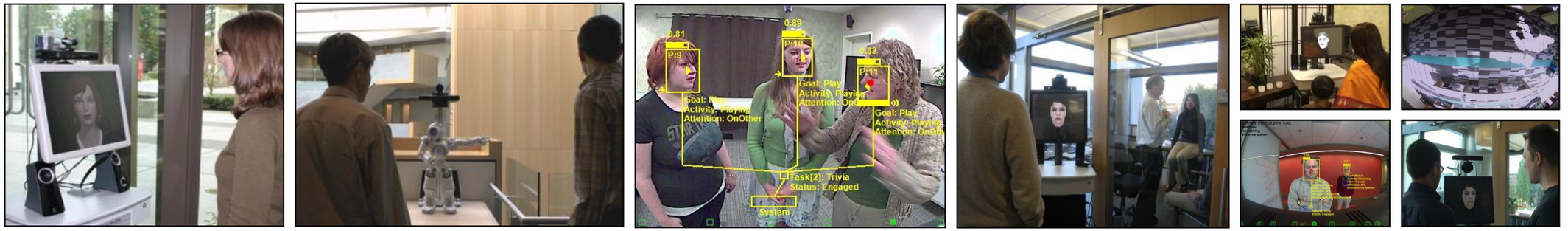
Microsoft

Physically Situated Language Interaction: an integrative-AI challenge

Dan Bohus

Microsoft Research
Faculty Summit
2015

Physically Situated Language Interaction: an integrative-AI challenge



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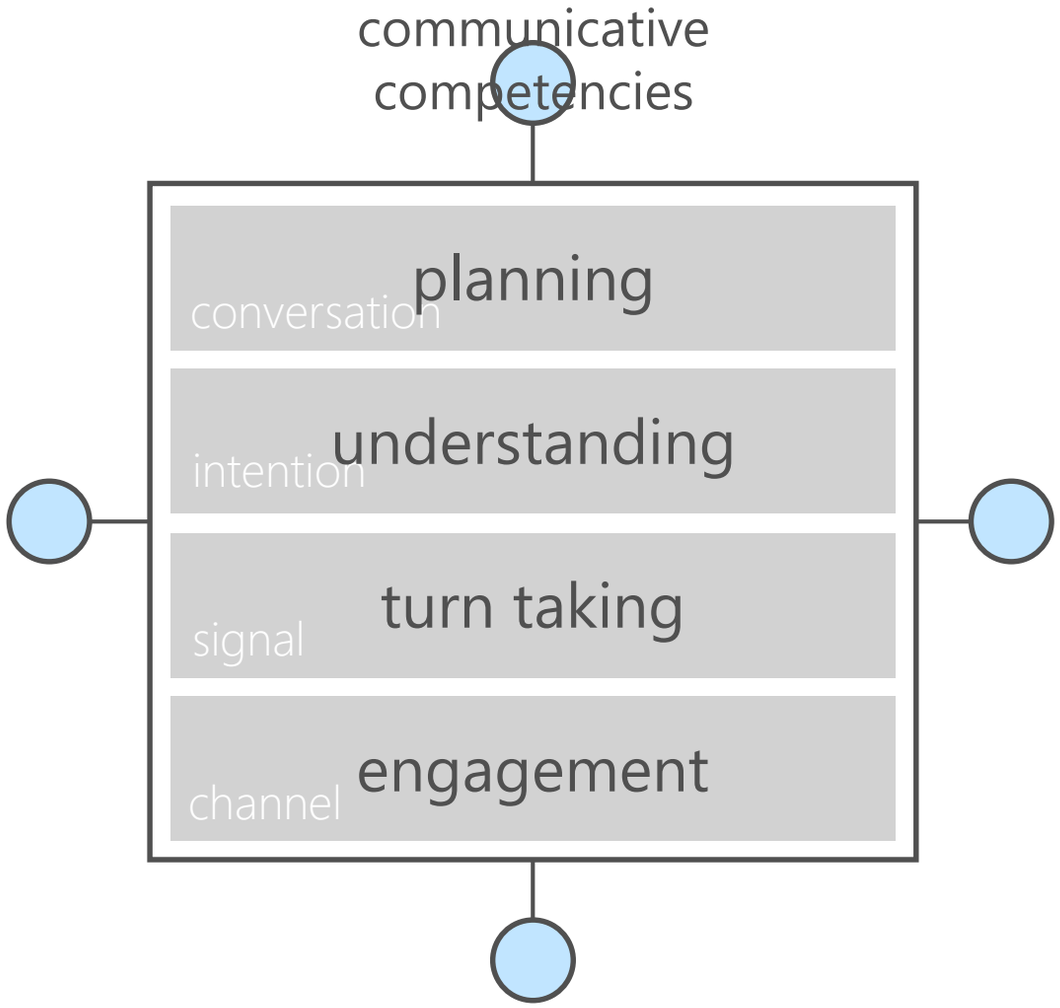
Physically situated language interaction



