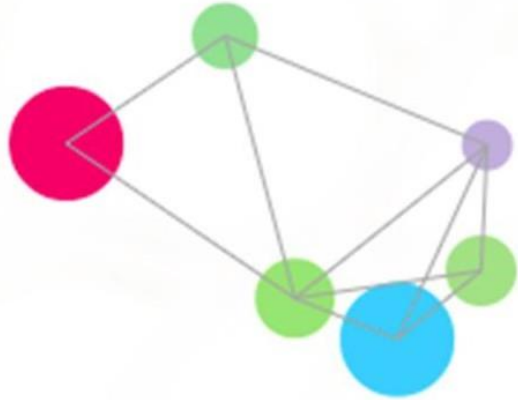


Cognitive Belief Modeling for Naturalistic Dialog Management

Eric Saund, Ph.D.*
Saund Laboratories

*This work conducted at the Palo Alto Research Center

Conversation



RE: Basic Conversational Competence

User: Alexa, when is the Superbowl?

*Alexa: Superbowl fifty-two will be on NBC on February fourth at three-thirty PM.
The teams competing are yet to be determined.*

User: Alexa, is that a Sunday?

Alexa: Sorry, I don't know that one.



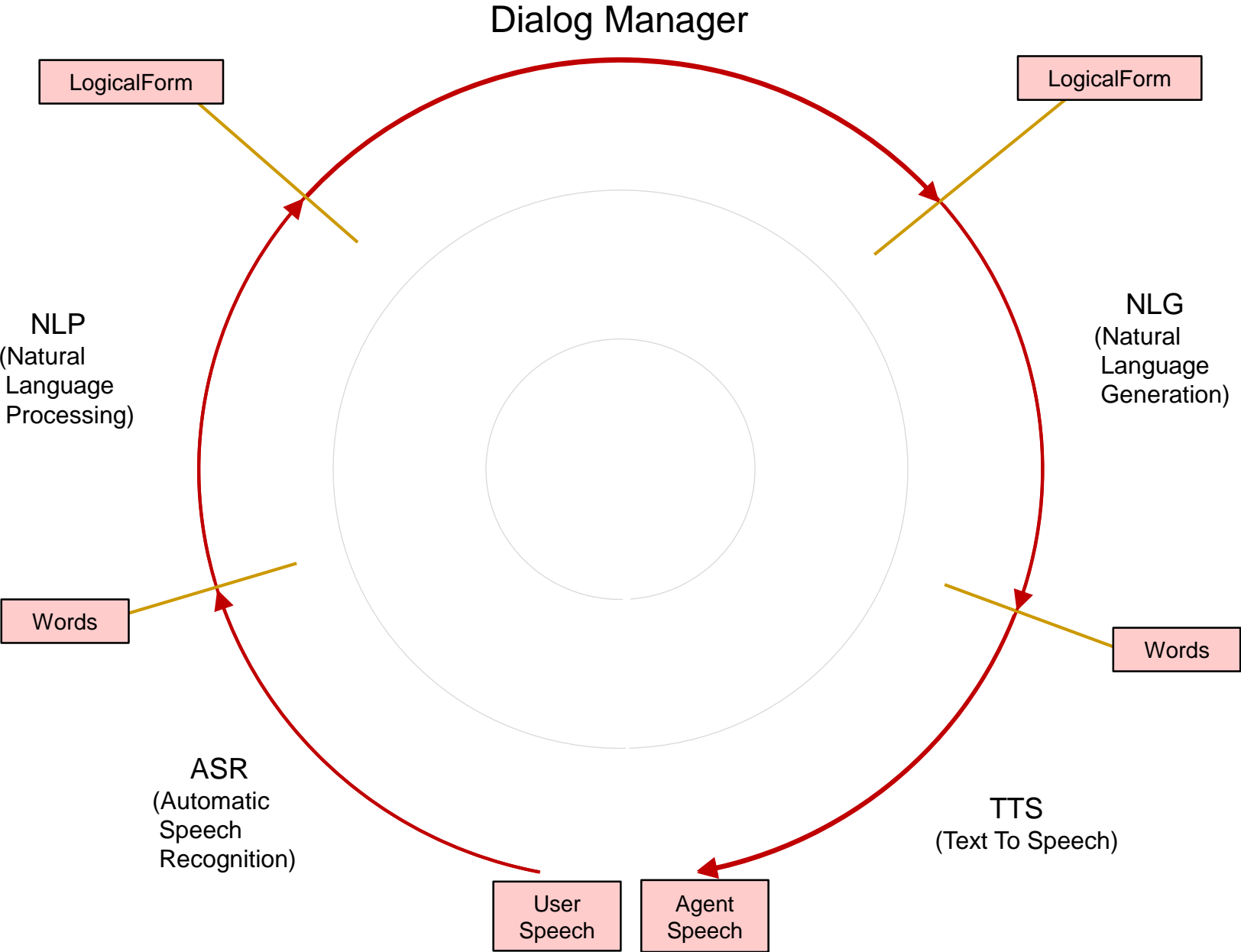
