Connections

Eric Horvitz

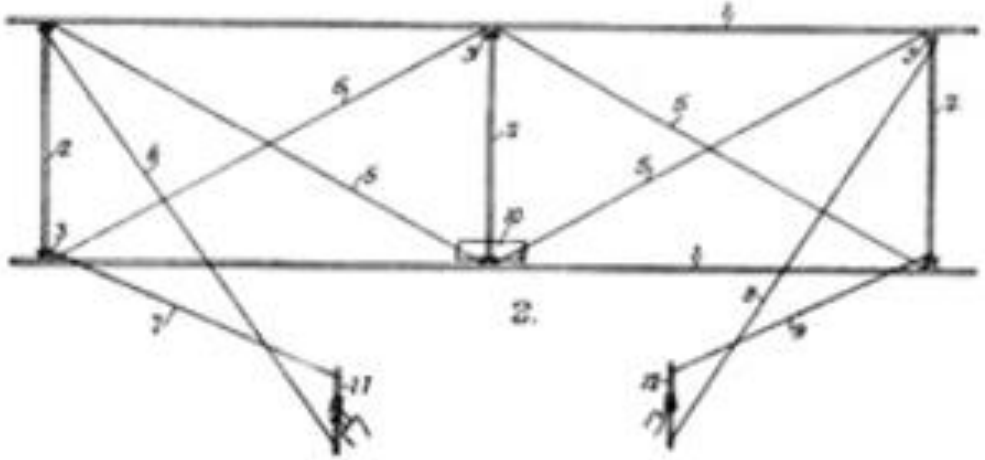
ICMI 2015
November 12, 2015

Sustained Accomplishment Award Lecture

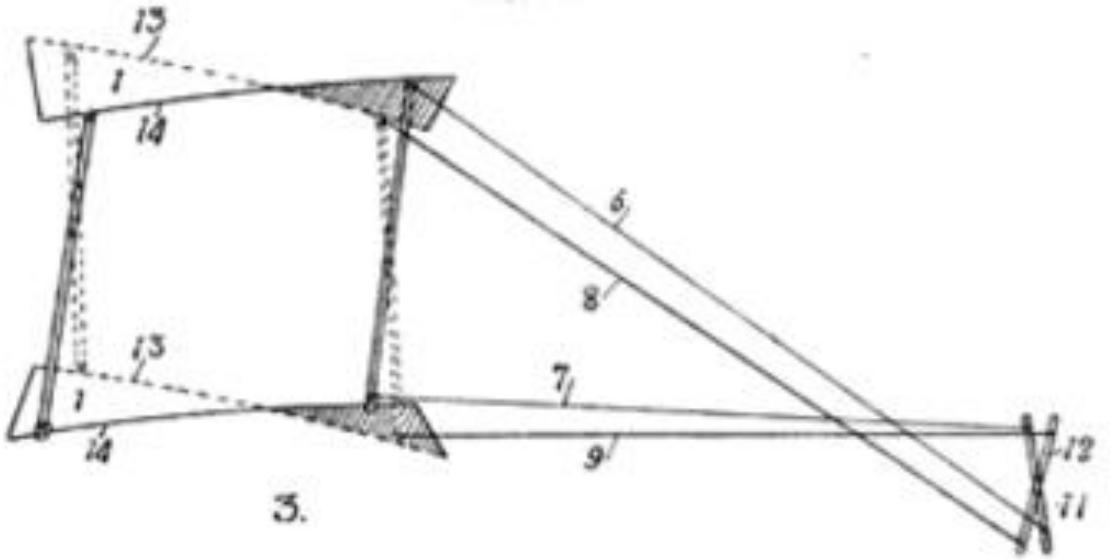
Connections

Toward Fluid Connectivity

Promise of Deeper Human-Machine Connection & Collaboration



2.

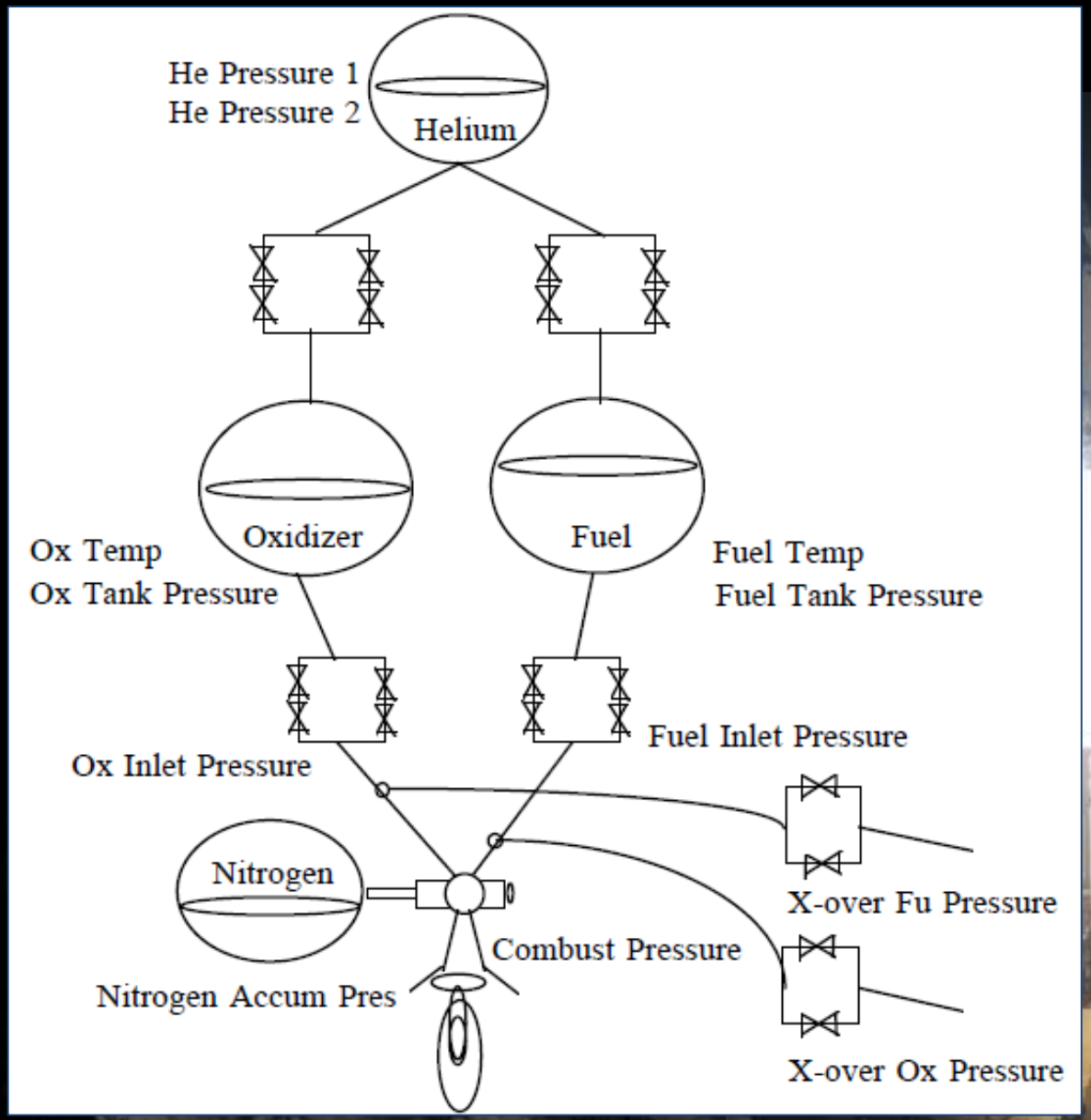


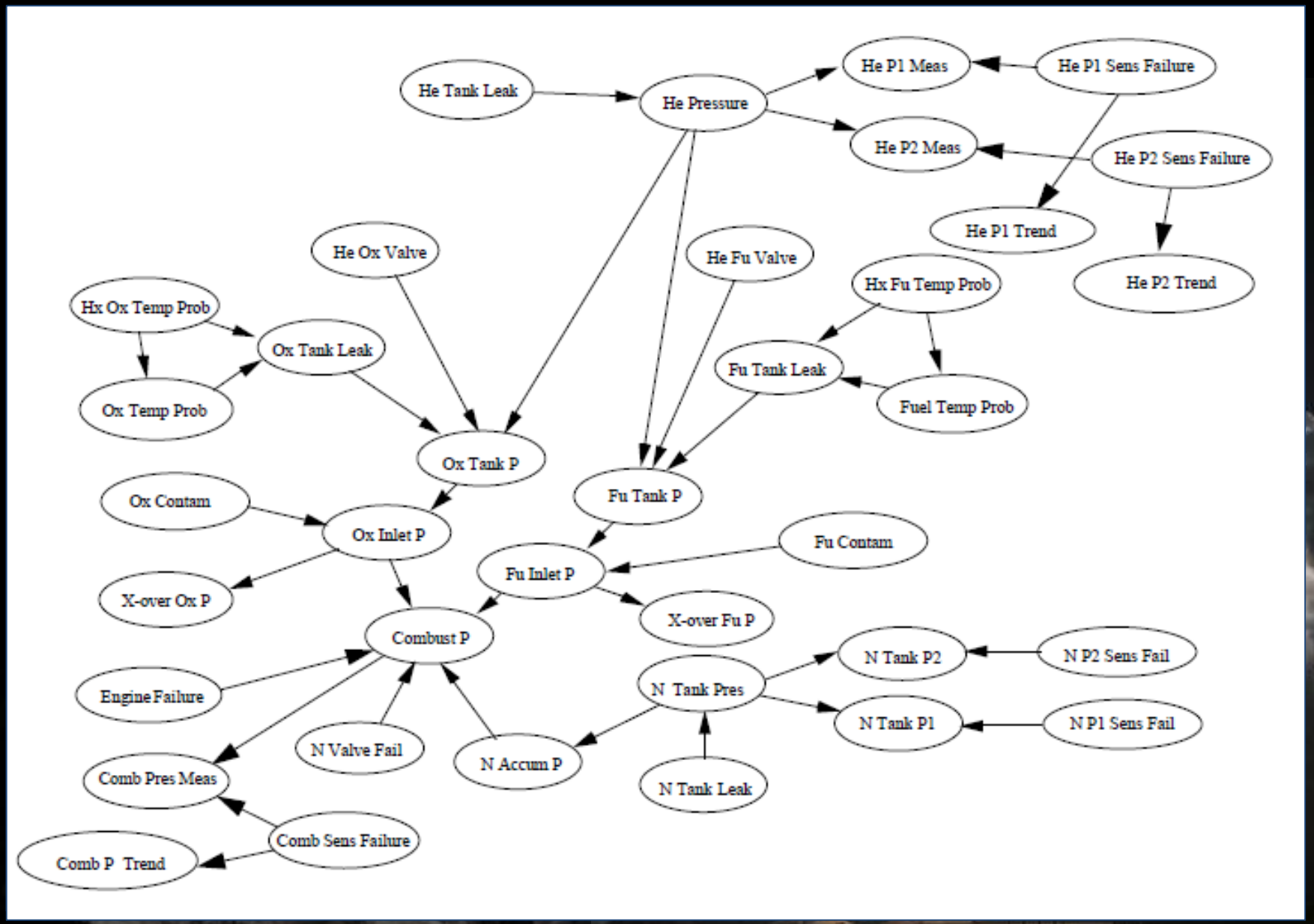
3.

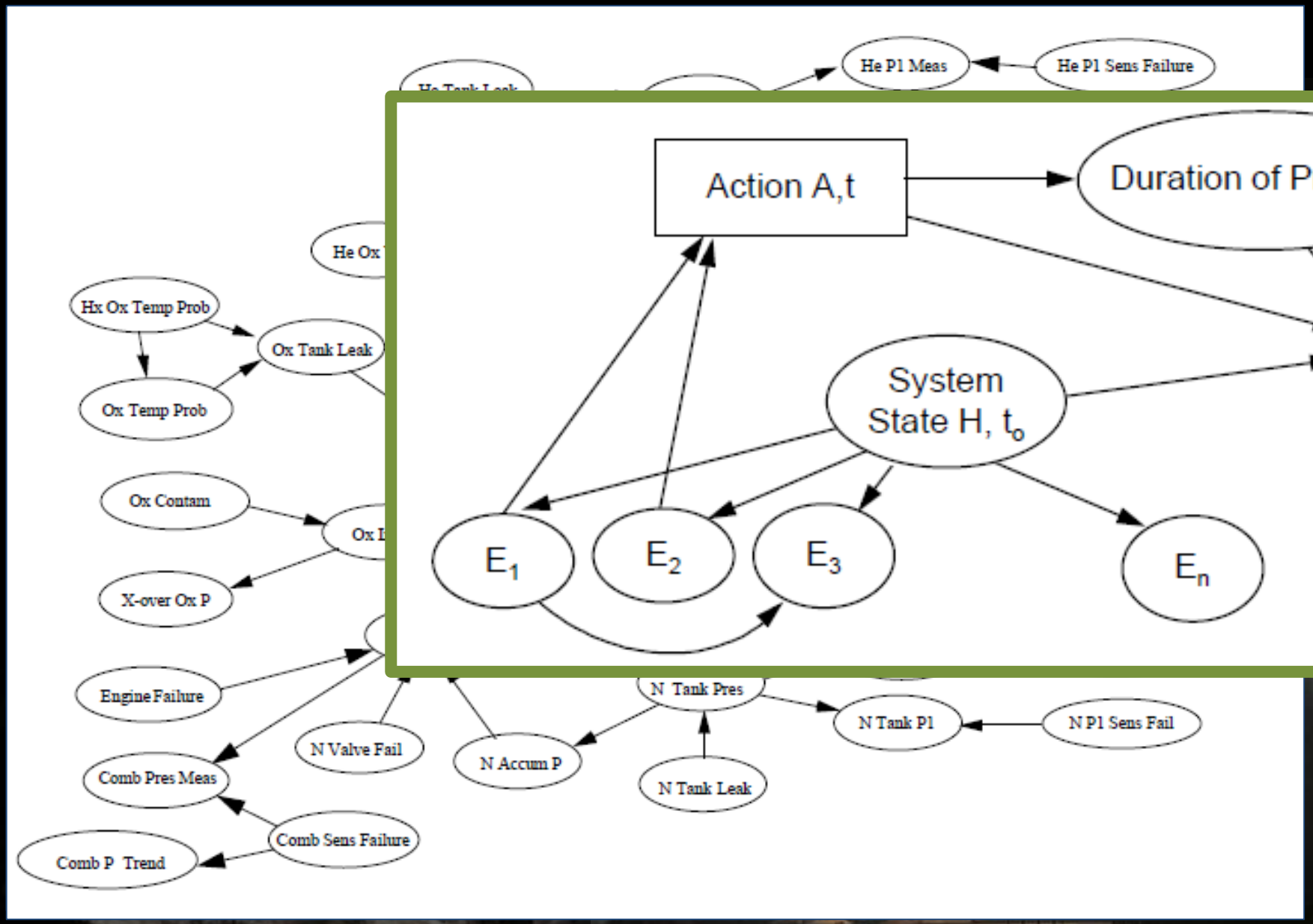
An early connection

Engaging at NASA's Mission Control Center on human-in-the loop

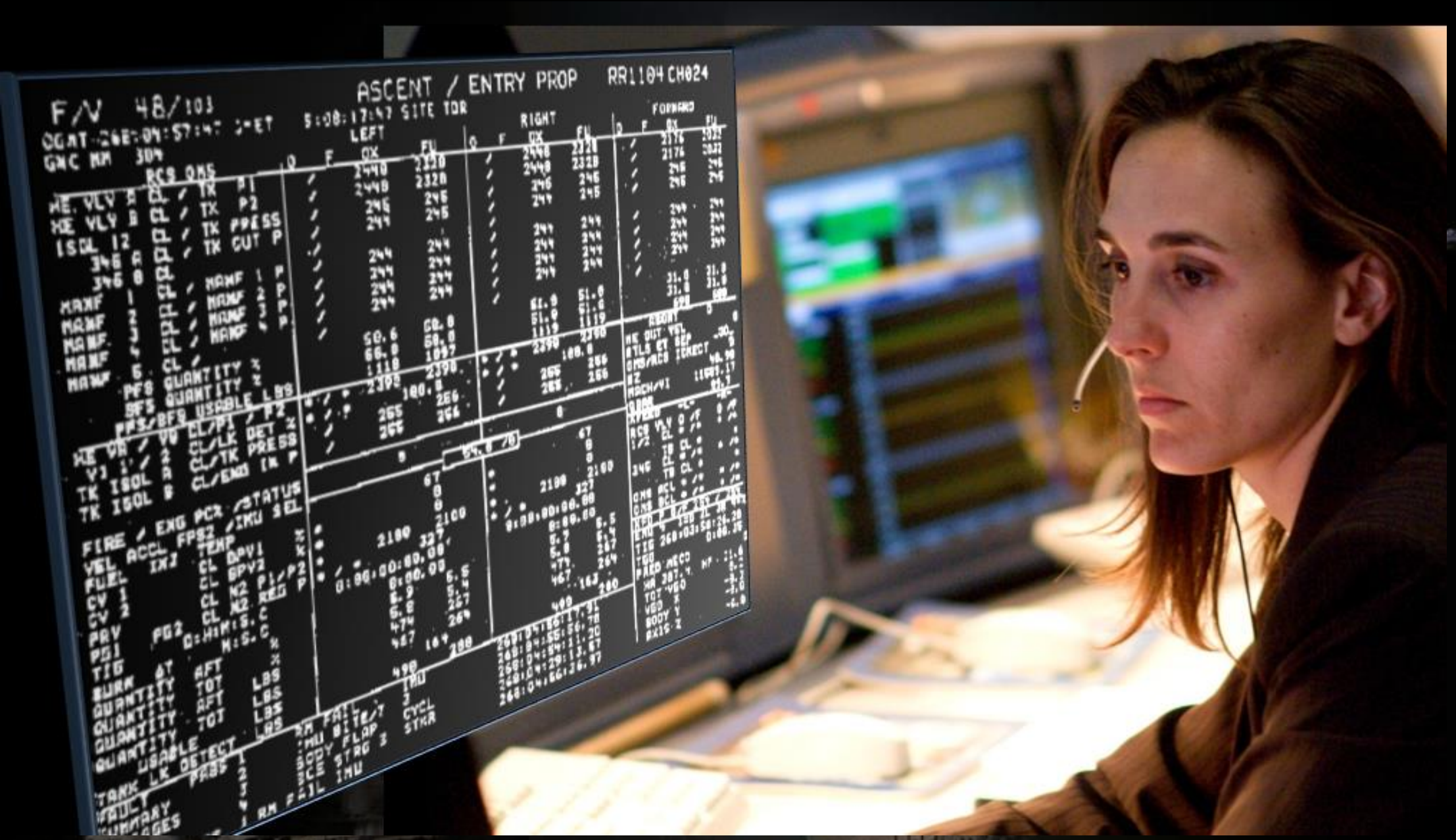

H
Ox
Fu
N


He Pressure 1
He Pressure 2
Helium
Oxidizer
Fuel
Ox Temp
Ox Tank Pressure
Fuel Temp
Fuel Tank Pressure
Fuel Inlet Pressure
Ox Inlet Pressure
Nitrogen
X-over Fu Pressure
Combust Pressure
Nitrogen Accum Pres
X-over Ox Pressure

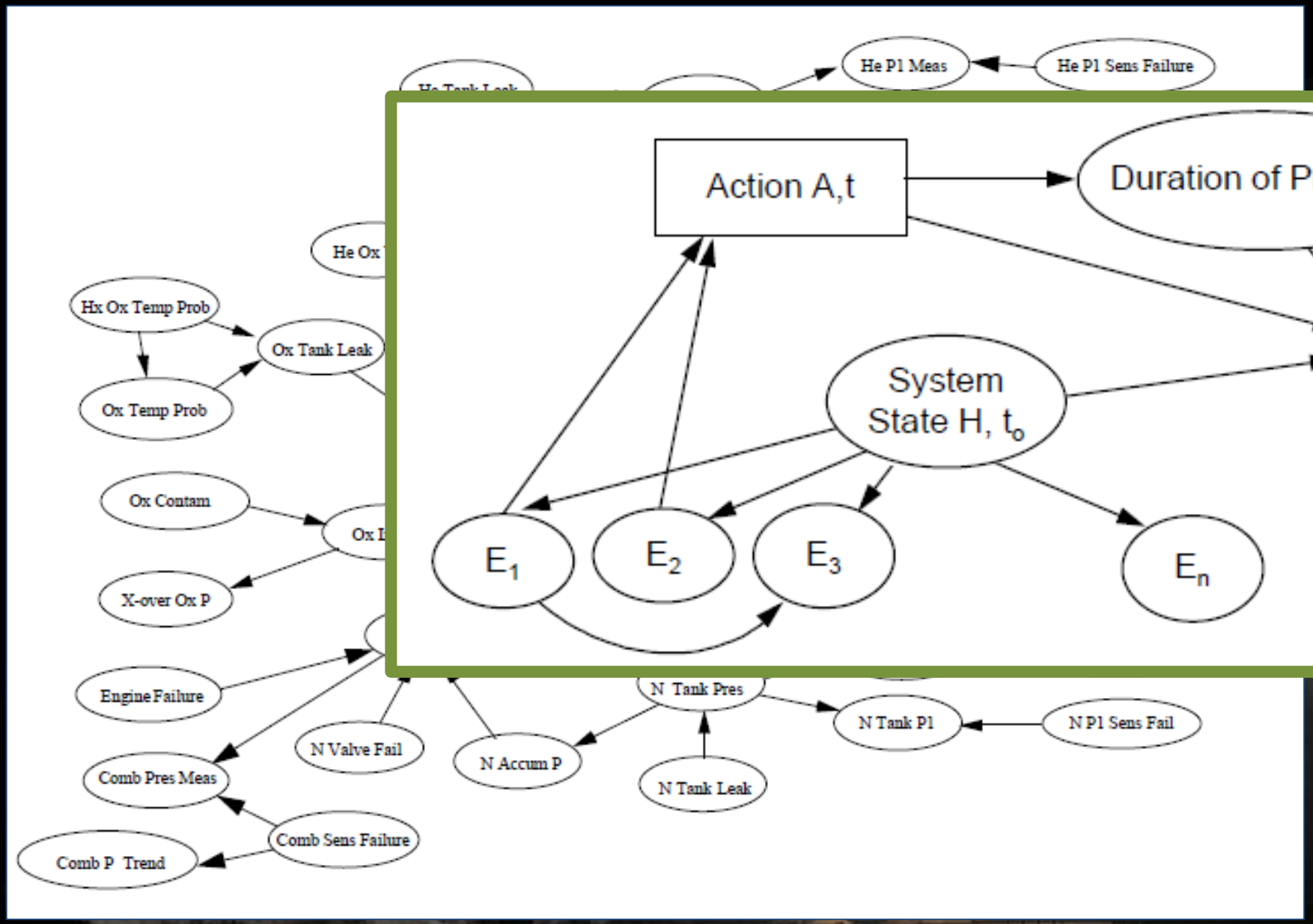

He Tank Leak
He Pressure
He P1 Meas
He P1 Sens Failure
He P2 Meas
He P2 Sens Failure
He P1 Trend
He P2 Trend
He Ox Valve
He Fu Valve
Hx Fu Temp Prob
Hx Ox Temp Prob
Ox Tank Leak
Fu Tank Leak
Ox Temp Prob
Fuel Temp Prob
Ox Tank P
Fu Tank P
Ox Contam
Ox Inlet P
Fu Contam
Fu Inlet P
X-over Ox P
X-over Fu P
Combust P
N Tank P2
N P2 Sens Fail
Engine Failure
N Tank Pres
N Tank P1
N P1 Sens Fail
N Valve Fail
N Accum P
Comb Pres Meas
N Tank Leak
Comb Sens Failure
Comb P Trend



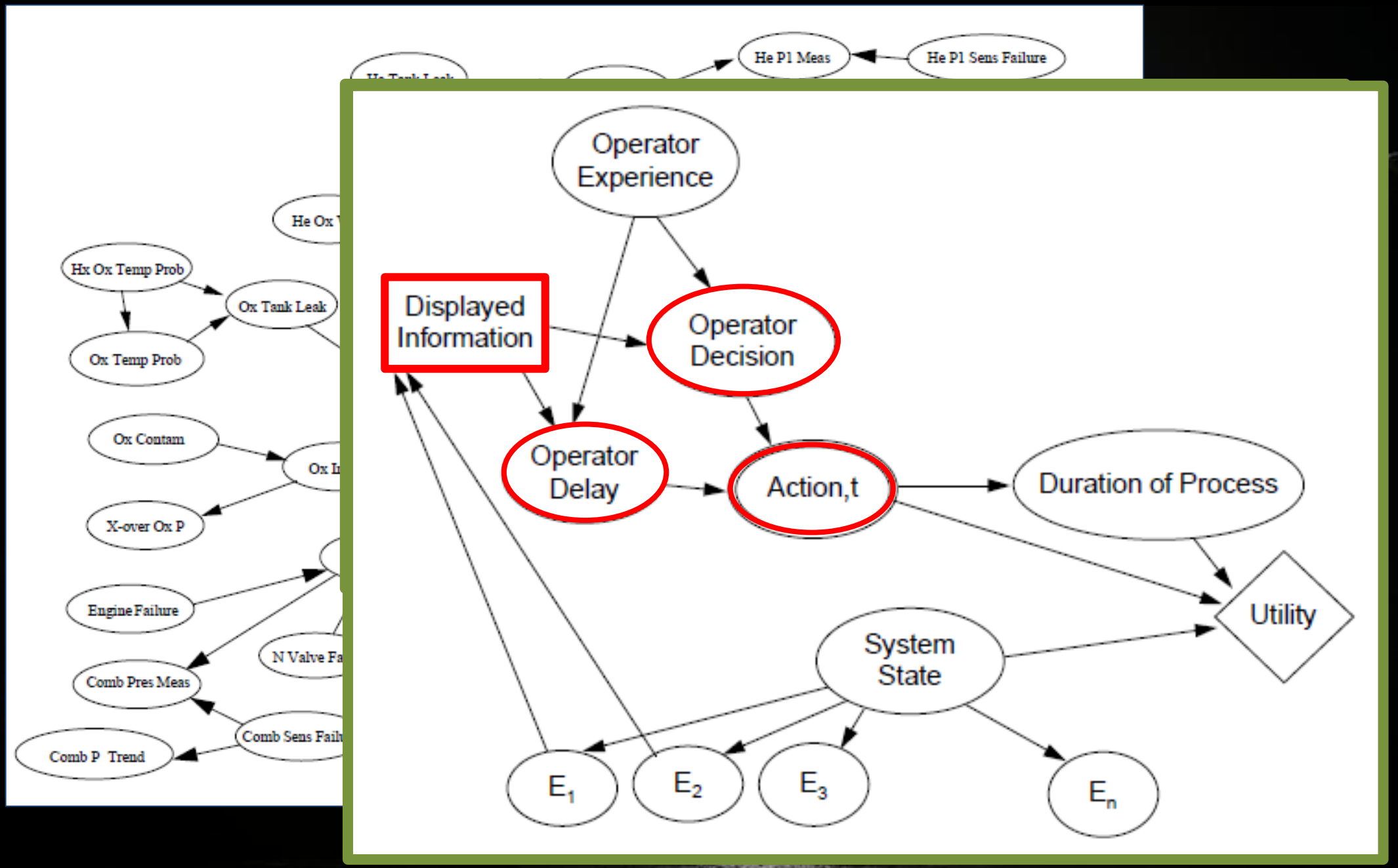
H., Barry. Display of Information for Time-Critical Decision Making. UAI, 1995.

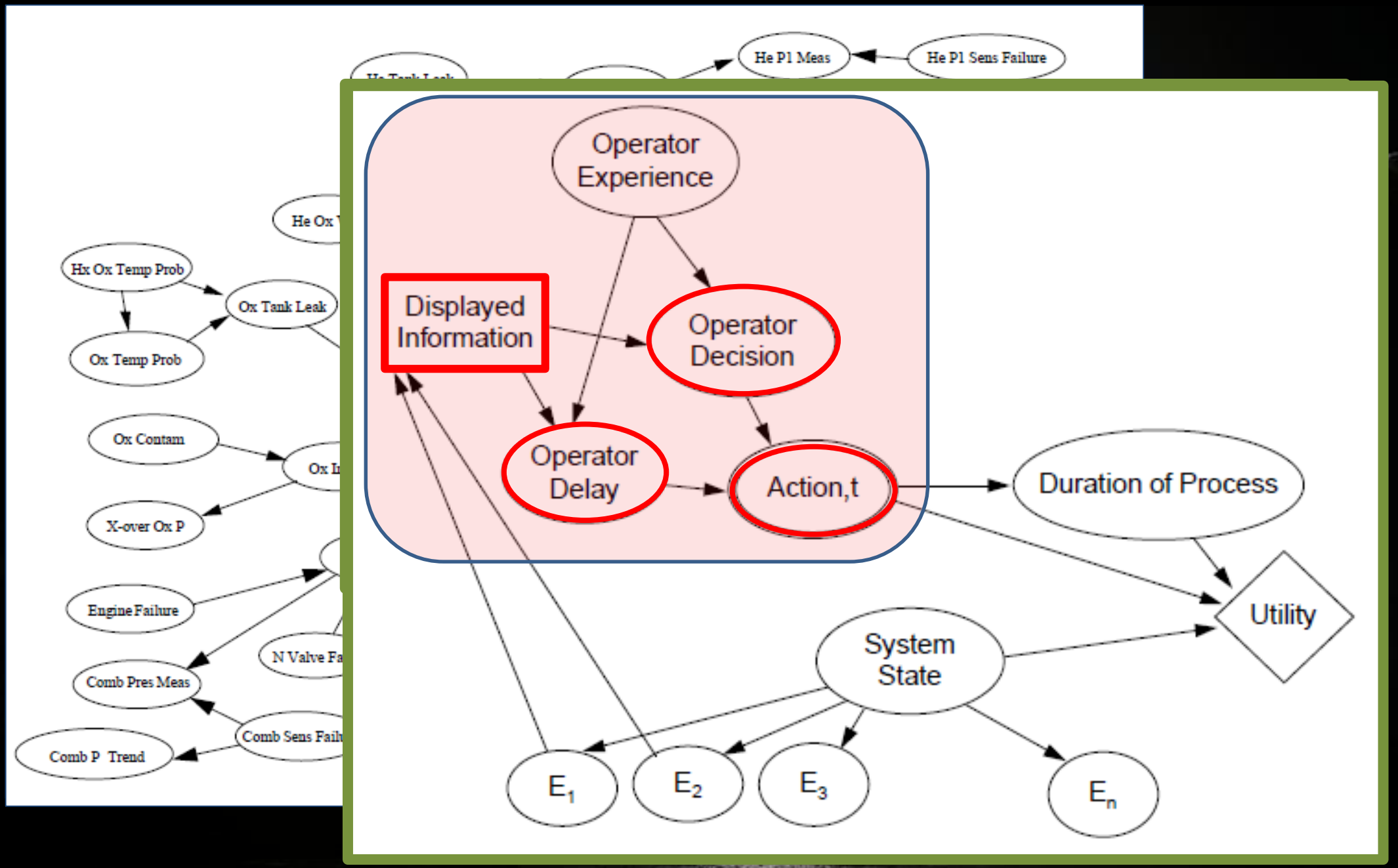


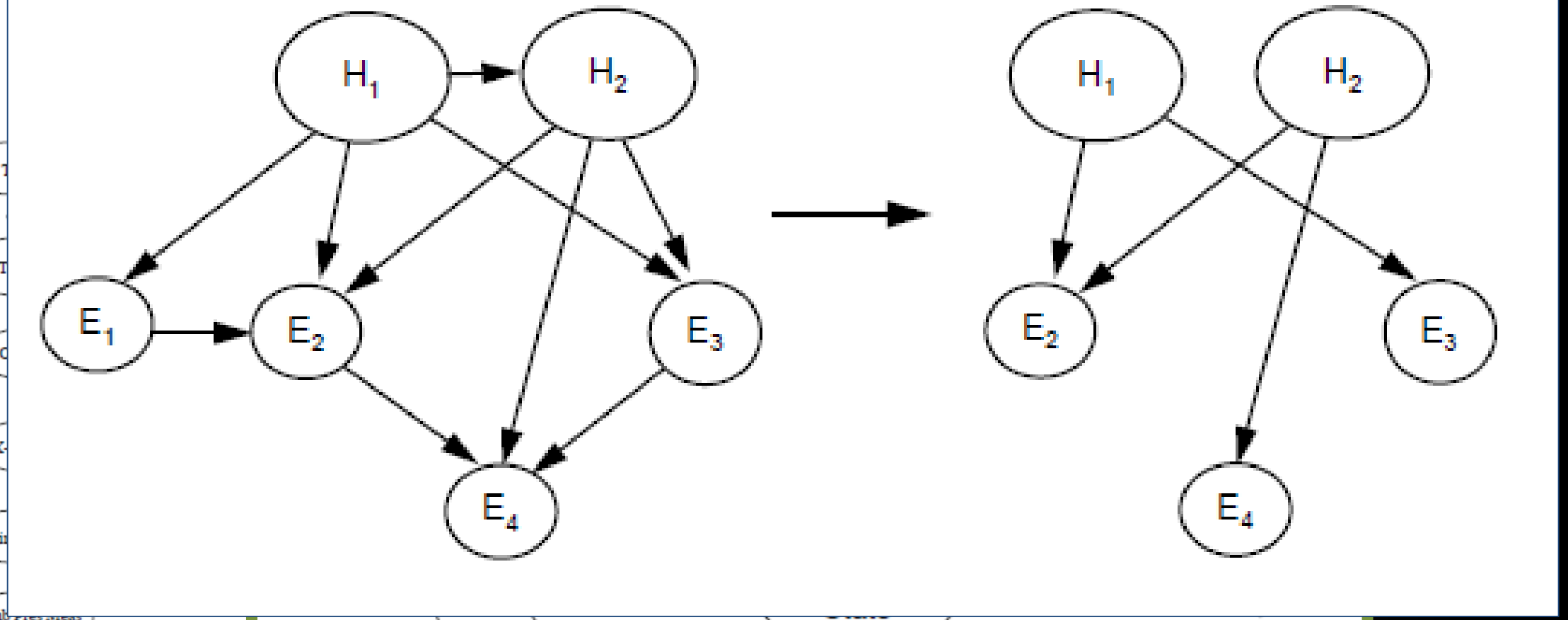
H., Barry. Display of Information for Time-Critical Decision Making. UAI, 1995.

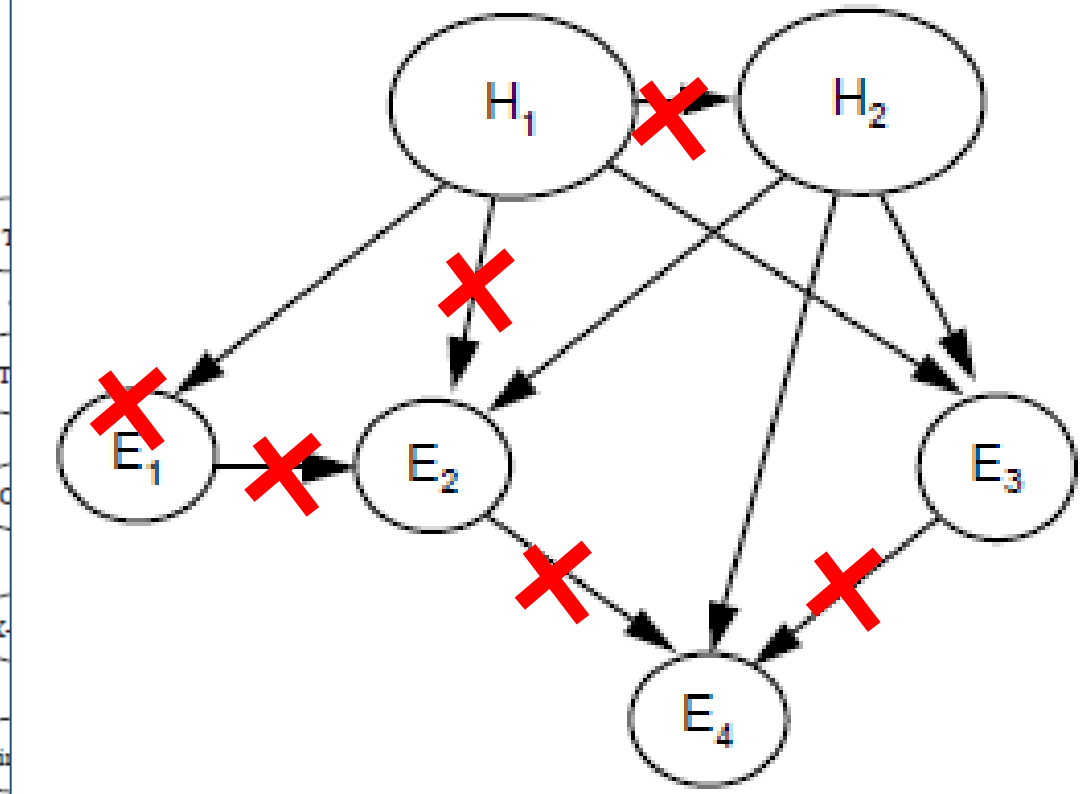


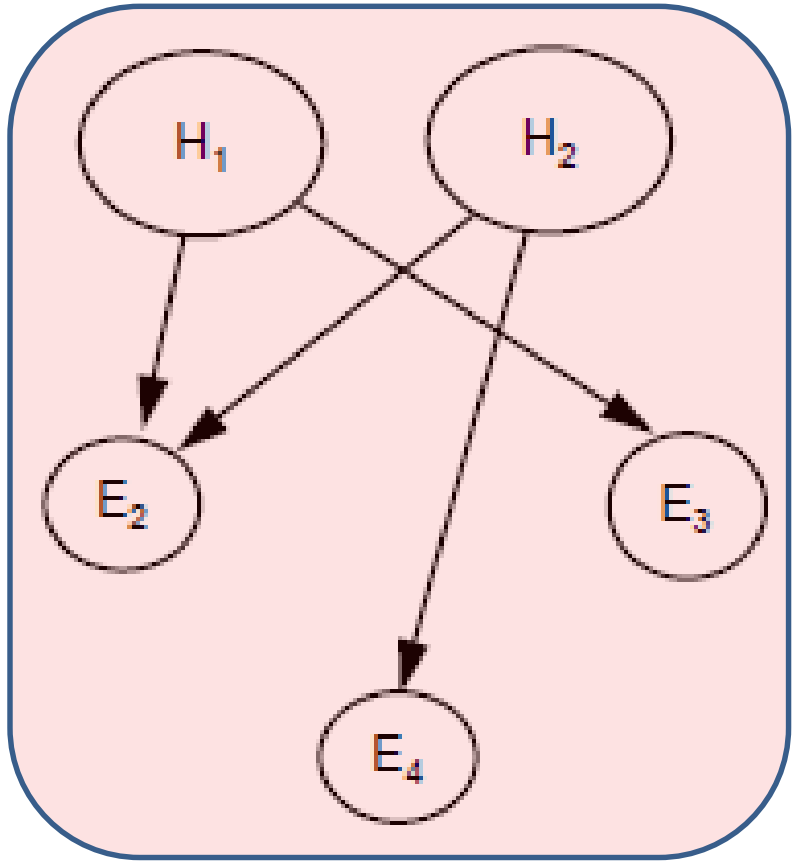
H., Barry. Display of Information for Time-Critical Decision Making. UAI, 1995.