Physically situated language interaction

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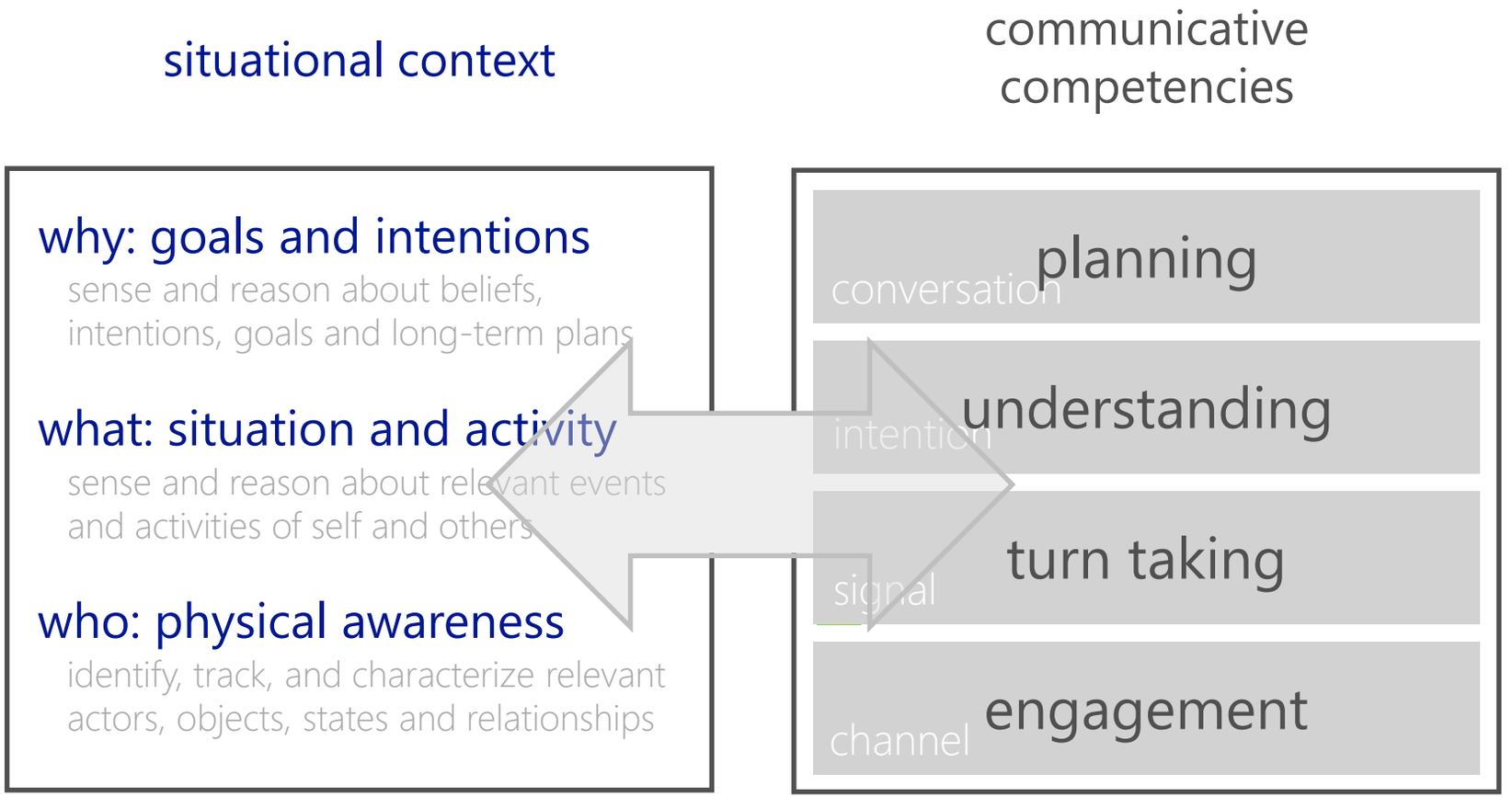
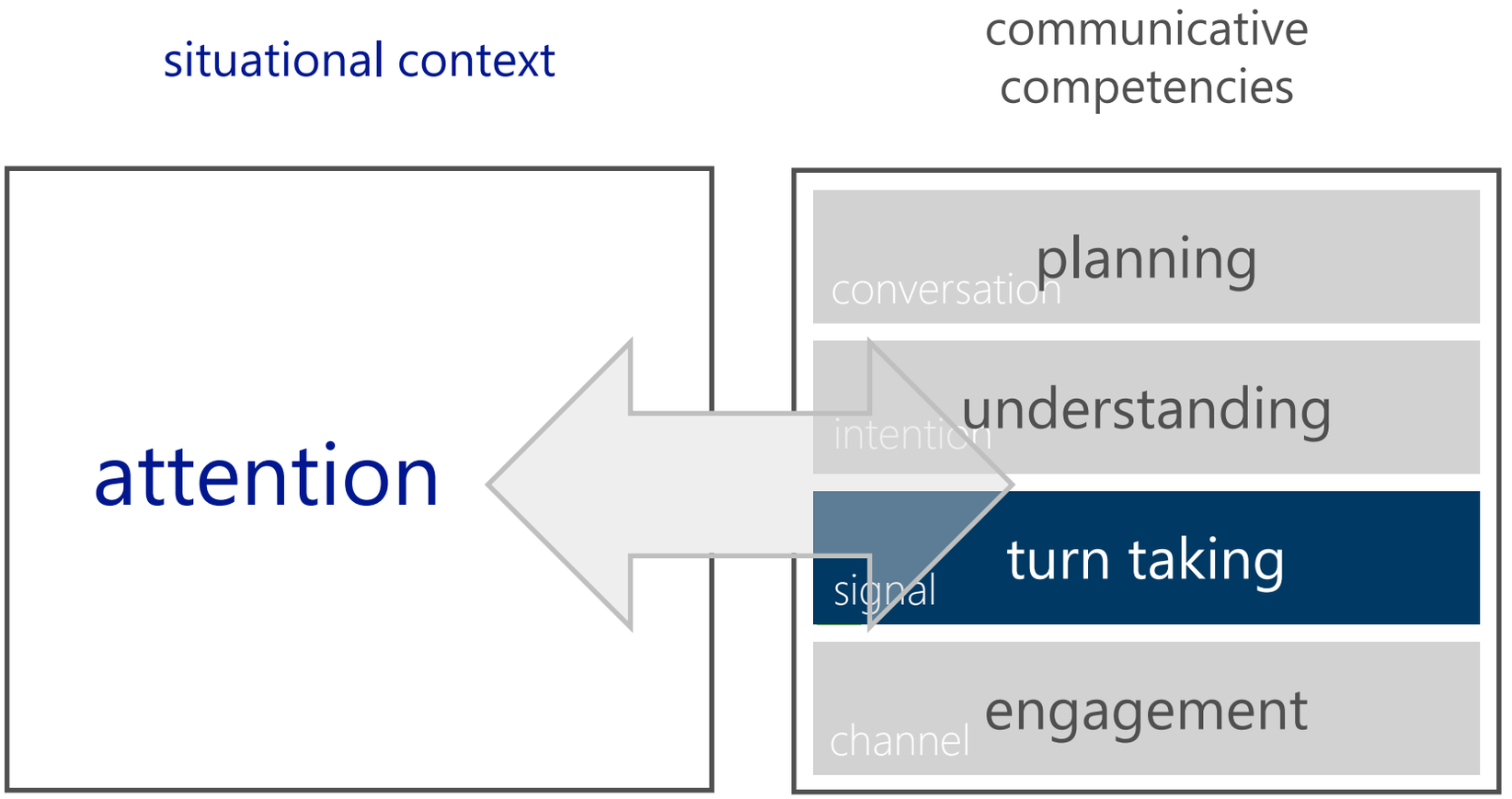


