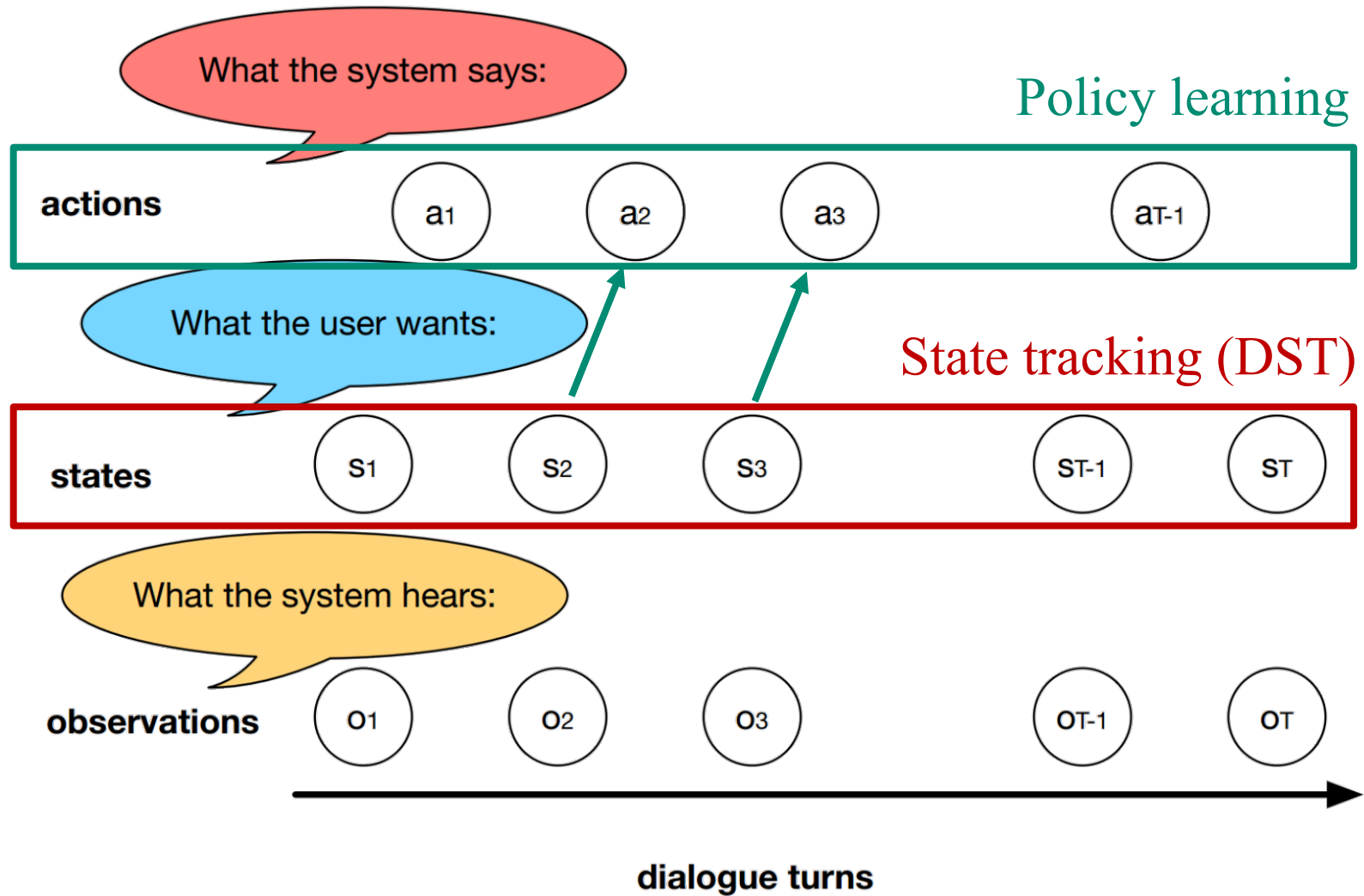


## **Dialog Manager (state tracking)**

# Dialog manager

- **State tracker** (requires hand-crafted states)
  - Queries the external database or knowledge base
  - Tracks the evolving state of the dialog
  - Constructs the state estimation
- **Policy learner**
  - Takes the state estimation as input and chooses a dialog action