User: Alexa, repeat that. ✓

User: Alexa, repeat that more slowly. ✗

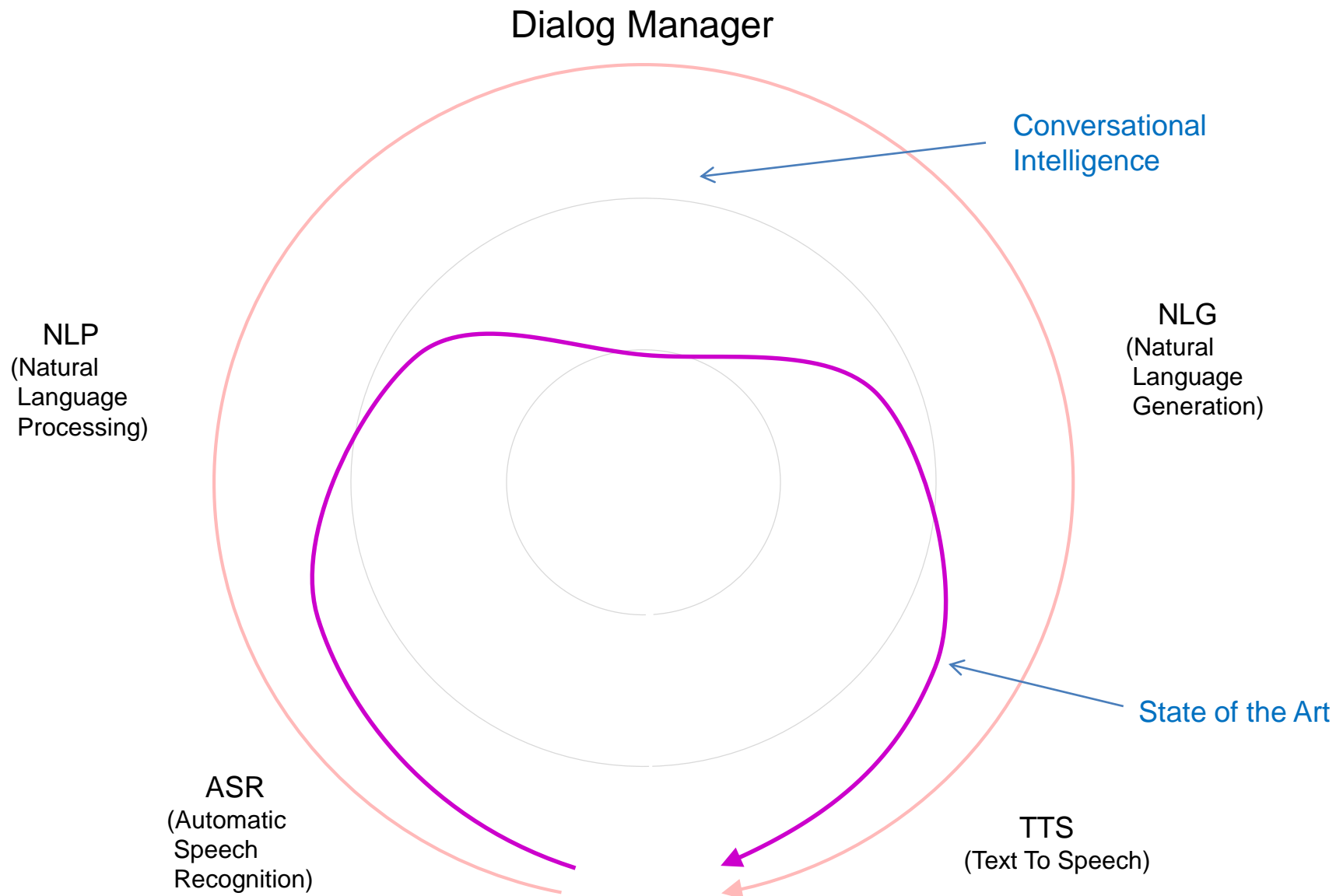
User: Alexa, what time did you say? ✗

User: Alexa, did you say three-thirty? ✗

Radar Map: Conversational Agent Architecture



State of the Art in Conversational Agents



Natural Conversation

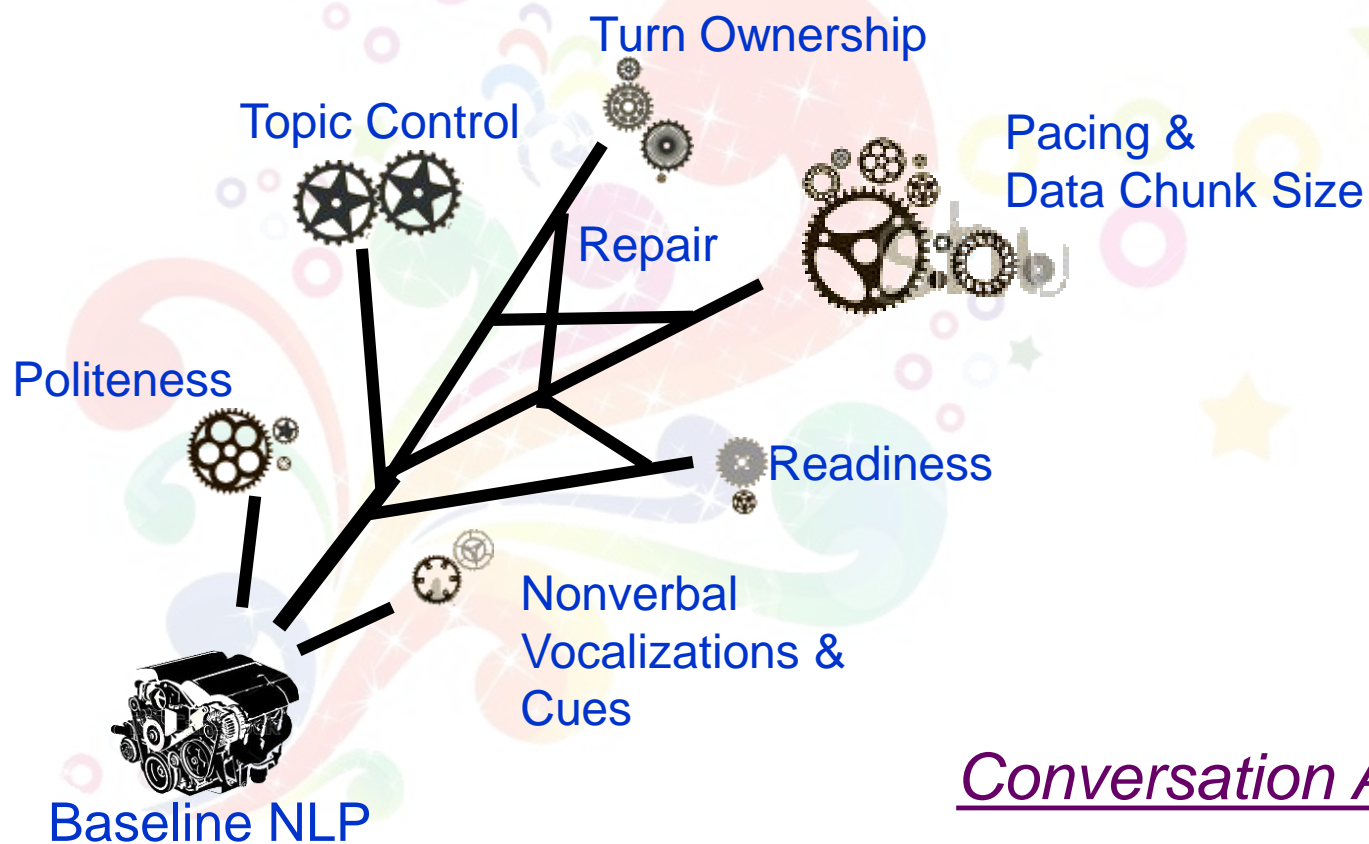


Natural Conversation



Conversation Analysis

Naturalistic Conversation



Conversation Analysis

Simple Task: Communicate Structured Data

U: what is the telephone number?