Coordination of attention and speech production



Coordination of attention and speech production

[Yu, Bohus and Horvitz, 2015 – *Incremental Coordination: Attention-Centric Speech Production in a Physically Situated Conversational Agent*, to appear in SIGdial'2015]

Charles Goodwin: disfluencies and attention

from *Conducting Interaction: Achieving Mutual Orientation at Turn Beginning*

Speaker: Anyway, (0.2) Uh:, (0.2) We went t- I went ta bed

Listener:

Speaker: Brian you're gonna hav- You kids'll *h*ave to go

Listener:

Speaker: I come int- I no sooner sit down on the couch

Listener:

Coordination of attention and speech production

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from *Conducting Interaction: Achieving Mutual Orientation at Turn Beginning*

Speaker: She– she's reaching the p– She's at the point I'm

Listener:

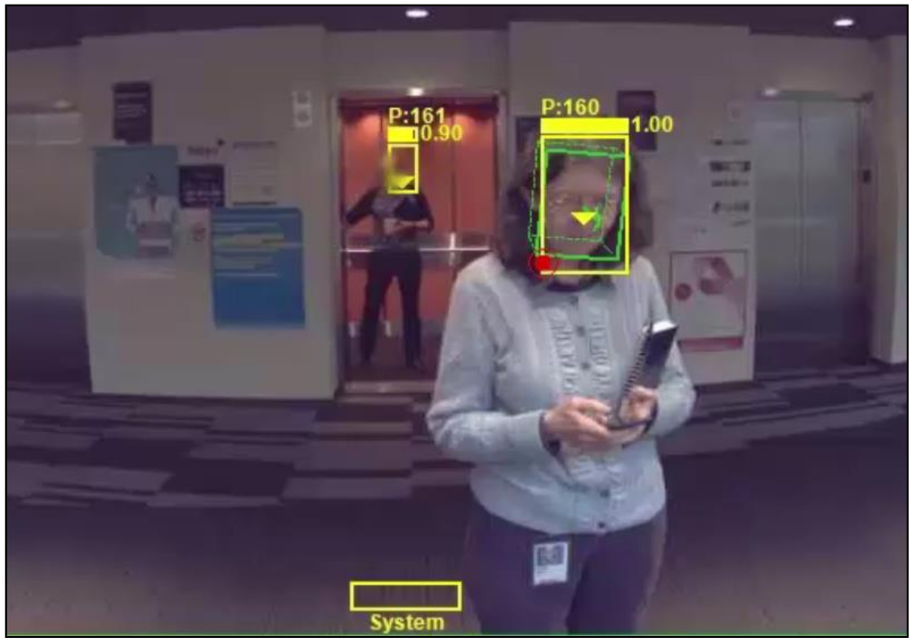
Speaker: I ask him, (0.1) I ask him if he– (0.4) could– If *you* could call 'im when you go *in*.

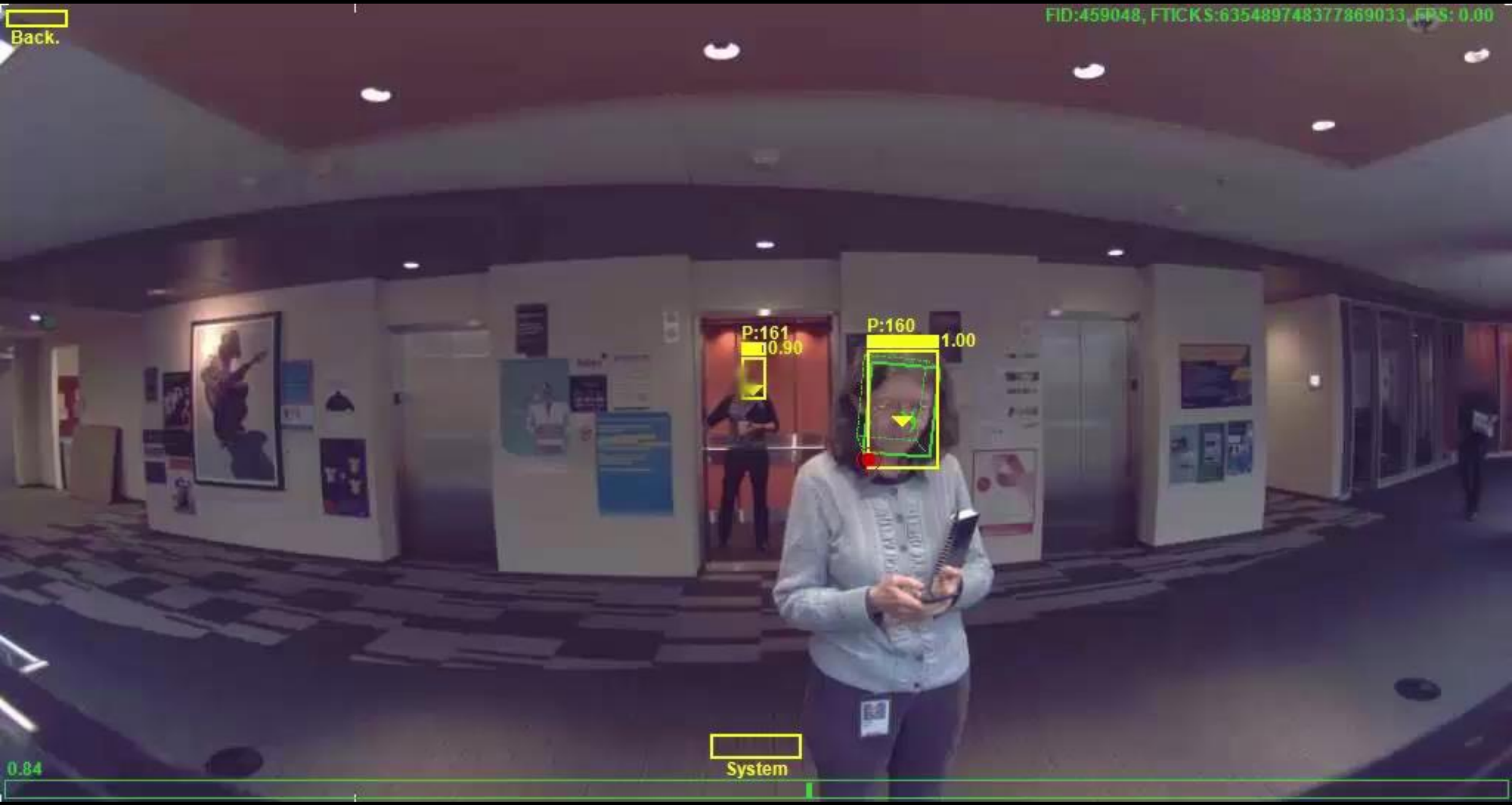
Listener:

Turn taking models dialog systems

Push to talk

You-speak-then-I-speak




Back.
FID:459048, FTICKS:635489748377869033, FPS: 0.00
P:161
0.90
P:160
1.00
System
0.84

Model

Attentional demands

Defined at phrase level
Specified at onset and production
Define expected targets

≠

Attentional supply

Infers attention on various targets
Relies on ML model for geometric visual attention
Leverage features from visual subsystems

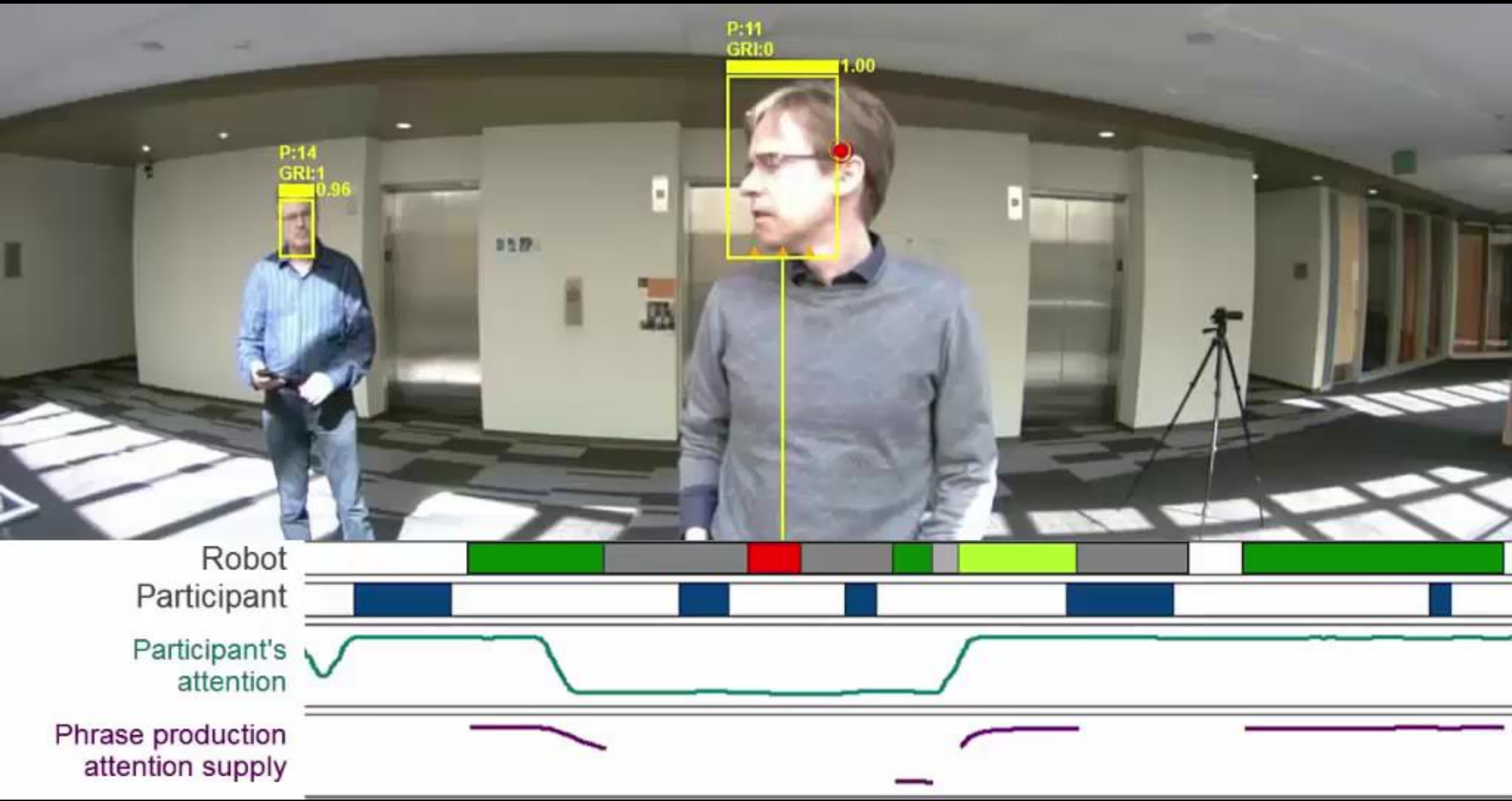
Coordinative policy

… … … Excuse me! … … … To get … … … To get to 3800 go to […]