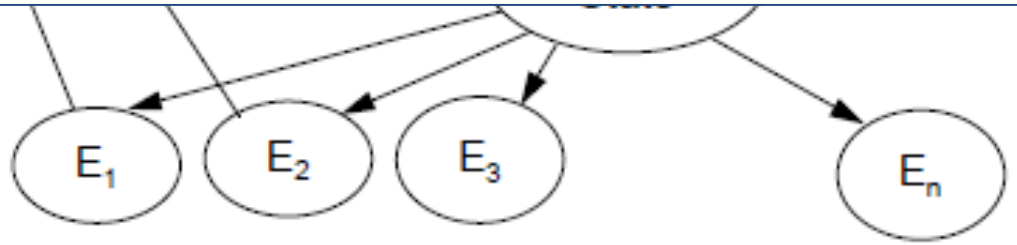

He P1 Meas
He P1 Sens Failure
Hx Ox Temp Prob
Ox Tank Leak
Ox Temp Prob
Ox Contam
X-over Ox P
Engine Failure
Comb Pres Meas
Comb P Trend
Operator Experience
Displayed Information
Operator Decision
Operator Delay
Action,t
Duration of Process
Utility
System State
E_1
E_2
E_3
E_n


He P1 Meas
He P1 Sens Failure
Hx Ox Temp Prob
Ox Tank Leak
Ox Temp Prob
Ox Contam
X-over Ox P
Engine Failure
Comb Pres Meas
Comb P Trend
Operator Experience
Displayed Information
Operator Decision
Operator Delay
Action,t
Duration of Process
Utility
System State
E_1
E_2
E_3
E_n

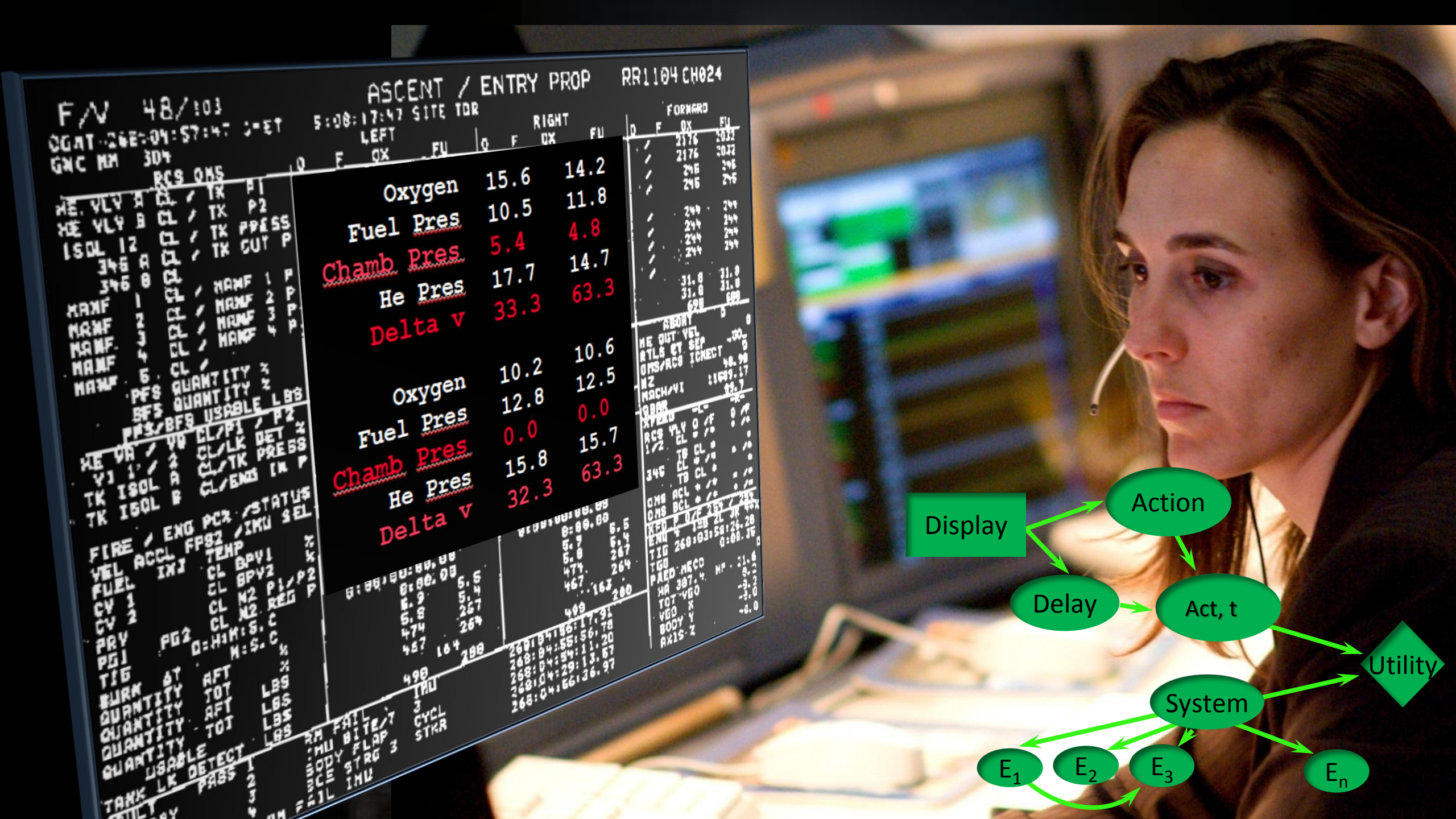

H1
H2
E1
E2
E3
E4
H1
H2
E2
E3
E4


H1
H2
E1
E2
E3
E4


H1
H2
E2
E3
E4

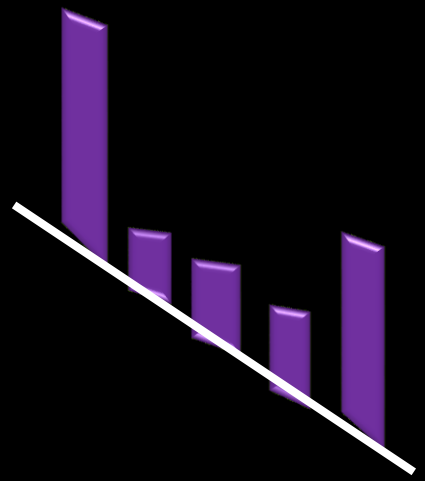

E1
E2
E3
En


ASCENT / ENTRY PROP
RR1104 CH024
F/V 48/101
GNC MM 304
LEFT
RIGHT
FORWARD
RCS QMS
PFS QUANTITY %
BFS QUANTITY %
PFS/BFS USABLE LBS
FIRE / ENG PC% /STATUS
VEL ACCL FPS2 /IMU SEL
FUEL INJ TEMP
CV 1 CL BPV1 %
CV 2 CL BPV2 %
PRV CL N2 P1/P2 P
PGI PG2 CL N2 REG P
TIG
BURN GT
QUANTITY AFT %
QUANTITY TOT LBS
QUANTITY AFT LBS
QUANTITY TOT LBS
USABLE
TANK LK DETECT
PASS 1
2
3
4
RA FAIL
IMU BITE/T
BODY FLAP
ENCE STRG 3
FAIL IMU
IMU
CYCL
STKR
ABORT
HE OUT VEL
ATLS ET SEP
OMS/RCS ICNECT
MACH/VI
RCS YLV
OMS ACL
OMS BCL
TIG
TGO
PRED MECO
HA 387.4
TOT VGO
VGO X
BODY Y
AXIS Z

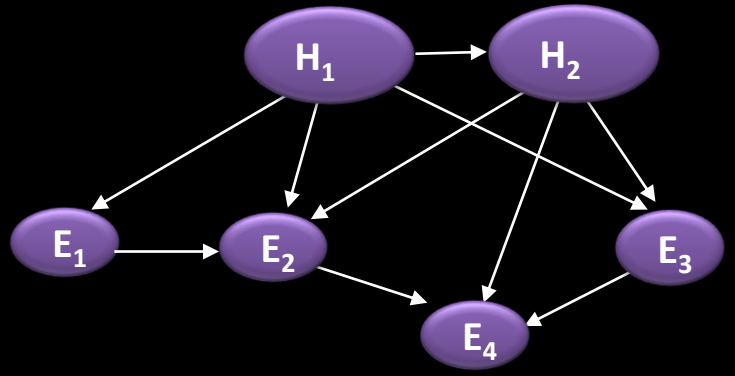

ASCENT / ENTRY PROP
RR1104 CH024
Oxygen 15.6 14.2
Fuel Pres 10.5 11.8
Chamb Pres 5.4 4.8
He Pres 17.7 14.7
Delta v 33.3 63.3
Oxygen 10.2 10.6
Fuel Pres 12.8 12.5
Chamb Pres 0.0 0.0
He Pres 15.8 15.7
Delta v 32.3 63.3
Display
Action
Delay
Act, t
Utility
System
E_1
E_2
E_3
E_n

Pillars

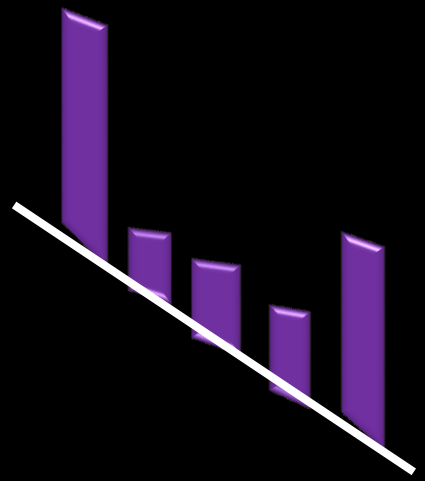
Pillar: Inferring Beliefs, Goals, Knowledge

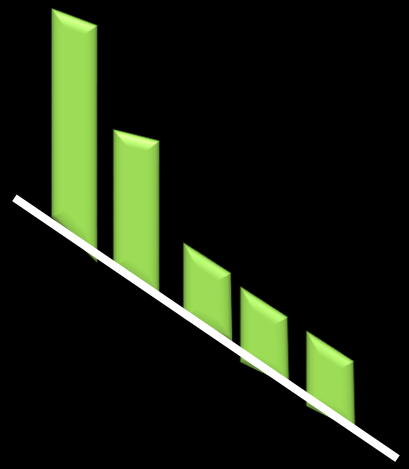


Predictions about world

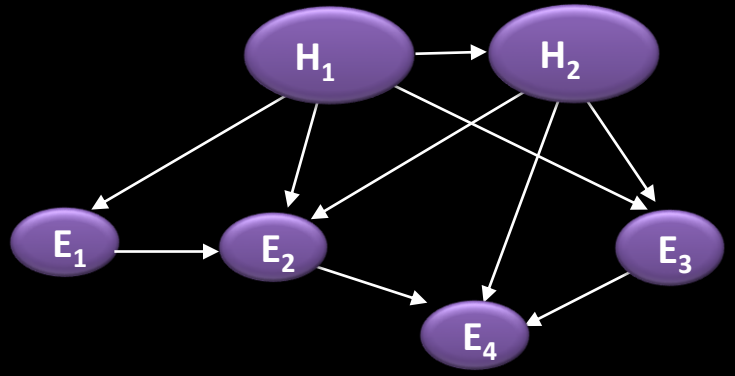


Pillar: Inferring Beliefs, Goals, Knowledge

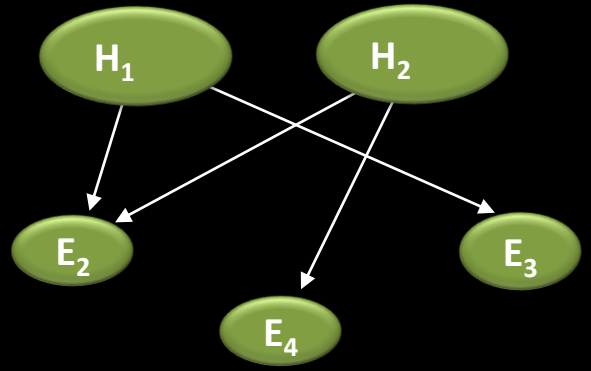




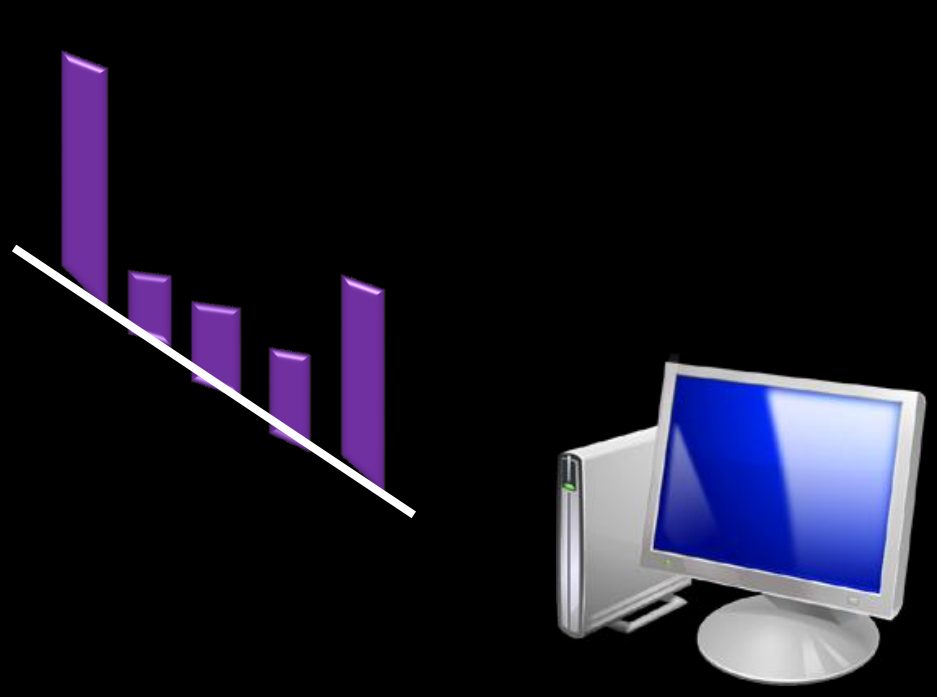
Predictions about world

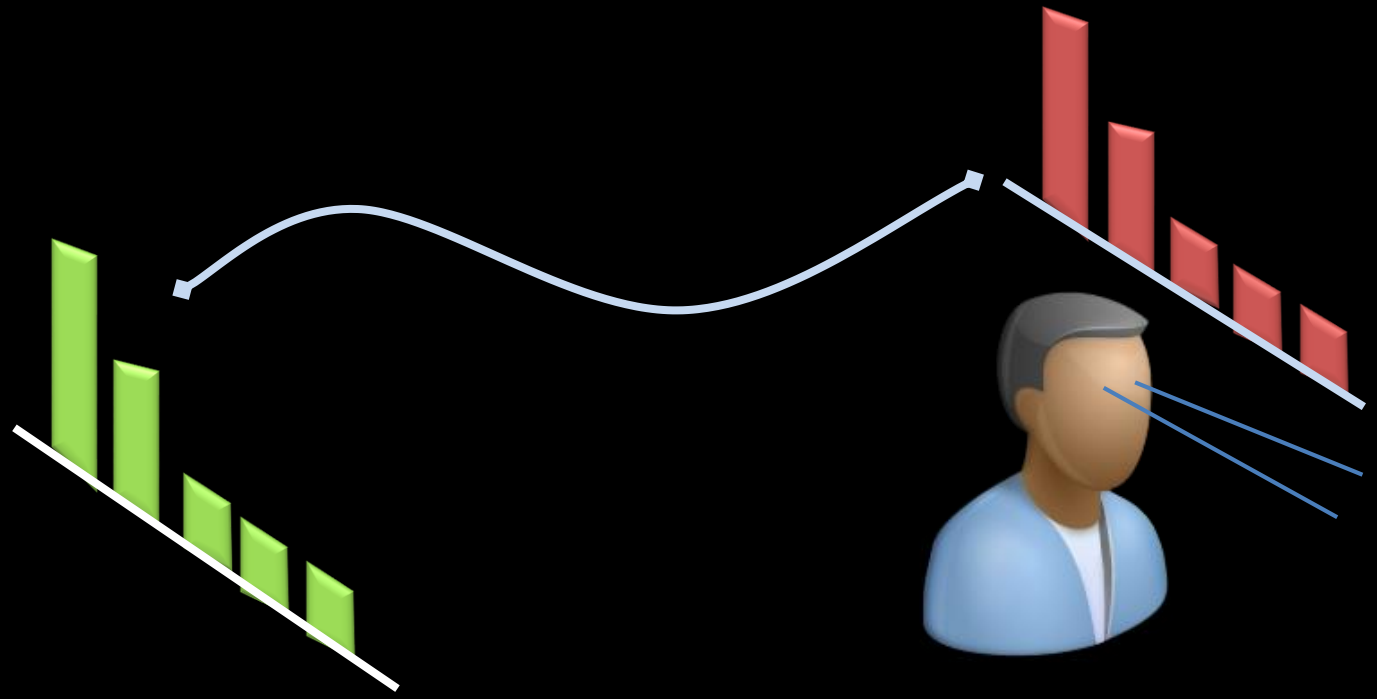


Inferences on beliefs, goals, knowledge

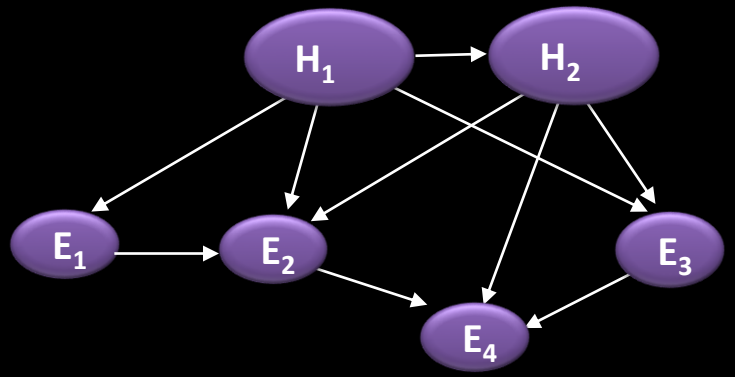


Pillar: Inferring Beliefs, Goals, Knowledge

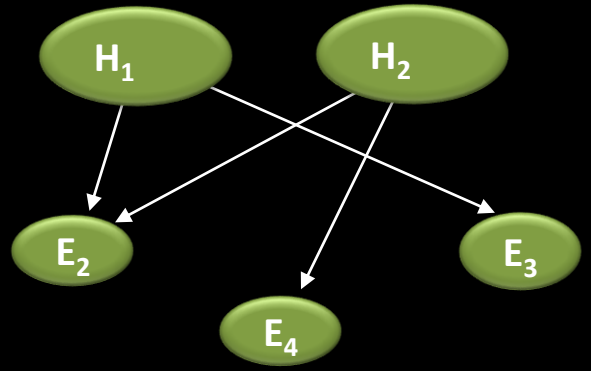




Predictions about world



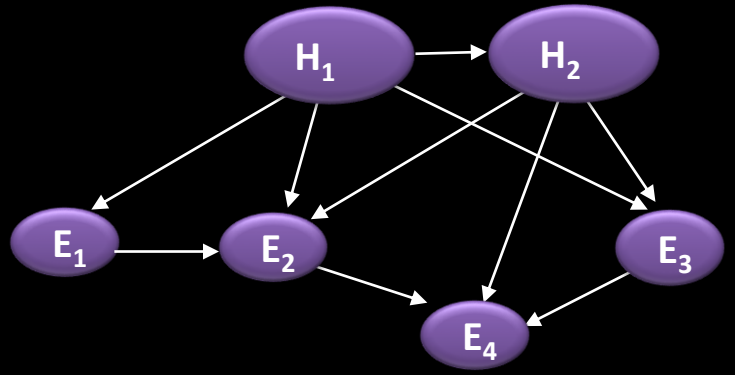
Inferences on beliefs, goals, knowledge



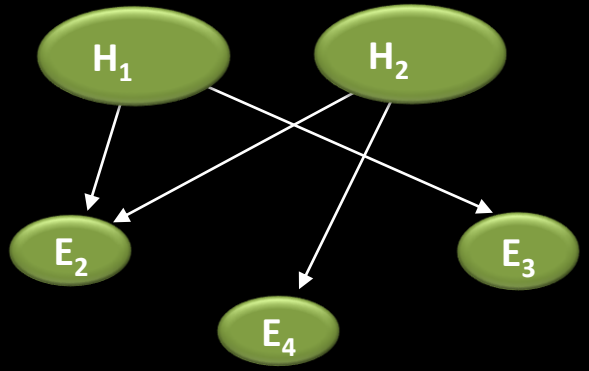
Pillar: Inferring Beliefs, Goals, Knowledge

Ideal actions under uncertainty

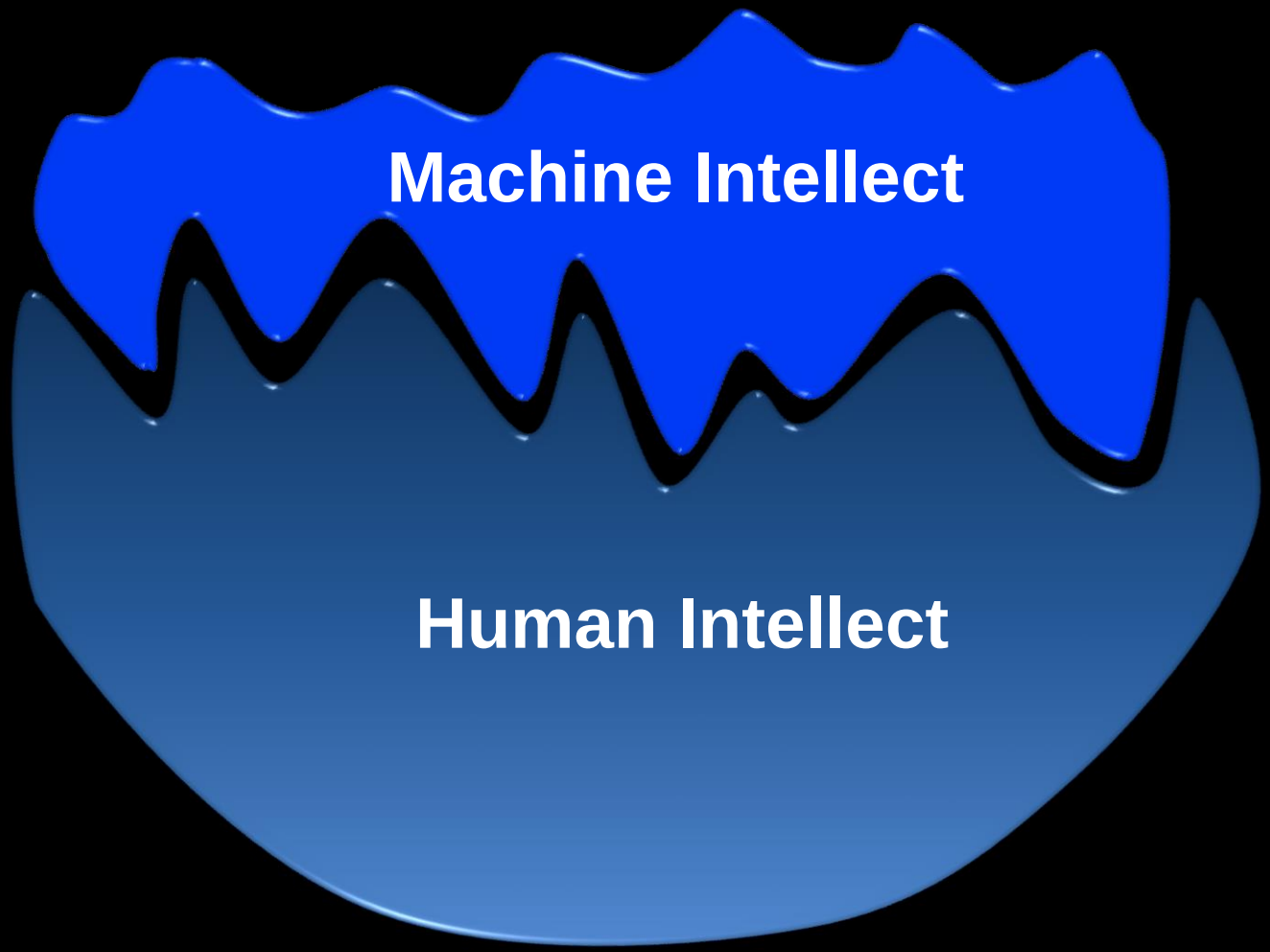
Predictions about world



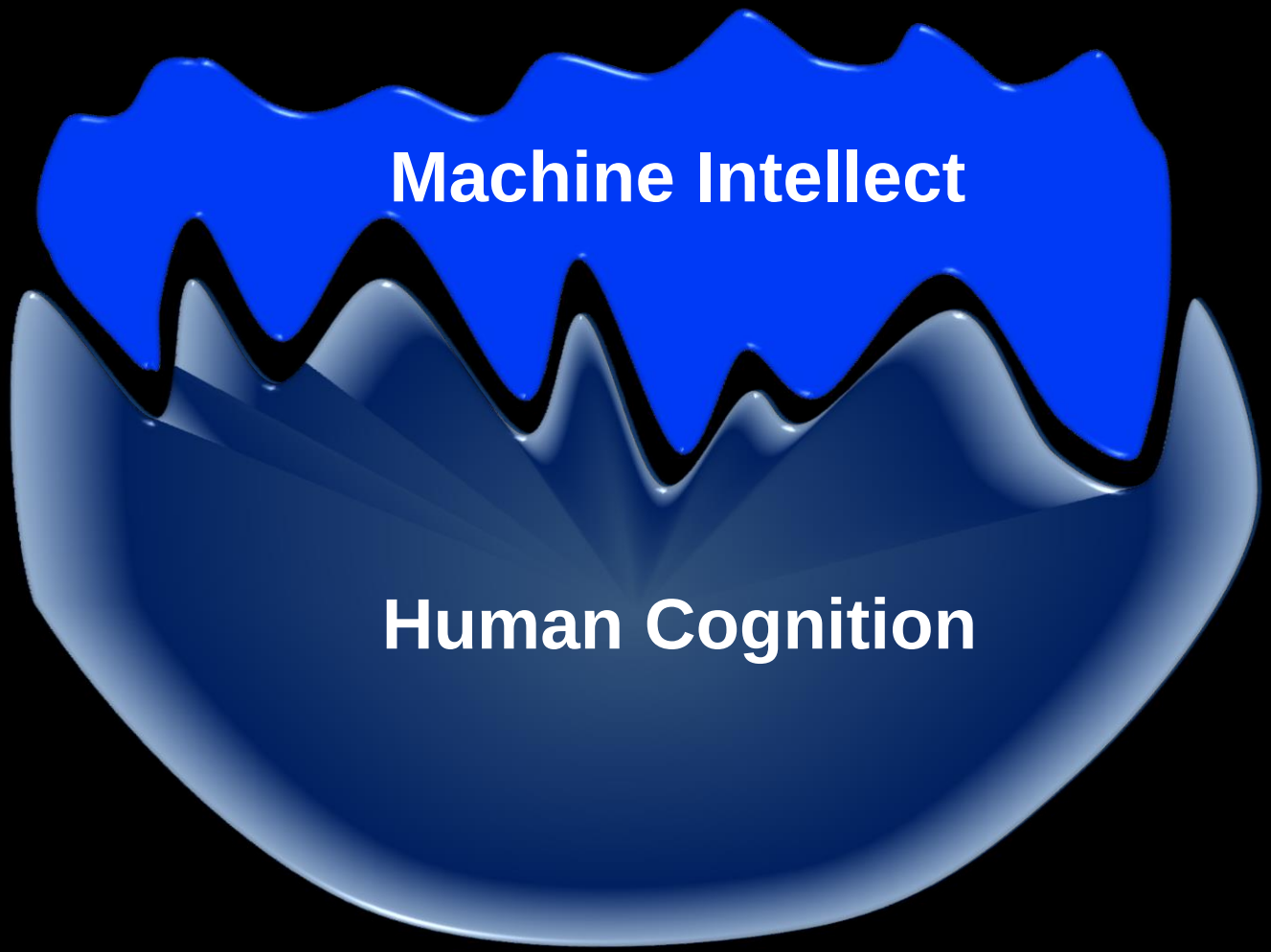
Inferences on beliefs, goals, knowledge



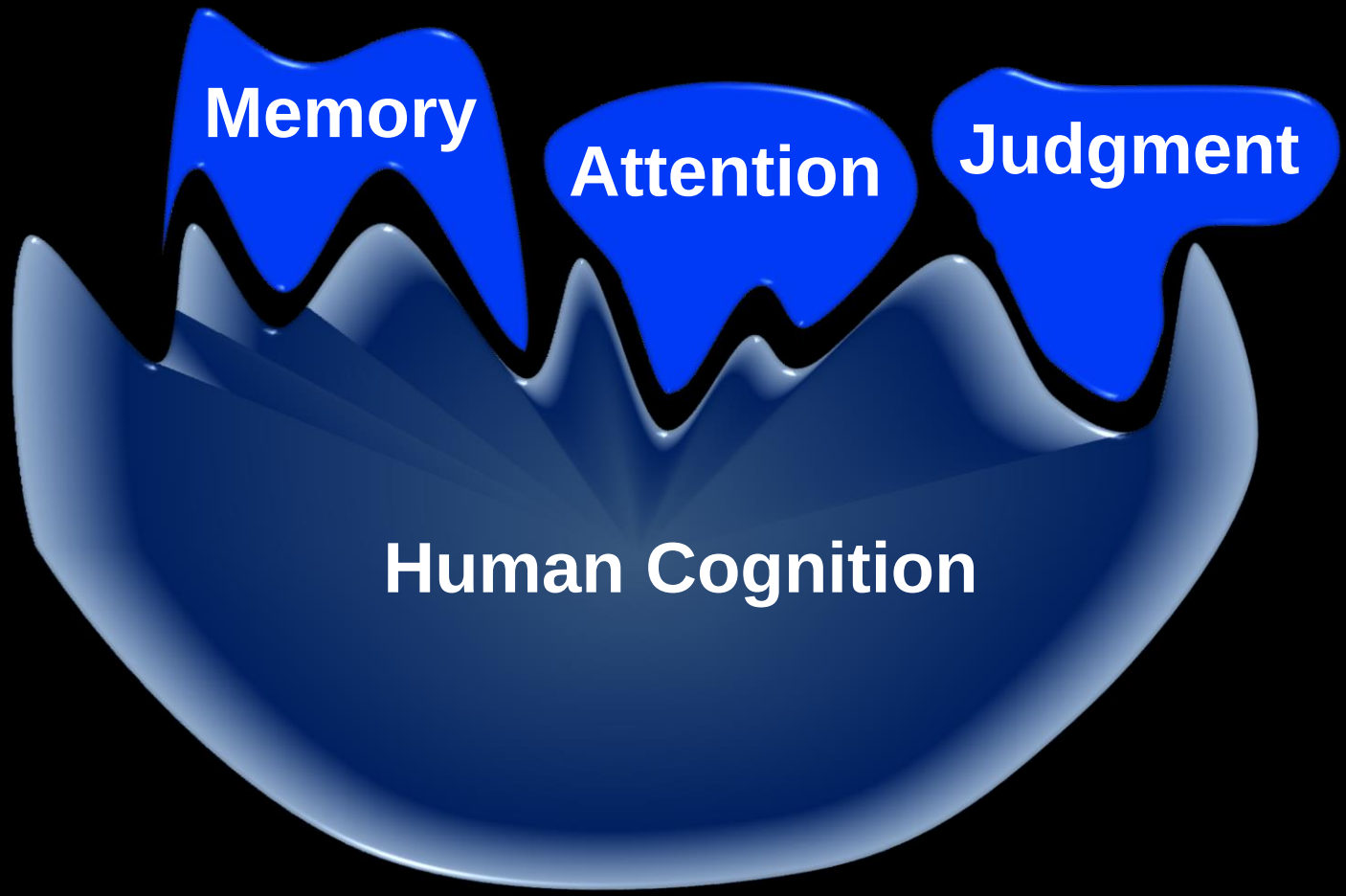
Pillar: Complementarity



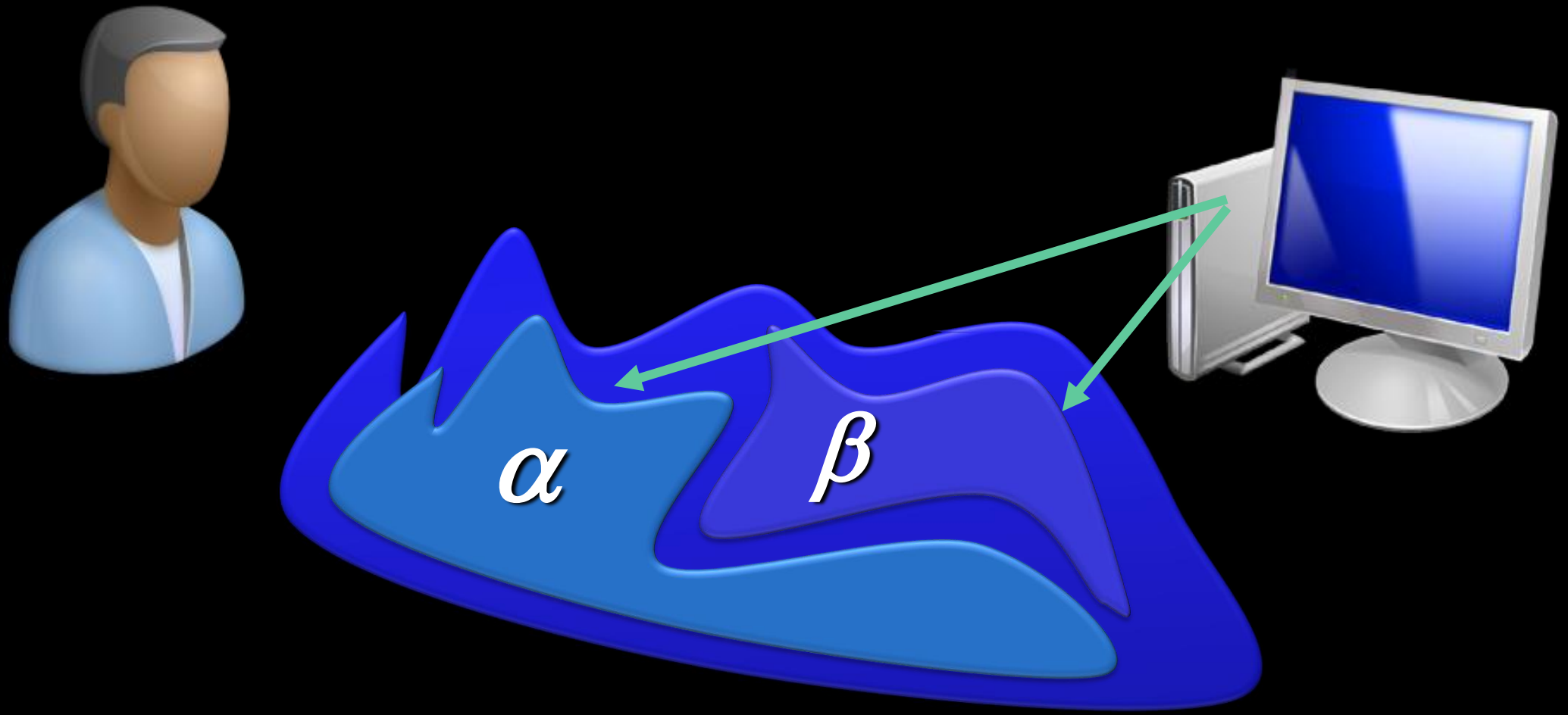
Pillar: Complementarity



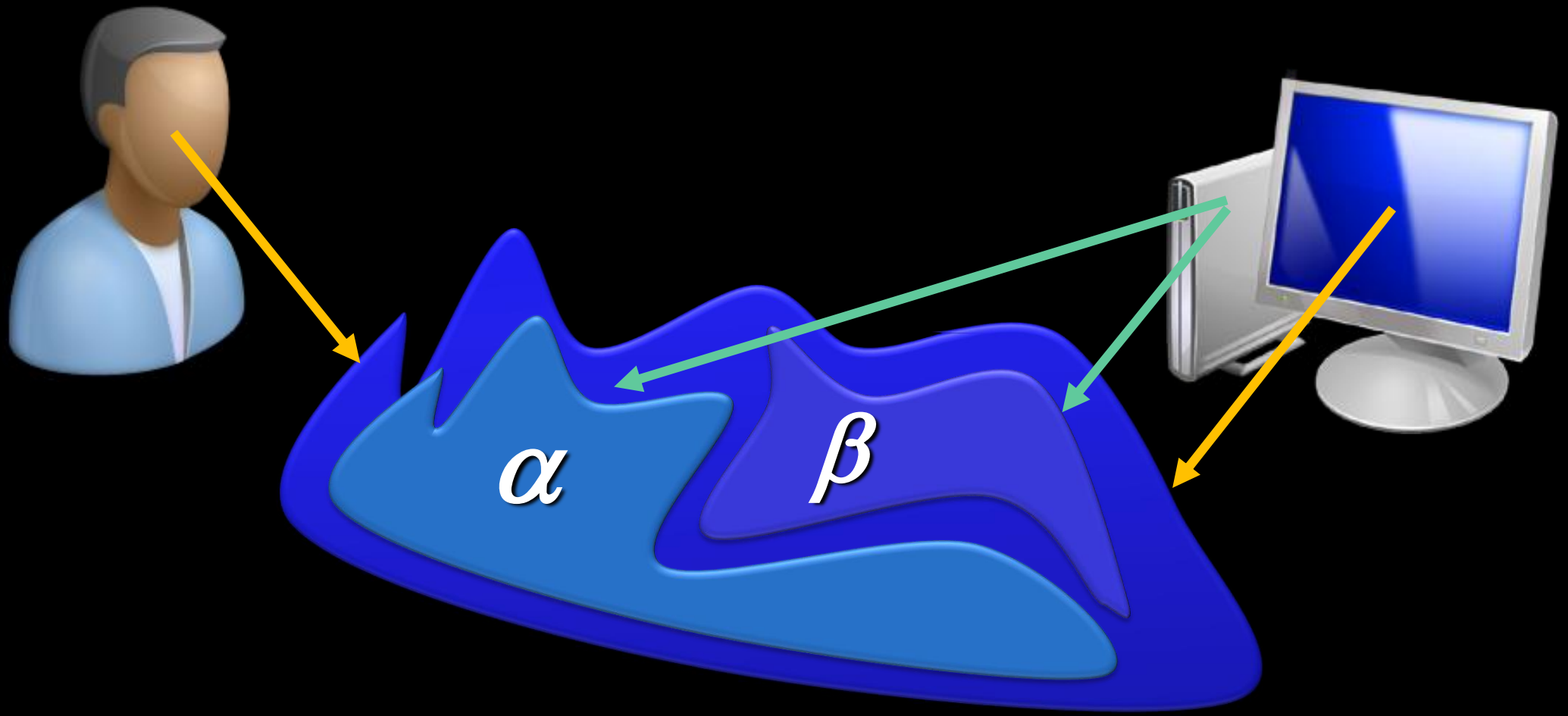
Pillar: Complementarity



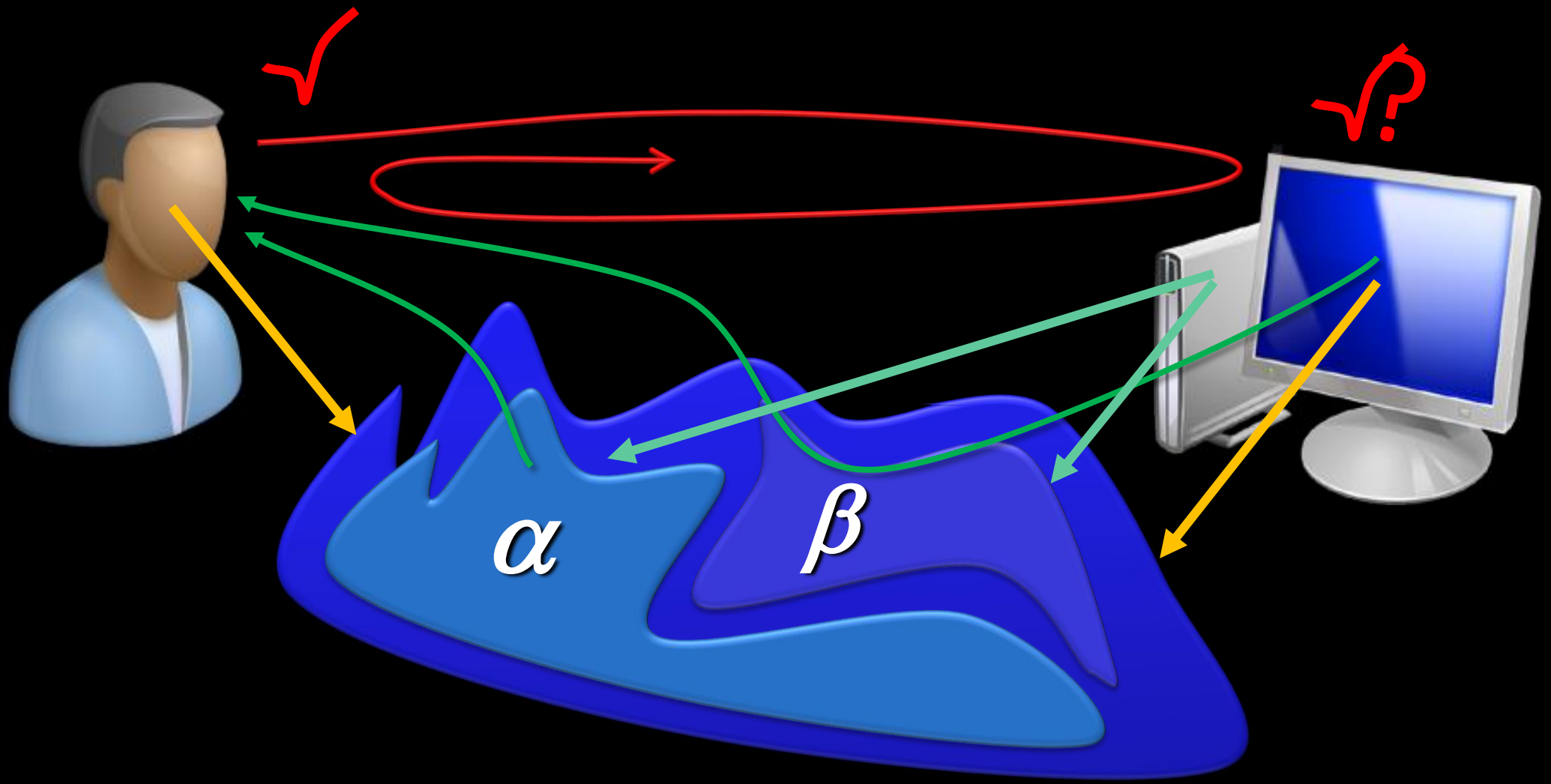
Pillar: Mix of Initiatives



Pillar: Mix of Initiatives



Pillar: Mix of Initiatives



Pillar: Coordination

Conversation

Intention

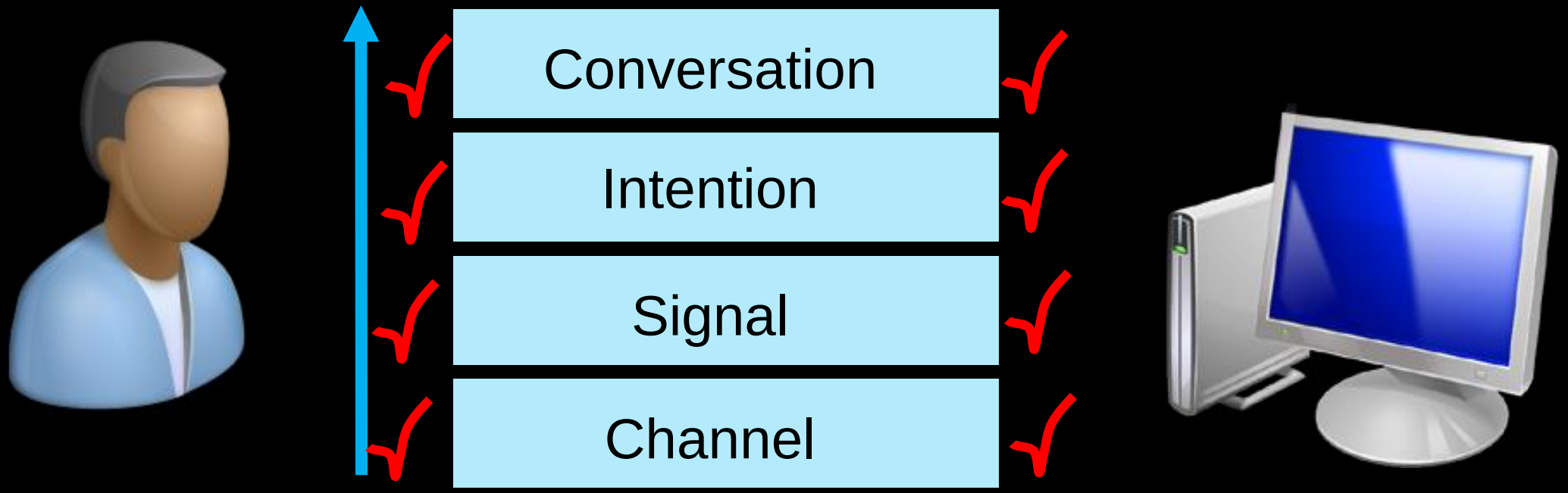
Signal

Channel

Continuous process of contributing, signaling, monitoring

Clark, Duncan, Goffman, Goodwin, Kendon, et al.