A: area code six five zero

U: six five zero

A: five nine two

U: sorry, did you say five nine three?

A: no. it's five nine two

U: okay. what comes after that?

A: the line number is zero five nine seven

U: zero five

A: nine seven

U: okay, got it

A: we're all done



Common Ground

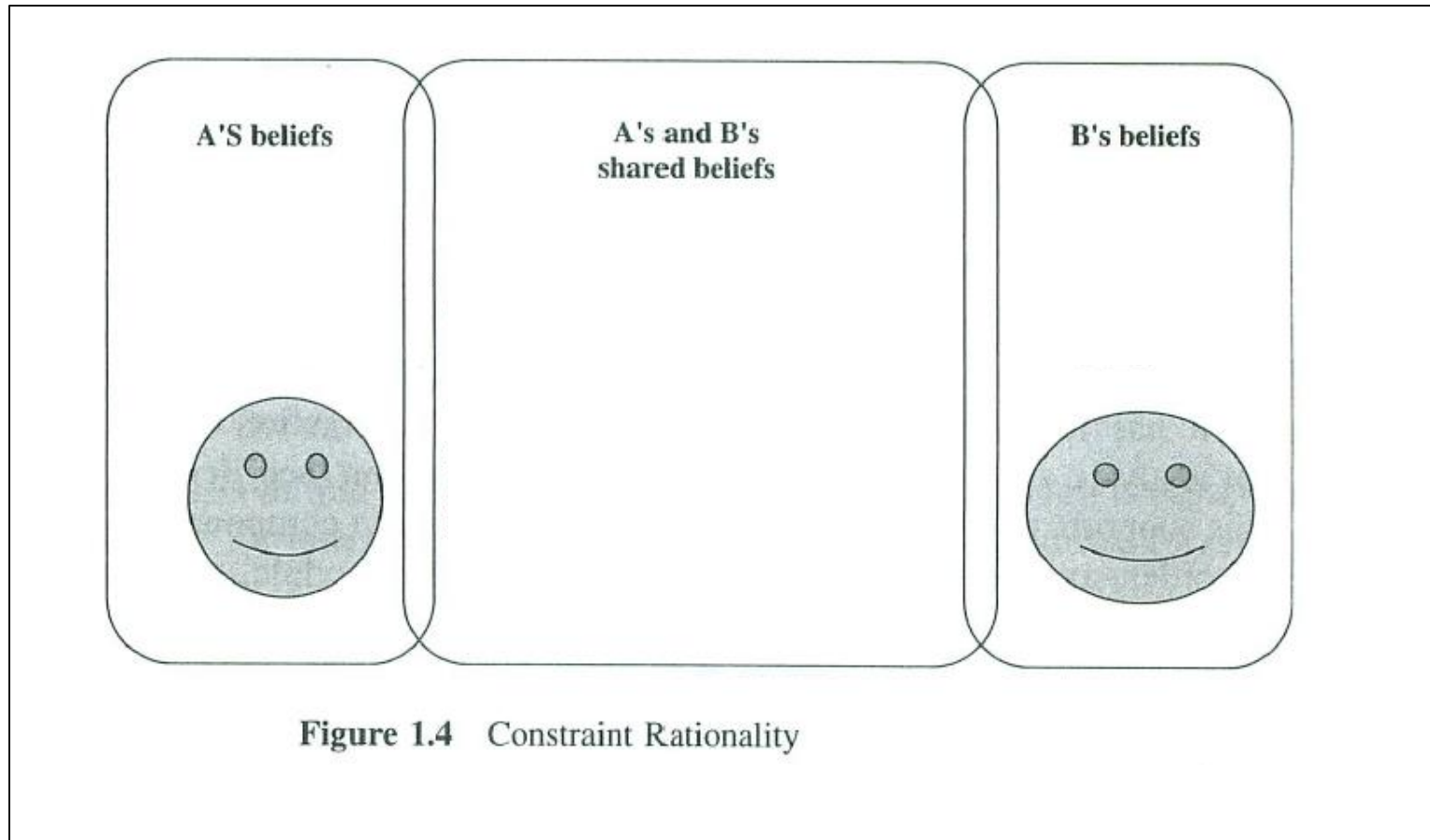


Figure 1.4 Constraint Rationality

K. Jokinen, "Constructive Dialog Modeling", 2009

H. Clark, 1985 (psycholinguistic theory)

D. Traum, 1993+ (in dialog managers)

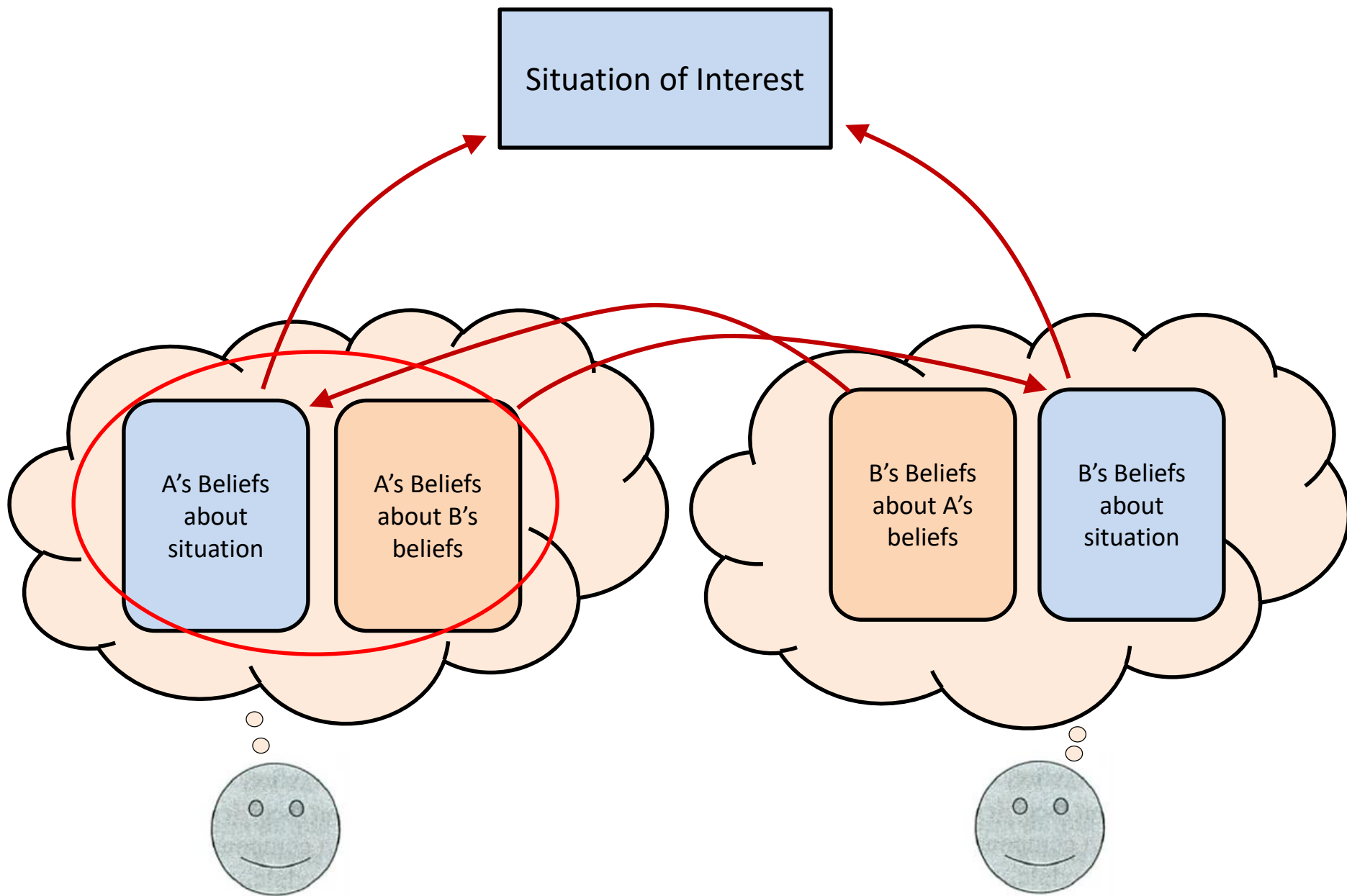
E. Horvitz, 1998+

N. Goodman, 2016+

...