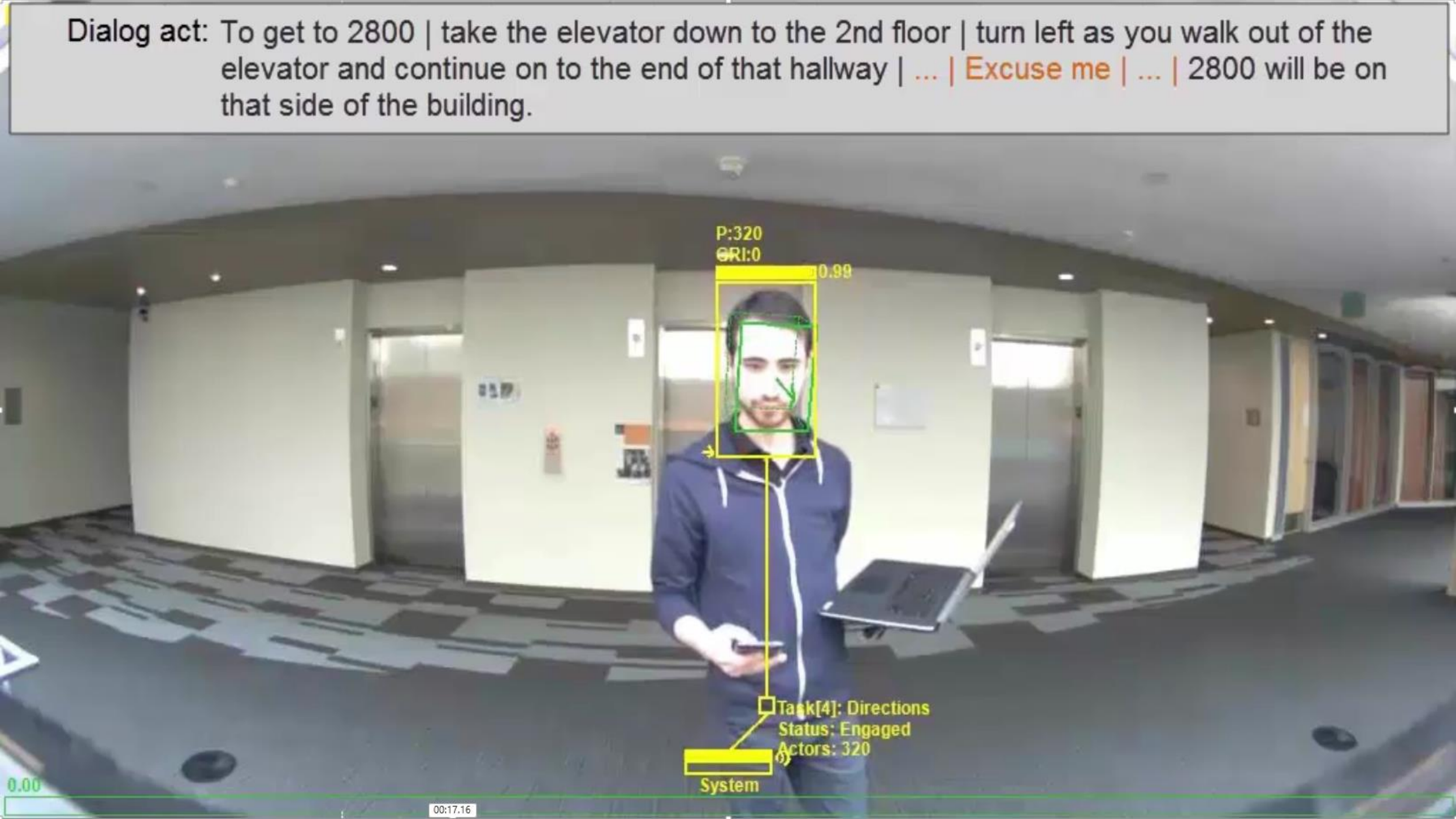
Phrase 1 | Phrase 2

a demonstration video …

the robot's view …
sensing and computation details


P:11
GRI:0
1.00
P:14
GRI:1
0.96
Robot
Participant
Participant's
attention
Phrase production
attention supply

sample natural interactions …


Dialog act: To get to 2800 | take the elevator down to the 2nd floor | turn left as you walk out of the elevator and continue on to the end of that hallway | ... | Excuse me | ... | 2800 will be on that side of the building.
P:320
GRI:0
0.99
Task[4]: Directions
Status: Engaged
Actors: 320
System
0.00
00:17.16

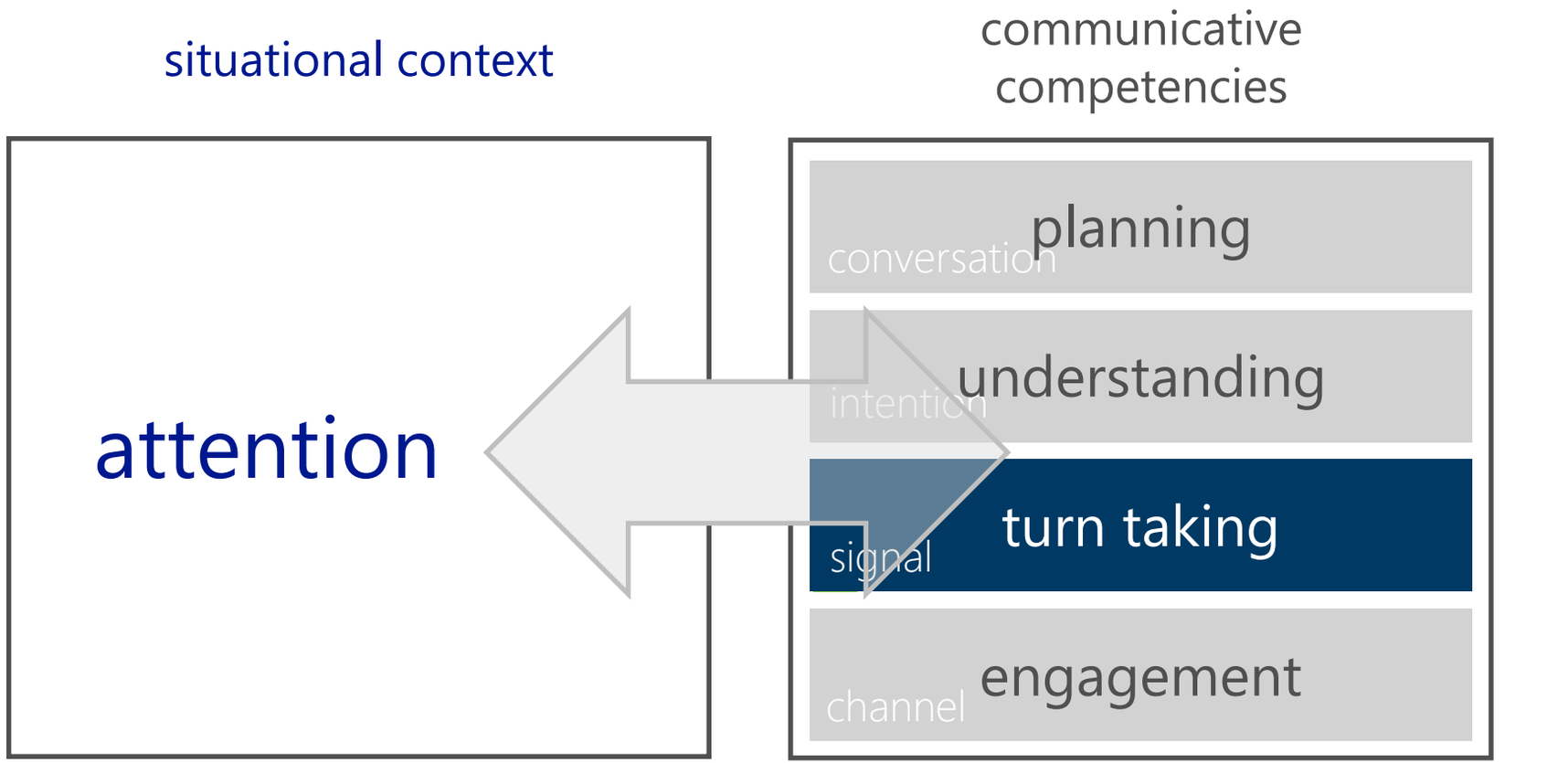
Dialog act:


P:320
GR:0
0.98
Task[4]: Directions
Status: Engaged
Actors: 20
System

failure cases …

system incorrectly infers user is not attending and inappropriately triggers pauses, interjections and restarts

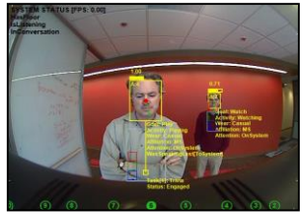
Physically situated language interaction



Physically situated language interaction








situational context

why: goals and intentions

sense and reason about beliefs, intentions, goals and long-term plans

what: situation and activity

sense and reason about relevant events and activities of self and others

who: physical awareness

identify, track, and characterize relevant actors, objects, states and relationships

communicative competencies

- planning
- understanding
- turn taking
- engagement

conversation

intention

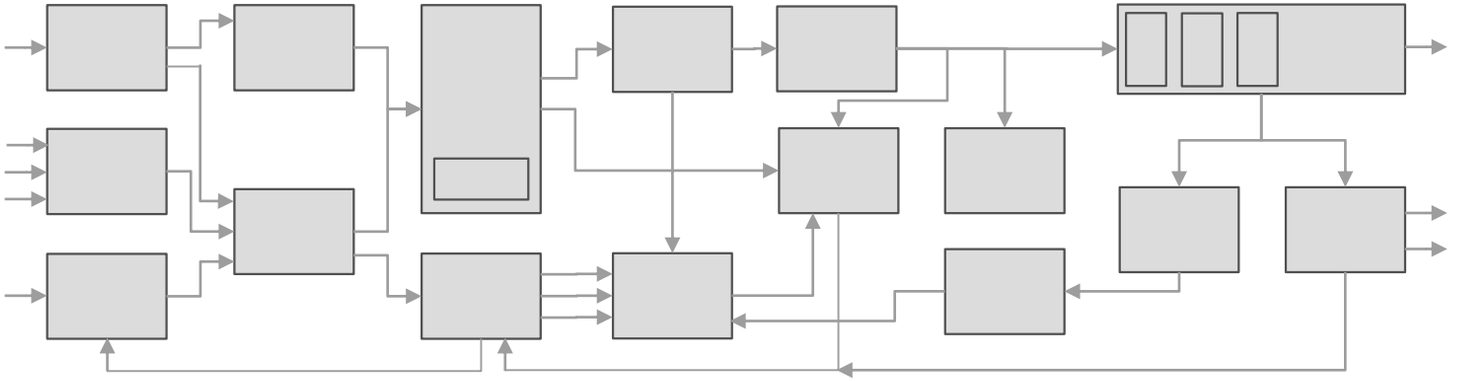
signal

channel

Challenges with integrative-AI systems

Challenges with integrative-AI systems

complex (many components)



Microphone array capture
Sound source localization
Speech recognition
Language understanding
Infrared proximity sensors
Badge sensors
Face detection and tracking
Head-pose tracking

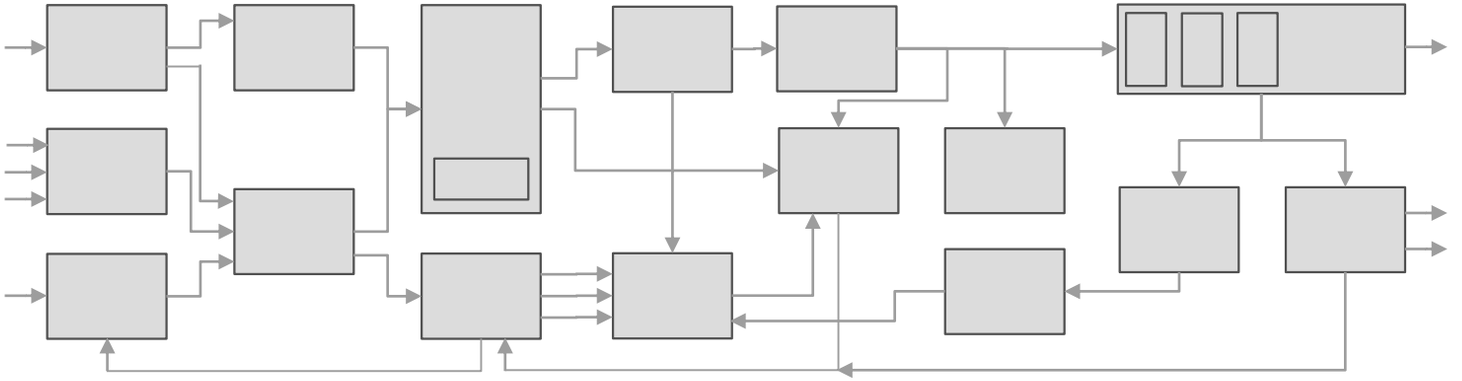
Facial feature tracking
Face identity recognition
Gender detection
Attention models
Engagement models
Turn-taking models
Behavioral control