# State tracking and policy learning



# DSTC 2 dataset

- Dialog State Tracking Challenge, collected in 2013
- **Human-computer** dialogs (finding a restaurant in Cambridge)
  - 3324 telephone-based dialogs, people were recruited using Amazon Mechanical Turk
  - *Dialog systems used: an MDP / POMDP for tracking the dialog state, and a hand-crafted policy / policy learnt using reinforcement learning*
- Labeling procedure:
  - Utterances transcription using Amazon Mechanical Turk
  - Annotation by heuristics
  - Checked & corrected by hand

# DSTC 2 dataset

- **Dialog state:**
  - *Goals*: A distribution over the values of each informable slot
  - *Method*: A distribution over methods: by name, by constraints, by alternatives or finished
  - *Requested slots*: A probability for each requestable slot that it has been requested by the user and the system should inform it
- User dialog acts: inform, request, negate, confirm, ...
  - What part of town is it?  $\rightarrow$  `request (area)`
- Method is inferred from act and goals:
  - `inform (food=chinese)`  $\rightarrow$  "by constraints"

# DSTC 2 dialog excerpt

<b>Utterance</b>	I'm looking for an expensive restaurant with venetian food
<b>Goals</b>	food=venetian, pricerange=expensive
<b>Method</b>	byconstraints
<b>Requested slots</b>	[]

<b>Utterance</b>	Is there one with thai food?
<b>Goals</b>	<b>food=thai</b> , pricerange=expensive
<b>Method</b>	byconstraints
<b>Requested slots</b>	[]

<b>Utterance</b>	Can I have the address?
<b>Goals</b>	food=thai, pricerange=expensive
<b>Method</b>	byconstraints
<b>Requested slots</b>	[ <b>addr</b> ]