Cognitive Belief Model

Cognitive Belief Modeling



Modeling Belief About User's Knowledge of Telephone Number

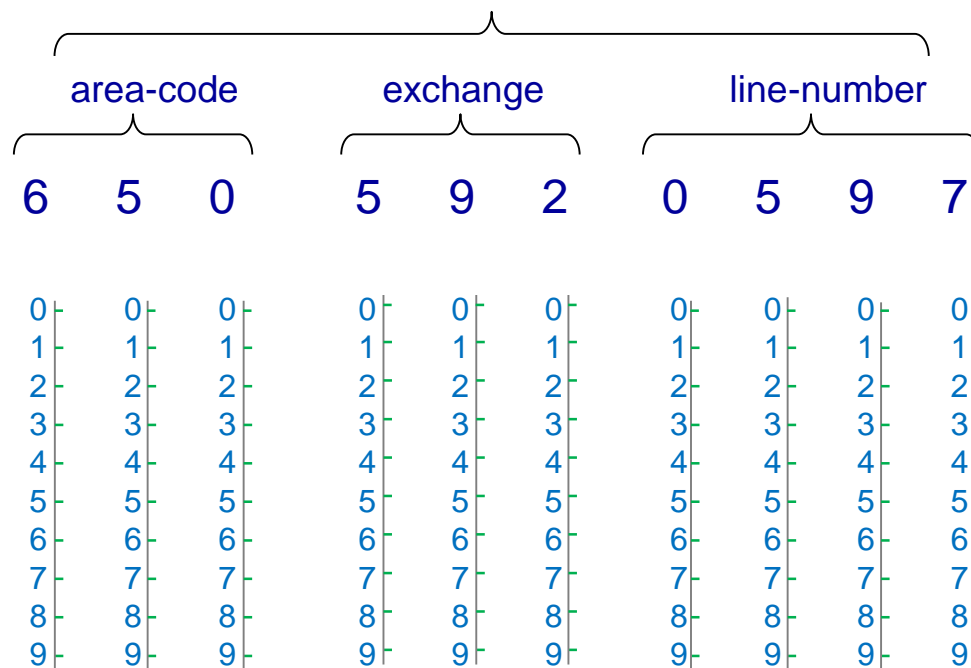
A's Beliefs
about
situation



A's Beliefs