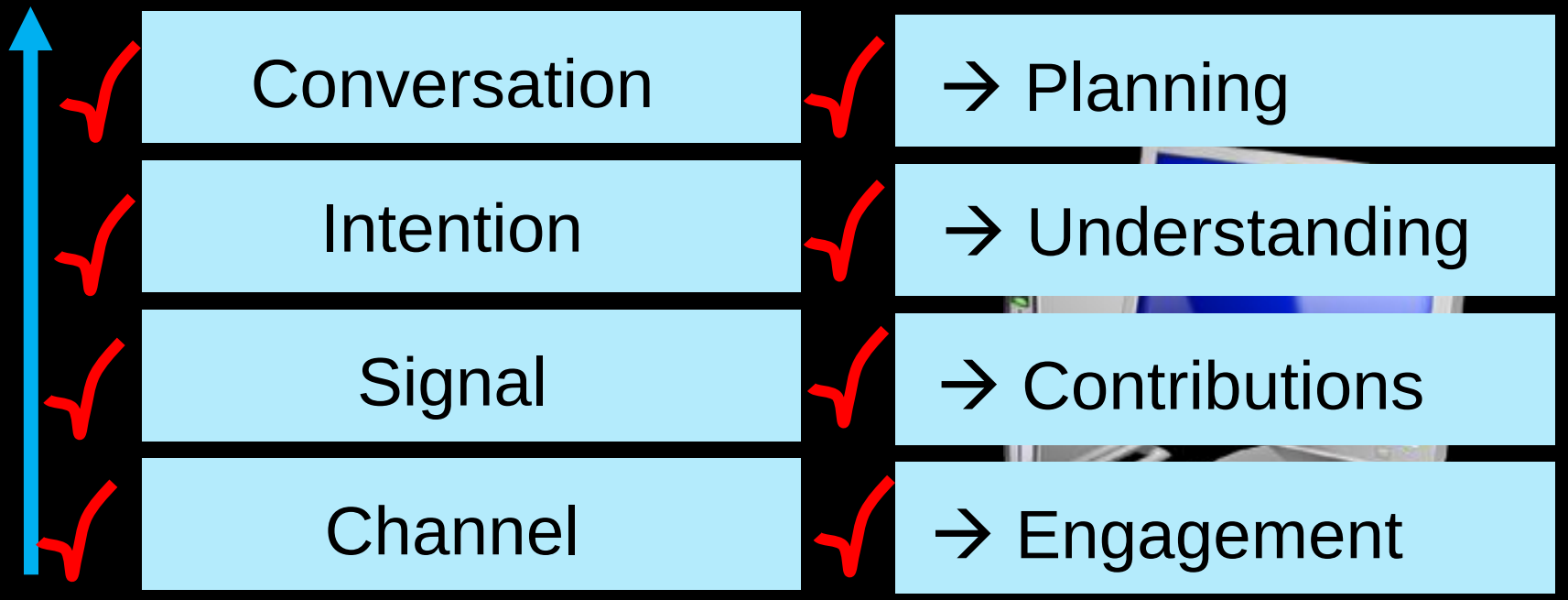
Pillar: Coordination



Continuous process of contributing, signaling, monitoring

Clark, Duncan, Goffman, Goodwin, Kendon, et al.

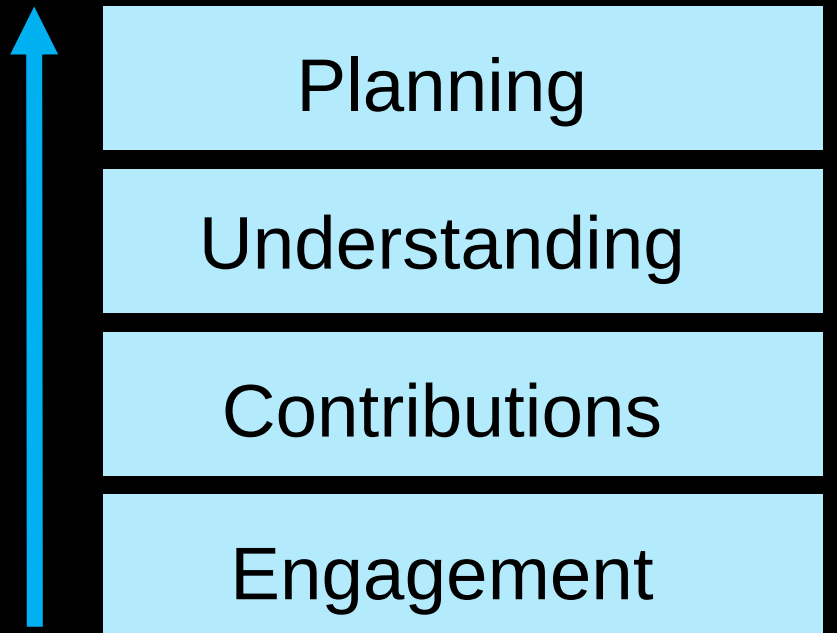
Pillar: Coordination



Continuous process of contributing, signaling, monitoring

Clark, Duncan, Goffman, Goodwin, Kendon, et al.

Pillar: Coordination



Continuous process of contributing, signaling, monitoring

Clark, Duncan, Goffman, Goodwin, Kendon, et al.

Coordination in Open World

Planning

Understanding

Contributions

Engagement

Situated interaction

Bohus, H. et al.

Coordination in Open World

Planning

Understanding

Contributions

Engagement

Beliefs,
intentions, plans

Activities & events

Actors, objects
in space & time

Situated interaction

Bohus, H. et al.

Coordination in Open World

Planning

Understanding

Contributions

Engagement

Beliefs,
intentions, plans

Activities & events

Actors, objects
in space & time

Situated interaction

Bohus, H. et al.

Coordination in Open World

Planning

Understanding

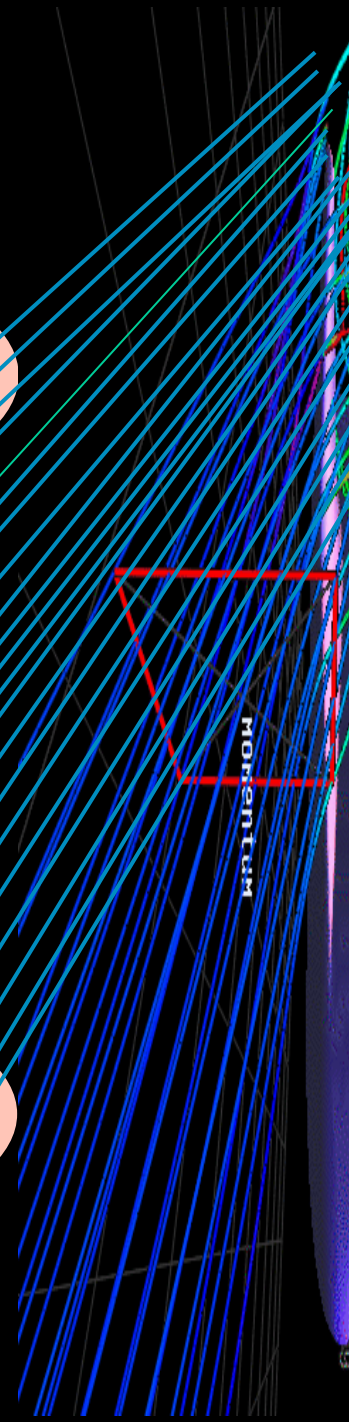
Contributions

Engagement

Beliefs,
intentions, plans

Activities & events

Actors, objects
in space & time

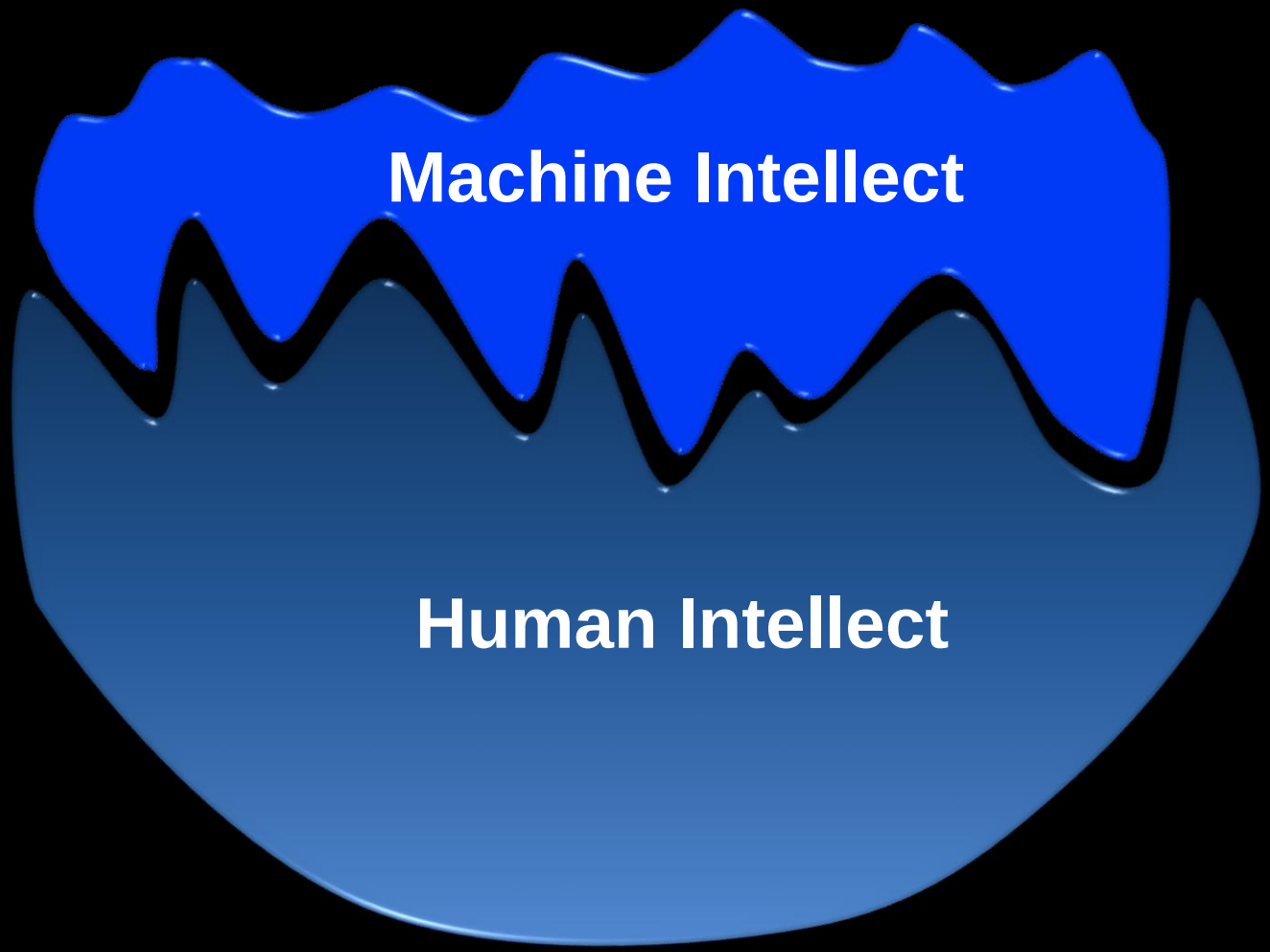


Situated interaction

Bohus, H. et al.

Reflections on several research efforts

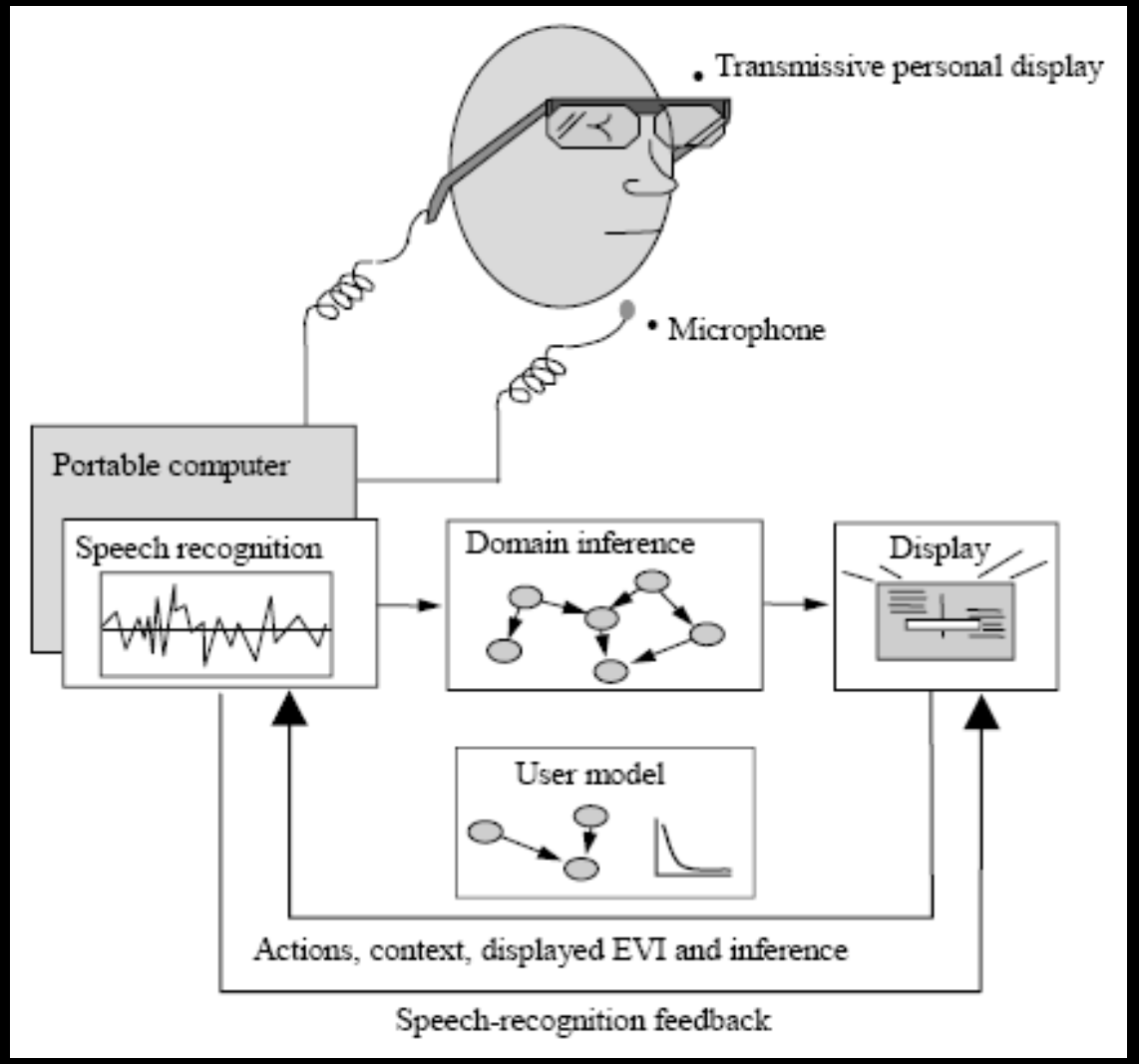
Efforts in Complementarity



Handsfree Trauma Care System (1991)

H., Shwe, Handsfree Decision Support: Toward a Non-invasive Human-Computer Interface, SCAMC, 1995.

Handsfree Trauma Care System



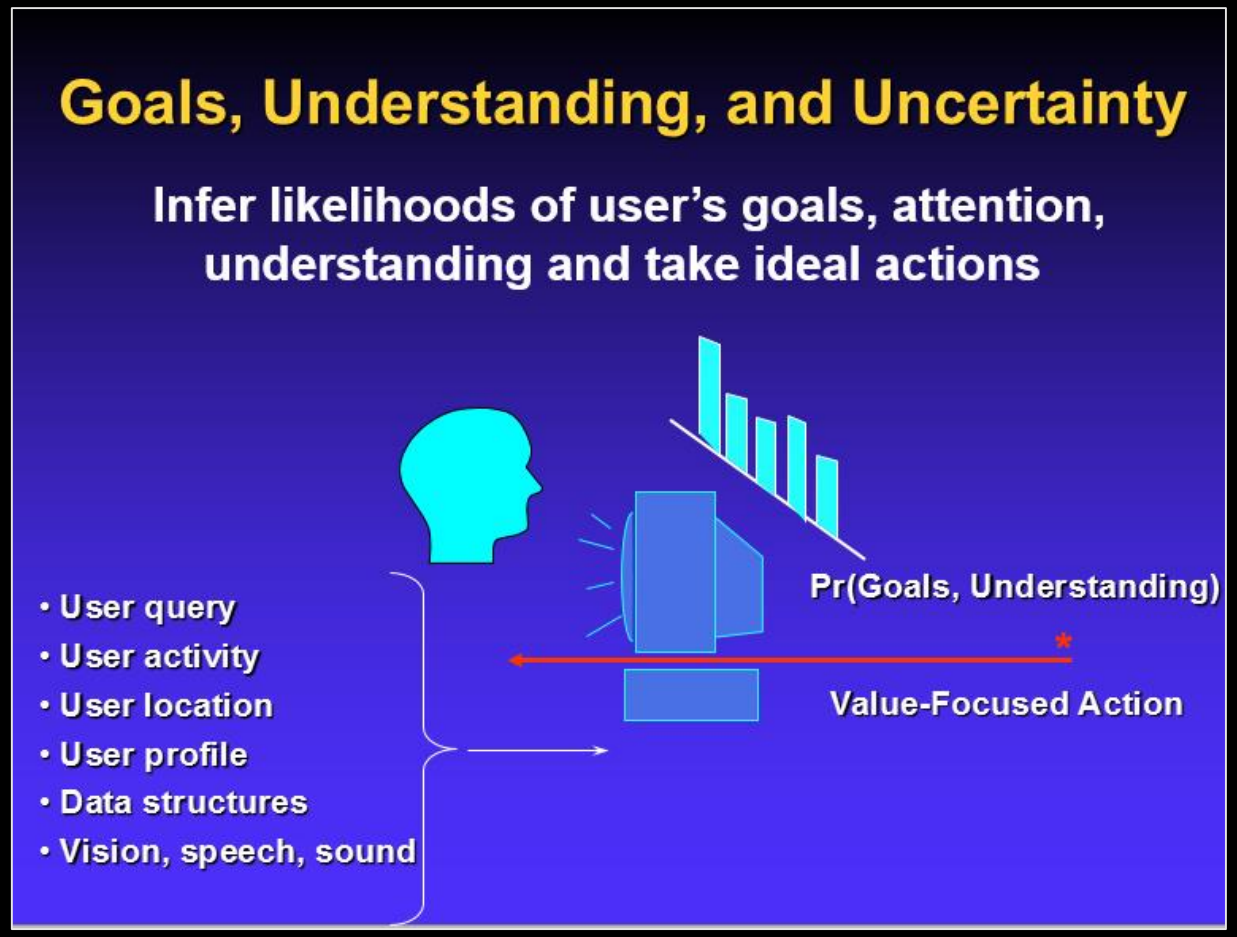
H., Shwe, Handsfree Decision Support: Toward a Non-invasive Human-Computer Interface, SCAMC, 1995.

Handsfree Trauma Care System

Video

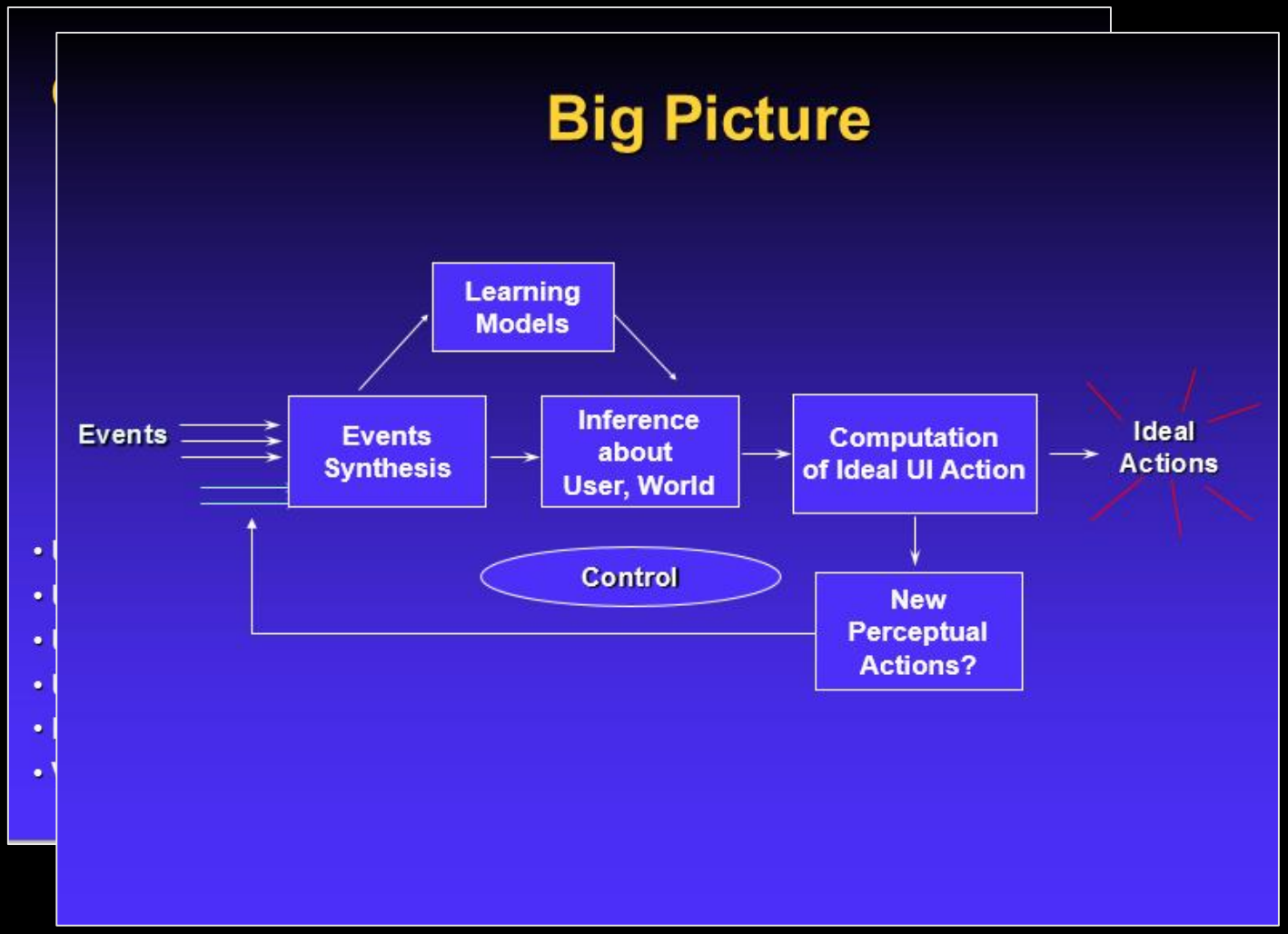
H., Shwe, Handsfree Decision Support: Toward a Non-invasive Human-Computer Interface, SCAMC, 1995.

Lumiere Project (1993)



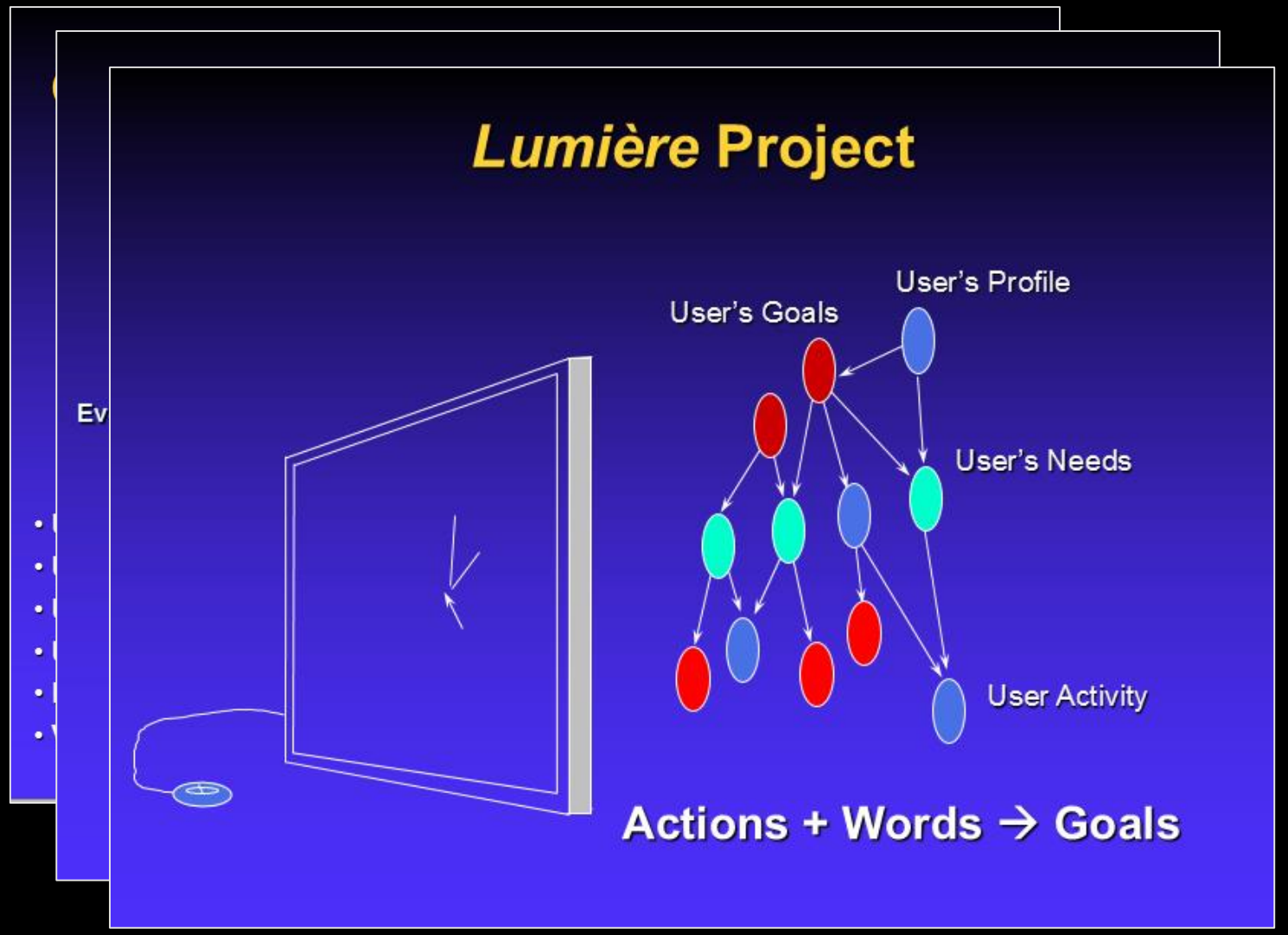
Slides from early days at Microsoft Research…

Lumiere Project (1993)



Slides from early days at Microsoft Research…

Lumiere Project (1993)

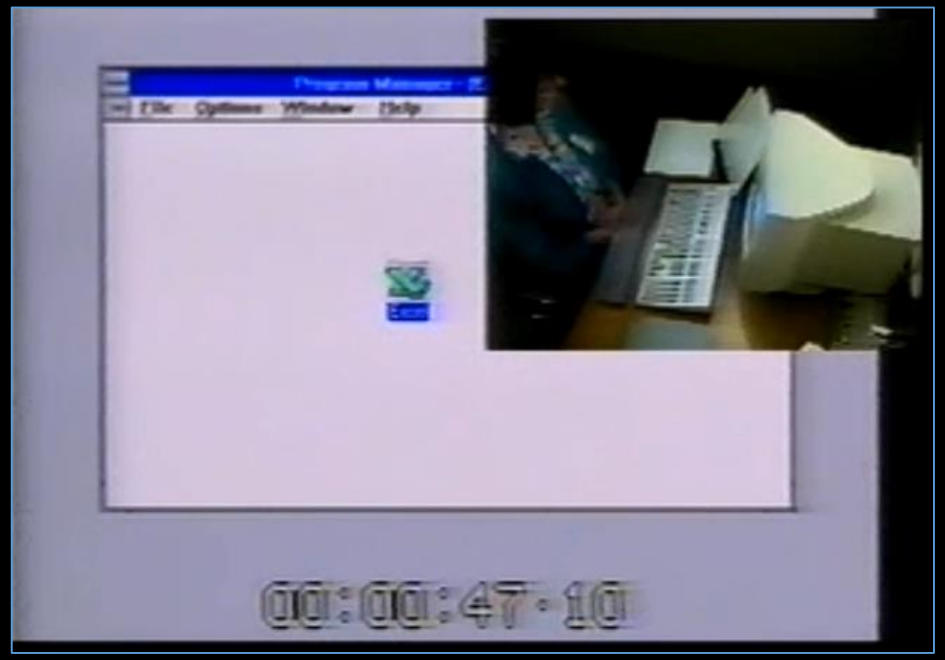


Slides from early days at Microsoft Research…

Learning about Assisting Computer Users

Wizard of Oz Studies

Expert peeks through a keyhole, plays assistant role



User with challenge task

Expert as Wizard of Oz “Agent”

Video

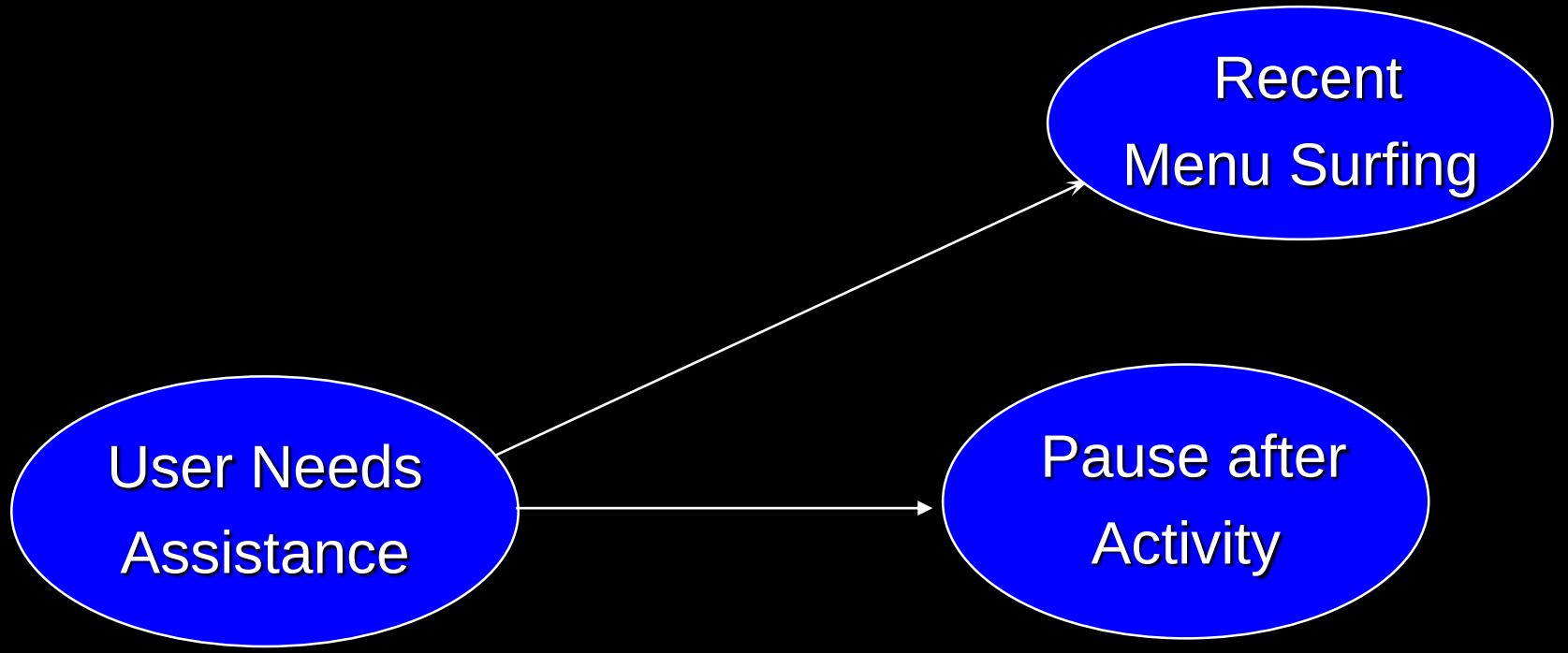
Evidential distinctions identified

- Search: e.g., exploring of multiple menus
- Introspection: e.g., sudden pause, slowing of command stream
- Focus of attention: e.g, selected objects
- Undesired effects: e.g., command/undo, dialogue opened and cancelled
- Inefficient command sequences
- Syntactic / semantic content of file
- Goal-specific sequences of actions

Building Bayesian user model

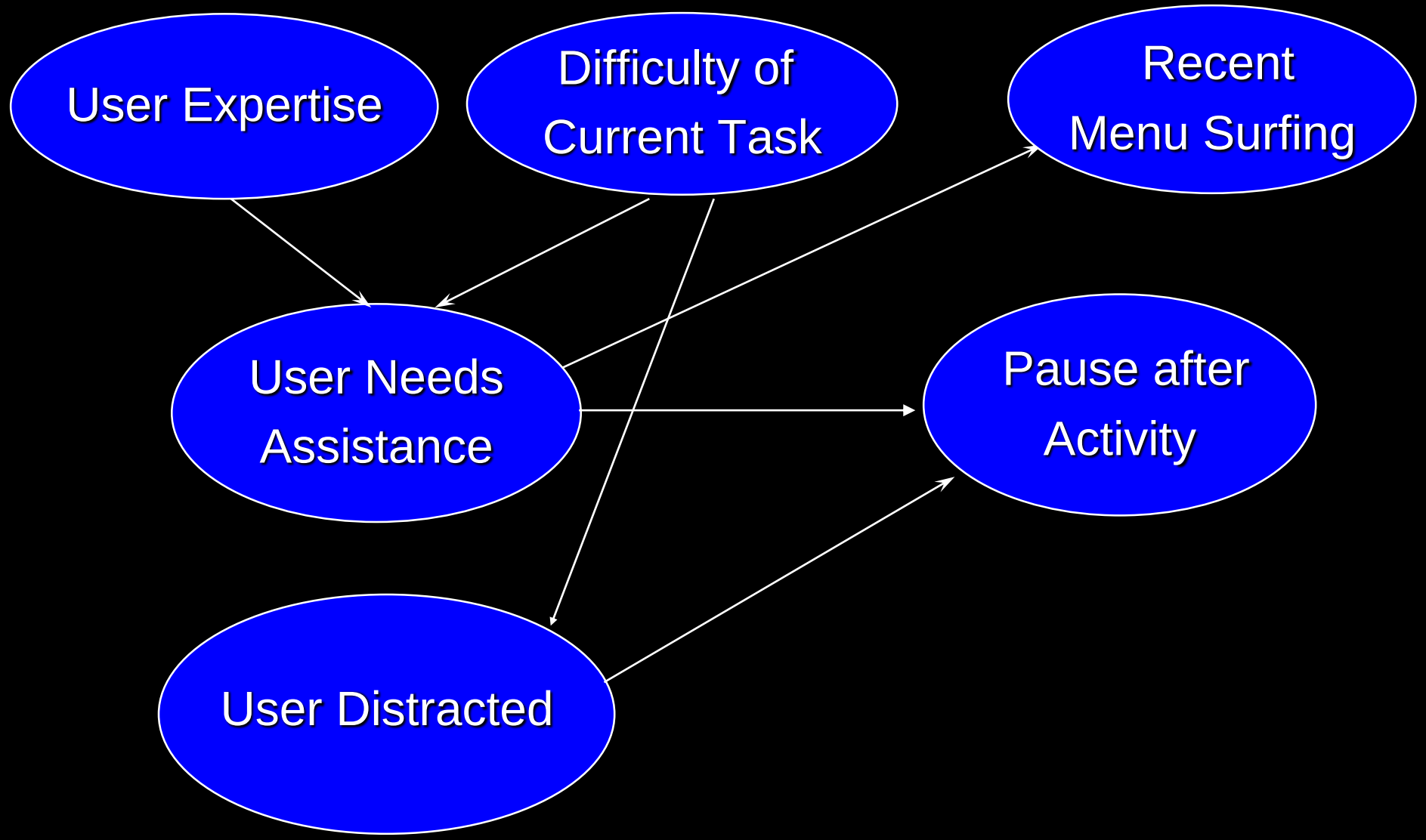
H., Breese, Heckerman, et al. The Lumiere Project: Bayesian User Modeling for Inferring the Goals and Needs of Software Users. UAI 1998.