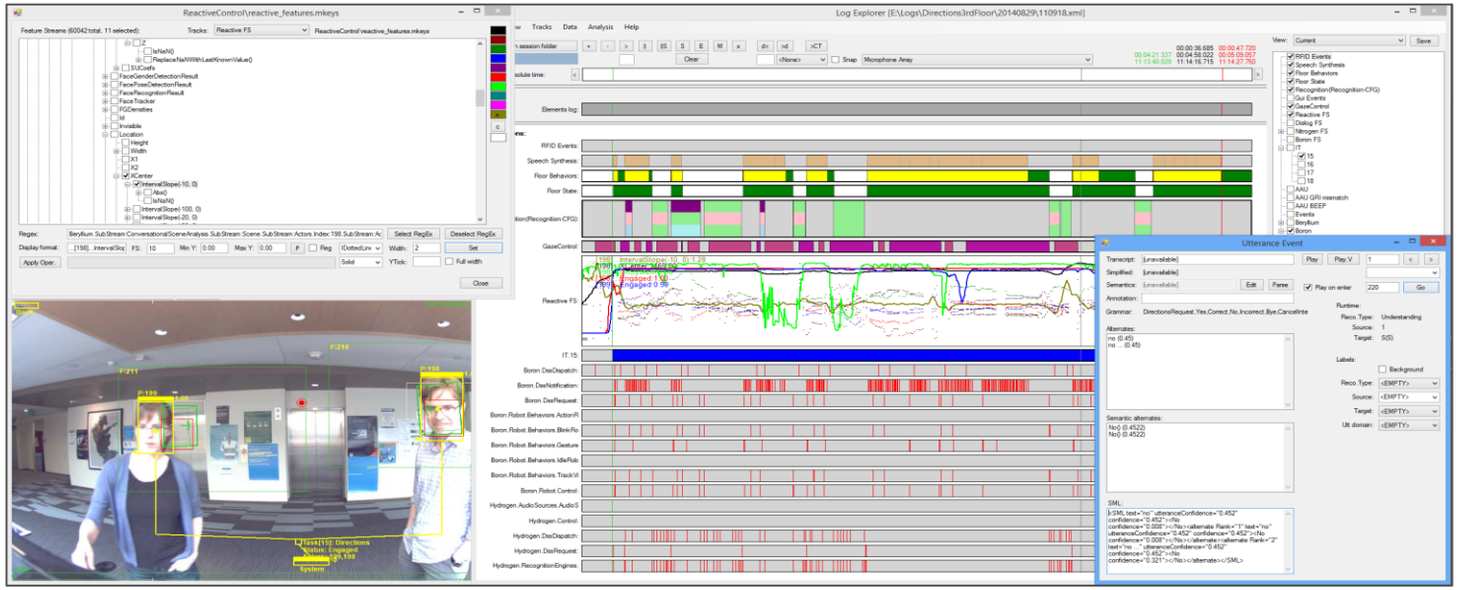
Dialog management
Natural language generation
Speech synthesis
Avatar synthesis
Robot motion control
Floor-plan models
User models

Challenges with integrative-AI systems

complex (many components)

programming models for coordinated computation; tools





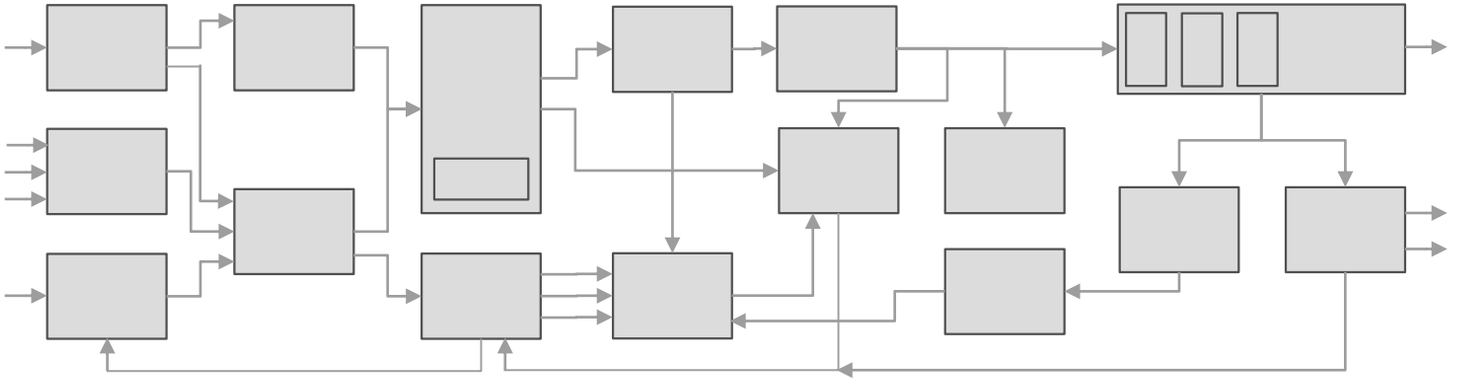
Challenges with integrative-AI systems

complex (many components)

programming models for coordinated computation; tools

act in real-time, under uncertainty

evolve programming languages? e.g. time & uncertainty

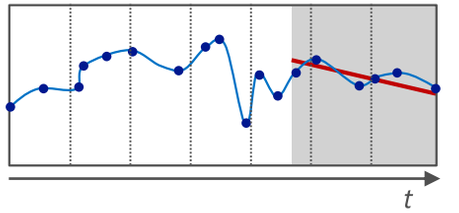


Time and streams as 1st order citizens

double f; → stream double f;

f=3; f=x*f-y;

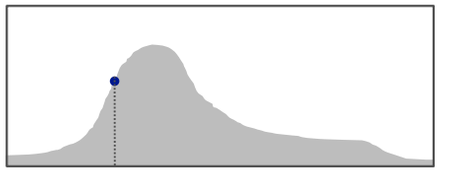
Automatic persistence, historical access, sampling, transforms



Uncertainty as 1st order citizen

double f; → uncertain double f;

Representation, sampling, inference, belief updates



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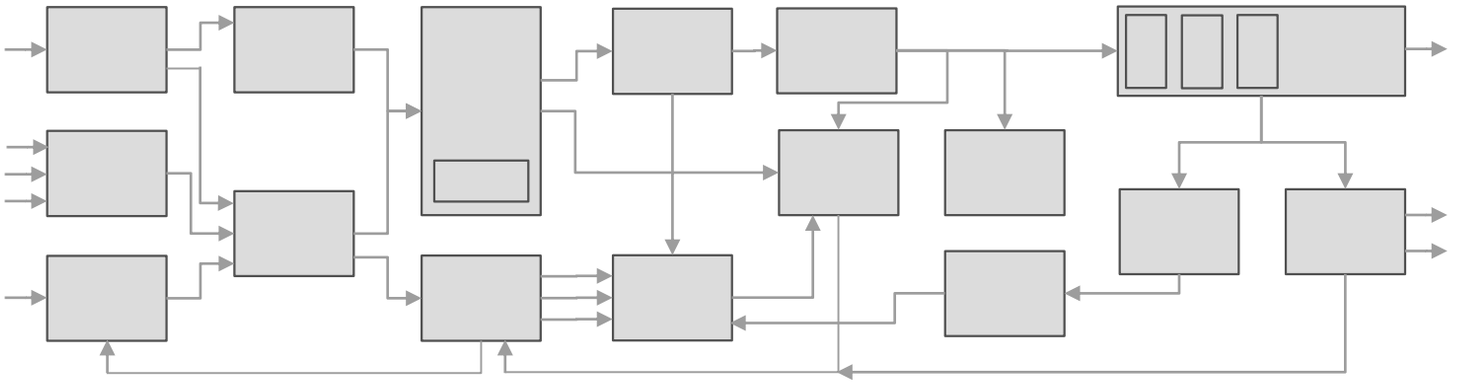
integration of human- and machine-authored components



