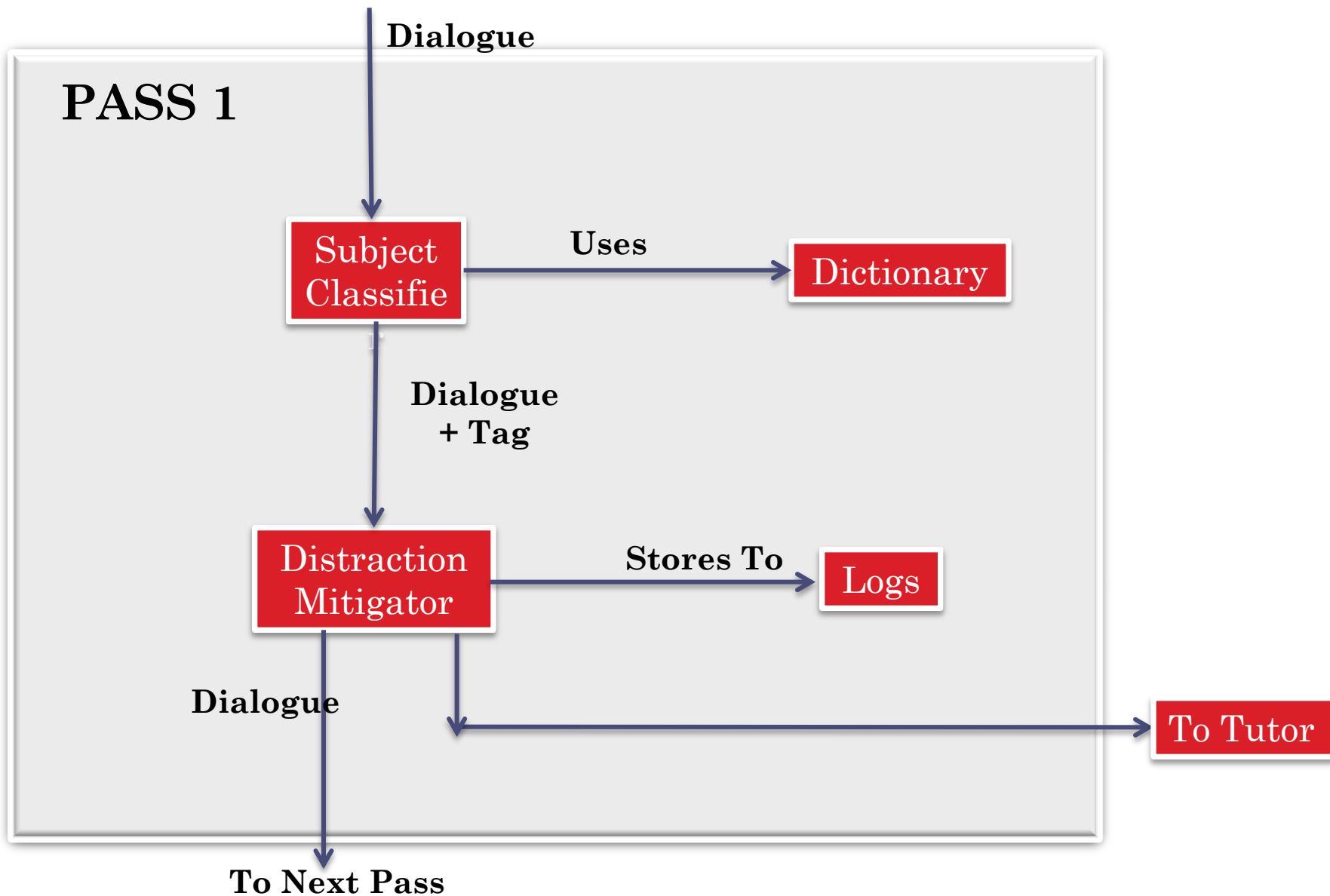


WORKSPACE SETTING

- ❖ Home like setting (Informal Setting)
 - No strict limit over time
 - Absence of teacher / authoritative figure

- ❖ Why?
 - Do not want time constraints on the completion of task.





Implementation:

- Built a classifier model from the available data sets over Chemistry chat sessions.
- Classifier showed results of : Kappa - .6909
Accuracy – 84%

From Pass

1

PASS 2

Use SOM (Sentence Opener Model) to categorize

Utterance Classifier

Proposal

Comment

Agreement

Question

Classified Categories

Model Selection

Individual Analysis

Group Analysis

Intervention Locator

Store
Uses

Logs

Send message if required

To Tutor



INDIVIDUAL ANALYSIS

- For evaluating whether students are involved in learning and in what way, we may calculate the above attributes for each student.

$$V_{ai} = \sum N_i * V_{ji}$$

where V_{ai} is the score for i th attribute that a student have

N_i is number of times student goes to that state

V_{ji} is the wieght of i th category

- These attributes may be used target questions or request s for elaboration to students that are participating less.
- We just want to make sure that students don't go by feeling of "not being caught" in group.



IMPLEMENTATION RESULTS

The figure displays three sequential screenshots of a chat window, illustrating the implementation of an FSM-based model. Each screenshot shows a chat history and a summary box at the bottom.

Chat Window 1:

- prakk joins the room 1:24:15 PM IST
- Anne O'Tater joins the room 1:26:07 PM IST
- prakk 1:28:54 PM IST: shall we discuss on ionic bonding in water
- Anne O'Tater 1:29:02 PM IST: prakk's message is: A+_PP_
- prakk 1:29:22 PM IST: i agree that water is ionic in nature
- Anne O'Tater 1:29:26 PM IST: prakk's message is: A+_AG_
- Anne O'Tater 1:29:29 PM IST: Hey guys! we encourage healthy discussion before being conclusive

Message: Conclusion without Agreement

Chat Window 2:

- prakk 1:30:35 PM IST: how does bonding happen
- Anne O'Tater 1:30:39 PM IST: prakk's message is: _QS_+Z
- prakk 1:31:05 PM IST: when is water more polar in nature
- Anne O'Tater 1:31:09 PM IST: prakk's message is: _QS_+A
- prakk 1:31:36 PM IST: how much water can be vapourised
- Anne O'Tater 1:31:42 PM IST: Please keep clarifying doubts/questions as you proceed!!!
- Anne O'Tater 1:31:44 PM IST: prakk's message is: _QS_+Z

Message: Doubts not getting clarified.

Chat Window 3:

- sure
- Anne O'Tater 1:32:57 PM IST: prakk's message is: _AG_+Z+_DT_
- prakk 1:34:34 PM IST: i have a doubt regarding covalent bonds
- Anne O'Tater 1:34:38 PM IST: prakk's message is: A+_DT_
- prakk 1:35:04 PM IST: thats fine let us proceed
- Anne O'Tater 1:35:09 PM IST: Please have no uncleared doubts before conclusively ending the topic!!
- Anne O'Tater 1:35:12 PM IST: prakk's message is: _AG_+Z

Message: Agreement before clarification.

Figure : Demonstration of FSM based implementation of our model.