# DSTC 2 results

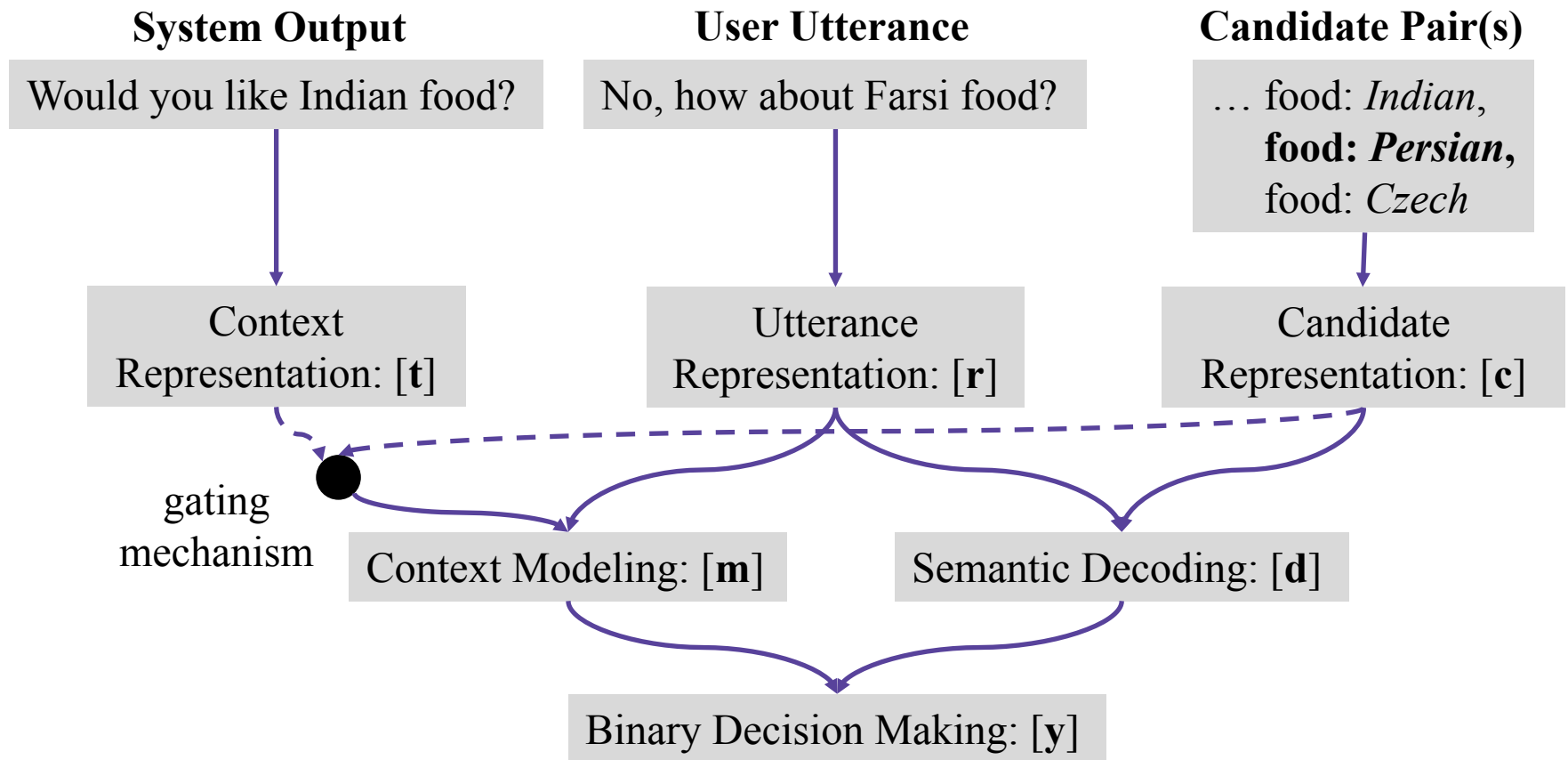
- Best results after competition:
  - Goals: 65% correct *combinations*
  - Method: 97% correct
  - Requested slots: 95% correct

# Rule-based state tracking

- Train a good NLU (intents and slots)
- Make simple hand-crafted rules for dialog state change