about B's
beliefs

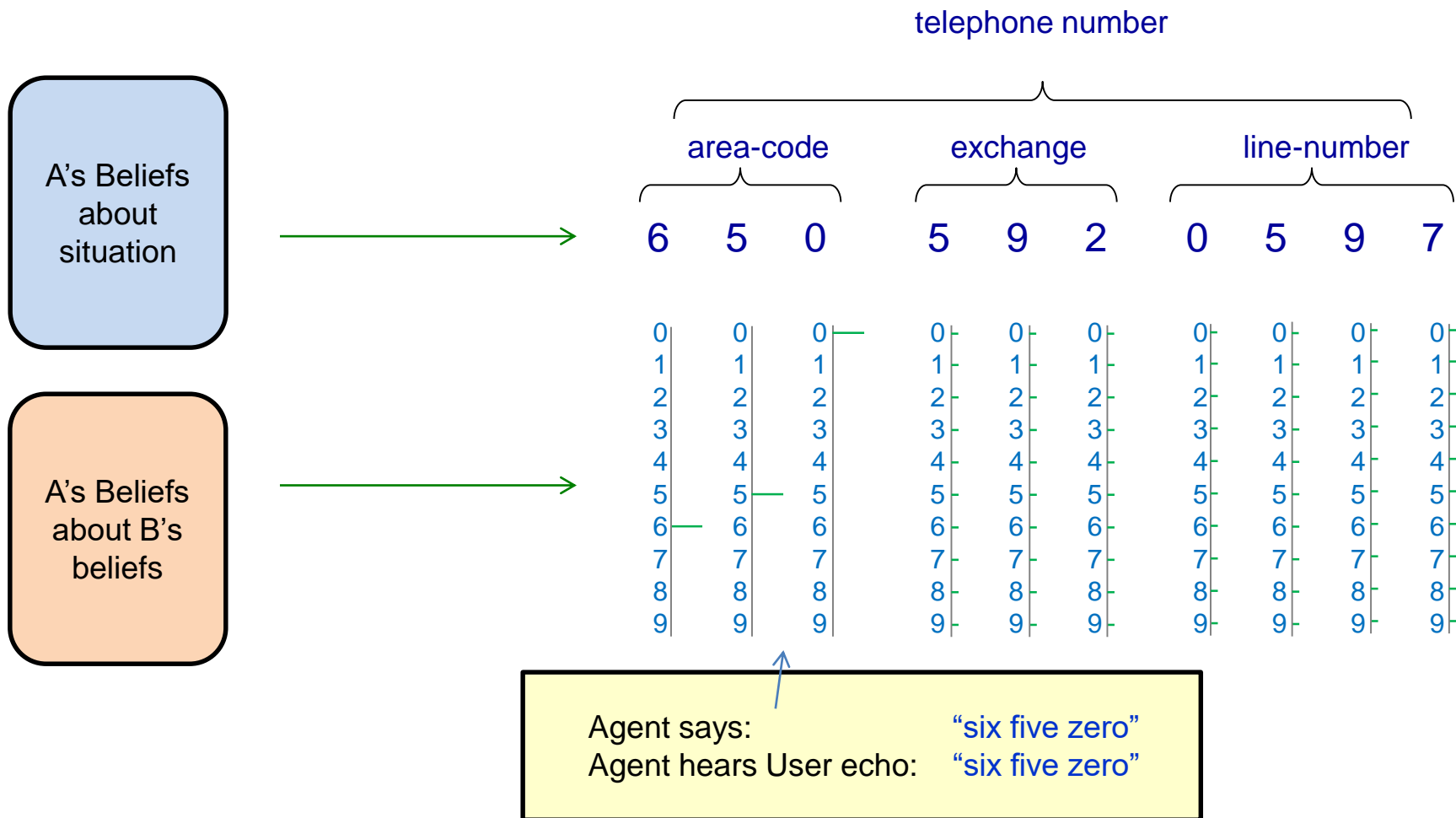


telephone number

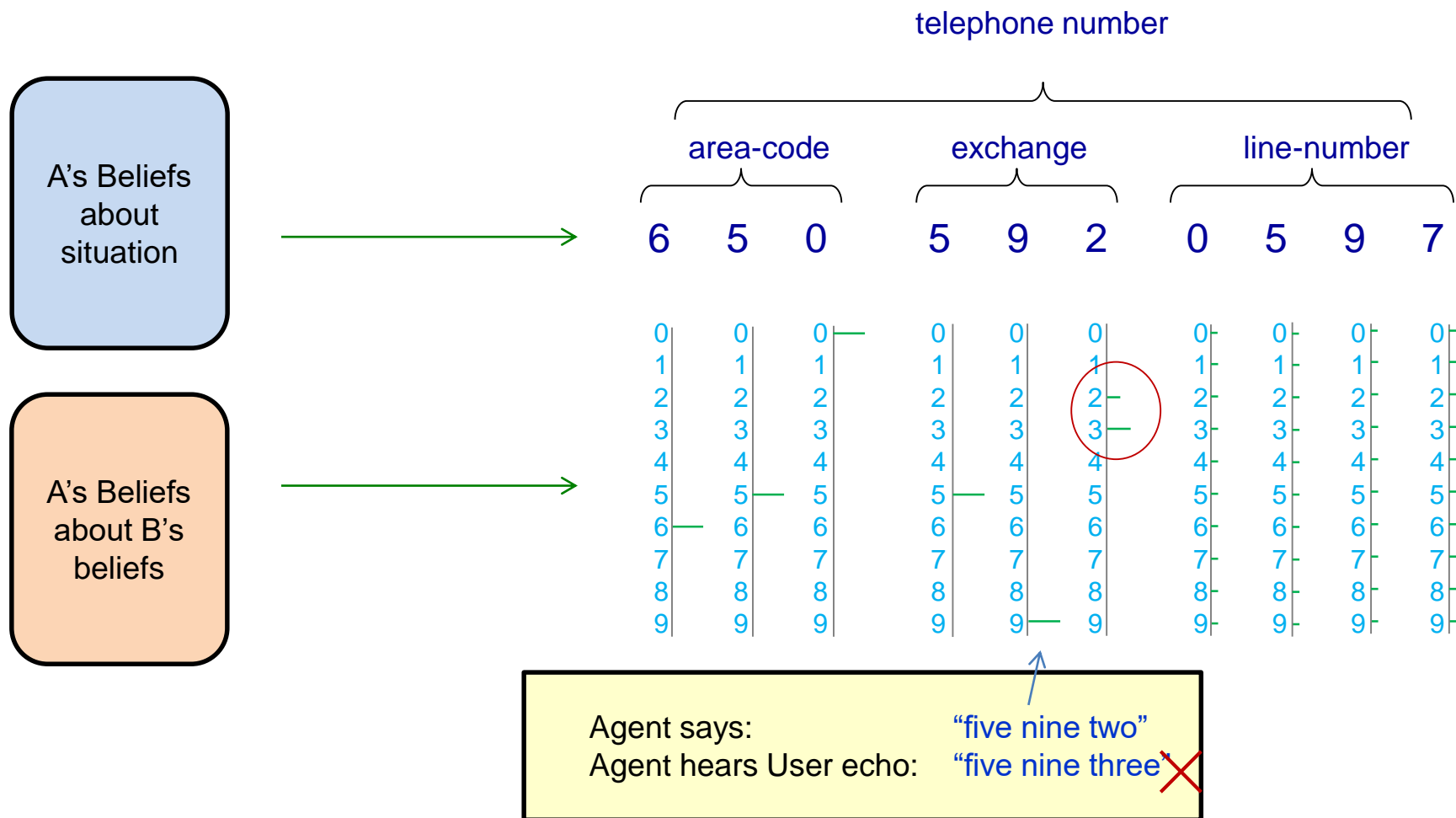


Distribution of belief that
user holds this number
as digit value.