Building Bayesian user model

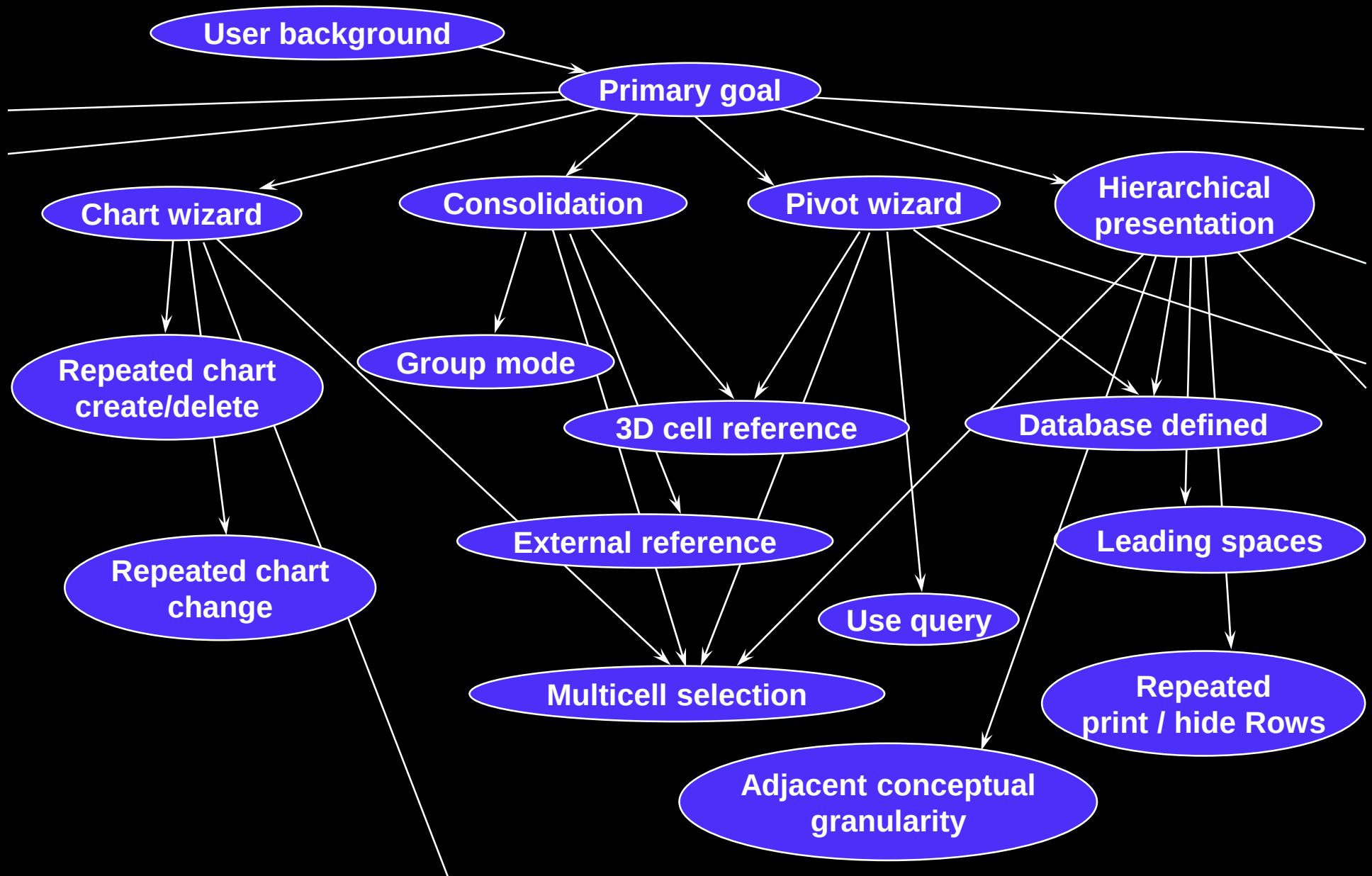


H., Breese, Heckerman, et al. The Lumiere Project: Bayesian User Modeling for Inferring the Goals and Needs of Software Users. UAI 1998.

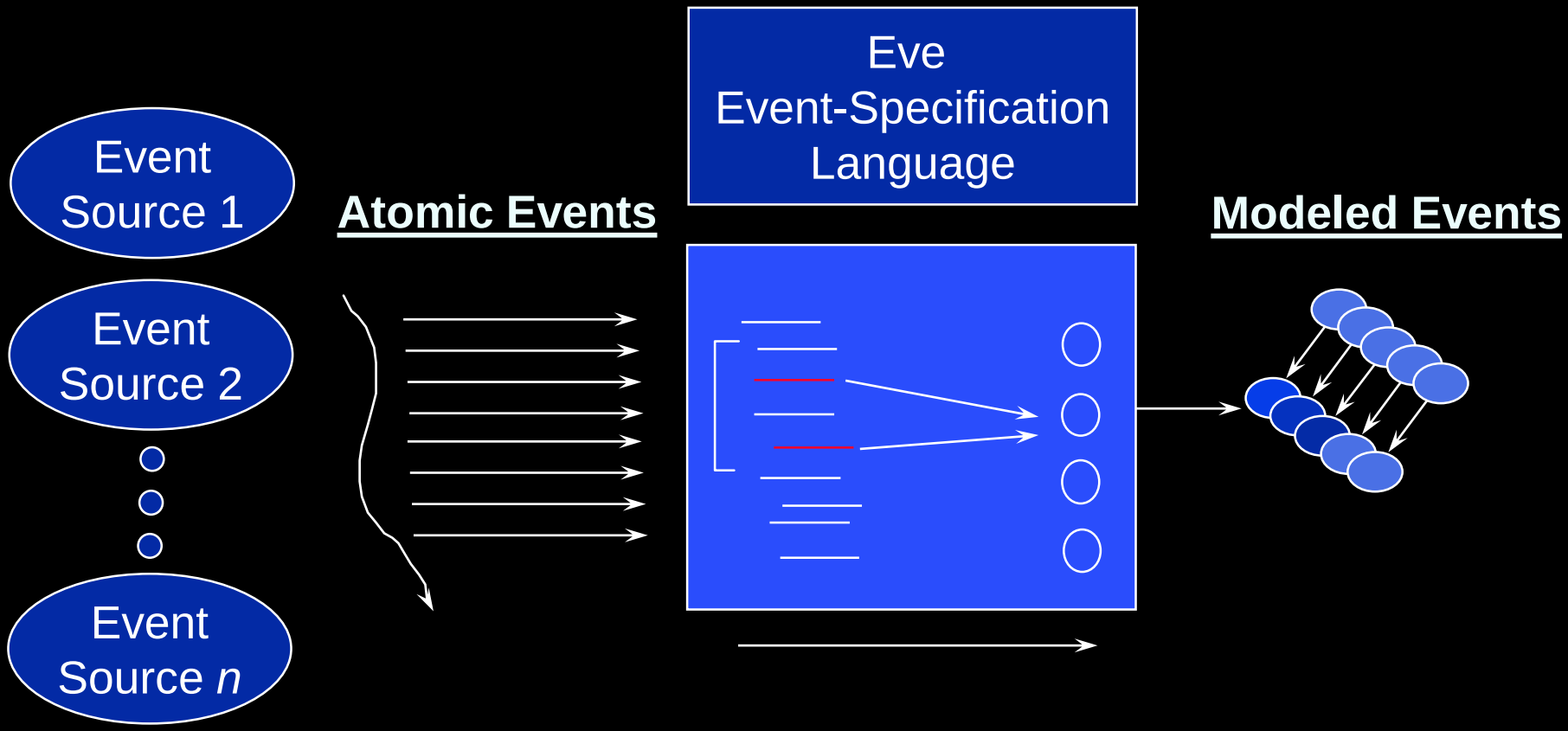
Building Bayesian user model



Lumière Bayesian Net

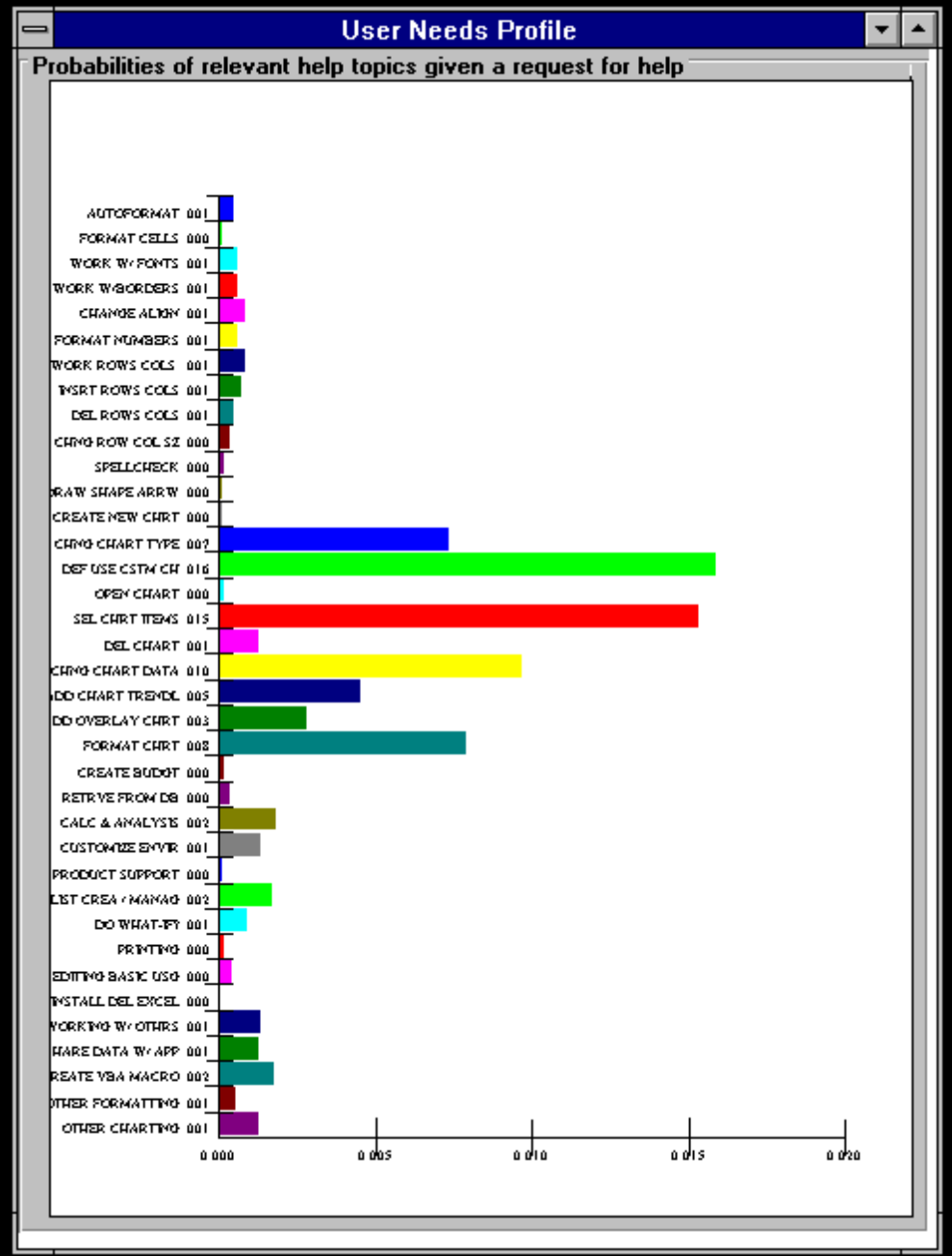


Event Streams and Architectures

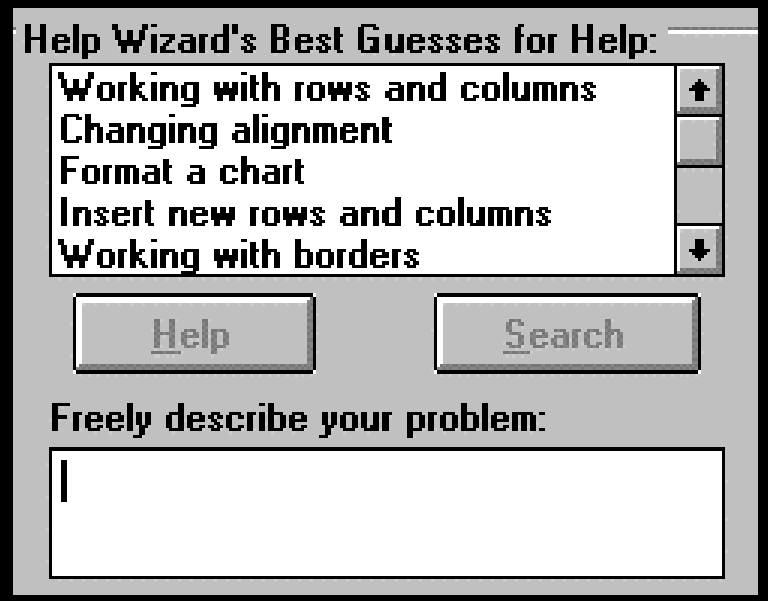


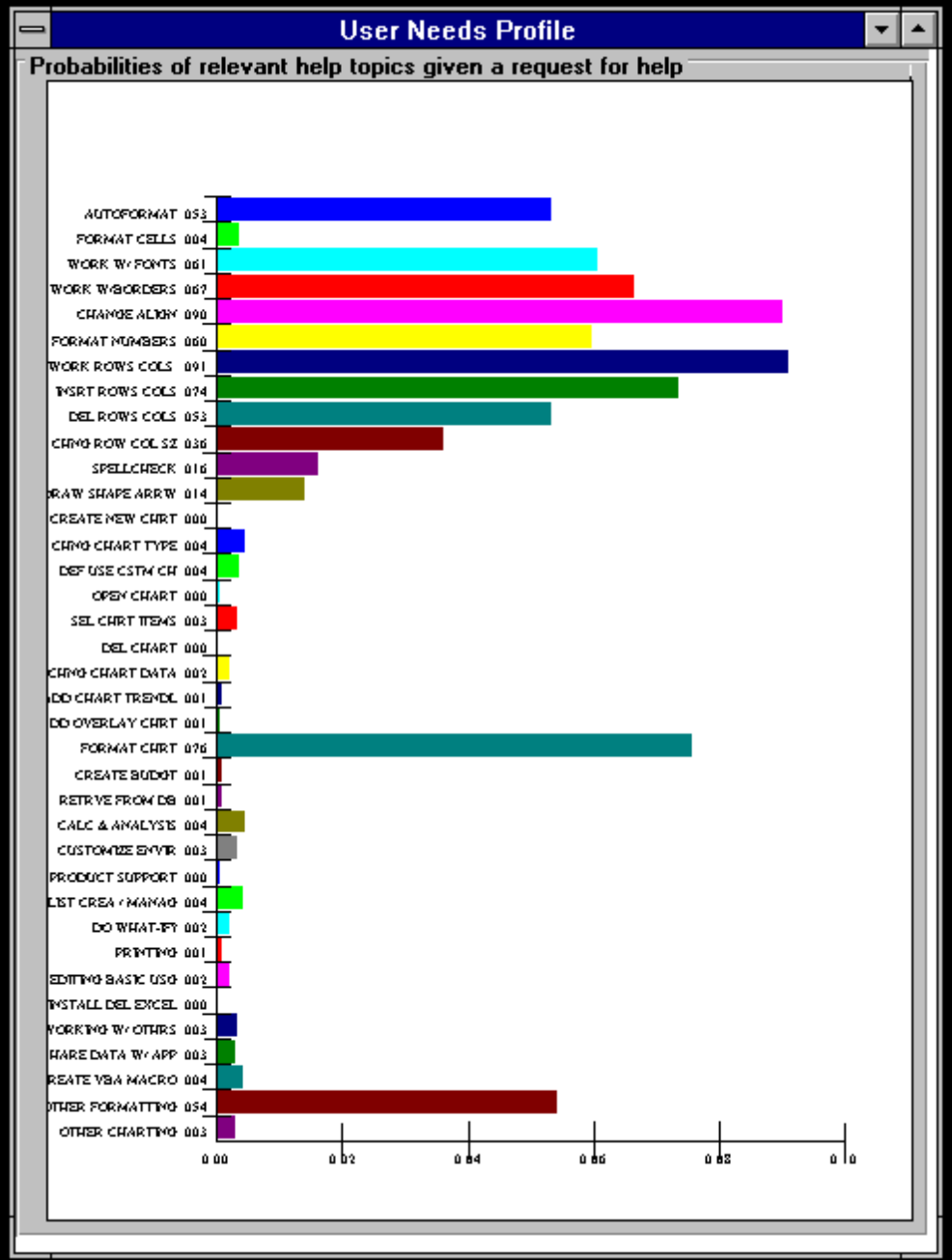
H., Breese, Heckerman, et al. The Lumiere Project: Bayesian User Modeling for Inferring the Goals and Needs of Software Users. UAI 1998.

Sensed actions



Sensed actions





Sensed actions

Help Wizard's Best Guesses for Help:

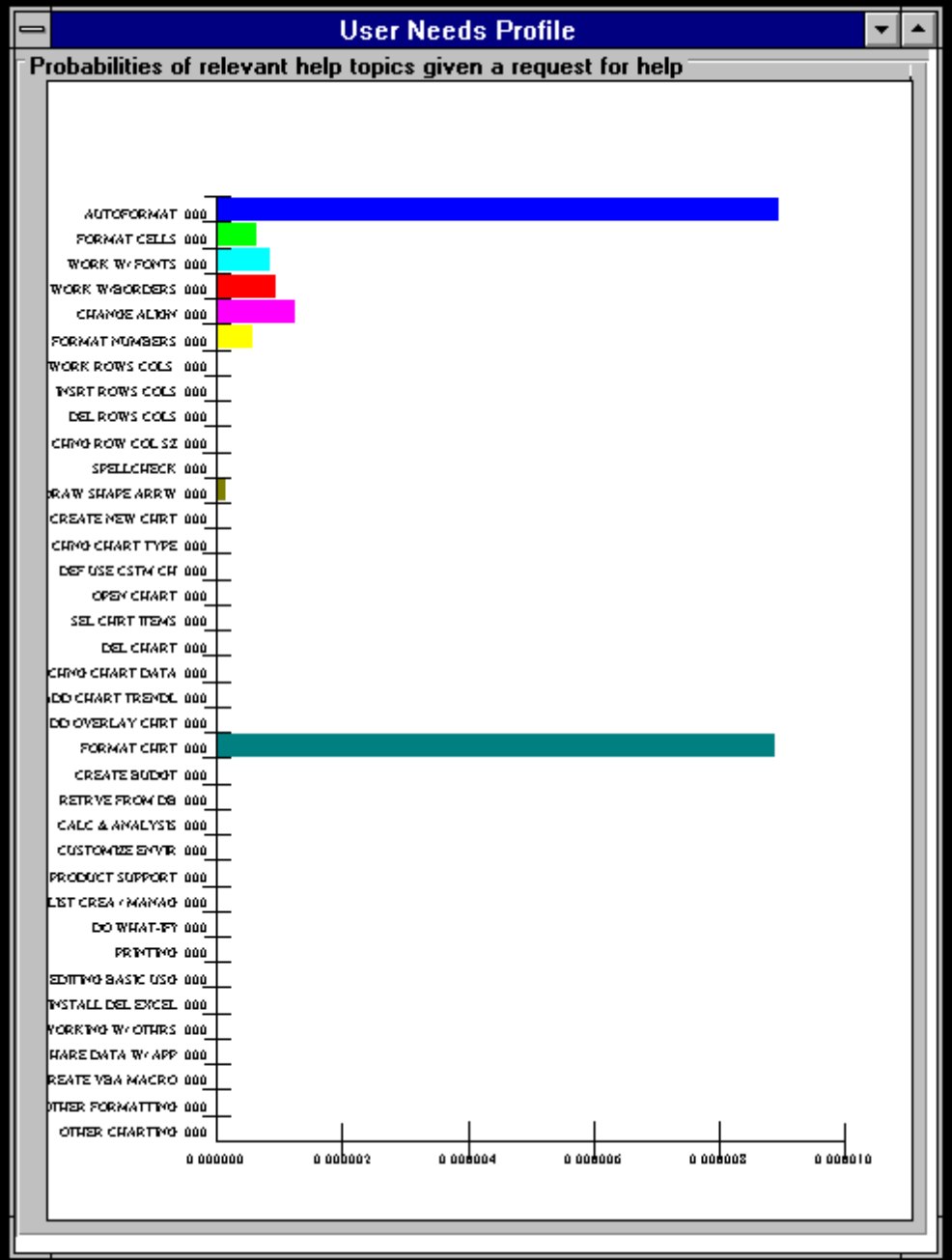
- Autoformatting my document
- Format a chart
- Changing alignment
- Working with borders
- Working with fonts

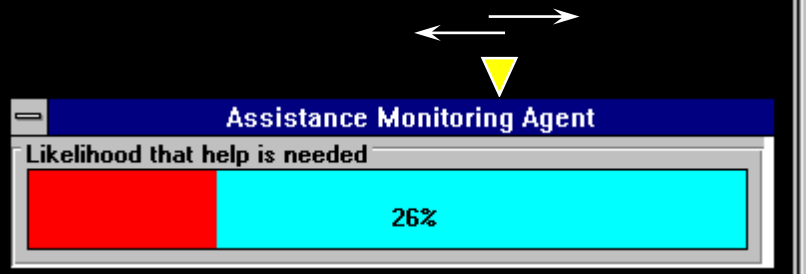
Help | Search

Freely describe your problem:

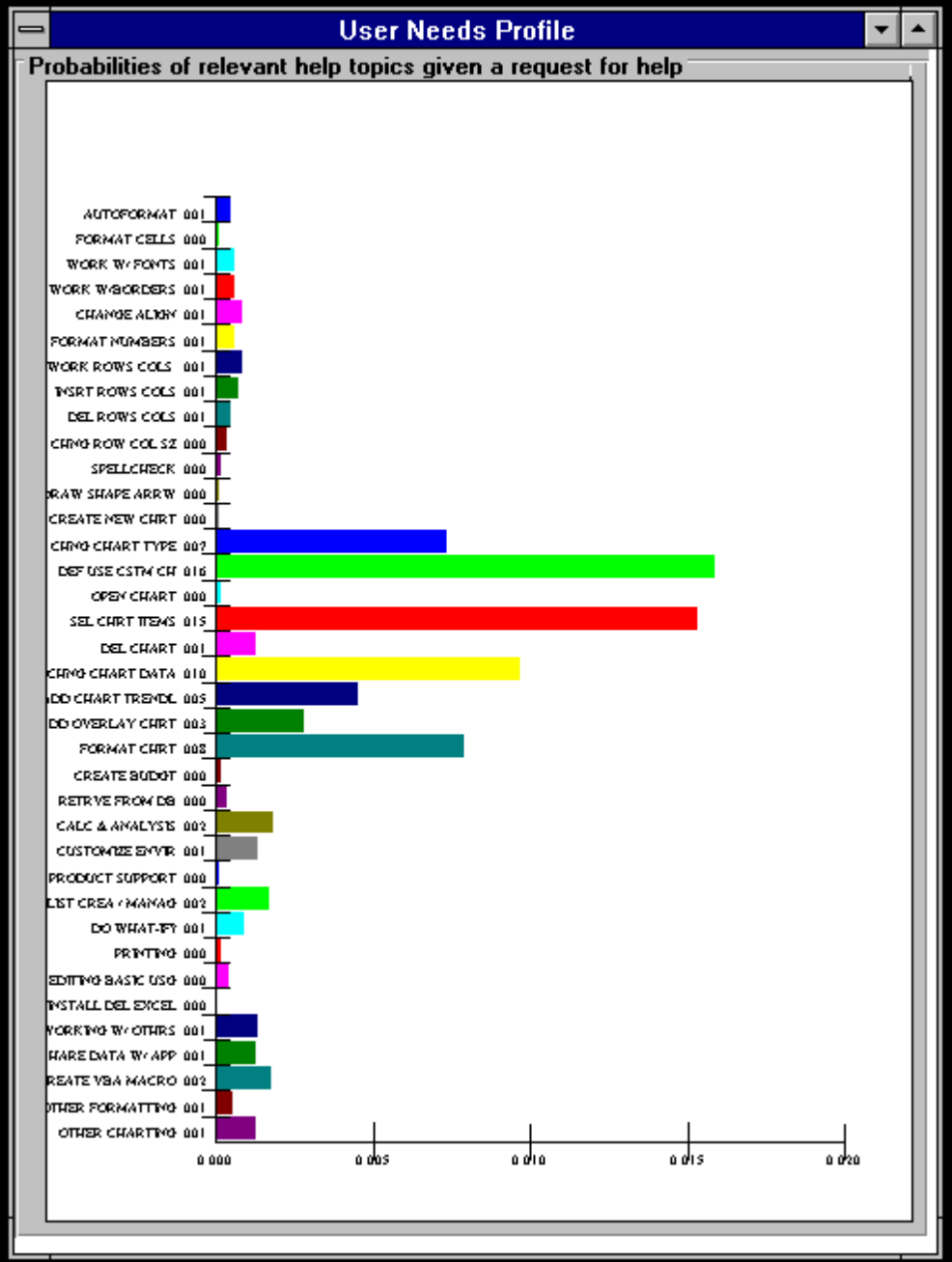
how do i make this look prettier?

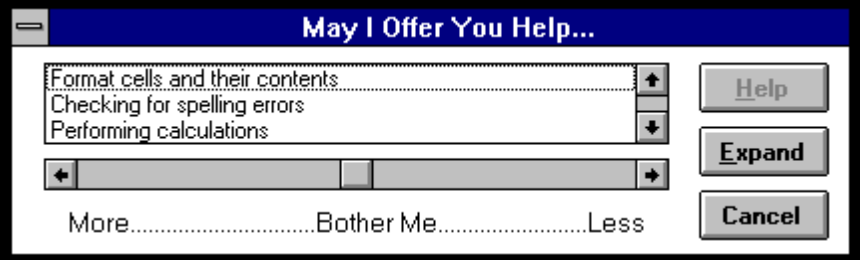
User's query

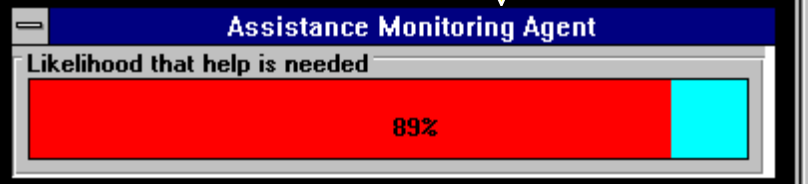


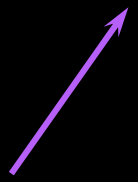


Prob. user desires assistance

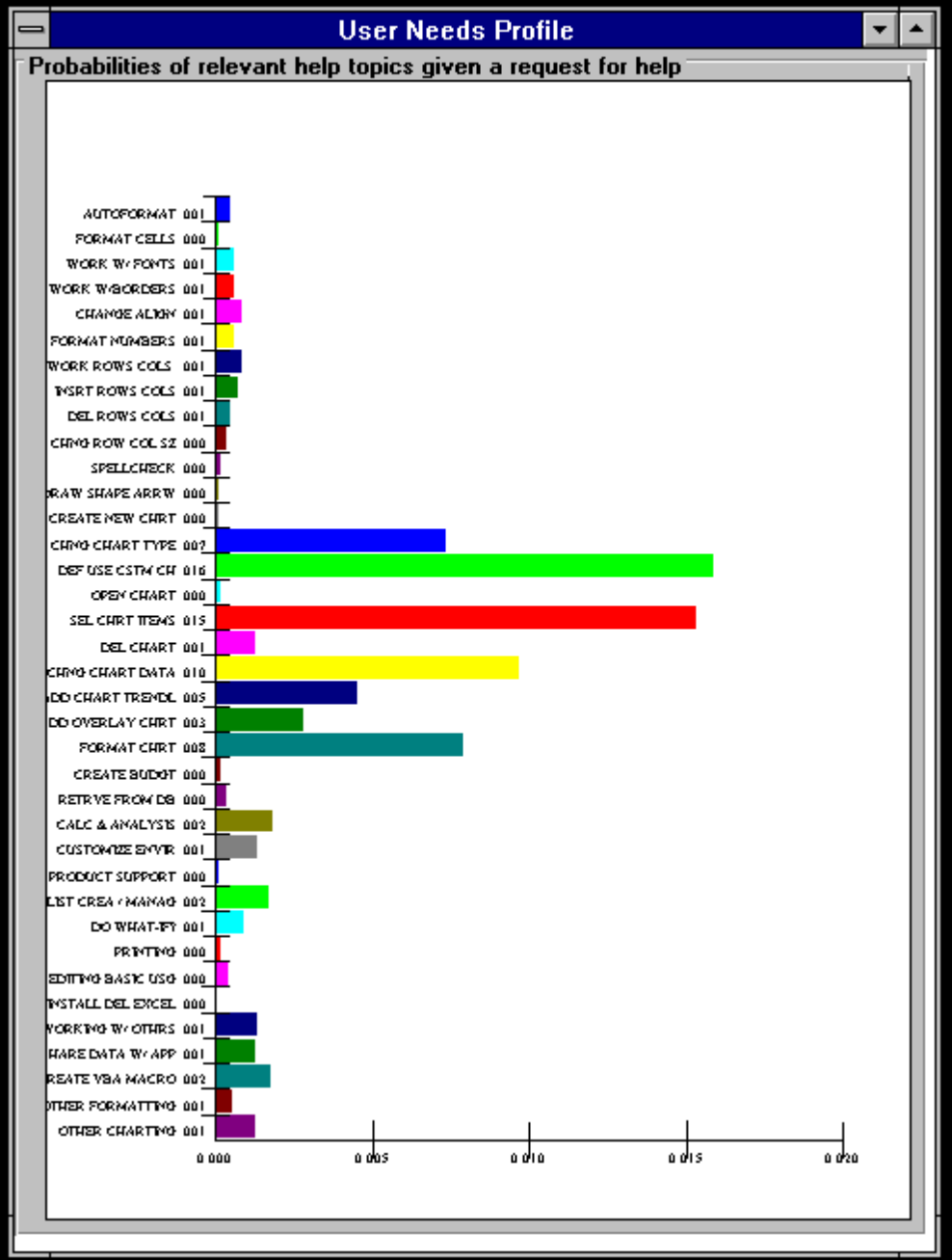




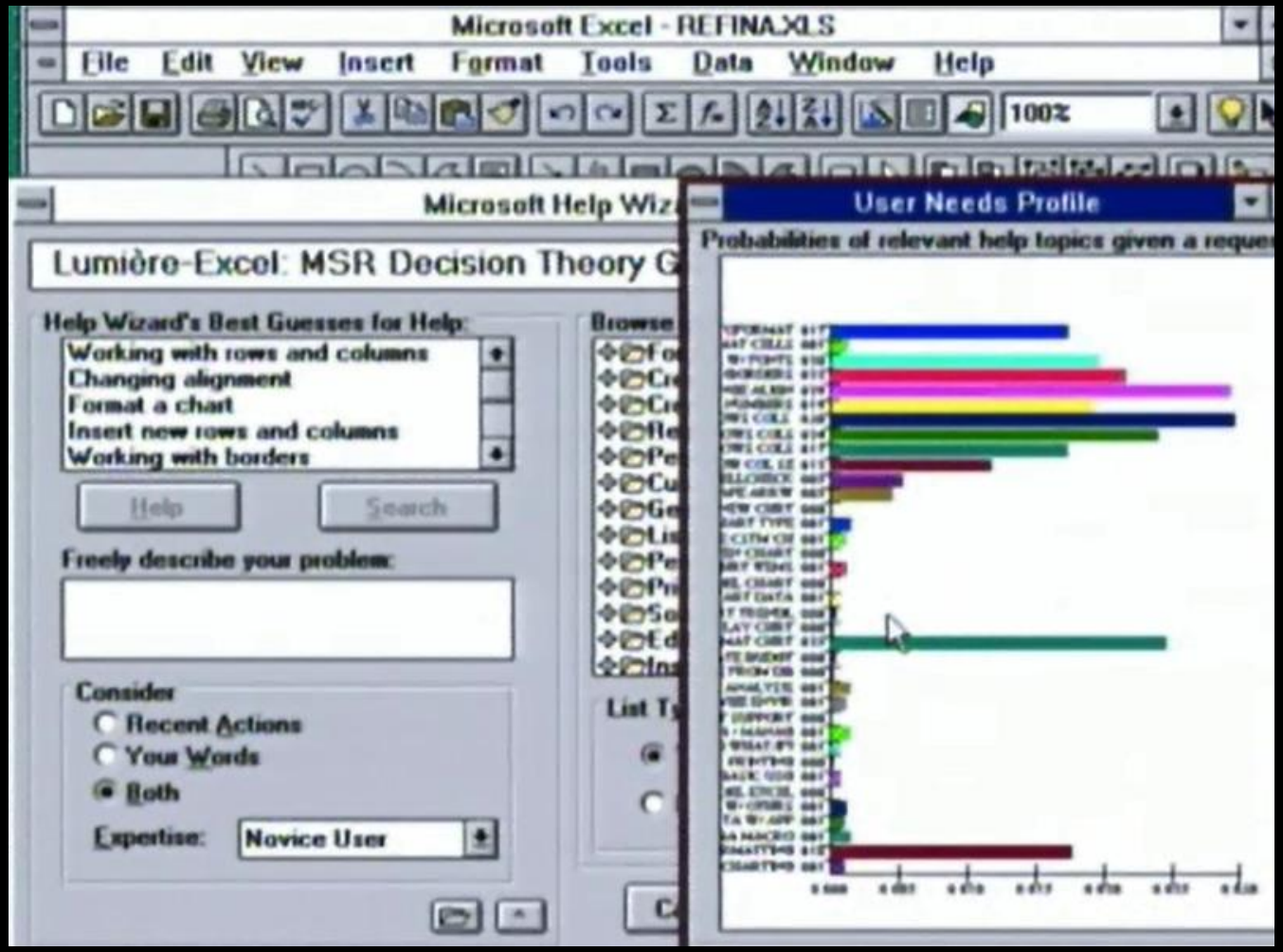




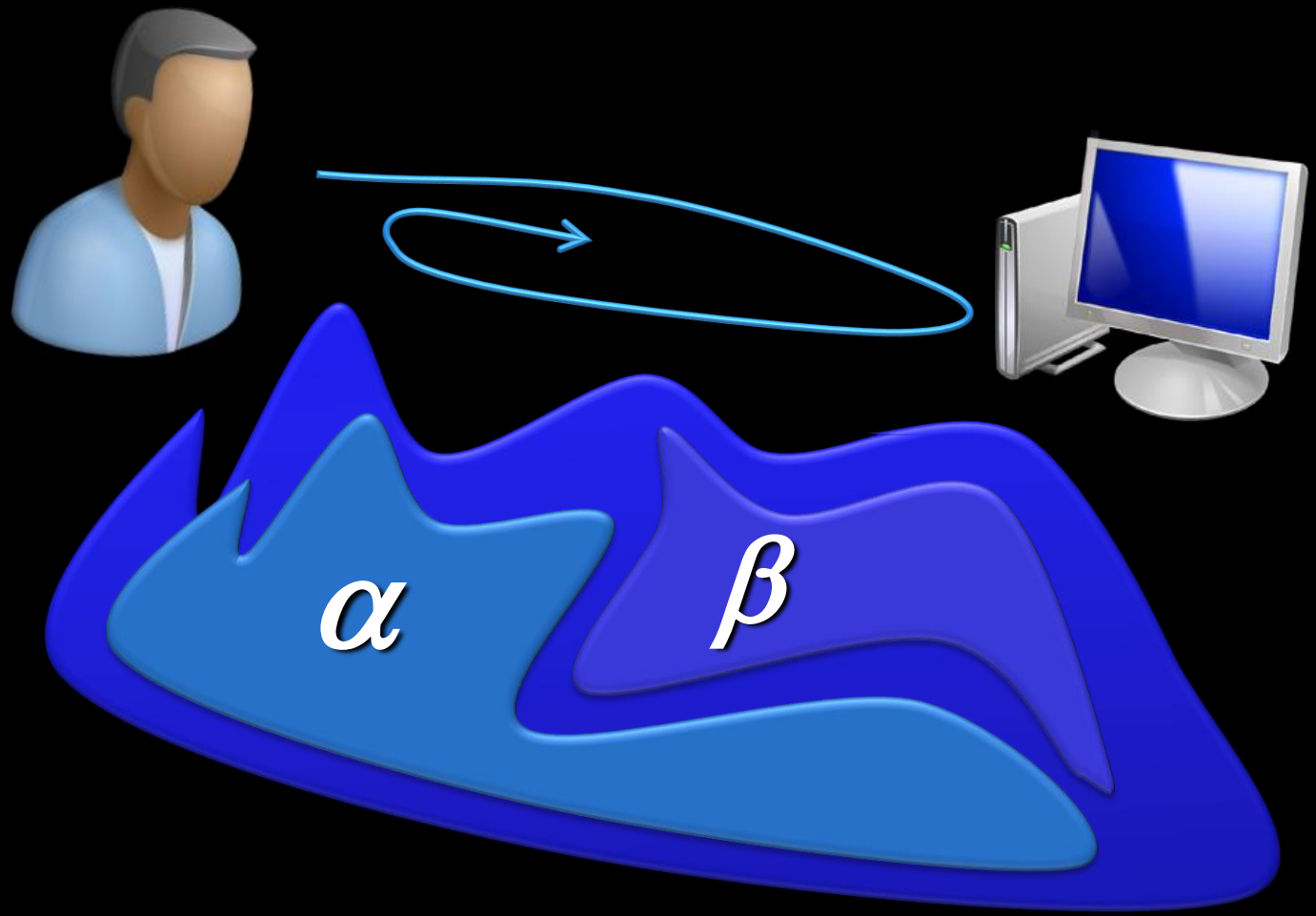
Prob. user desires assistance



Video: Lumiere



Efforts with Mix of Initiatives



H. Reflections on Challenges and Promises of Mixed-Initiative Interaction, *AAAI Magazine* 28, 2007.

Lookout (1998)

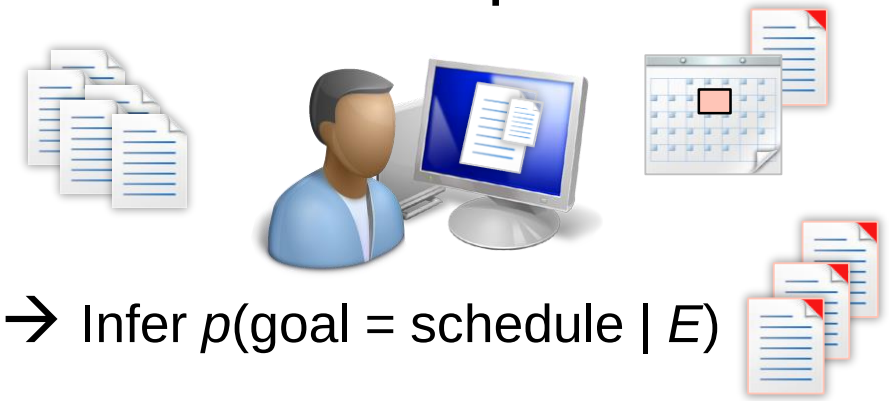
In-stream supervision

→ Infer *p*(goal = schedule | *E*)

H. Principles of Mixed-Initiative User Interfaces. CHI 1999.

Lookout (1998)

In-stream supervision



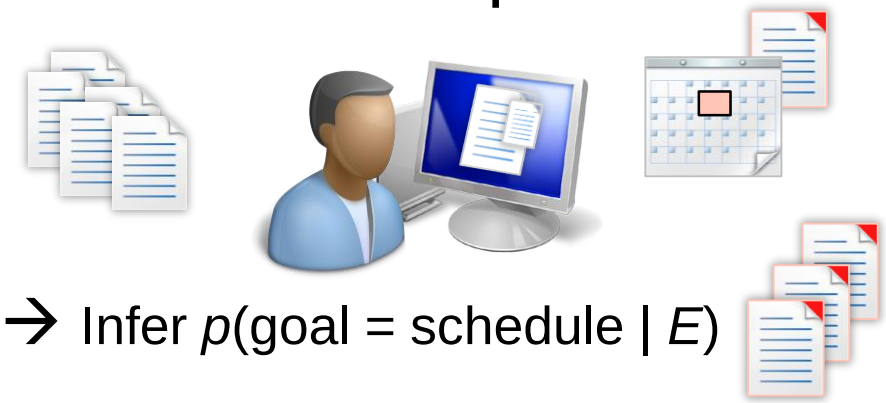
→ Infer *p*(goal = schedule | *E*)

- Do nothing?
- Engage user? *(and when?)*
- Just do it?