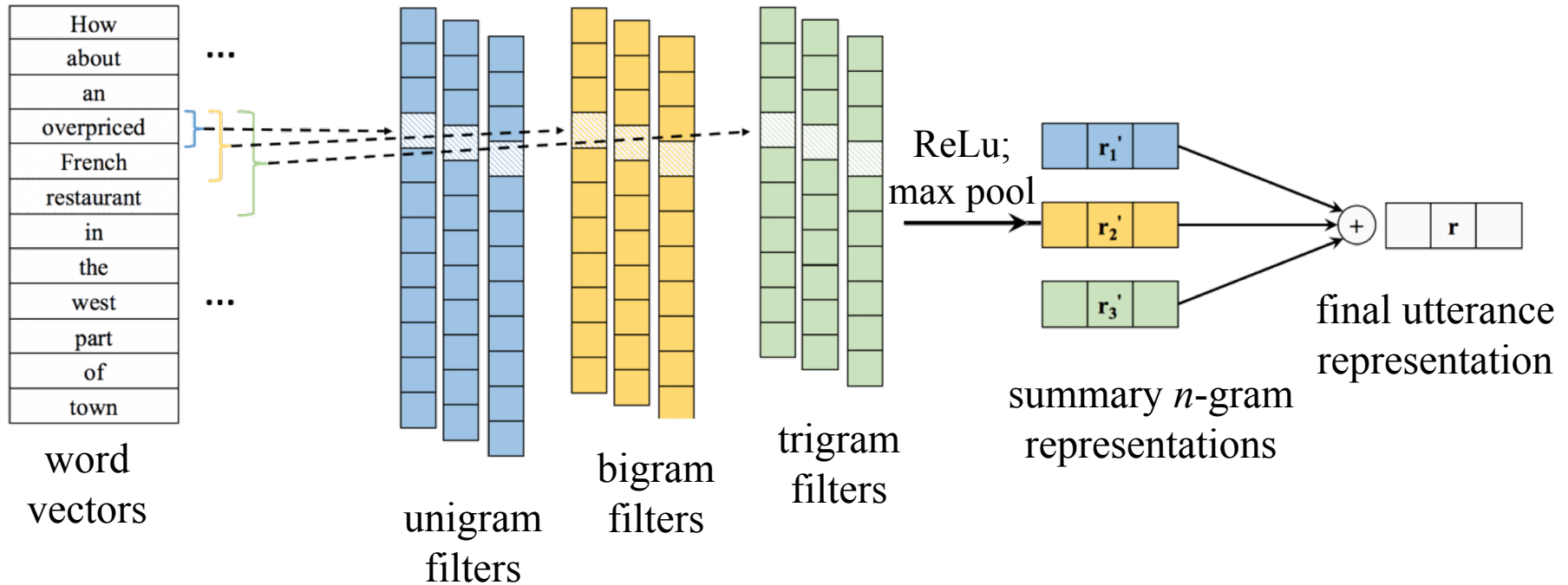


# Neural Belief Tracker



Joint NLU/DST

# Utterance representation



# Neural Belief Tracker results

DST Model	DSTC2		WOZ 2.0	
	Goals	Requests	Goals	Requests
Delexicalisation-based Model	69.1	95.7	70.8	87.1
Delexicalisation-based Model + Semantic Dictionary	72.9*	95.7	83.7*	87.6
Neural Belief Tracker: NBT-DNN	72.6*	96.4	<b>84.4*</b>	91.2*
Neural Belief Tracker: NBT-CNN	<b>73.4*</b>	<b>96.5</b>	84.2*	<b>91.6*</b>

# Frames dataset

- Collected in 2016
- **Human-human** goal-oriented dataset
  - 12 participants, 20 days, 1369 dialogues
  - Two humans talked to each other via a Slack chat

Find a vacation between September 1st and September 8th to Havana from Stuttgart for under \$700. Dates are not flexible. If not available, then end the conversation.

User



You have access to a database of 250+ packages, each composed of a hotel and round-trip flights. Provide help via a chat interface.

Wizard

# Frames dataset

- It introduces a new task called **frame tracking**, which extends state tracking to a setting where several states are tracked simultaneously
- In this dataset users can compare results corresponding to different constraints and go back-and-forth between results

Author	Utterance	Frame
User	I'd like to book a trip to Atlantis from Caprica on Saturday, August 13, 2016 for 8 adults. I have a tight budget of 1700.	1
Wizard	Hi...I checked a few options for you, and unfortunately, we do not currently have any trips that meet this criteria. Would you like to book an alternate travel option?	1
User	Yes, how about going to Neverland from Caprica on August 13, 2016 for 5 adults. For this trip, my budget would be 1900.	2
Wizard	I checked the availability for those dates and there were no trips available. Would you like to select some alternate dates?	2

Dialogue excerpt with active frame annotation

# Frames dataset

- It's annotated with the following:
  - Dialogue acts, slot types, slot values, and references to other frames for each utterance.
  - The ID of the currently active frame.
- Examples:

<code>inform(category=2.5)</code>
-----------------------------------

2.5 stars will do
-------------------

<code>offer(ref=[6], seat=business, price=1002.27)</code>
-----------------------------------------------------------

What about a \$1002.27 business class ticket to San Francisco?
----------------------------------------------------------------

# Summary

- We've overviewed a state tracker of a DM
- We've discussed the datasets for DM training
- State tracking can be done by hand rules having a good NLU
- Or you can do better with neural network approaches
- In the next video we'll talk about dialog policies in DM