Modeling Belief About User's Knowledge of Telephone Number



Modeling Belief About User's Knowledge of Telephone Number



Similarly for...

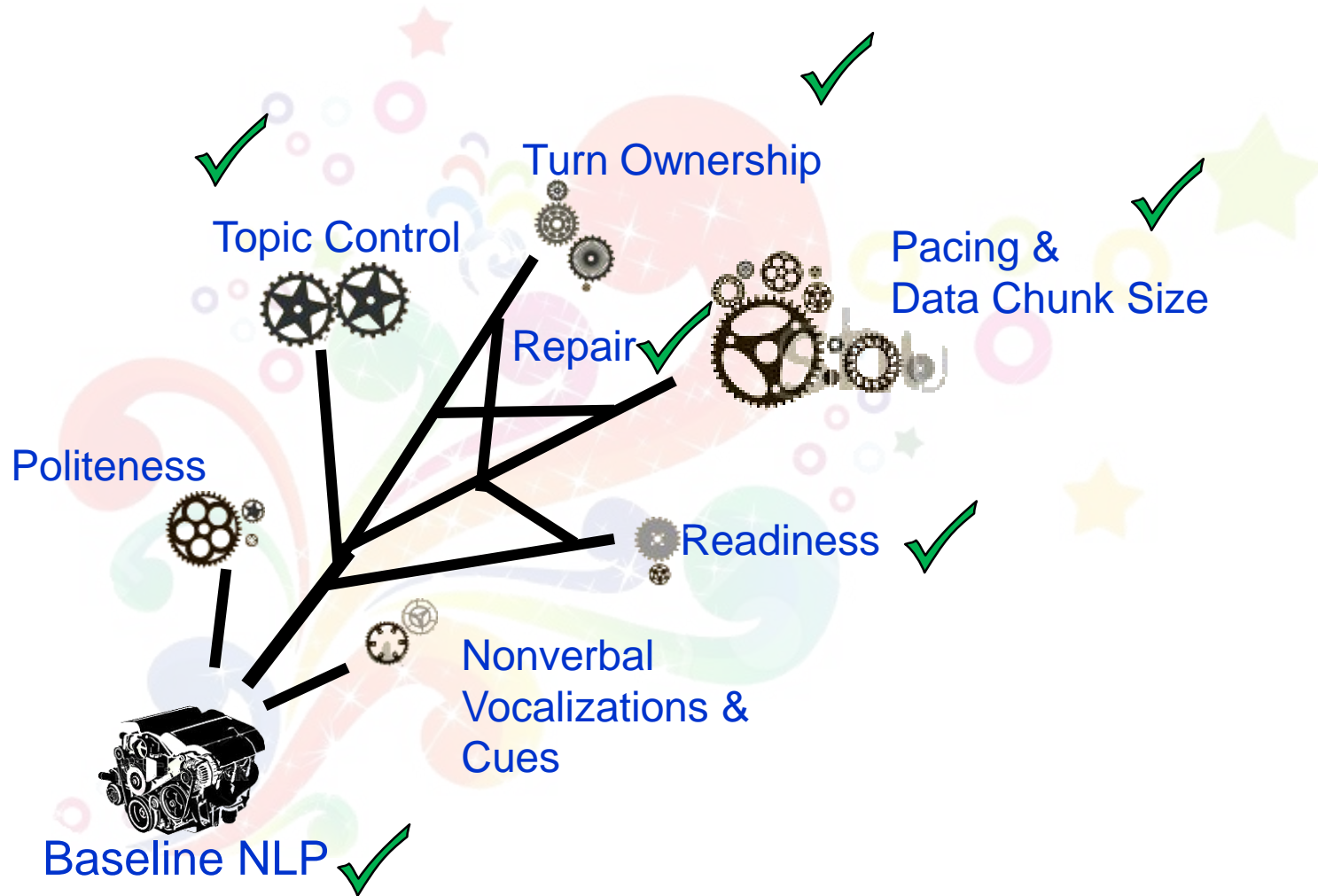
- Readiness
- Turn Ownership
- Chunk Size

Conversational mechanics in communicating structured data.