H. Principles of Mixed-Initiative User Interfaces. CHI 1999.

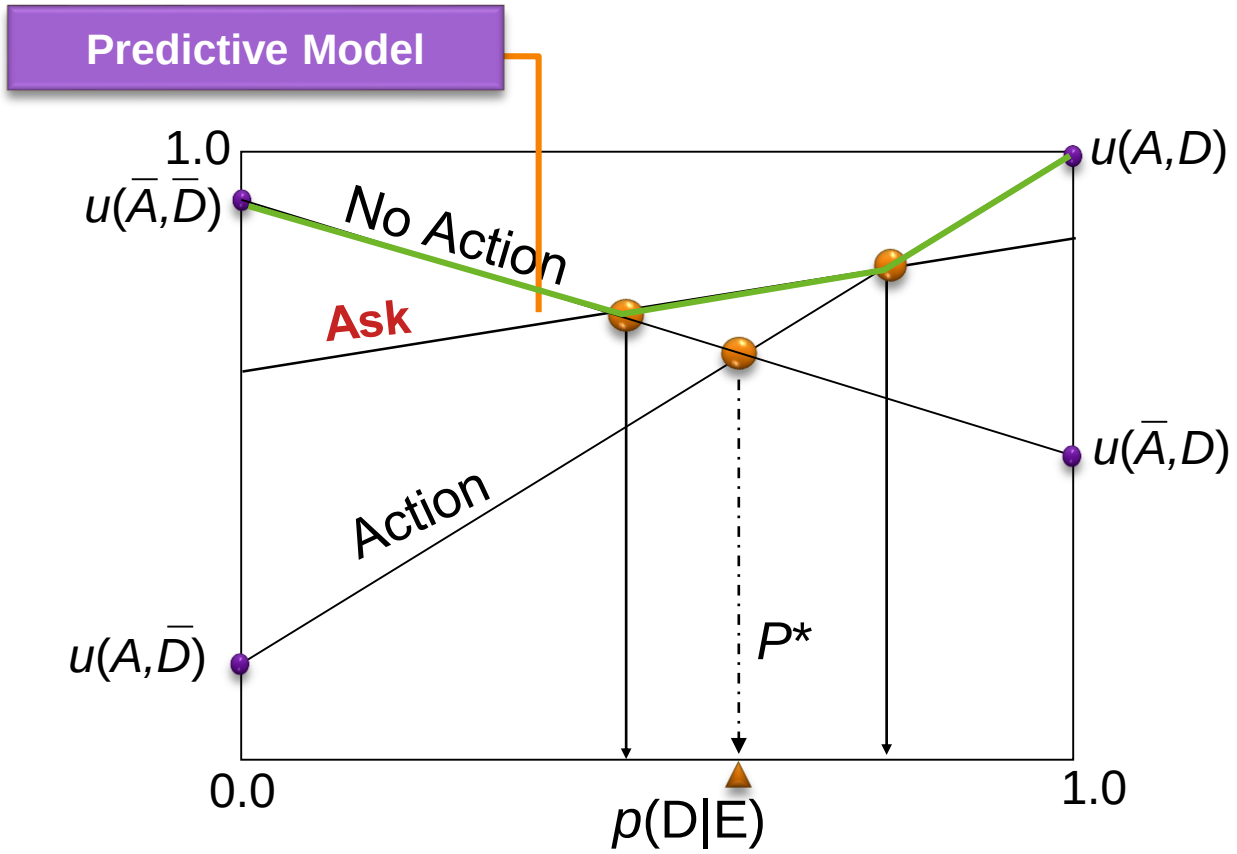
Lookout (1998)

In-stream supervision



→ Infer $p(\text{goal} = \text{schedule} \mid E)$

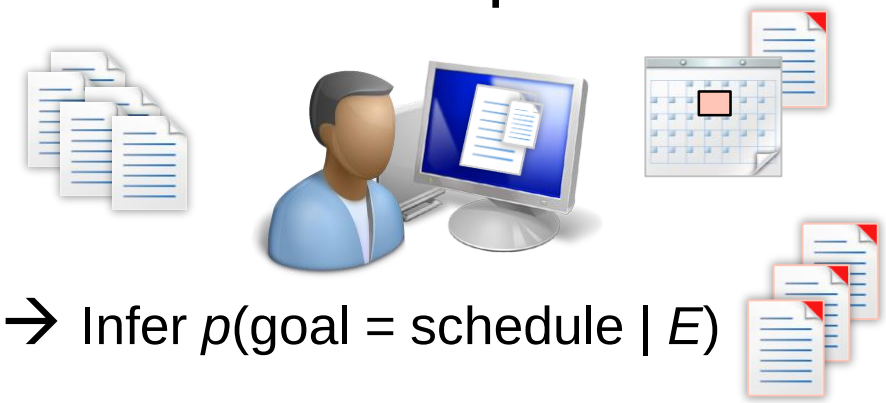
- Do nothing?
- Engage user? *(and when?)*
- Just do it?



H. Principles of Mixed-Initiative User Interfaces. CHI 1999.

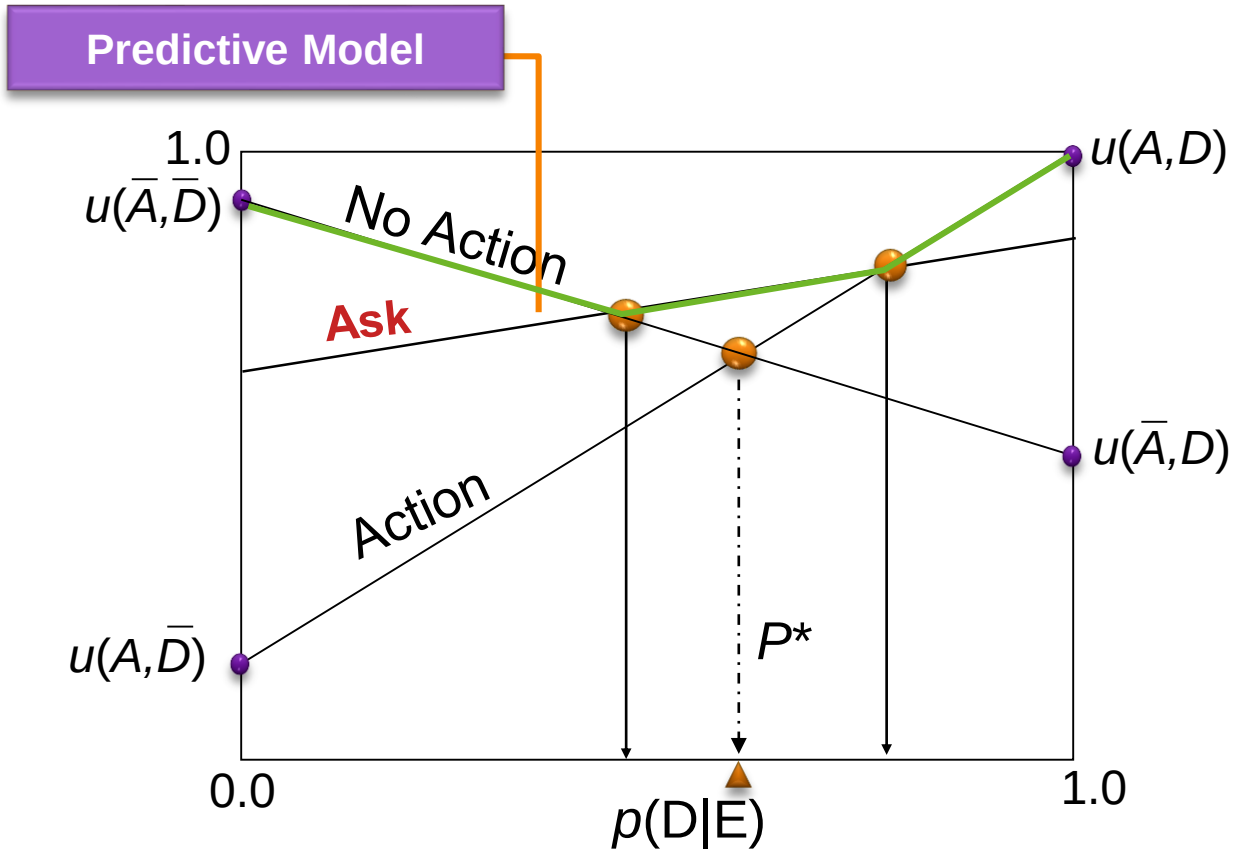
Lookout (1998)

In-stream supervision

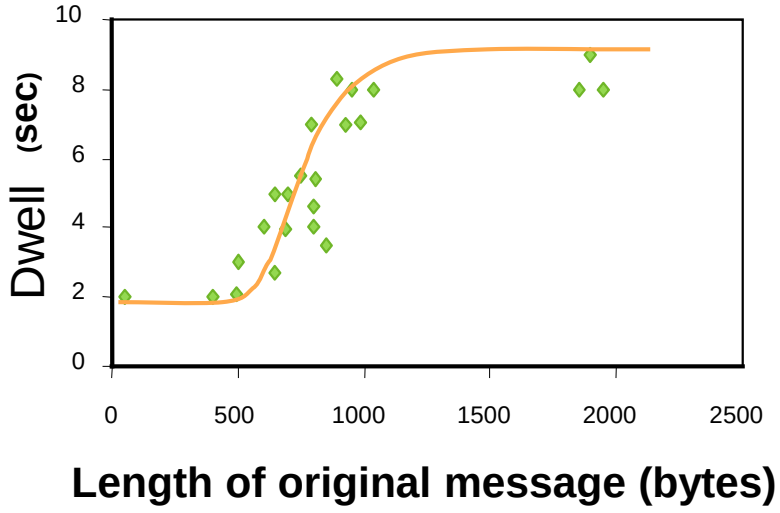


→ Infer *p*(goal = schedule | *E*)

- Do nothing?
- Engage user? *(and when?)*
- Just do it?

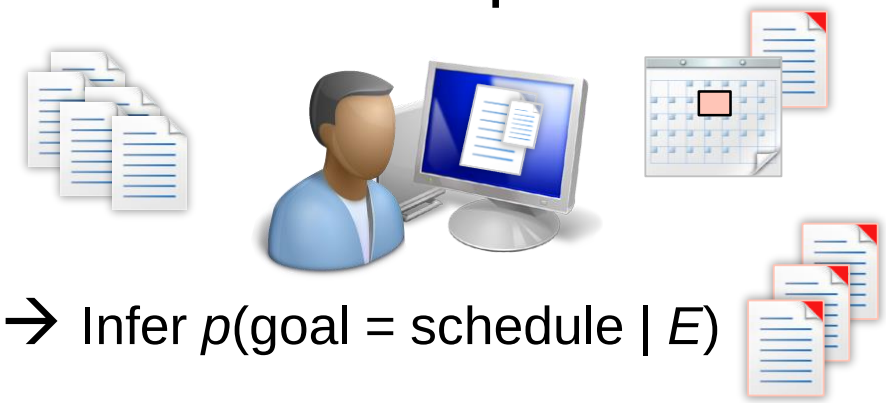


Getting the timing right



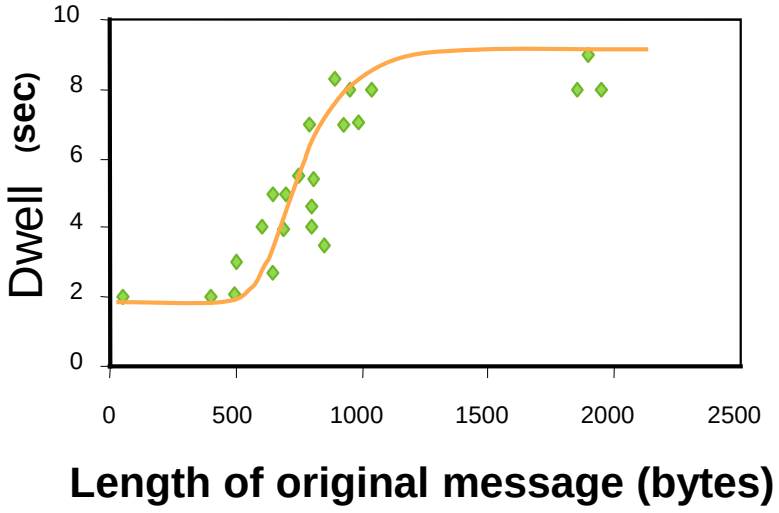
Lookout (1998)

In-stream supervision

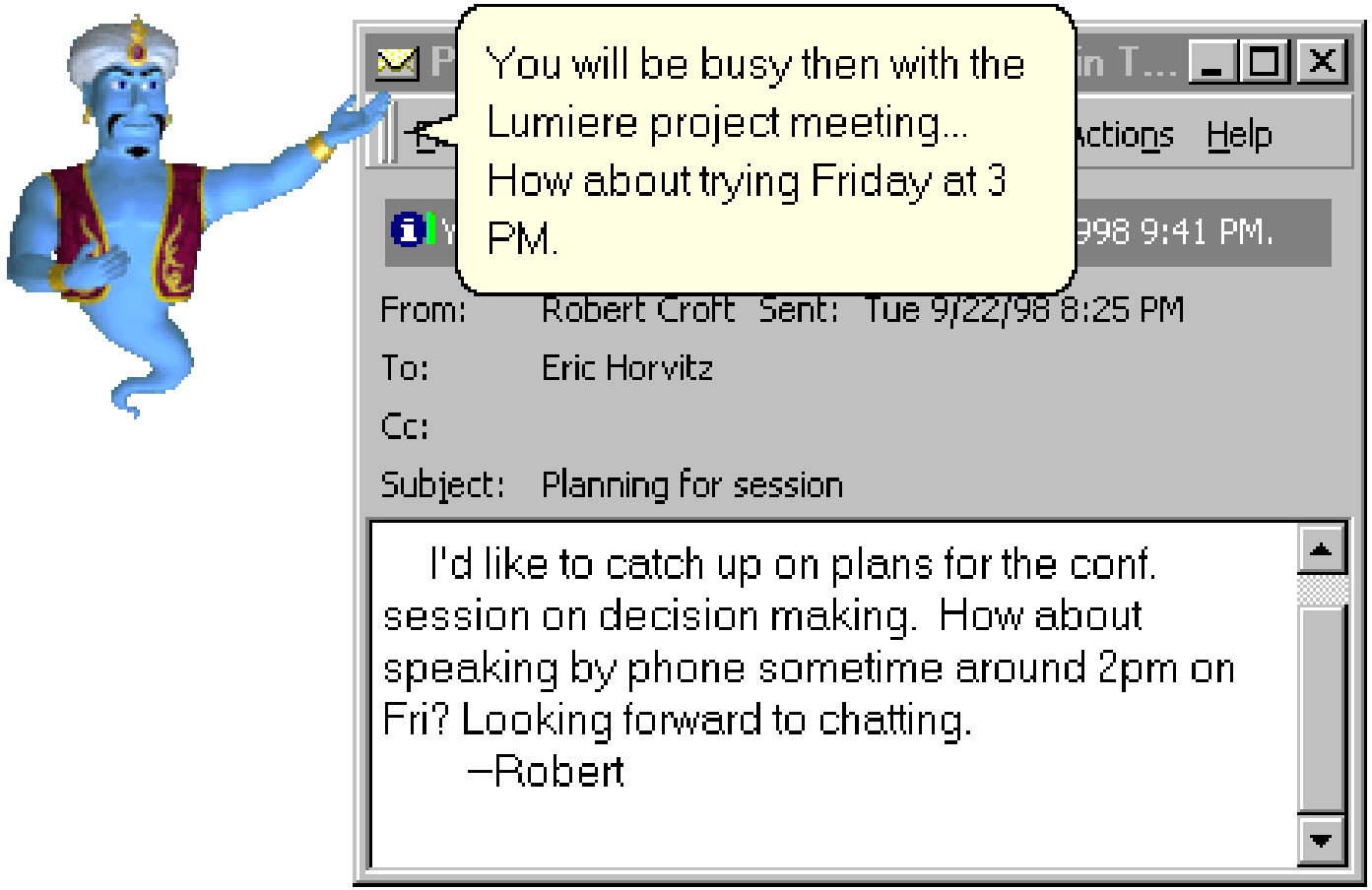


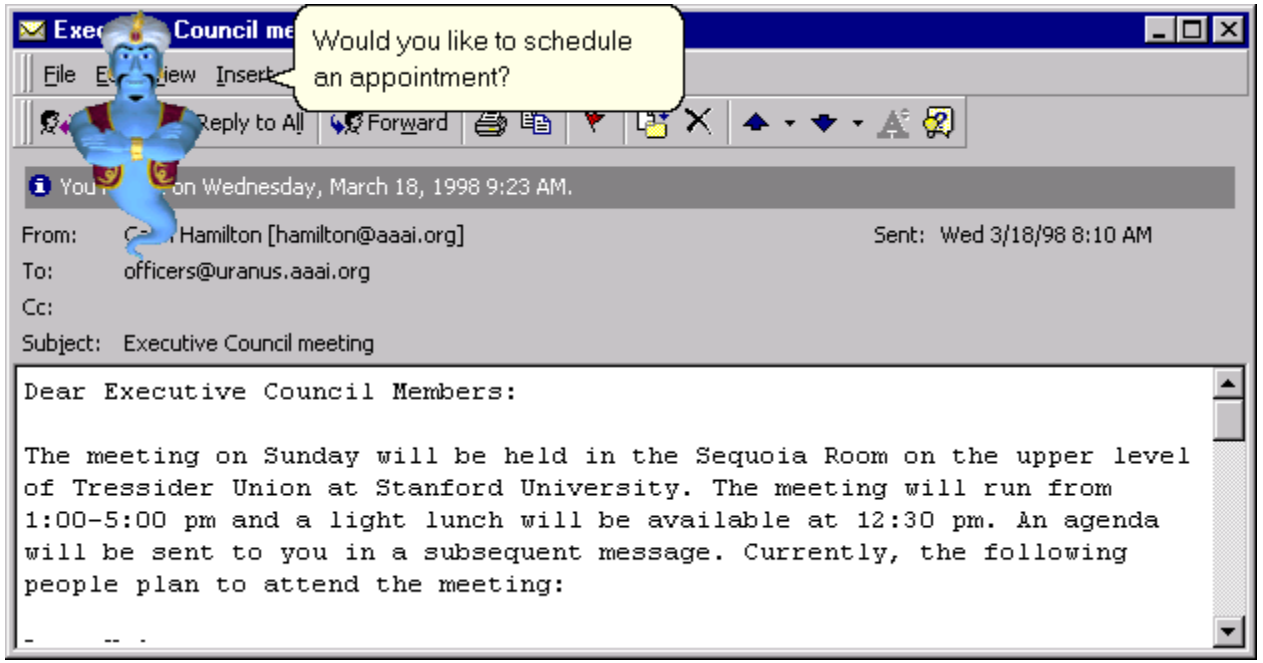
→ Infer *p*(goal = schedule | *E*)

Getting the timing right

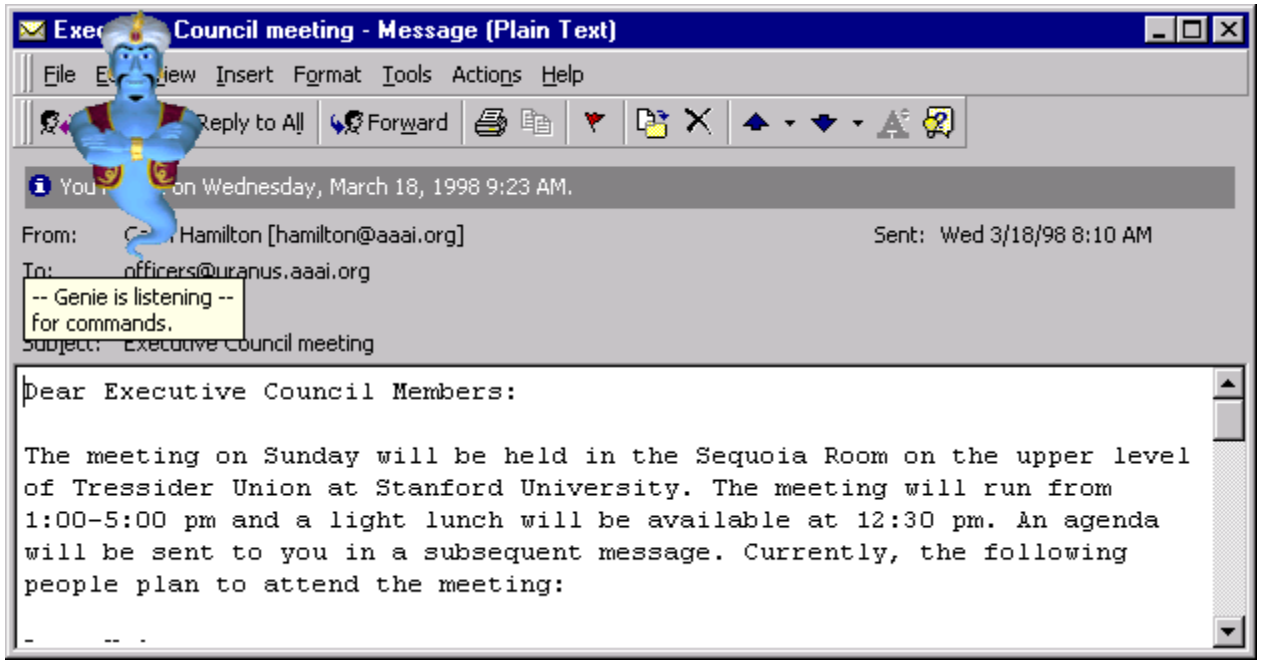


- Do nothing?
- Engage user? *(and when?)*
- Just do it?

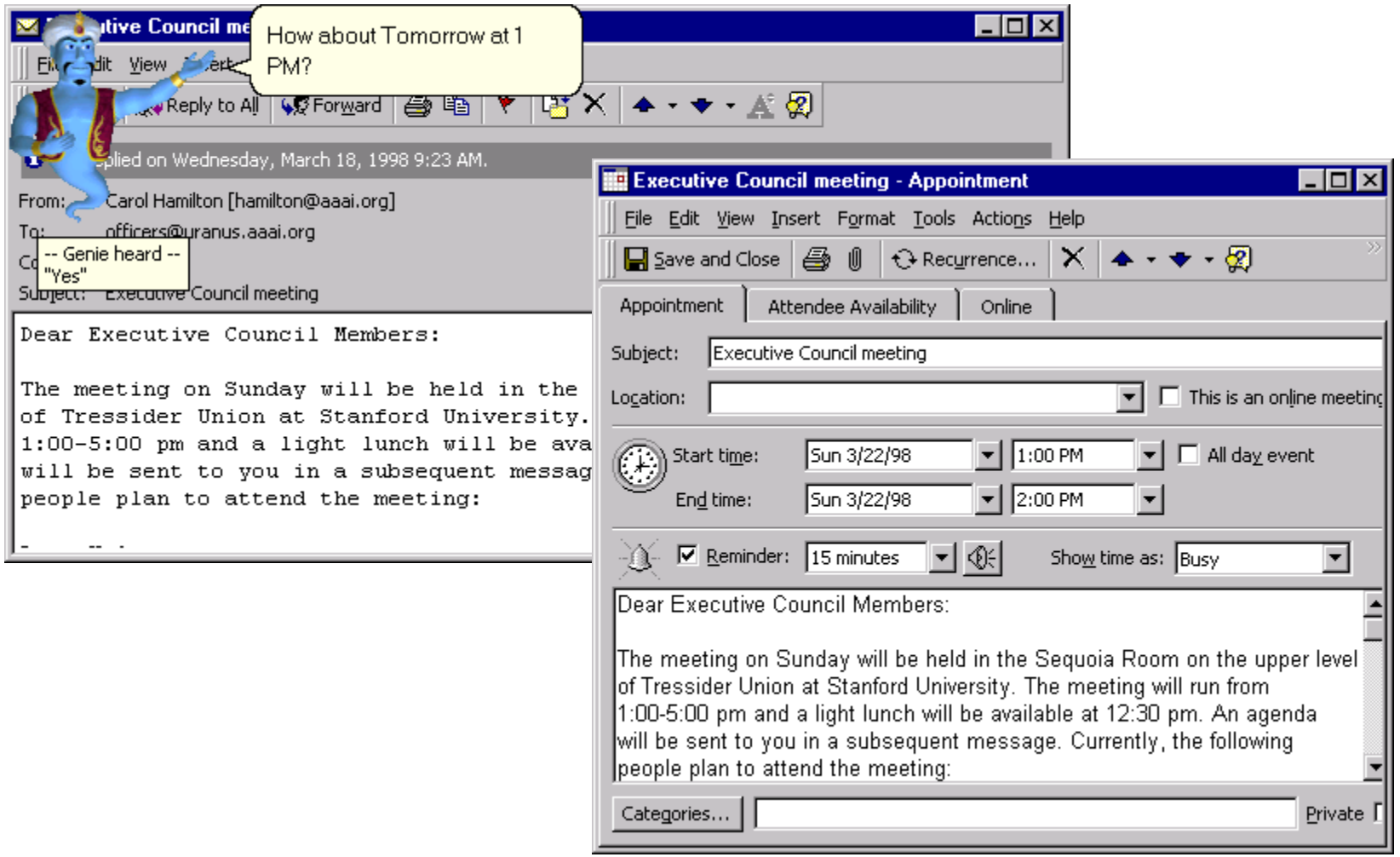




H. Principles of Mixed-Initiative User Interfaces. CHI 1999.

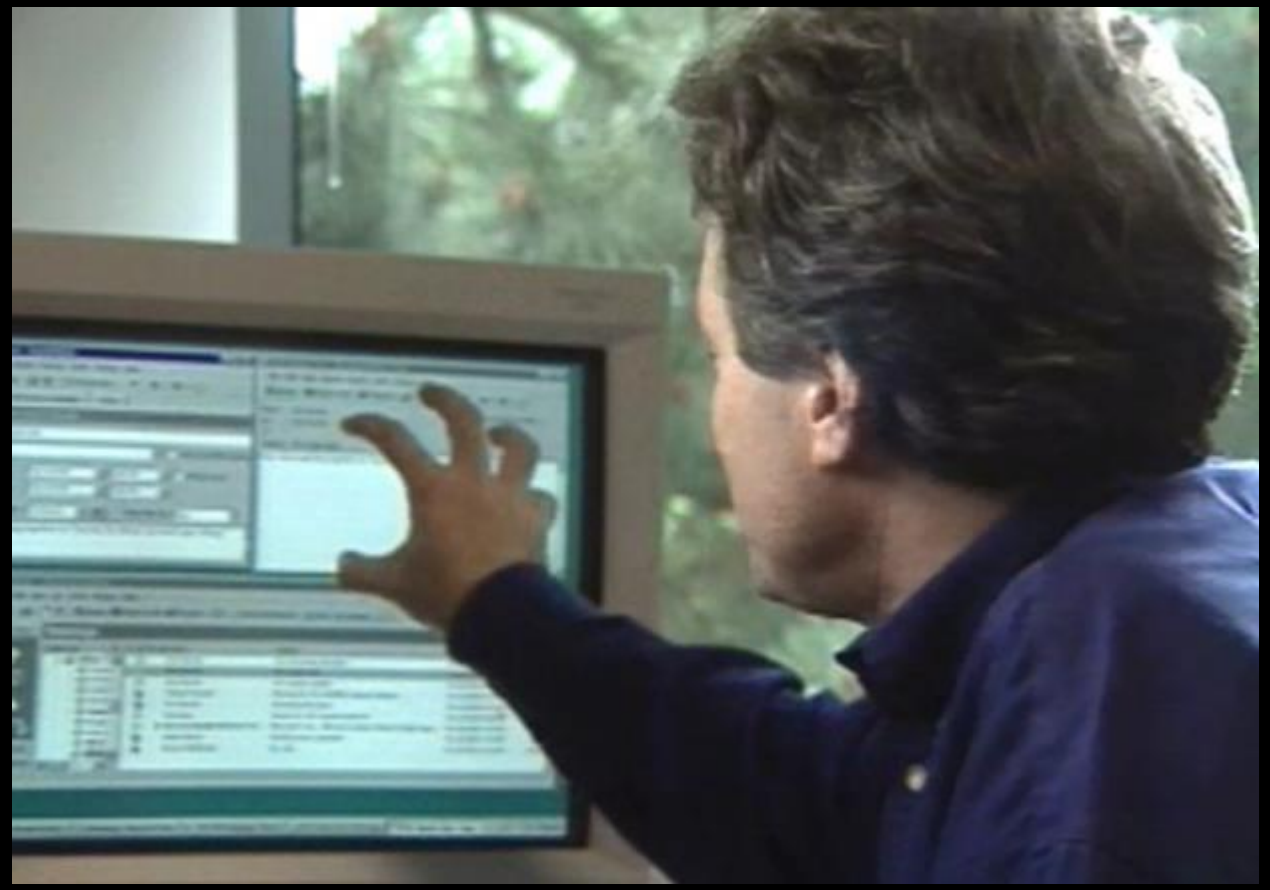


H. Principles of Mixed-Initiative User Interfaces. CHI 1999.

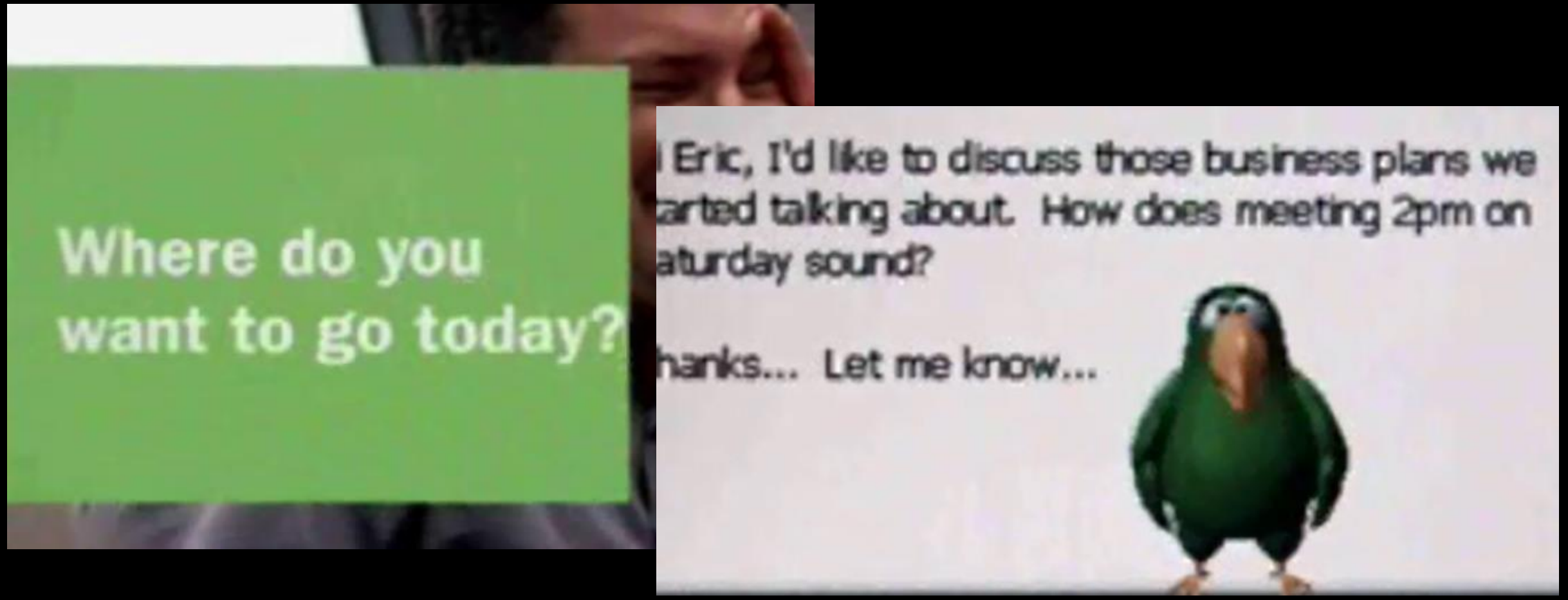


H. Principles of Mixed-Initiative User Interfaces. CHI 1999.

Video: Lookout system



TV commercial (1999)



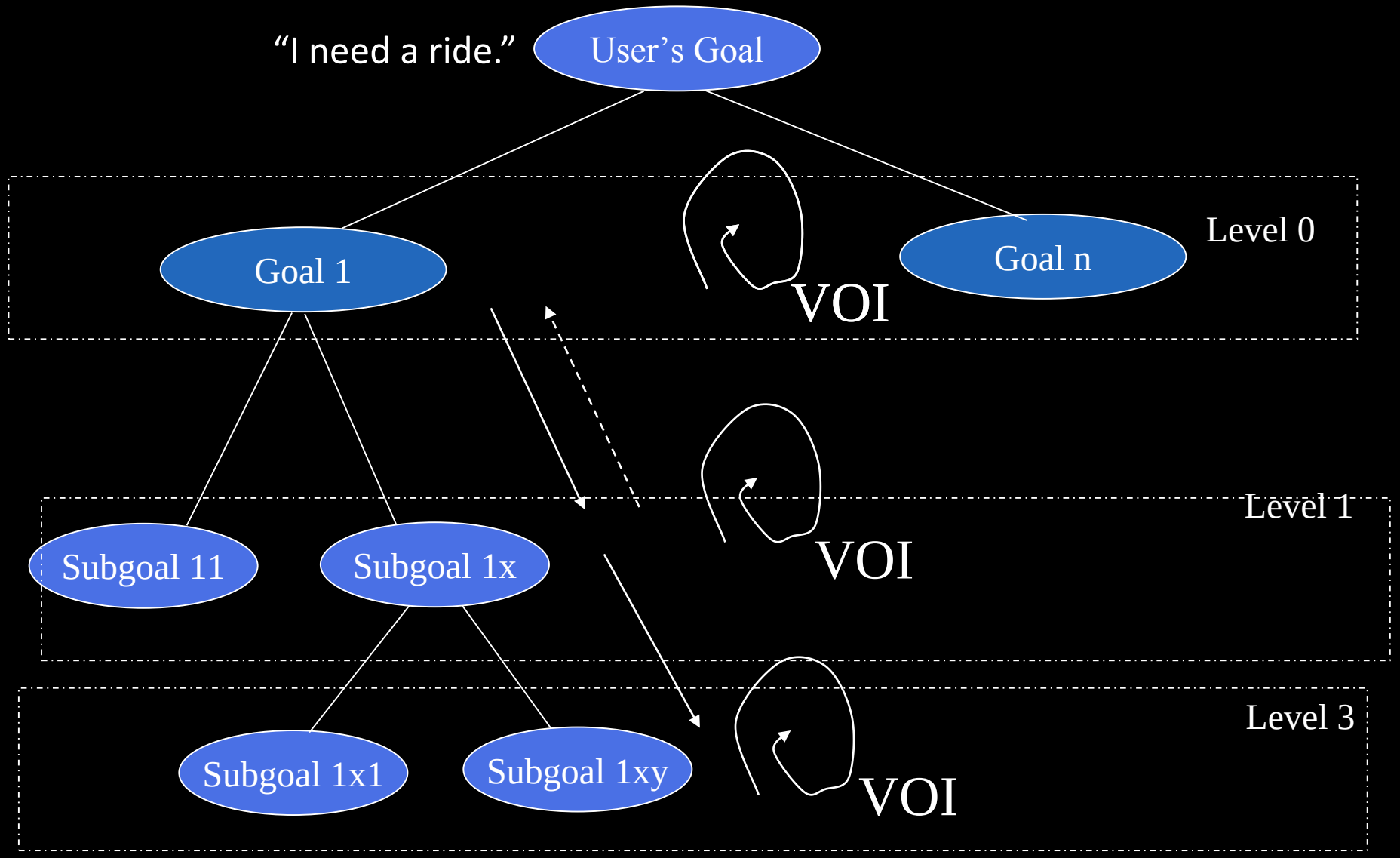
Architecture for conversation (1999)

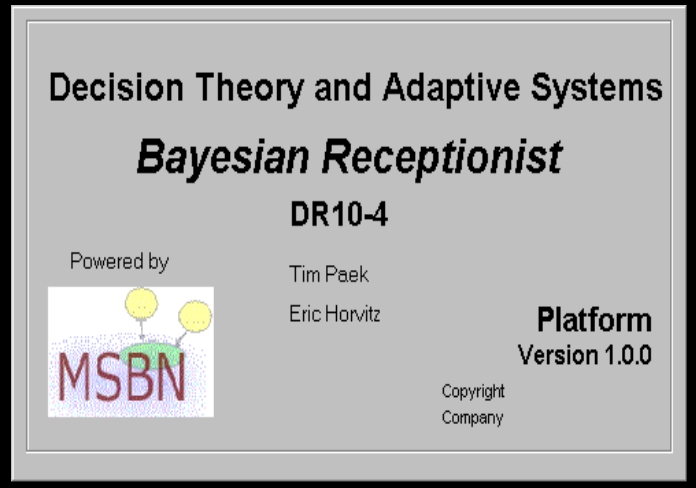
Extending mixed-initiative interaction to hierarchies of contribution

H.. Paek. A Computational Architecture for Conversation. User Modeling 1999

Paek, H. Conversation as Action Under Uncertainty, UAI 2000

Bayesian Receptionist (2000)





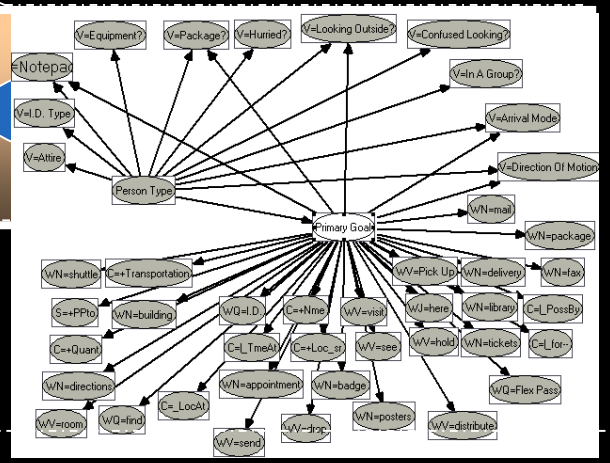
Bayesian Receptionist (2000)

"I need a ride." User's Goal

```
I need a ride please.
DECL1      NP1        PRON1*     "I"
           VERB1*     "need"
           NP2        DETP1      ADJ1*
                      NOUN1*     "ride"
           AVP1       ADV1*      "please"
           CHAR1      "."
```

Goal 1

VOI



VOI

Subgoal 11

Subgoal 1x

Subgoal 1x1

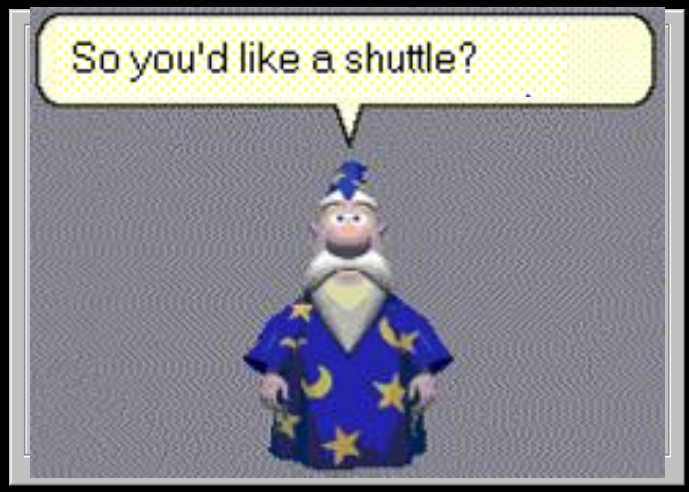
Subgoal 1xy

VOI

Level 3

VOI

Bayesian Receptionist (2000)



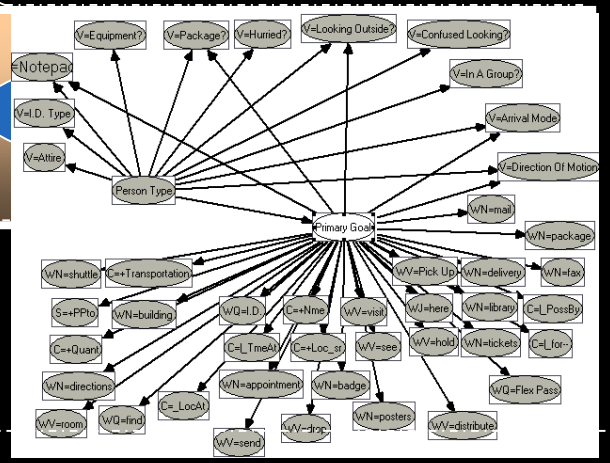
"I need a ride."