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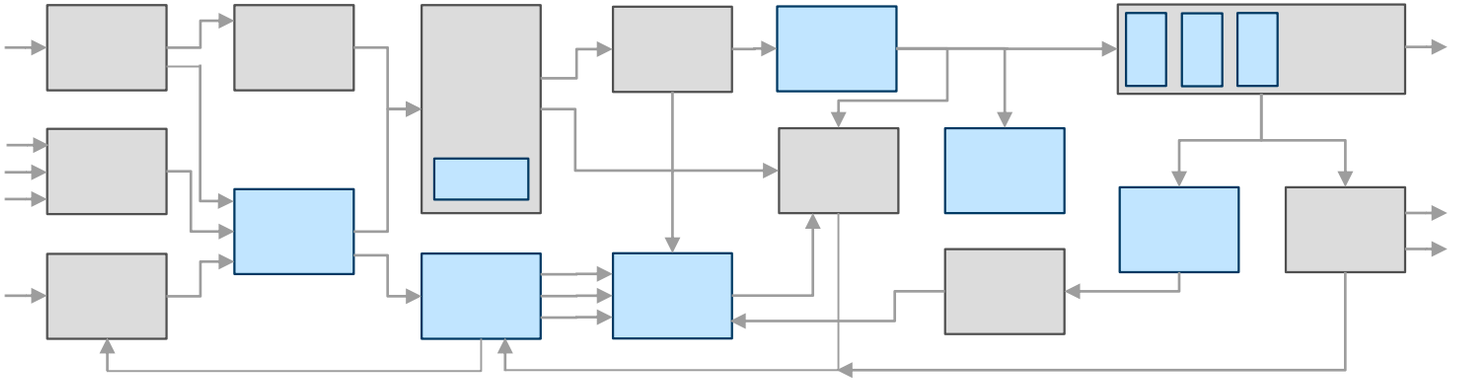

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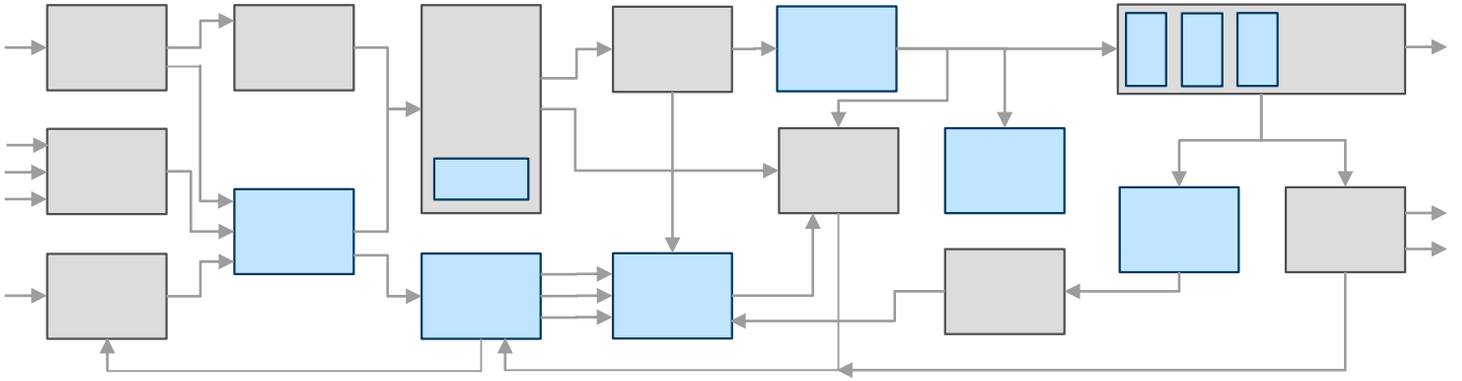
engineering of integrated learning systems



Engineering of integrated learning systems

learning in connected systems (new frontiers for ML & software engineering?)

learning in interactive settings: online, lifelong vs. batch

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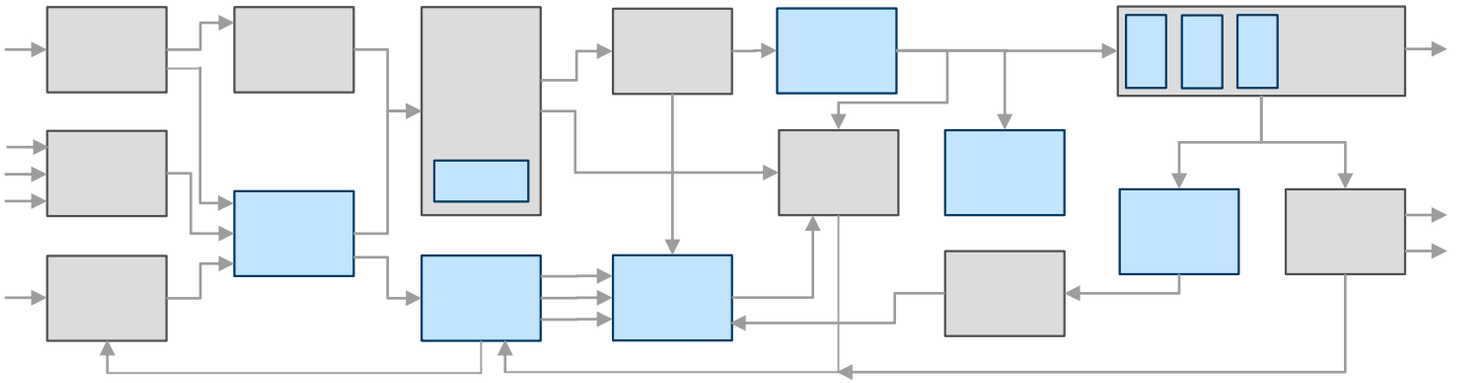
engineering of integrated learning systems

meta-reasoning & system-level (self)-optimization



Engineering of integrated learning systems

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Meta-reasoning and system-level (self)-optimization

self-monitoring and diagnosis / blame assignment

self-optimization

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