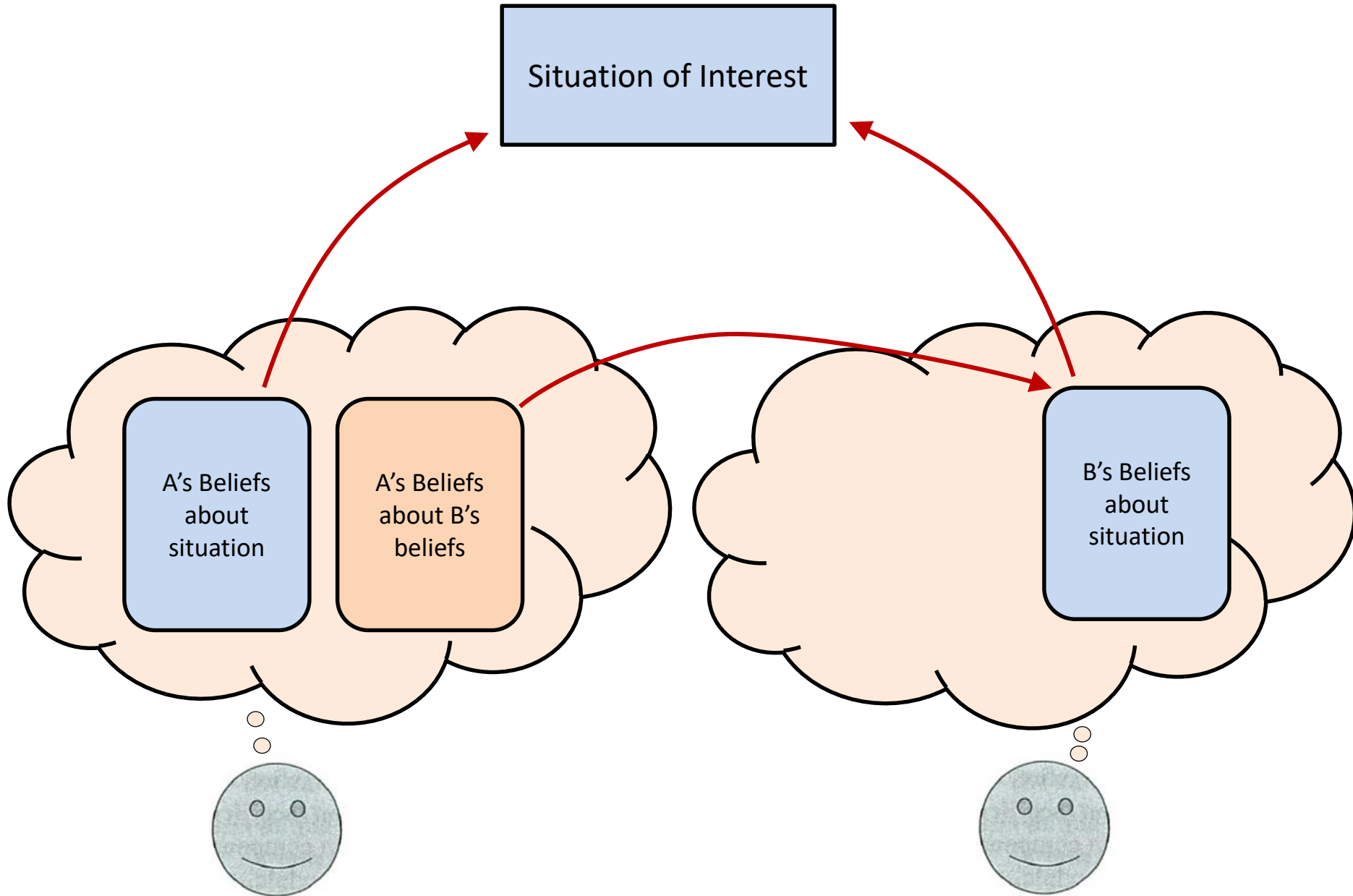


A: would you like to send or receive a telephone number?	<i>Opening</i>
U: no not yet	<i>Readiness</i>
A: okay i'm standing by.	<i>Readiness</i>
U: tell me the phone number now.	<i>Readiness, topic control</i>
A: area code six five zero	<i>Data index + data values</i>
U: six	<i>Echo repeat check, signal chunk size</i>
A: five	<i>Implicit confirmation; adjust chunk size</i>
U: five	<i>Echo repeat check check</i>
A: zero	<i>Data value</i>
U: six five zero	<i>Confirmation check, signal chunk size</i>
A: the exchange is five nine two	<i>Data index + values, readjust chunk size</i>
A: zero five nine seven	<i>Automatic retake of turn ownership</i>
U: got it	<i>Confirmation</i>
A: we're all done	<i>Closing</i>
U: stop now	<i>Topic control</i>
A: okay	<i>Confirmation of topic control</i>

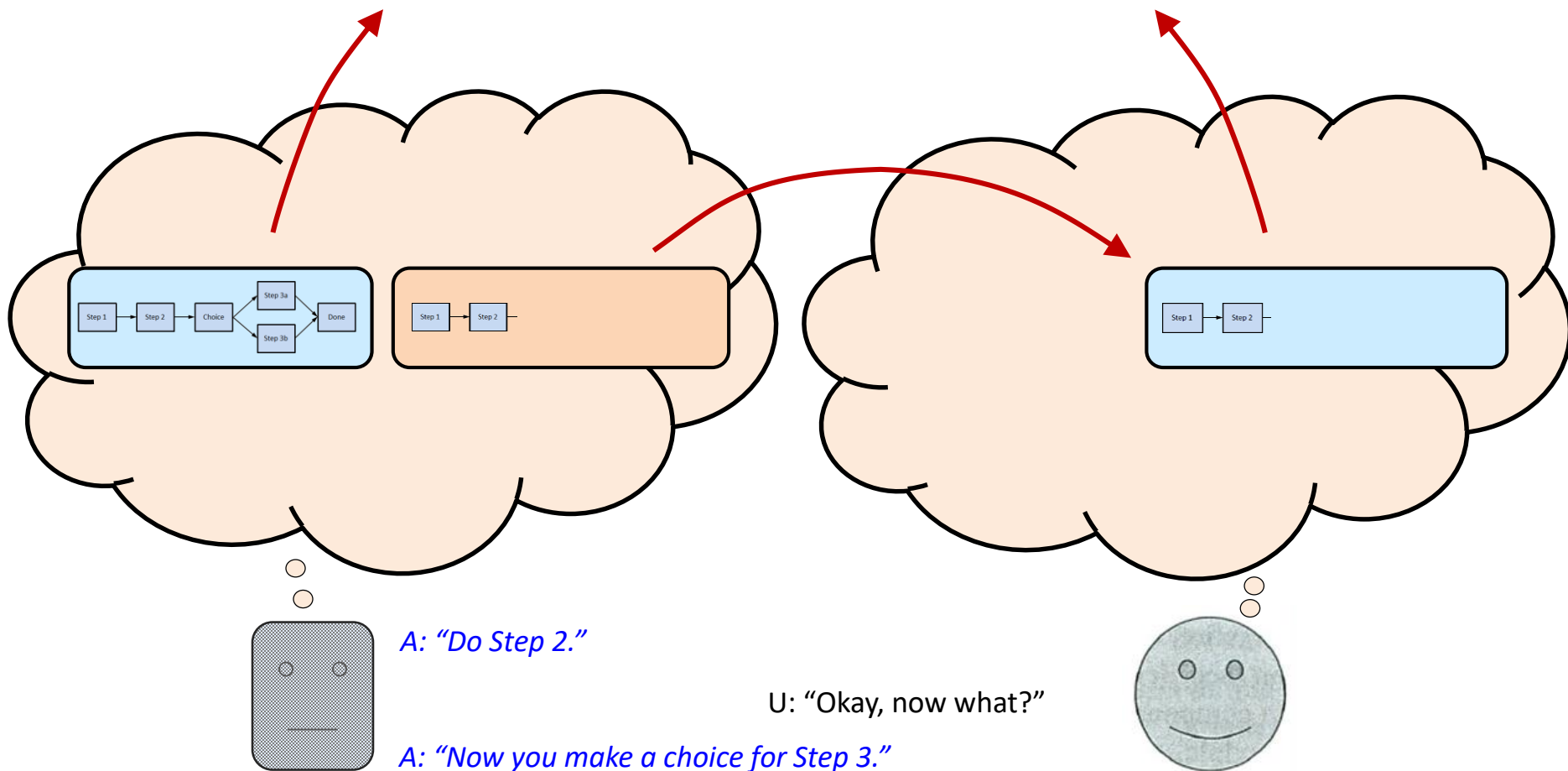
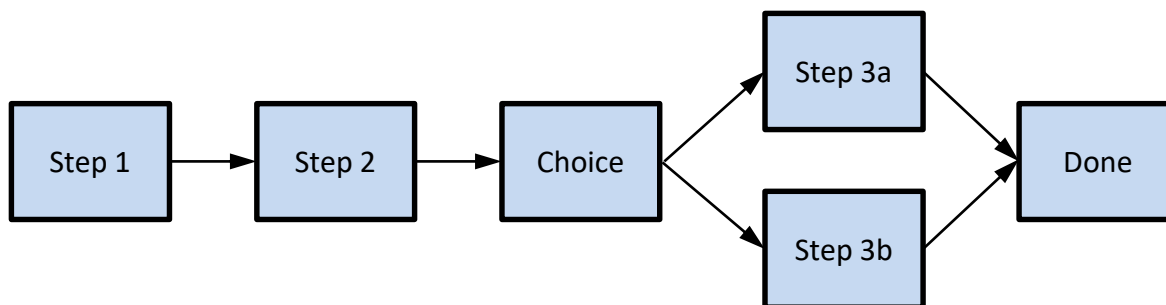
Naturalistic Dialog about Structured Data through Cognitive Belief Modeling