User's Goal

```
I need a ride please.
DECL1      NP1        PRON1*     "I"
           VERB1*     "need"
           NP2        DETP1      ADJ1*
                      NOUN1*     "ride"
           AVP1       ADV1*      "please"
           CHAR1      "."
```

Goal 1

VOI



Subgoal 11

Subgoal 1x

VOI

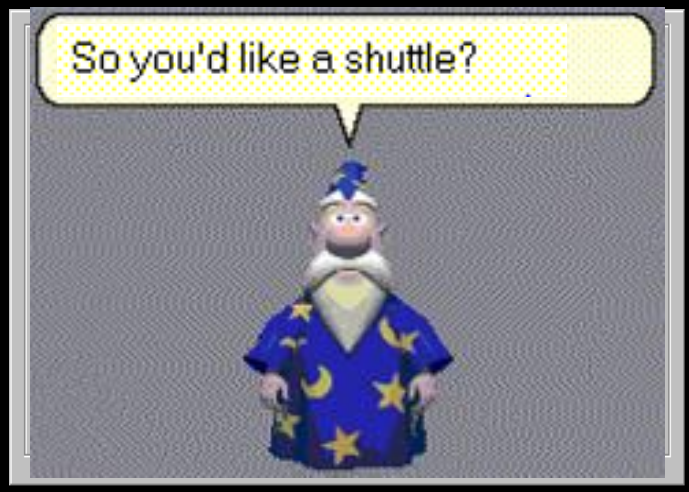
Subgoal 1x1

Subgoal 1xy

VOI

Level 3

Bayesian Receptionist (2000)



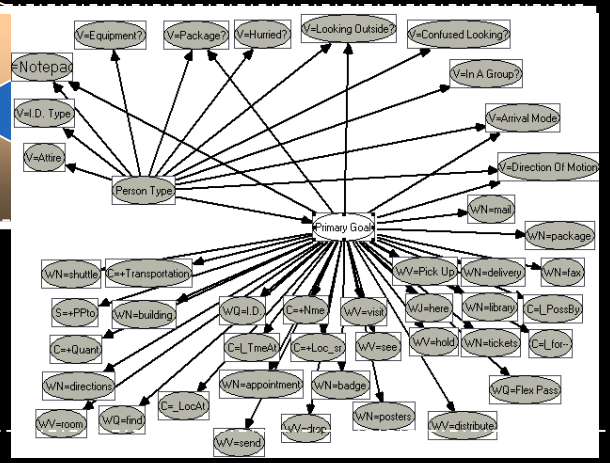
"I need a ride."

User's Goal

```
I need a ride please.
DECL1      NP1        PRON1*     "I"
           VERB1*     "need"
           NP2        DETP1      ADJ1*
                      NOUN1*     "ride"
           AVP1       ADV1*      "please"
           CHAR1      "."
```

Goal 1

VOI



Subgoal 11

Subgoal 1x

VOI

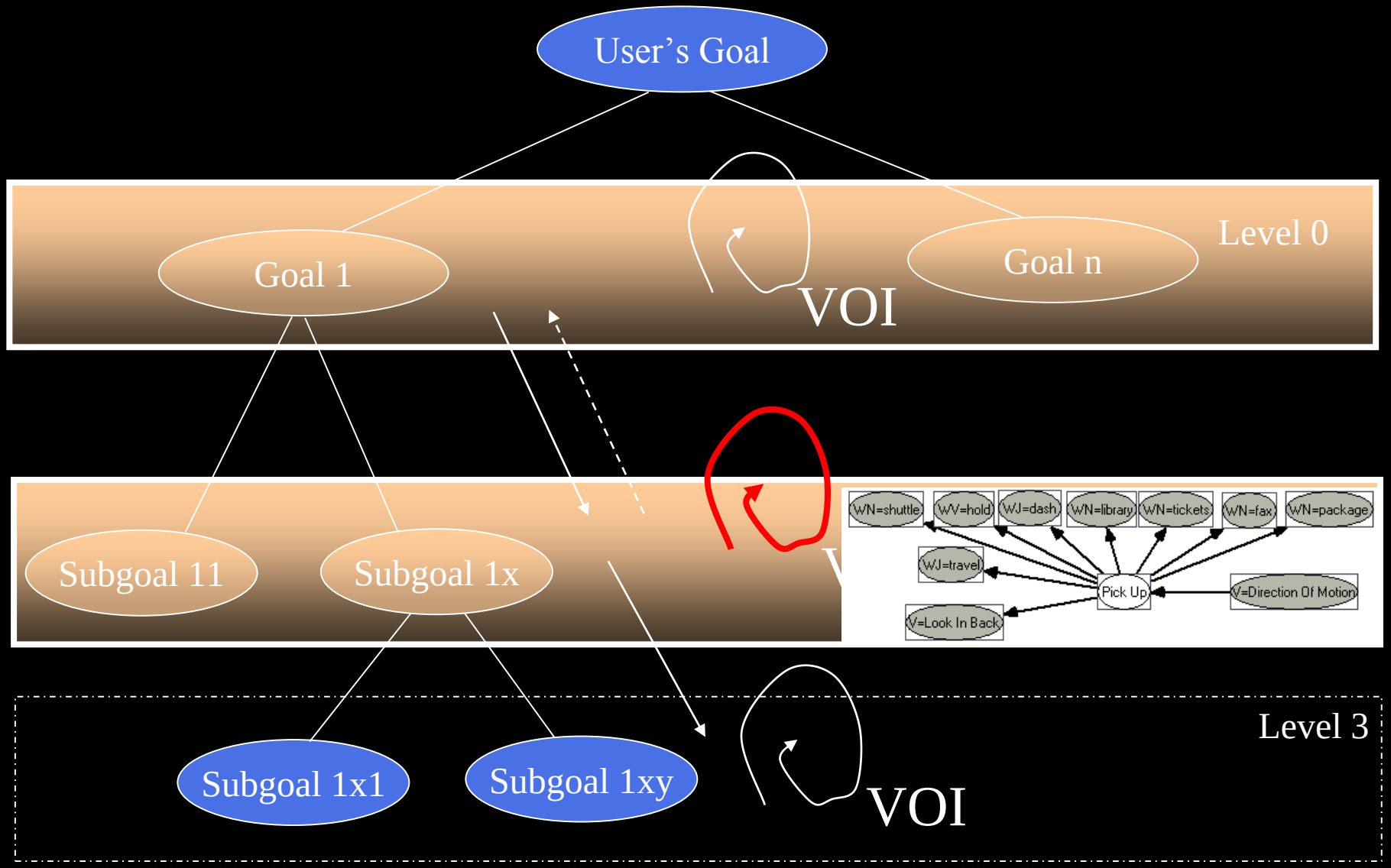
Subgoal 1x1

Subgoal 1xy

VOI

Level 3

Bayesian Receptionist (2000)

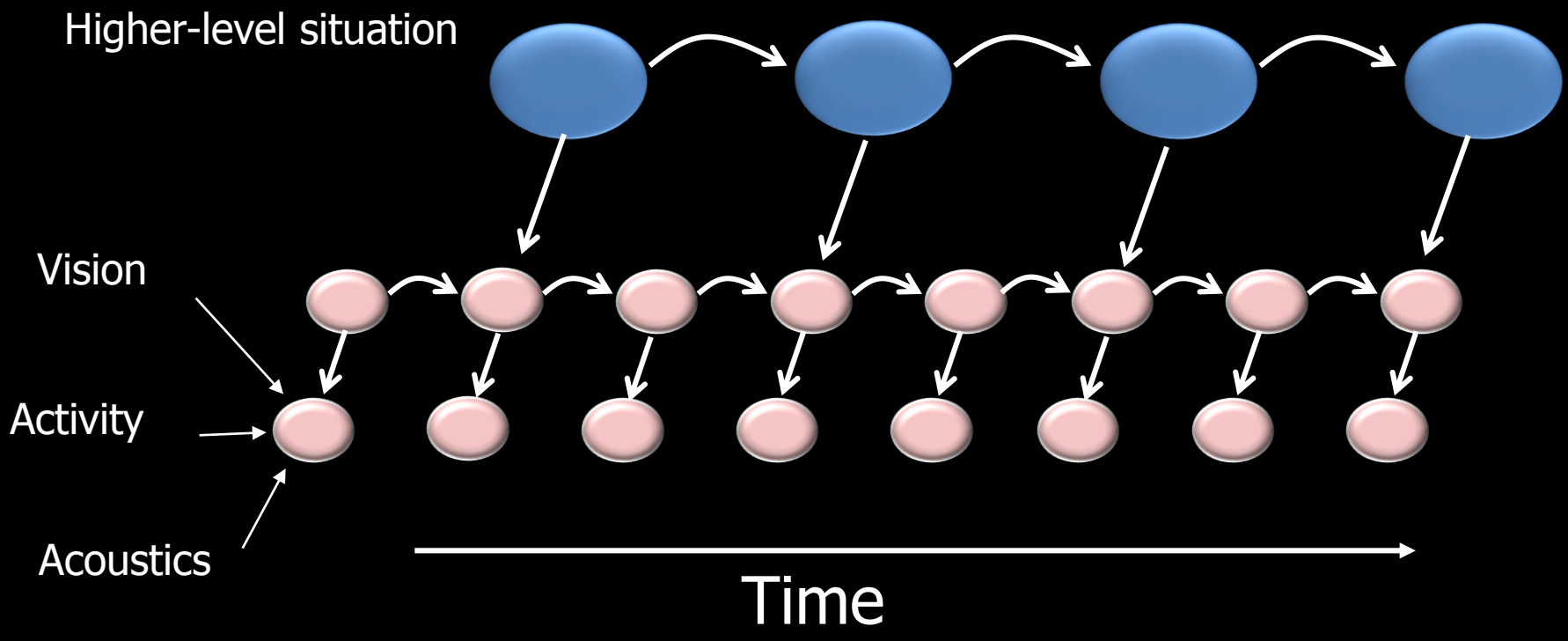


Advances in Core Capabilities

Core Fabric: Multisensory Fusion

Fuse vision, acoustics, activity with computer (Seer, ICMI 2002)

→ Representation, learning, inference

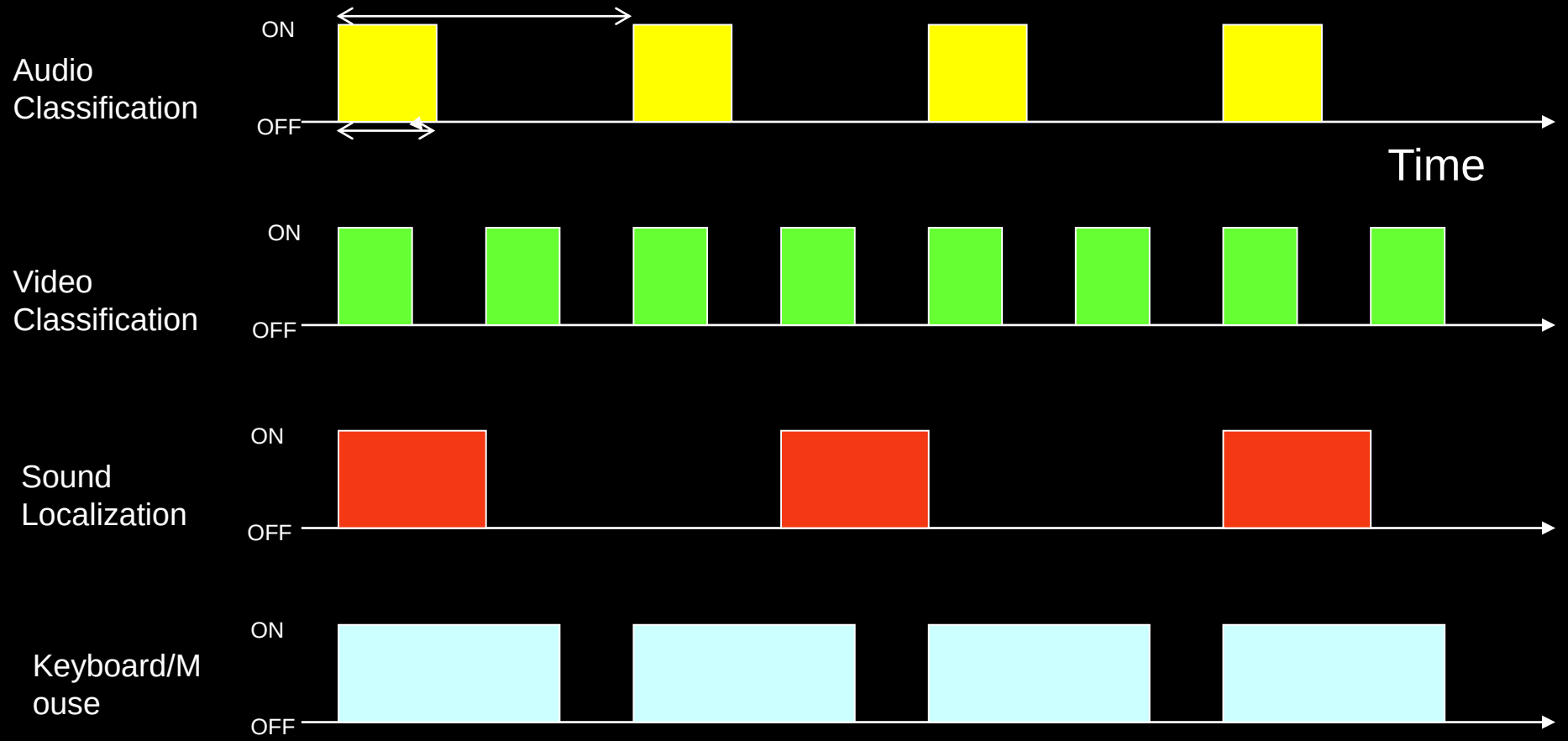


Oliver, H., Garg. Layered Representations for Recognizing Office Activity, ICMI 2002.

Core Fabric: Selective Perception

Guide computation to where it counts (S-SEER, ICMI 2003)

Compute expected value of information

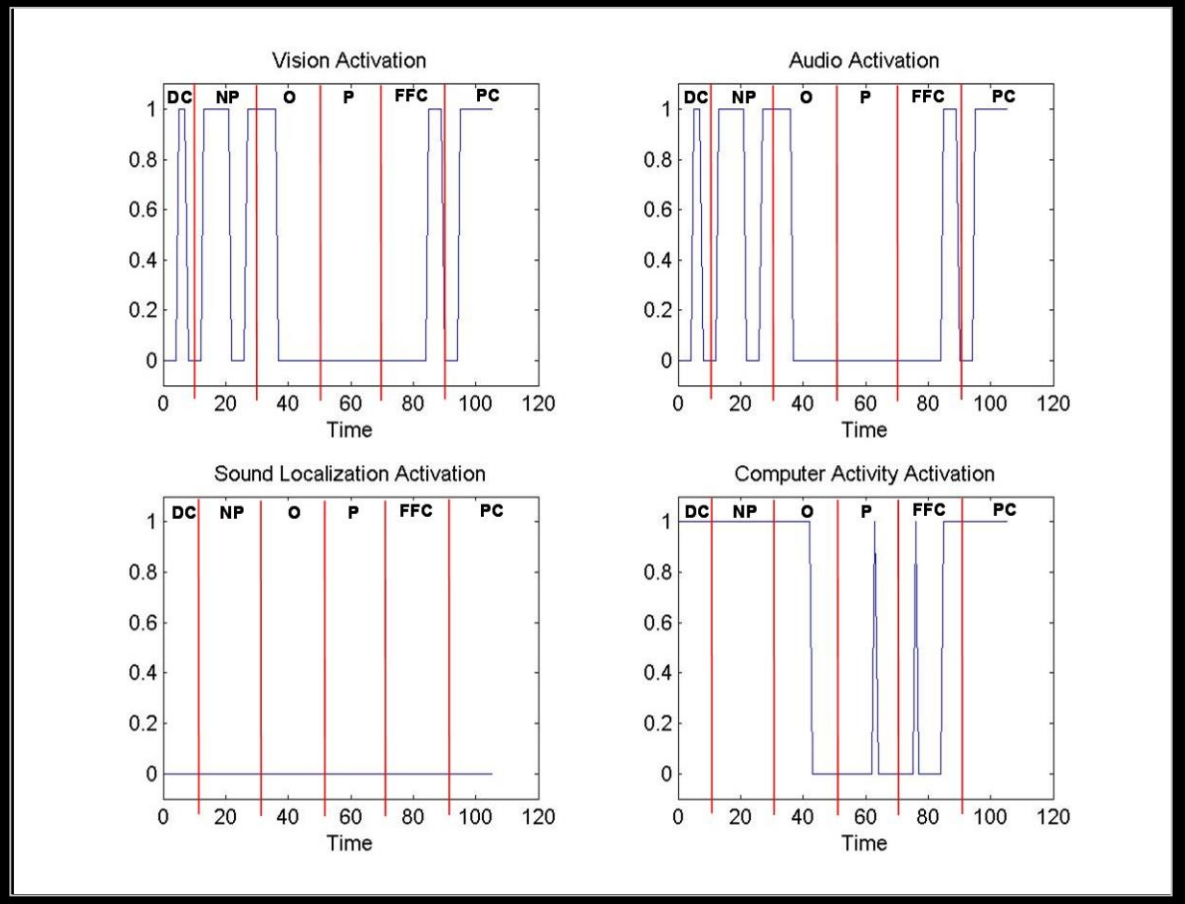


Oliver, H. Selective Perception Policies for Limiting Computation in Multimodal Systems: A Comparative Analysis, ICMI 2003

Core Fabric: Selective Perception

Guide computation to where it counts (S-SEER, ICMI 2003)

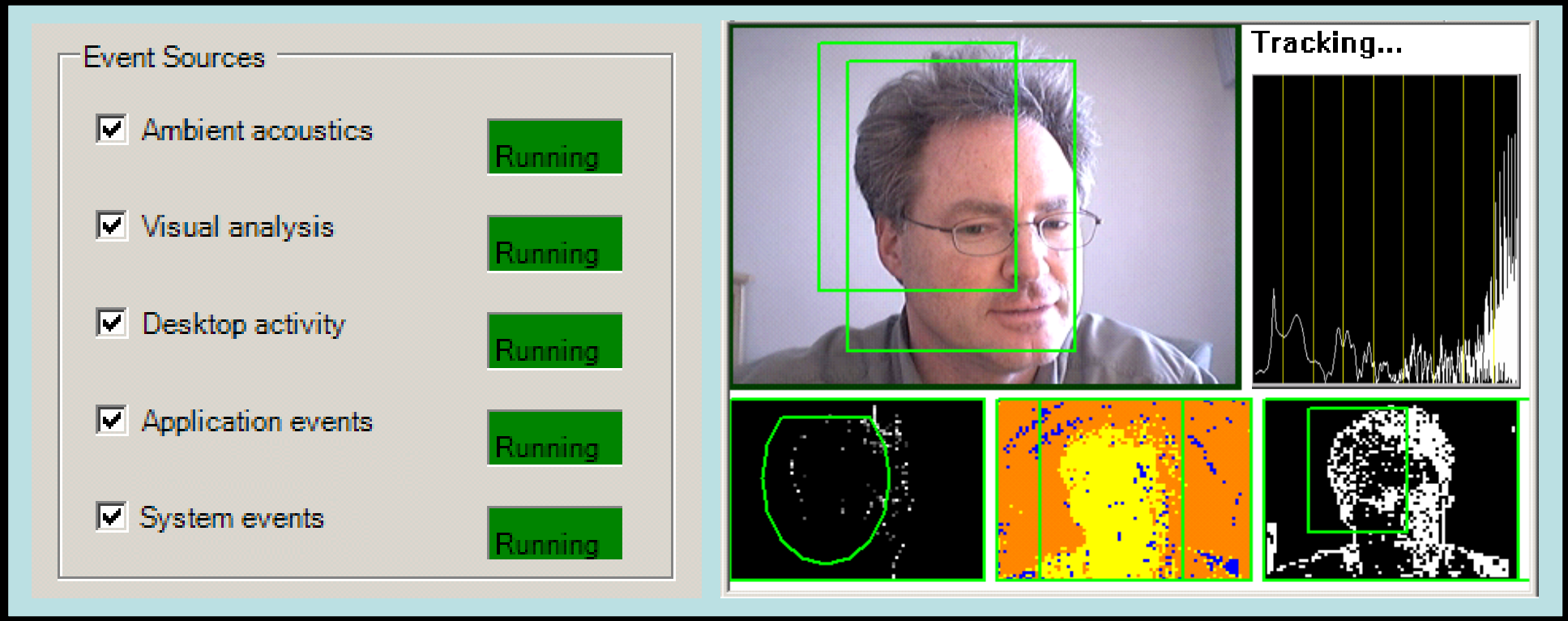
Compute expected value of information



DC: Distant Conversation
NP: Nobody Present
O: Other
P: Presentation
FFC: F-F Conversation
WC: Working on computer
PC: Phone Conversation

Oliver, H. Selective Perception Policies for Limiting Computation in Multimodal Systems: A Comparative Analysis, ICMI 2003

Core Fabric: Tools for Multisensory Prototypes



Core Fabric: Tools for Multisensory Prototypes

Video: Sensing Smartphone (2000)

Hinckley, Pierce, Sinclair, Horvitz. Sensing Techniques for Mobile Interaction, UIST 2000

Core Fabric: Tools for Multisensory Prototypes

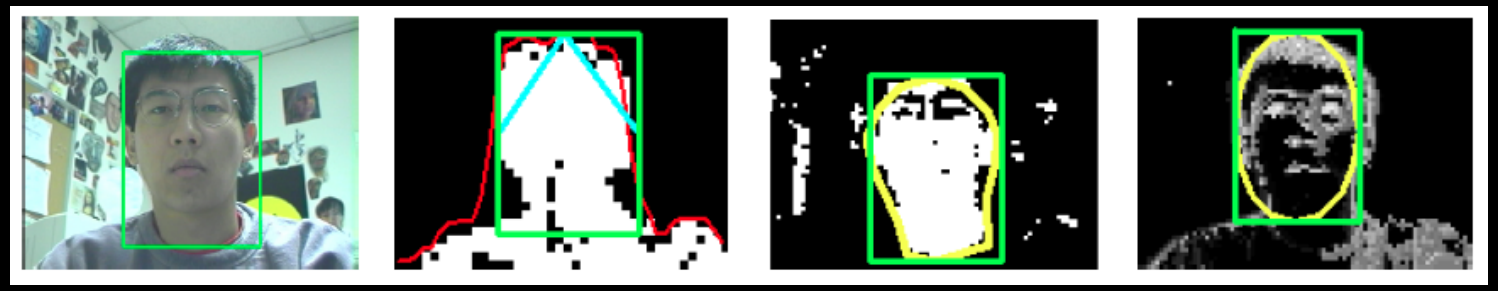
Video: Surface computing (2004)

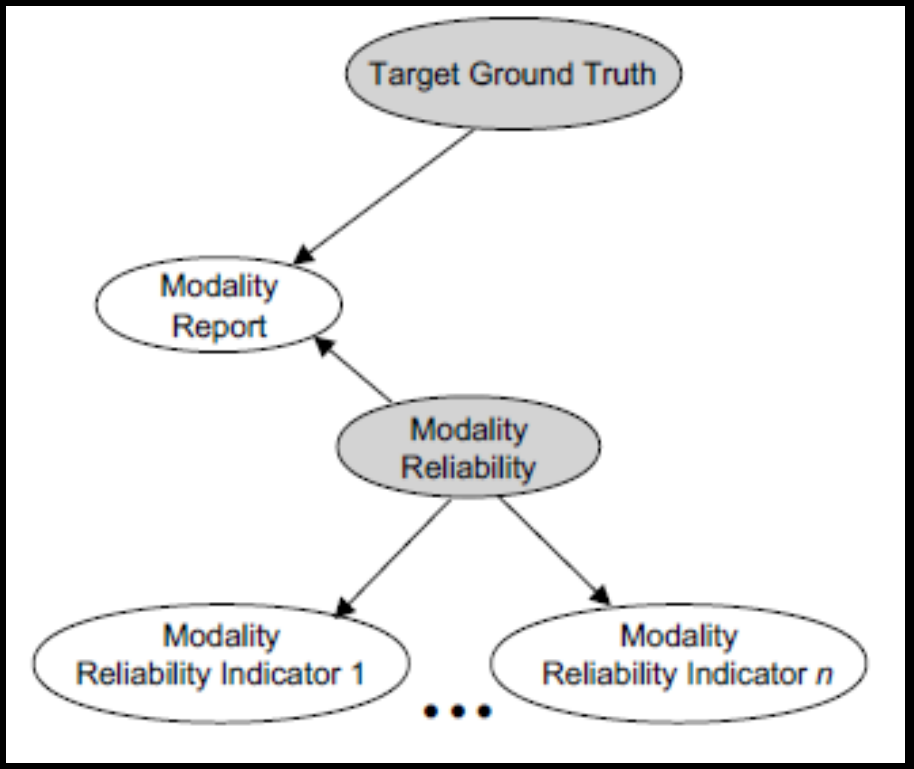
Wilson. PlayAnywhere: A Compact Tabletop Computer Vision System, UIST 2005

Wilson, Sarin. BlueTable: Connecting Wireless Mobile Devices on Interactive Surfaces Using Vision-Based Handshaking, GI 2007

Olwal, Wilson. SurfaceFusion: Unobtrusive Tracking of Everyday Objects in Tangible User Interfaces, GI 2008

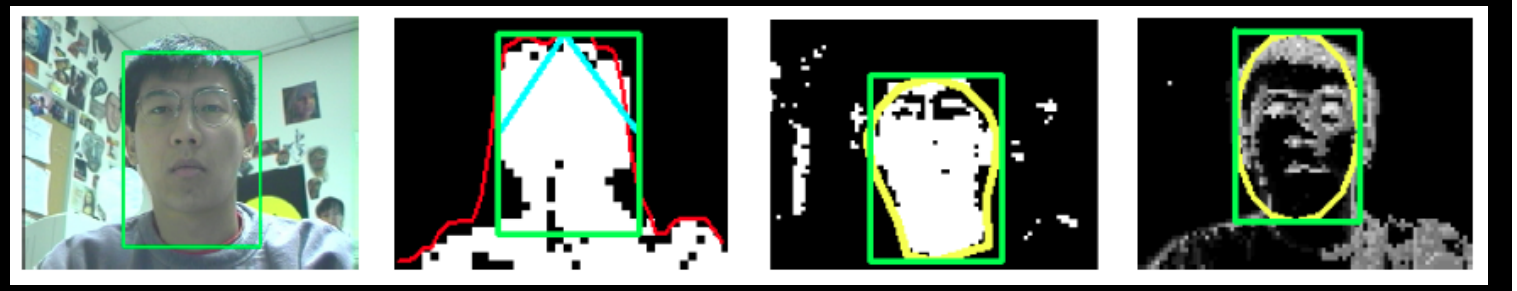
Core Fabric: Probabilistic Fusion of Signals

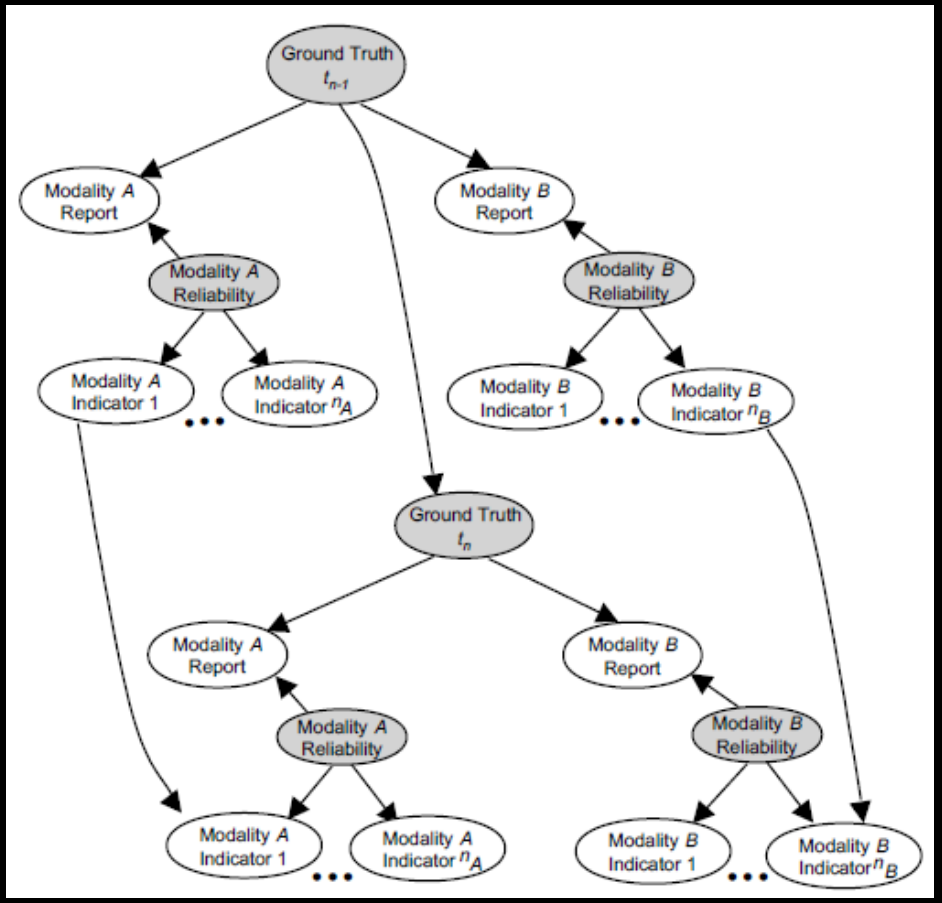




Toyama, H. Bayesian Modality Fusion: Probabilistic Integration of Multiple Vision Algorithms for Head Tracking. ACCV 2000.

Core Fabric: Probabilistic Fusion of Signals



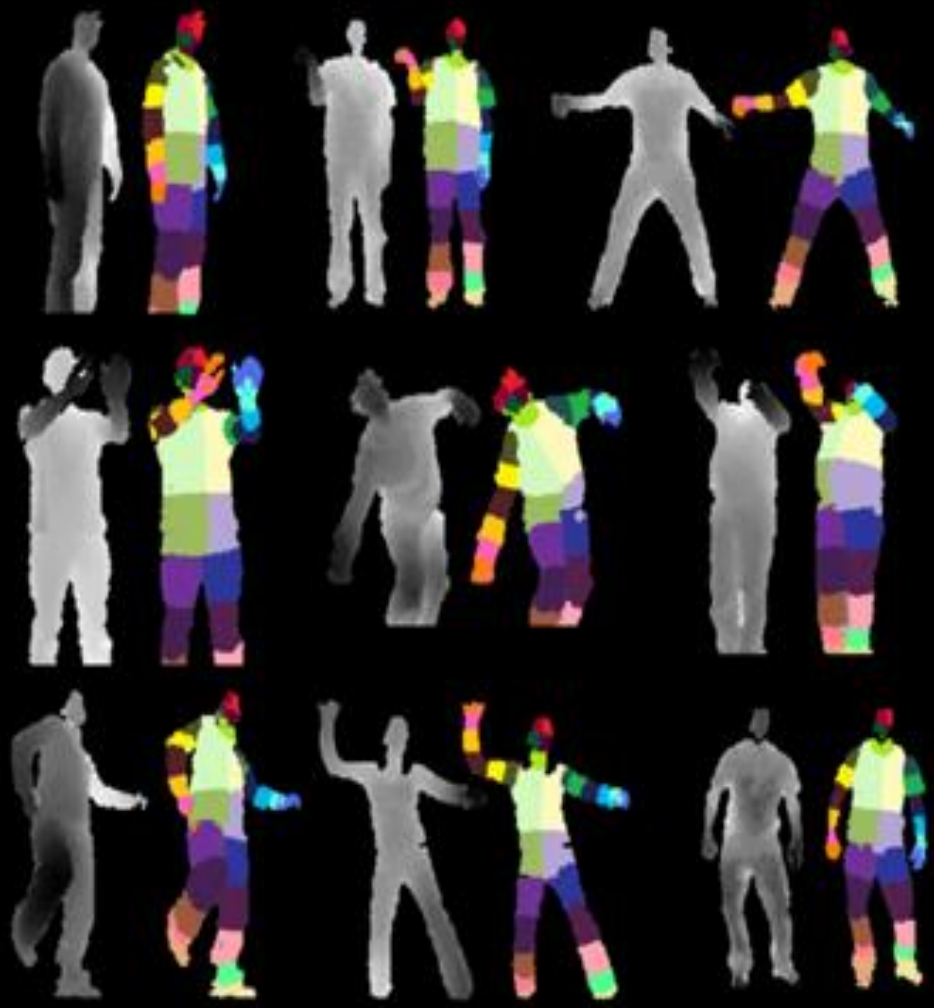


Toyama, H. Bayesian Modality Fusion: Probabilistic Integration of Multiple Vision Algorithms for Head Tracking. ACCV 2000.

Core Advances in Perception

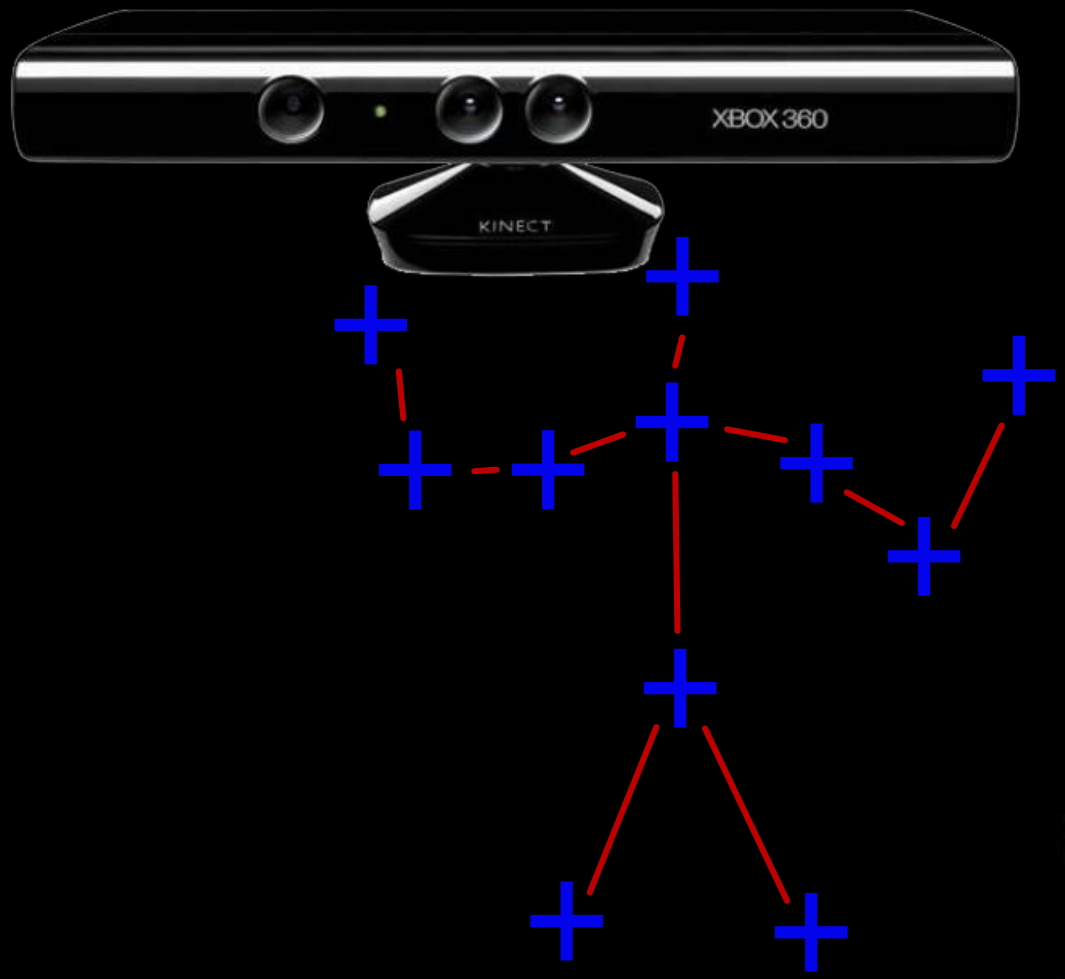
Core Advances in Perception

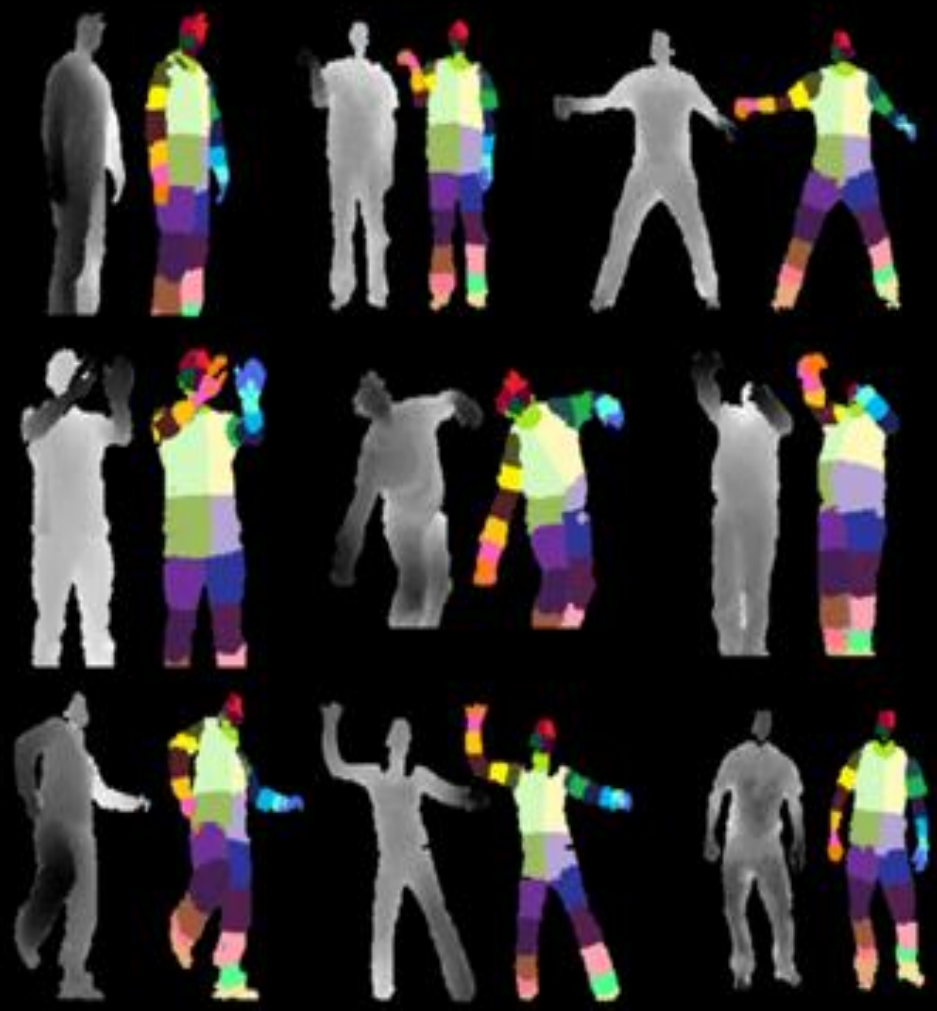
Core Advances in Perception



Shotton, Fitzgibbon, Cook, et al., Real-Time Human Pose Recognition in Parts from Single Depth Images, CVPR 2011.

Core Advances in Perception

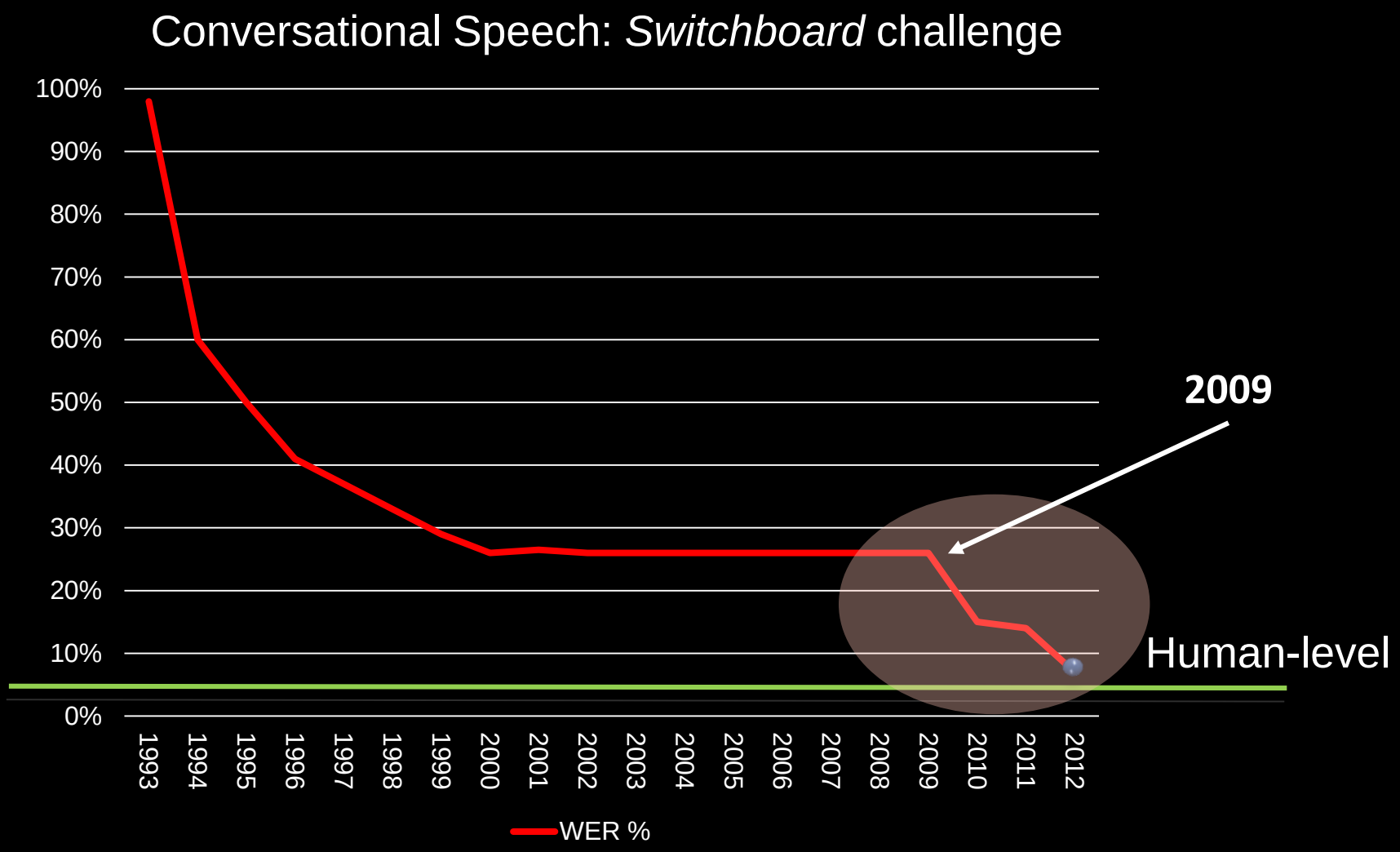




Shotton, Fitzgibbon, Cook, et al., Real-Time Human Pose Recognition in Parts from Single Depth Images, CVPR 2011.

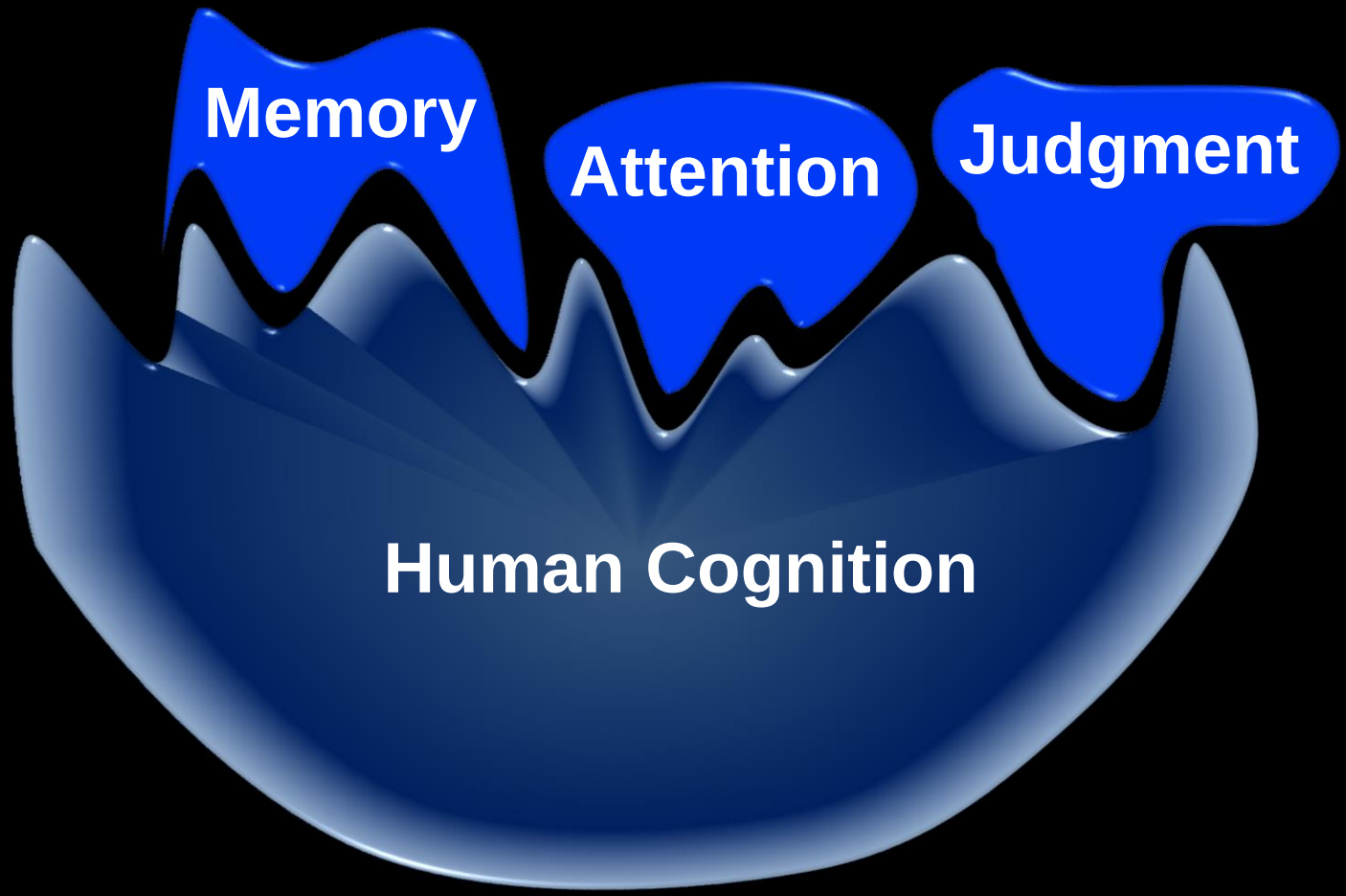
Core Advances in Perception

Power of data + CNNs

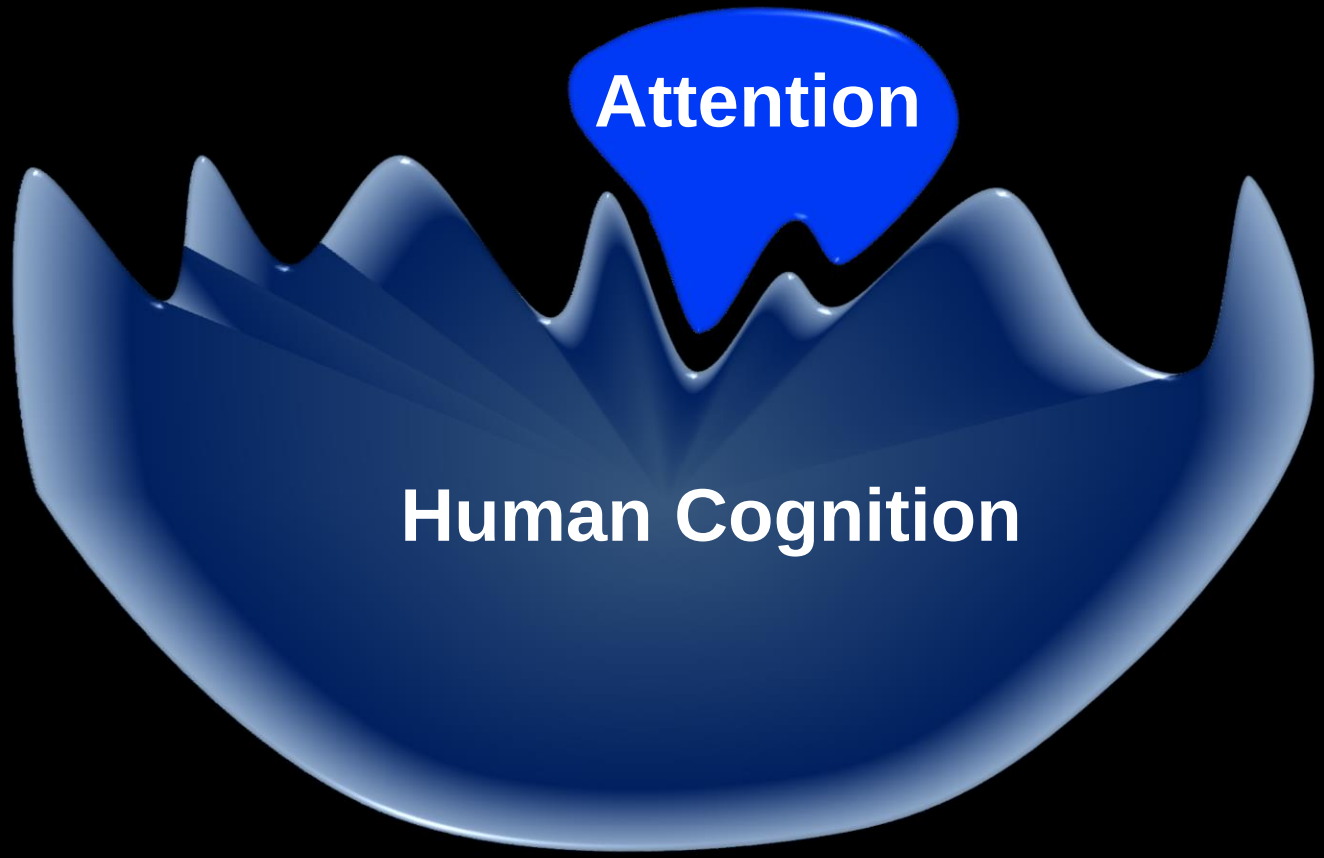


Understanding Human Cognition

Studies of Attention & Memory

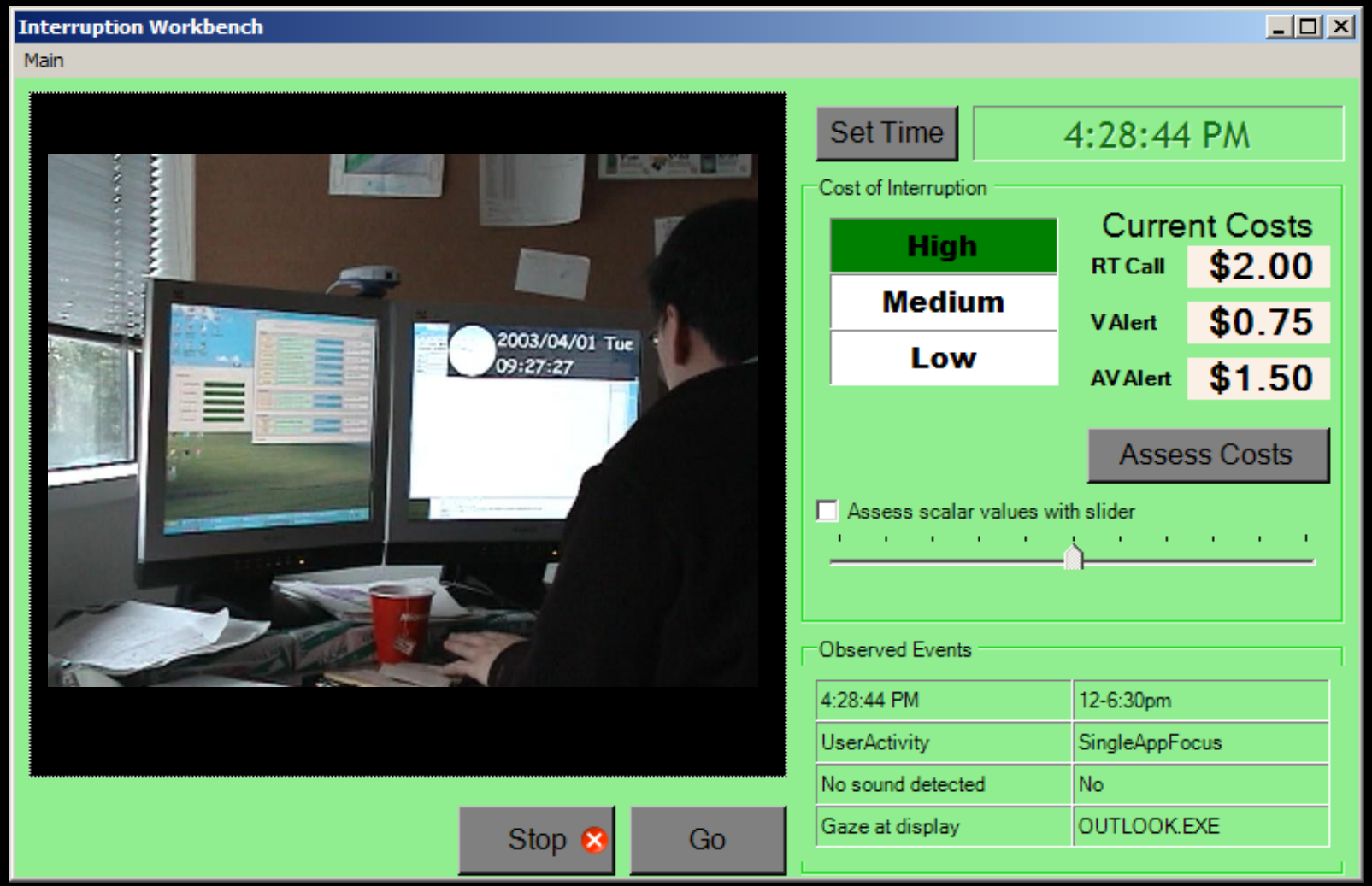


Models of Attention



Kadie, Paek,Hovel. Models of Attention in Computing and Communications: From Principles to Applications, CACM 46(3) 2003.

Predict Cost of Interruption

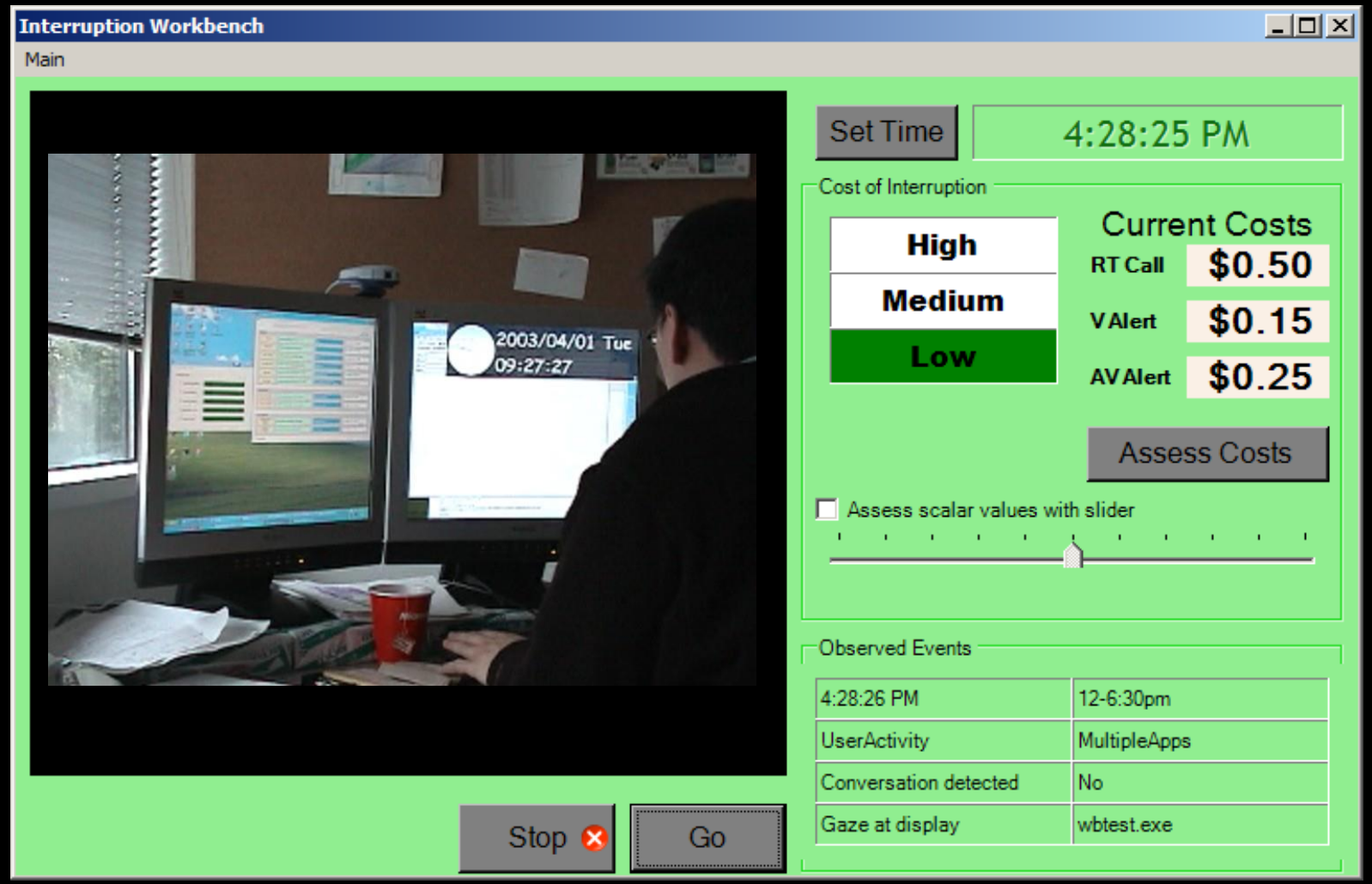


ICMI 2003

H., Apacible. Learning and Reasoning about Interruption. ICMI 2003

H., Apacible, Koch. BusyBody: Creating and Fielding Personalized Models of the Cost of Interruption, CSCW 2004.

Predict Cost of Interruption



ICMI 2003

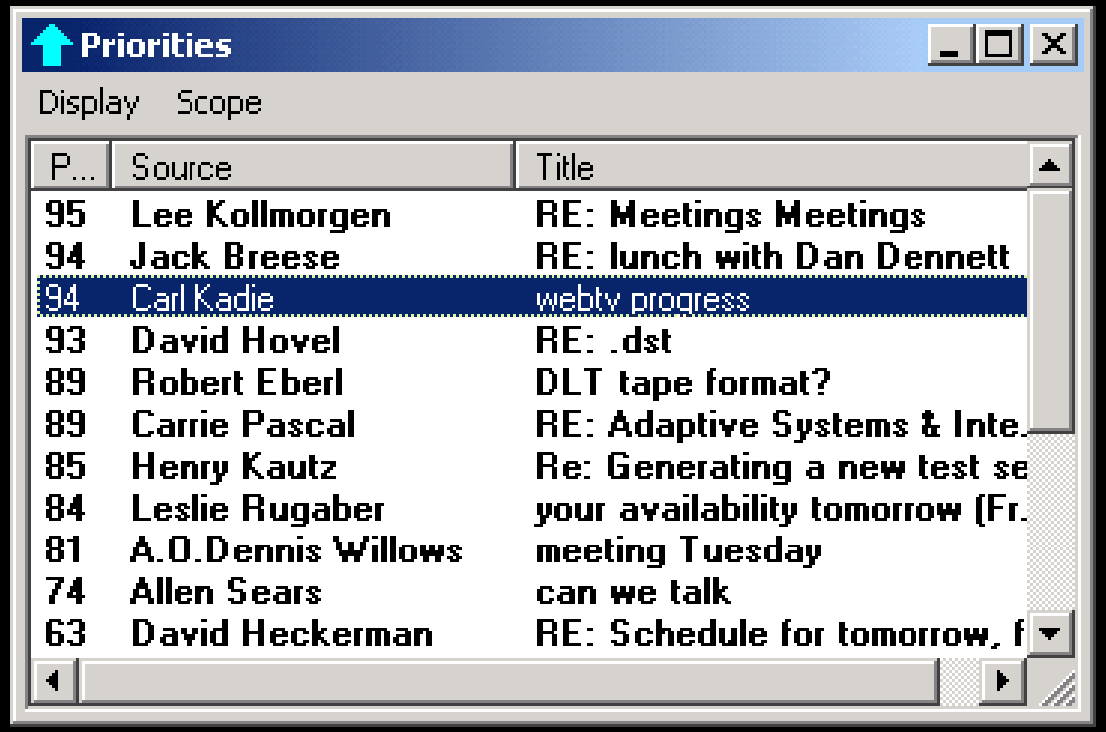
H., Apacible. Learning and Reasoning about Interruption. ICMI 2003

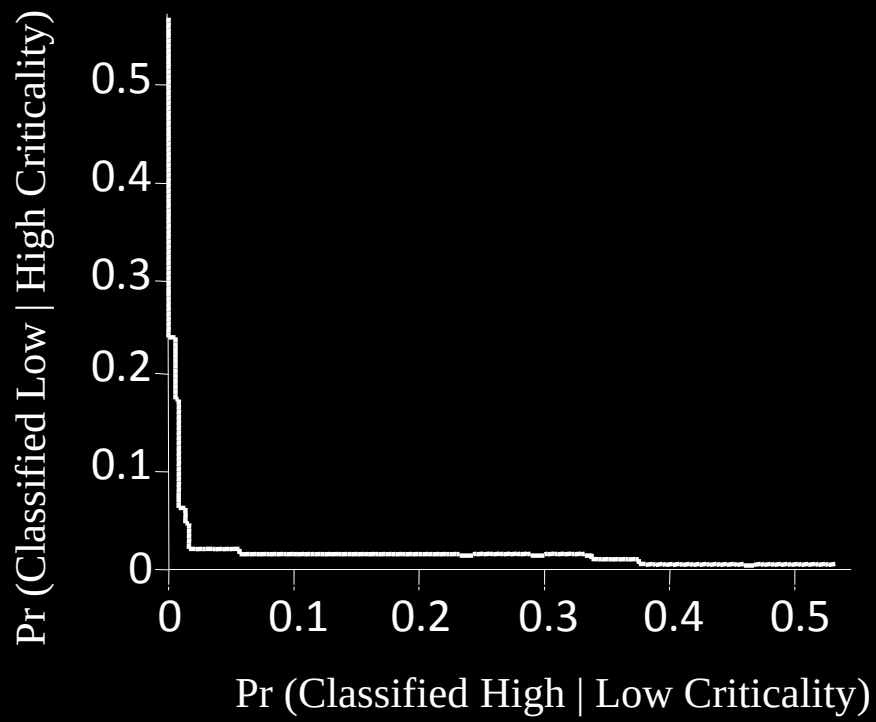
H., Apacible, Koch. BusyBody: Creating and Fielding Personalized Models of the Cost of Interruption, CSCW 2004.

Leveraging Models of People

Priorities (1999)

Learn to sort & route email by urgency

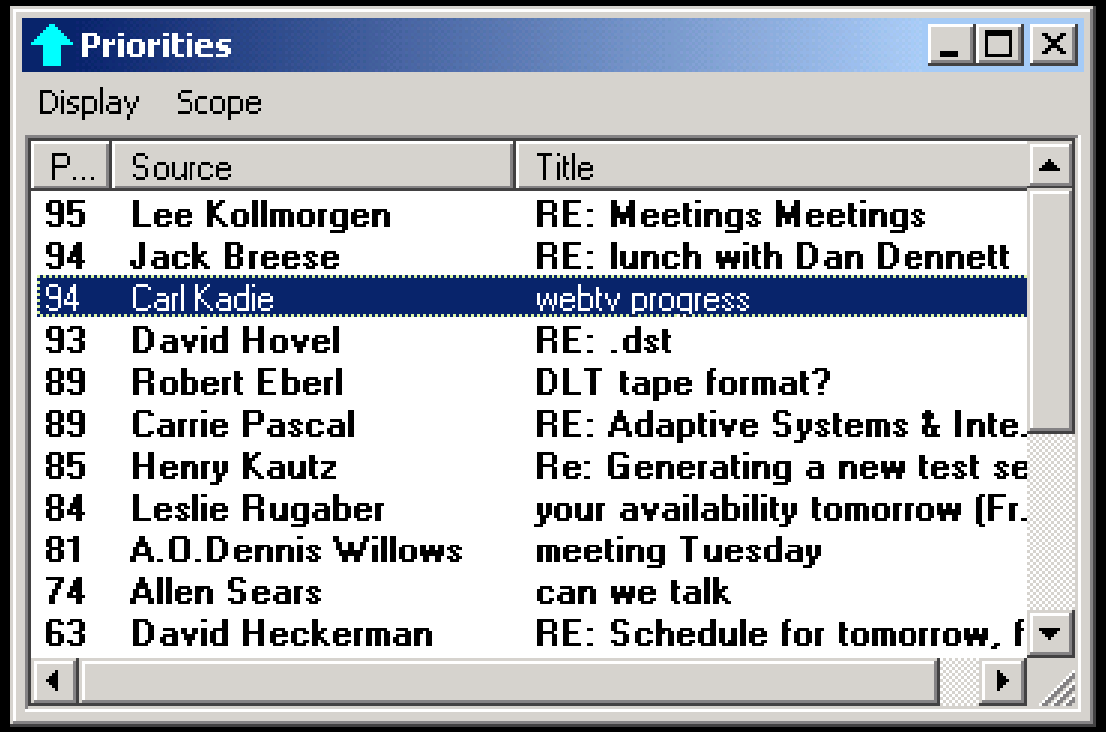




H., Jacobs, Hovel. Attention-Sensitive Alerting. UAI 1999.

Priorities (1999)

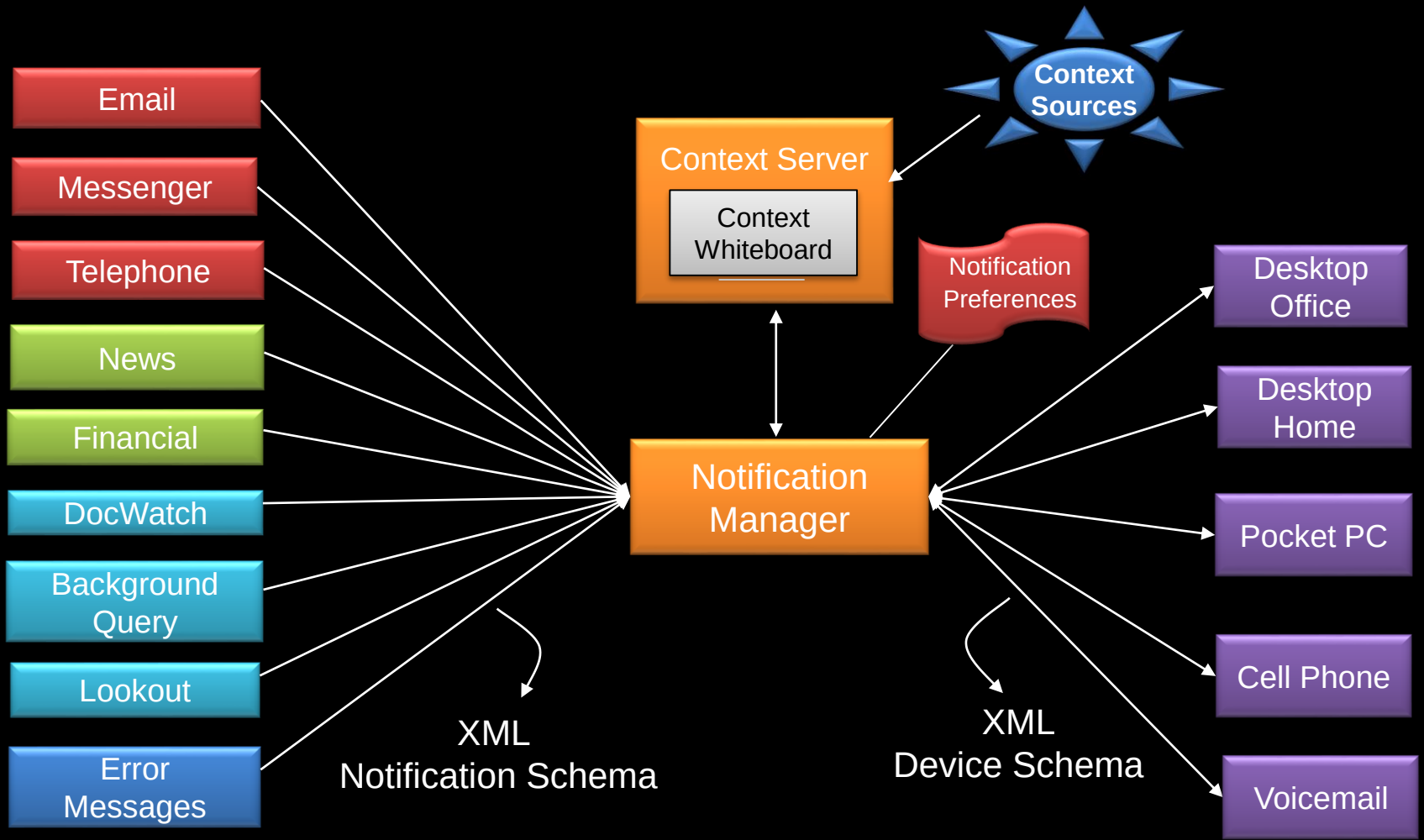
Learn to sort & route email by urgency



H., Jacobs, Hovel. Attention-Sensitive Alerting. UAI 1999.

Notification Platform (2000)

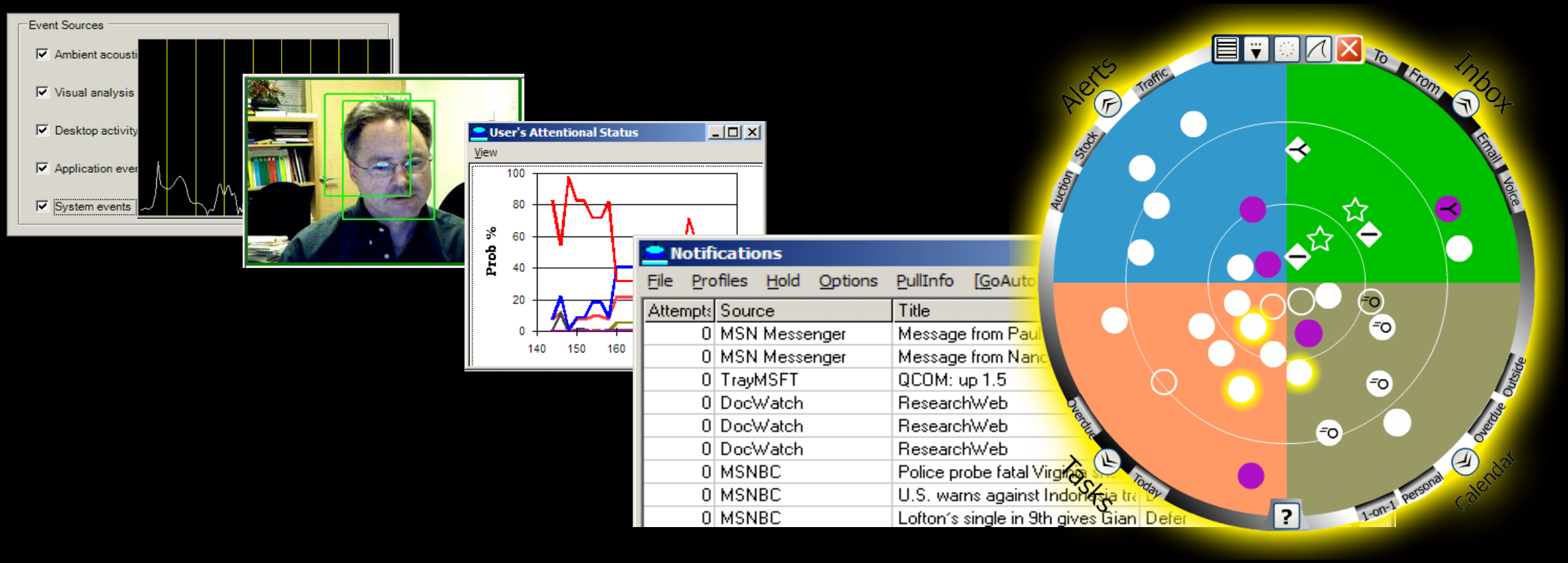
Generalize to multiple sources & endpoints



H, Kadie, Paek,Hovel. Models of Attention in Computing and Communications: From Principles to Applications, CACM 46(3). 2003.

Notification Platform (2000)

Generalize to multiple sources & endpoints

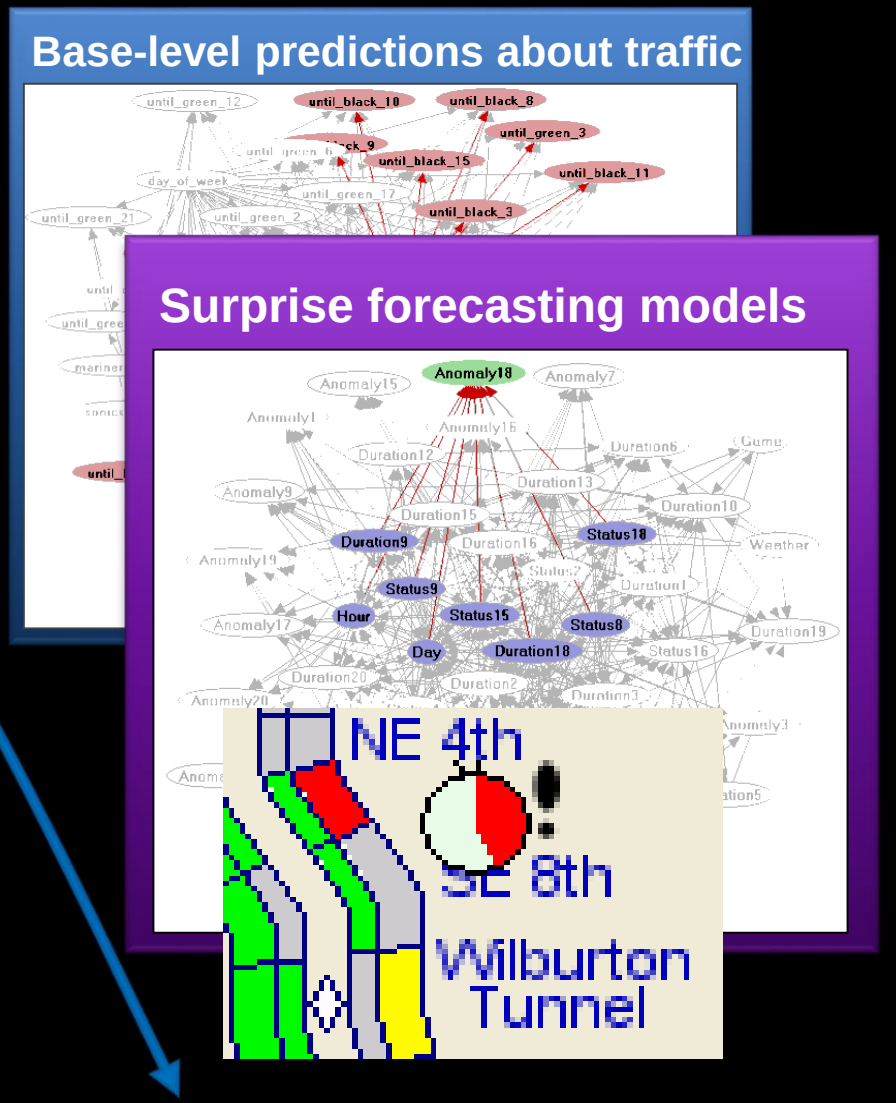


H, Kadie, Paek,Hovel. Models of Attention in Computing and Communications: From Principles to Applications, CACM 46(3). 2003.

van Dantzich, Robbins, H., Czerwinski, Scope: Providing Awareness of Multiple Notifications at a Glance. AVI 2002.