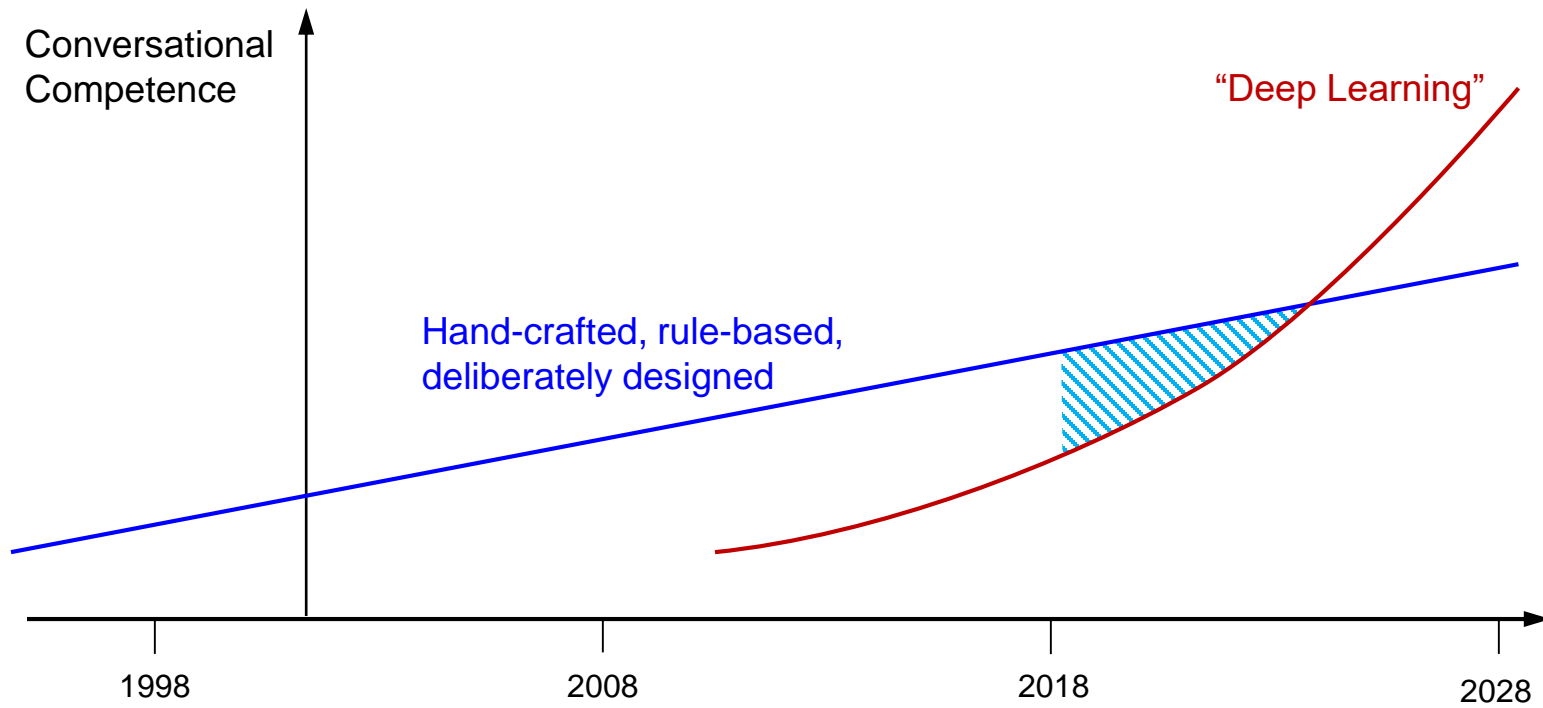
Structured Domains



Structured Domains: Task Workflow



To Build Practical* Dialog Managers



- *Practical:
- task-constrained
 - small reference/training data sets
 - predictable engineering
 - debuggable

(fin)