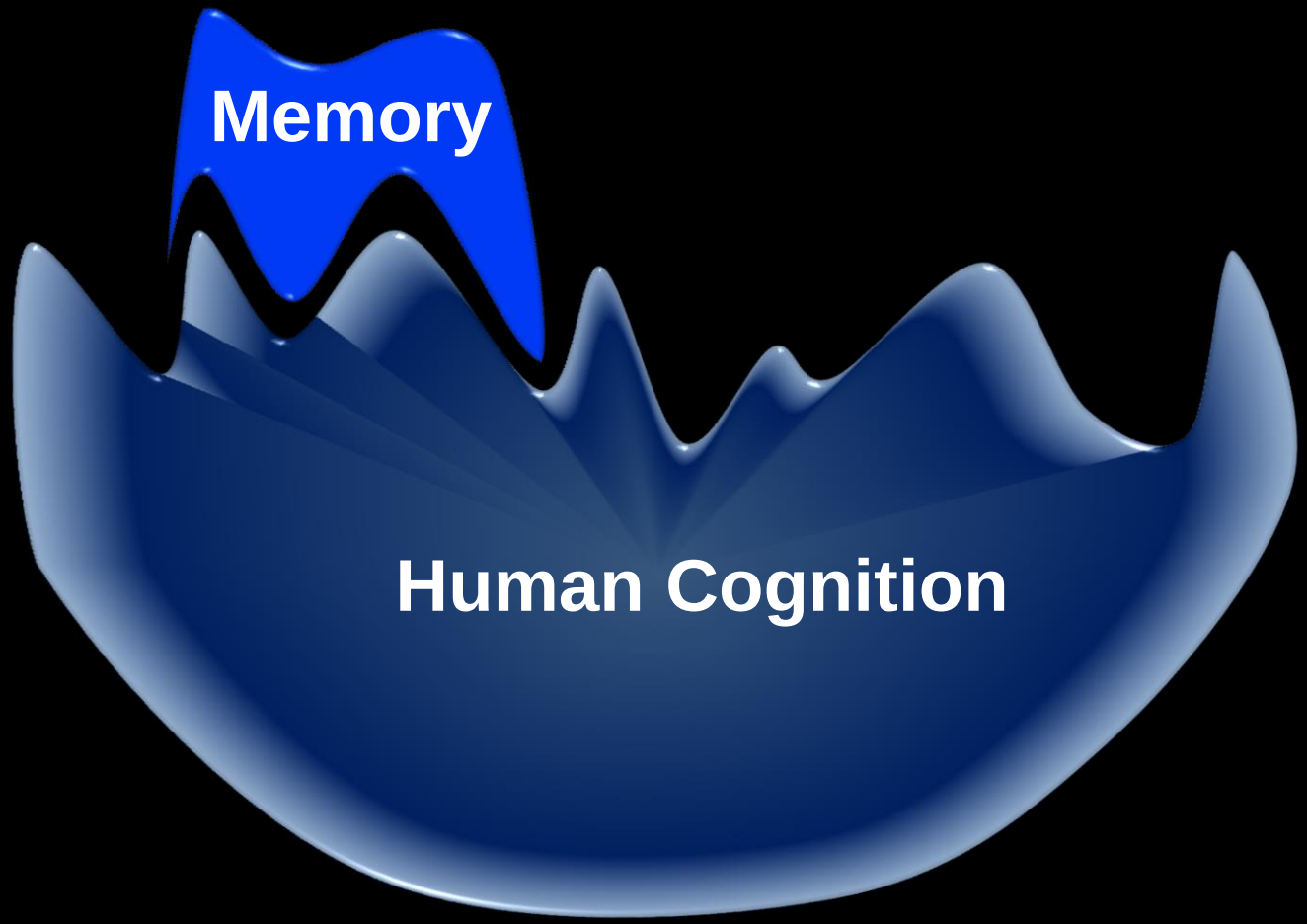
Video: Gates keynote & demo, CHI 2001

Models of Surprise



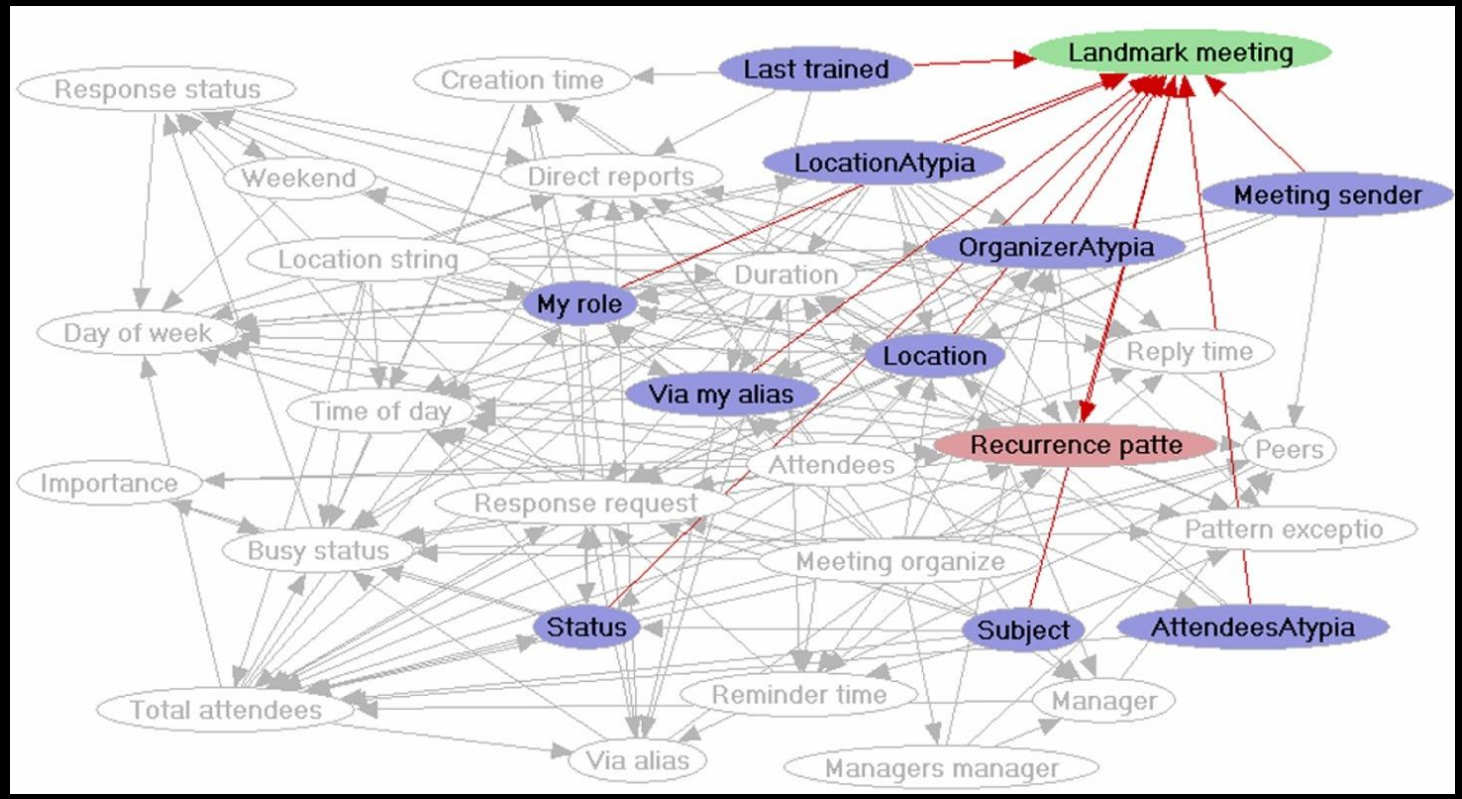
H., Apacible, Sarin, Liao. Prediction, Expectation, and Surprise: Methods, Designs, and Study of a Deployed Traffic Forecasting Service, UAI 2005.

Models of Memory



Models of Memory Landmarks

Lifebrowser (2004), *Memory Milestones* (2003)

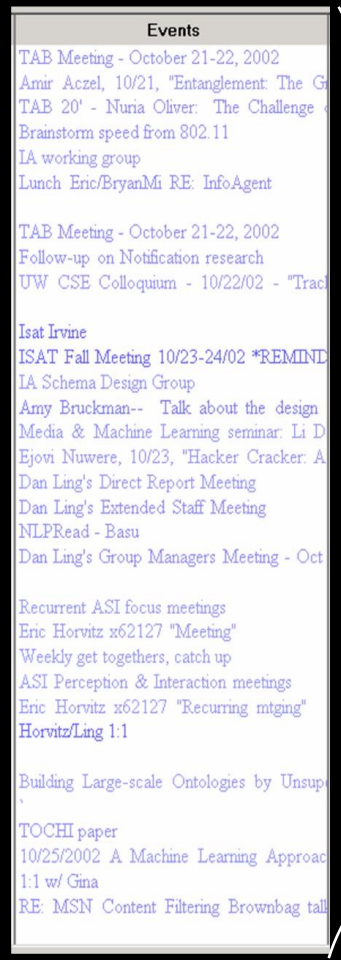


H., Dumais, Koch. Learning Predictive Models of Memory Landmarks, Cognitive Science 2004.

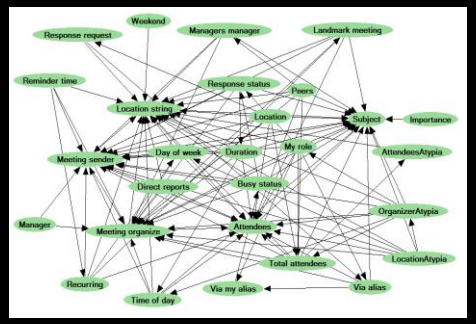
Ringel, Cutrell, Dumais, H. Milestones in Time: Value of Landmarks in Retrieving Information from Personal Stores. Interact 2003.

Models of Memory Landmarks

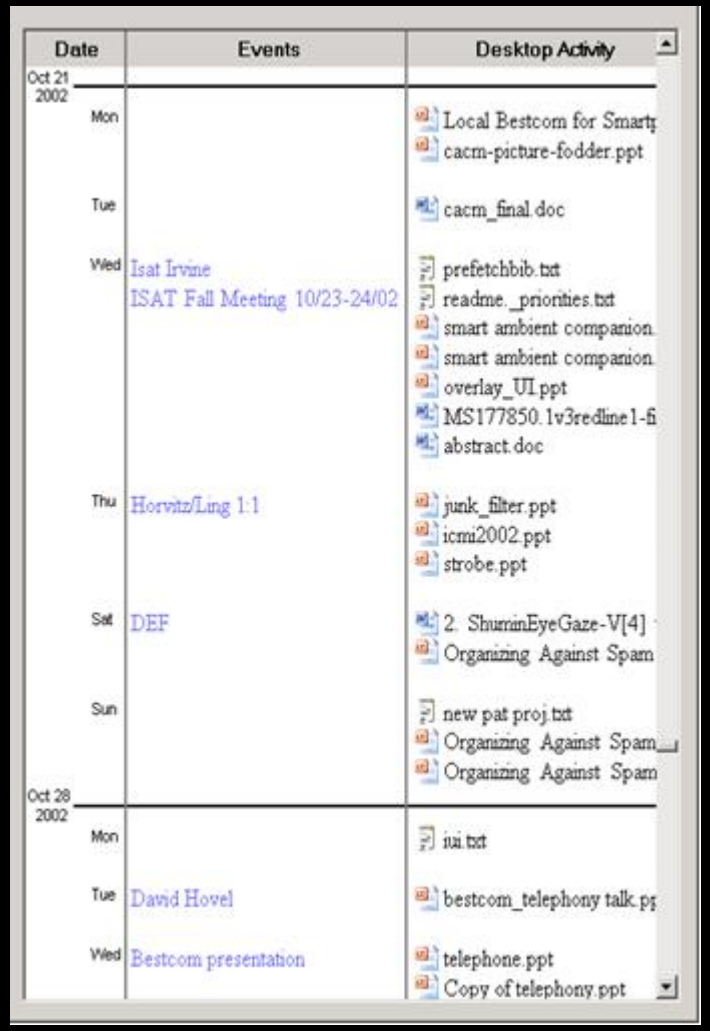
Lifebrowser (2004)



Selective memory



Machine learning to predict memory landmarks

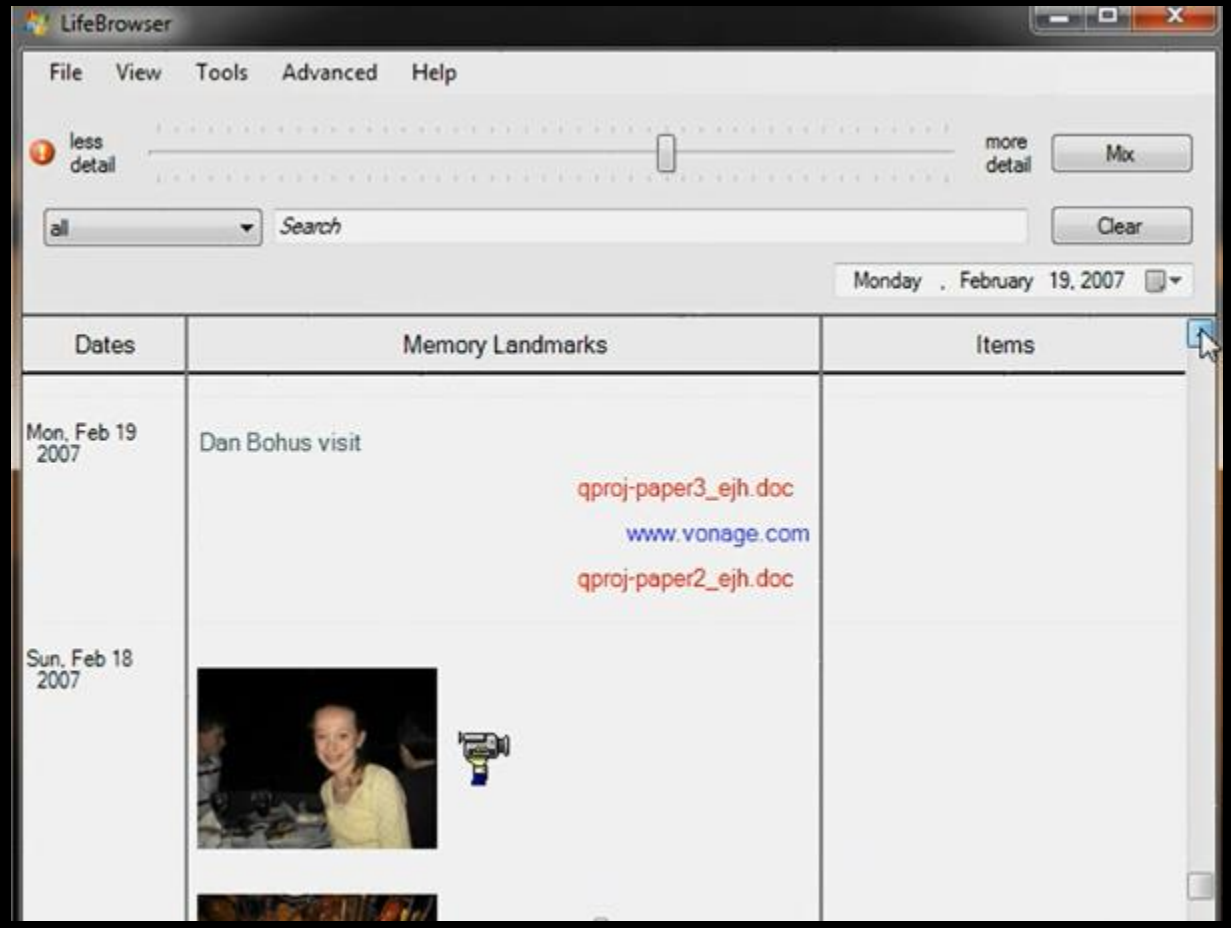


H., Dumais, Koch. Learning Predictive Models of Memory Landmarks, Cognitive Science 2004.

Models of Memory Landmarks

Lifebrowser (2004)

Video: Lifebrowser



Rich timeline of predicted memory landmarks:

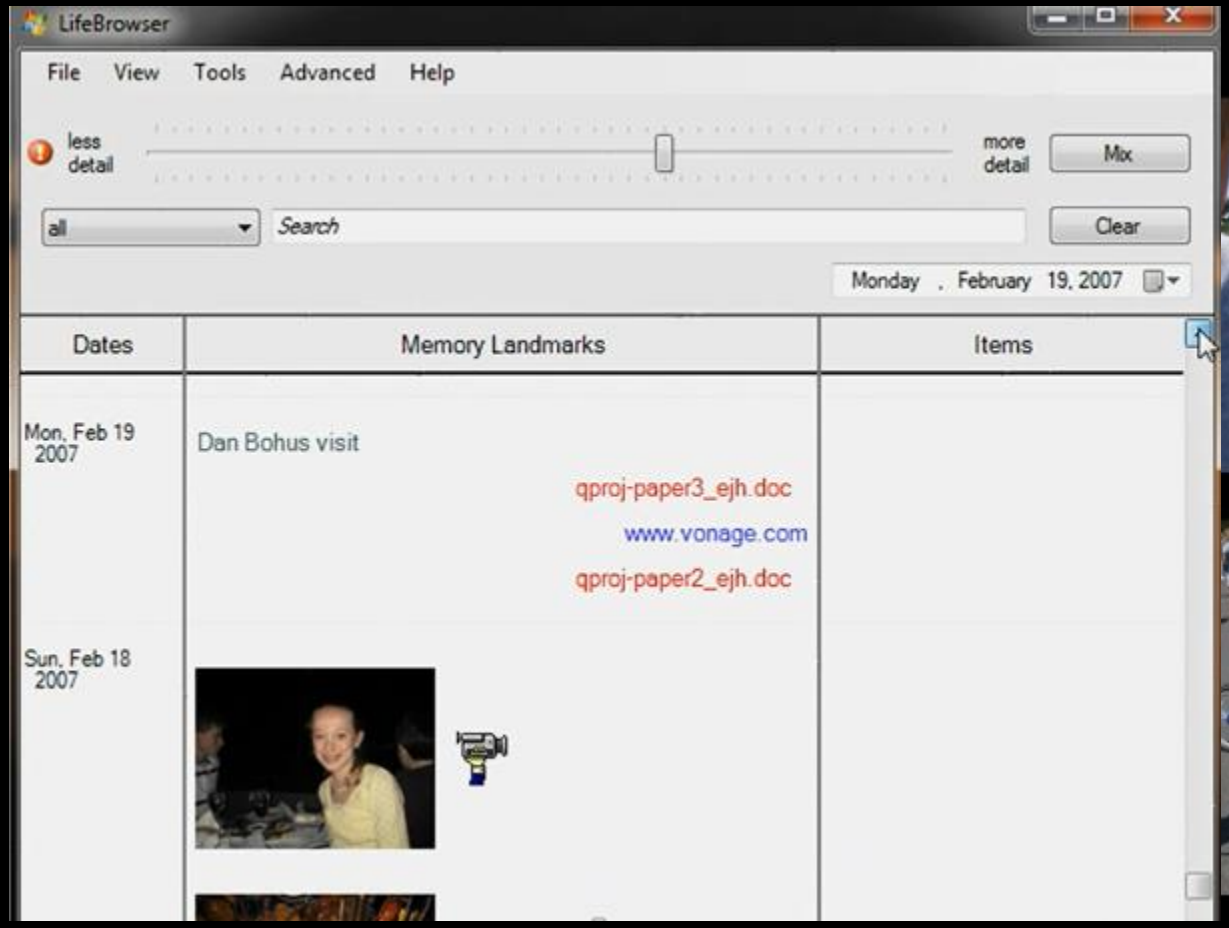
- Meetings
- Photos/videos
- Activities
- Locations

Multimodal training data

Models of Memory Landmarks

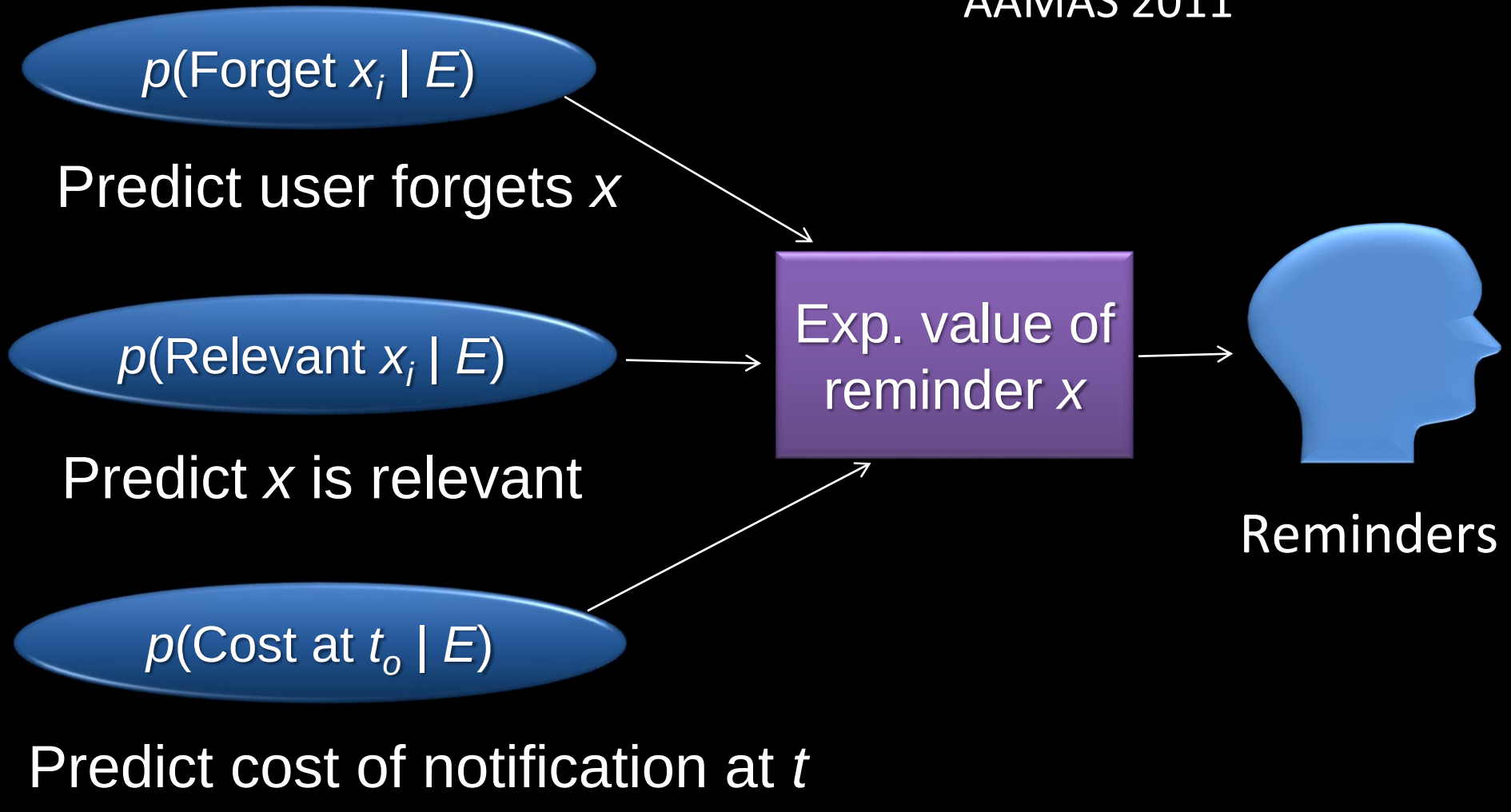
Lifebrowser (2004)

Video: Lifebrowser



Forgetting & Reminding: *Jogger*

AAMAS 2011



Kamar, H. Jogger: Investigation of Principles of Context-Sensitive Reminding, AAMAS 2011.

Toward Deeper Collaborations

In our Lifetimes?

Situated Interaction

Planning

Understanding

Contributions

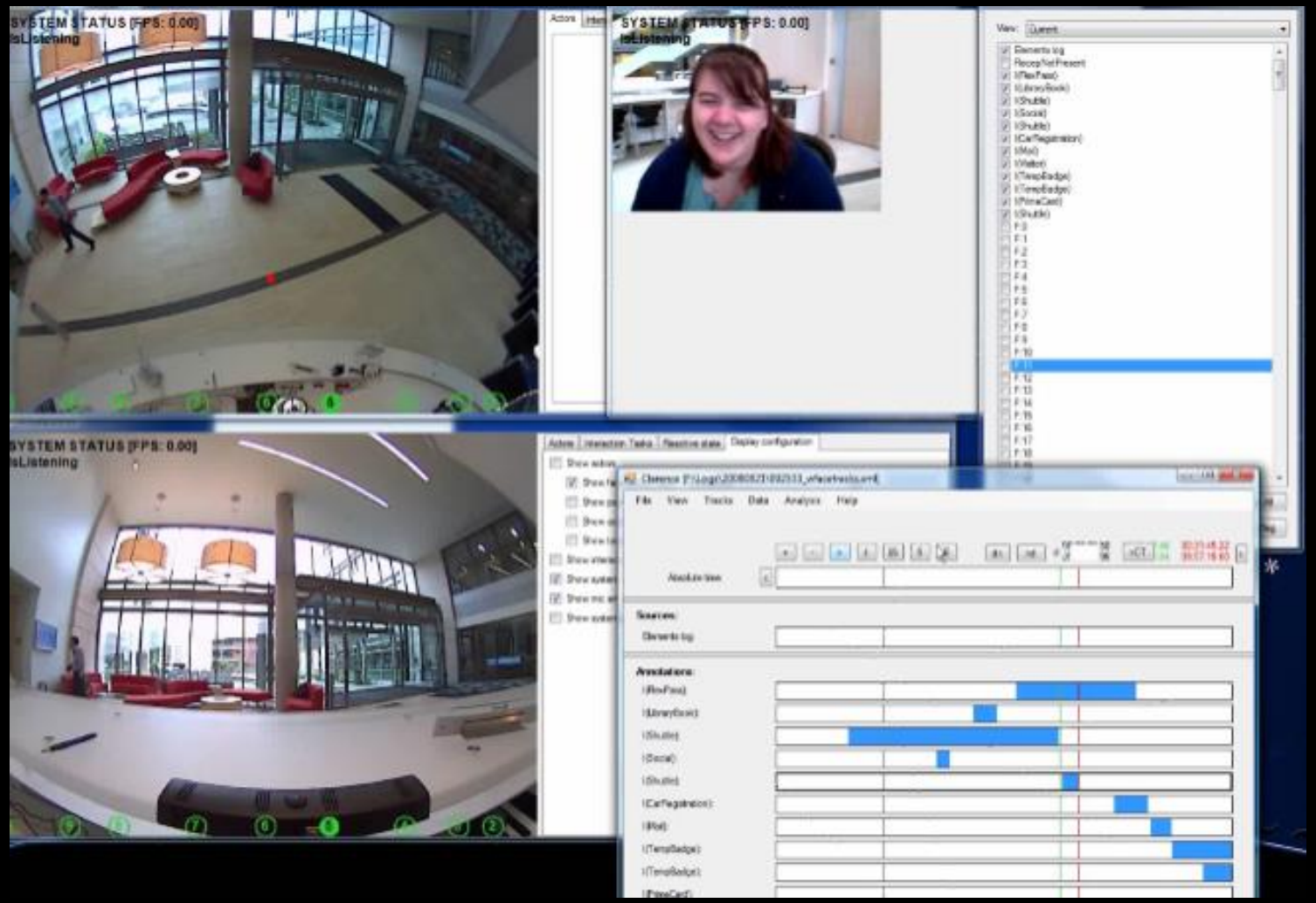
Engagement

Beliefs,
intentions, plans

Activities & events

Actors, objects
in space & time

Situated Interaction Project



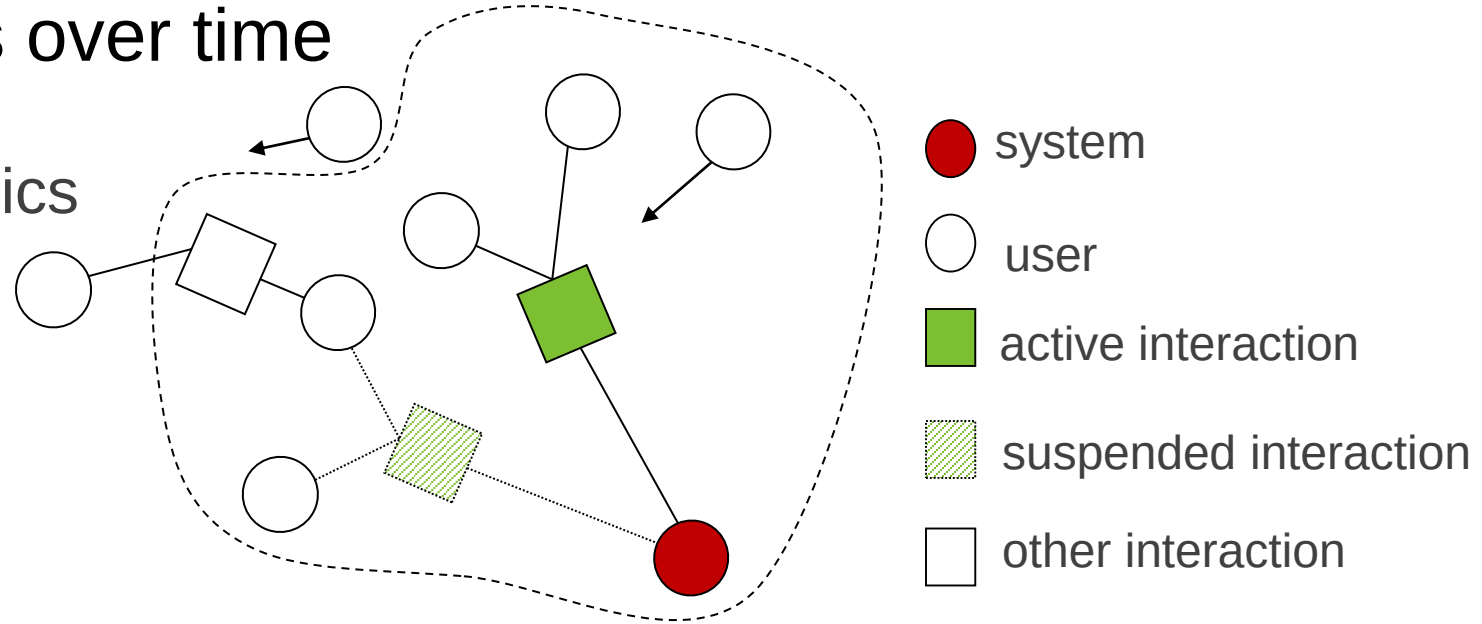
Study: Tasks undertaken by receptionists

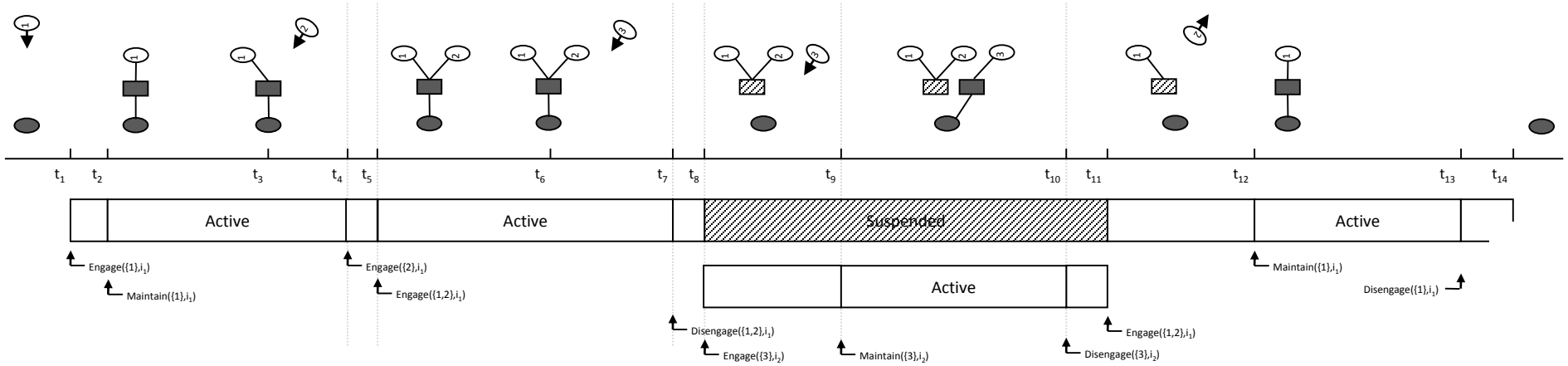
Situated Interaction Project

Entities, relations, intentions over time

Track conversational dynamics

Make turn-taking decisions





wide-angle camera

Kinect microphone array

touch screen

speakers

multi-core PC

Speech Synthesis

Avatar Synthesis

Speech Recognition

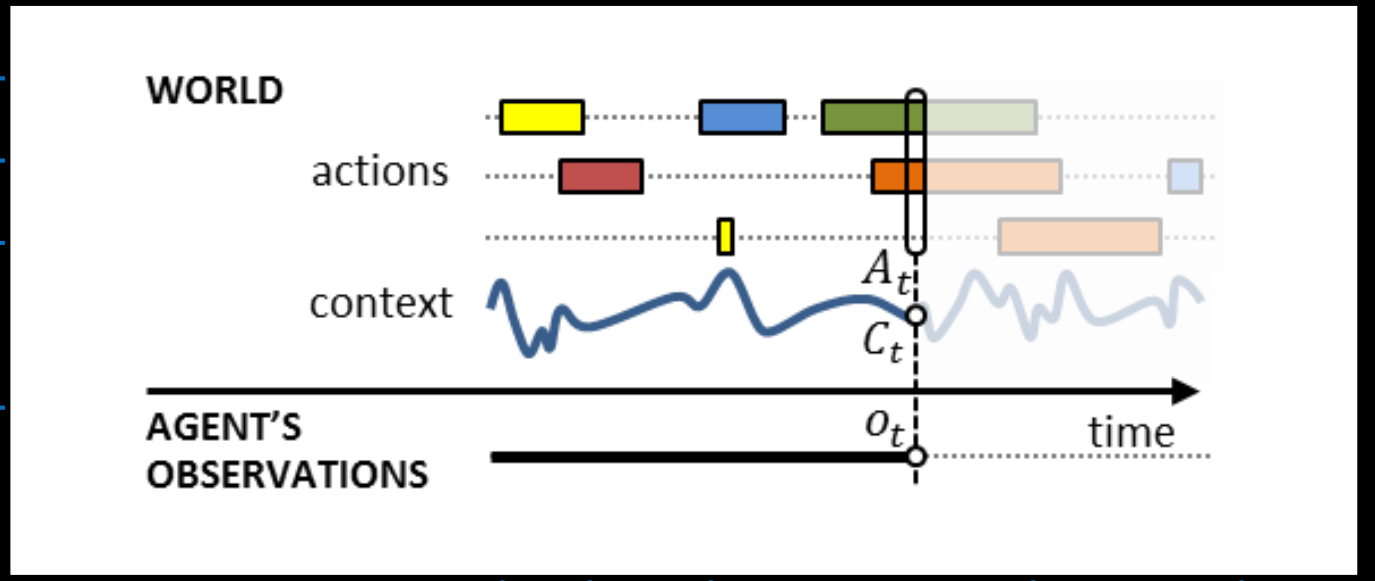
Tracker

Output Management

Conversational Scene Analysis

Behavioral control

Dialog management & Interaction Planning



multi-core PC

Speech Synthesis

Avatar Synthesis

Speech Recognition

Tracker

Output Management

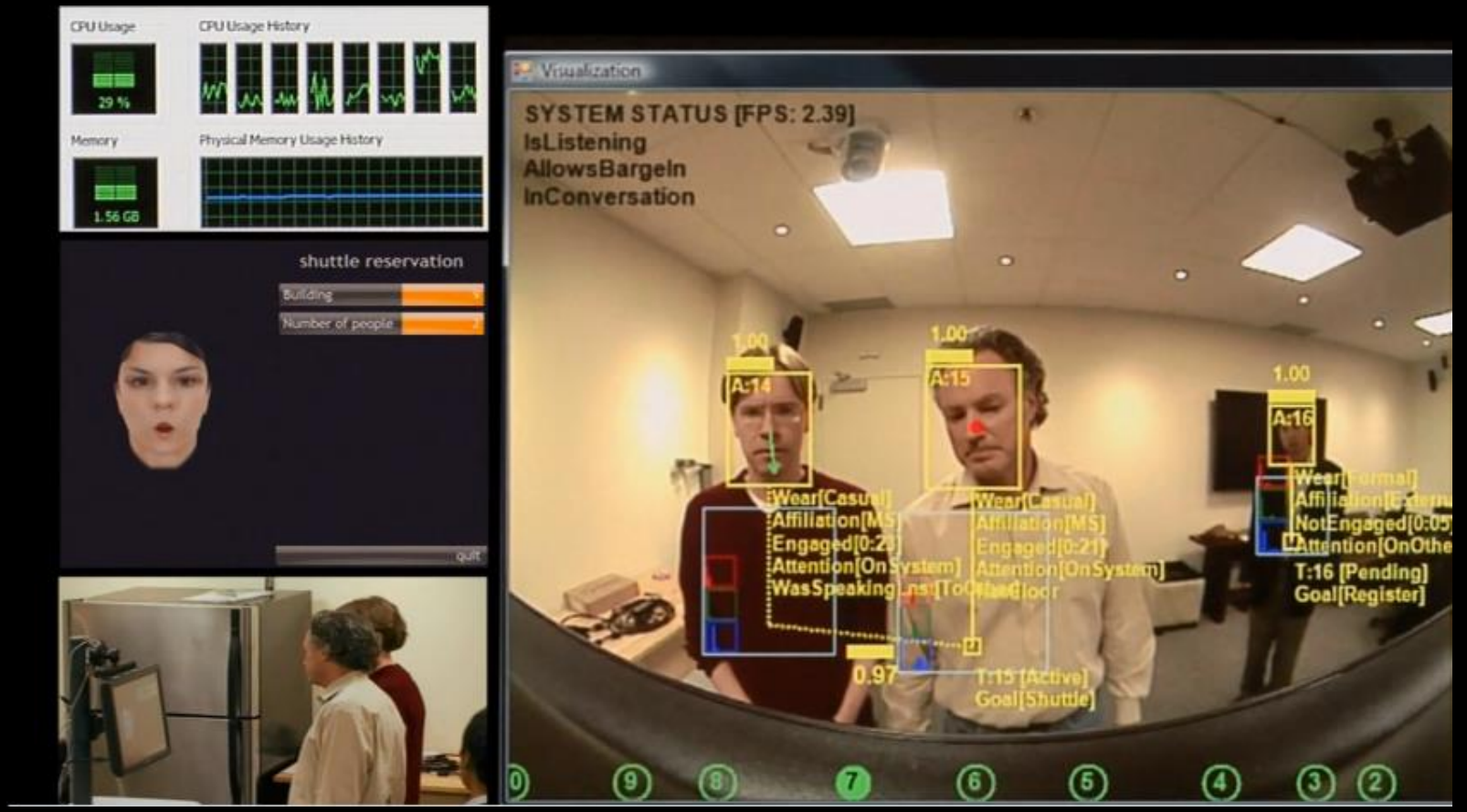
Conversational Scene Analysis

Behavioral control

Dialog management & Interaction Planning

The Receptionist

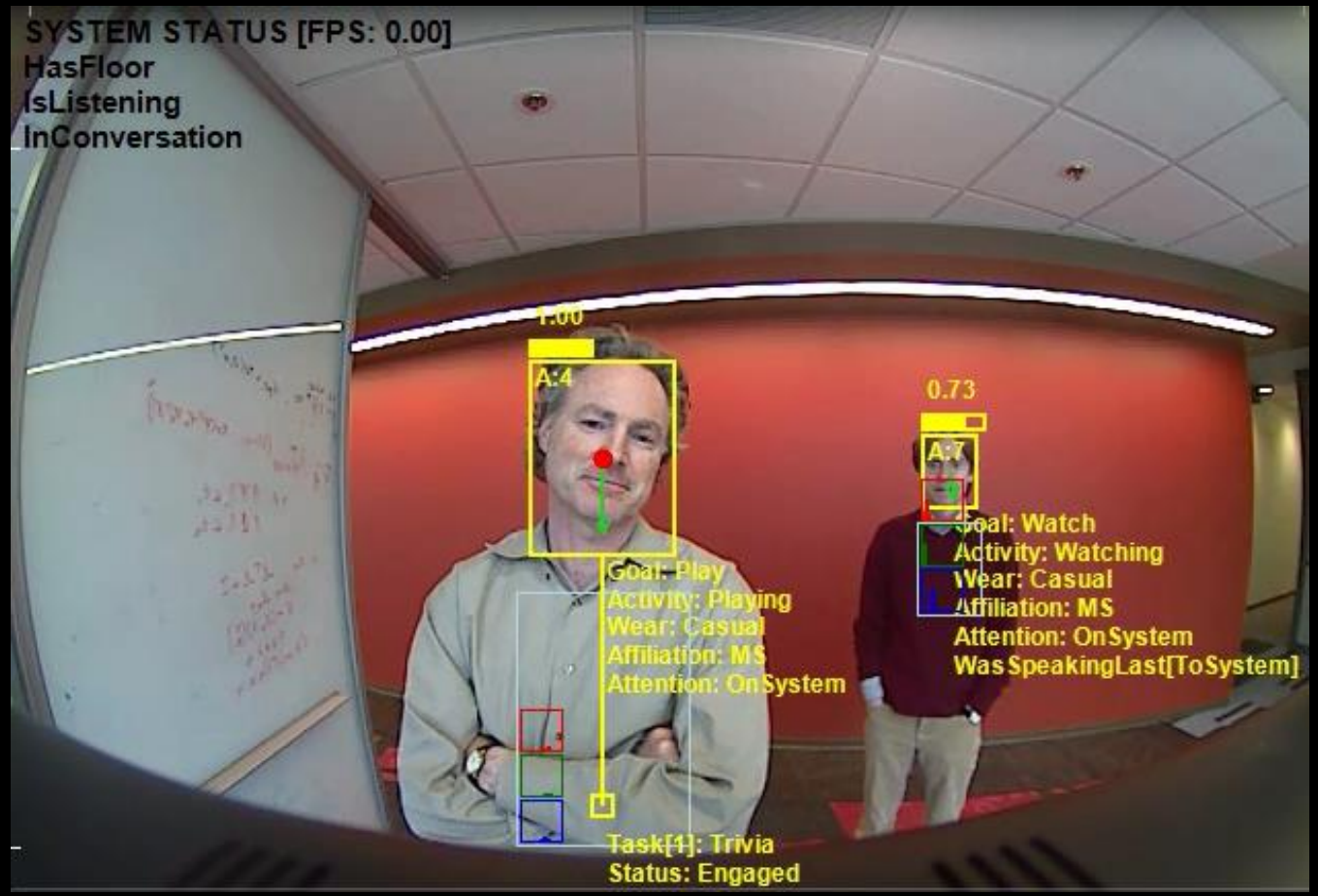
Video: The Receptionist



Bohus and E. Horvitz. Dialog in the Open World: Platform and Applications, ICMI 2009.

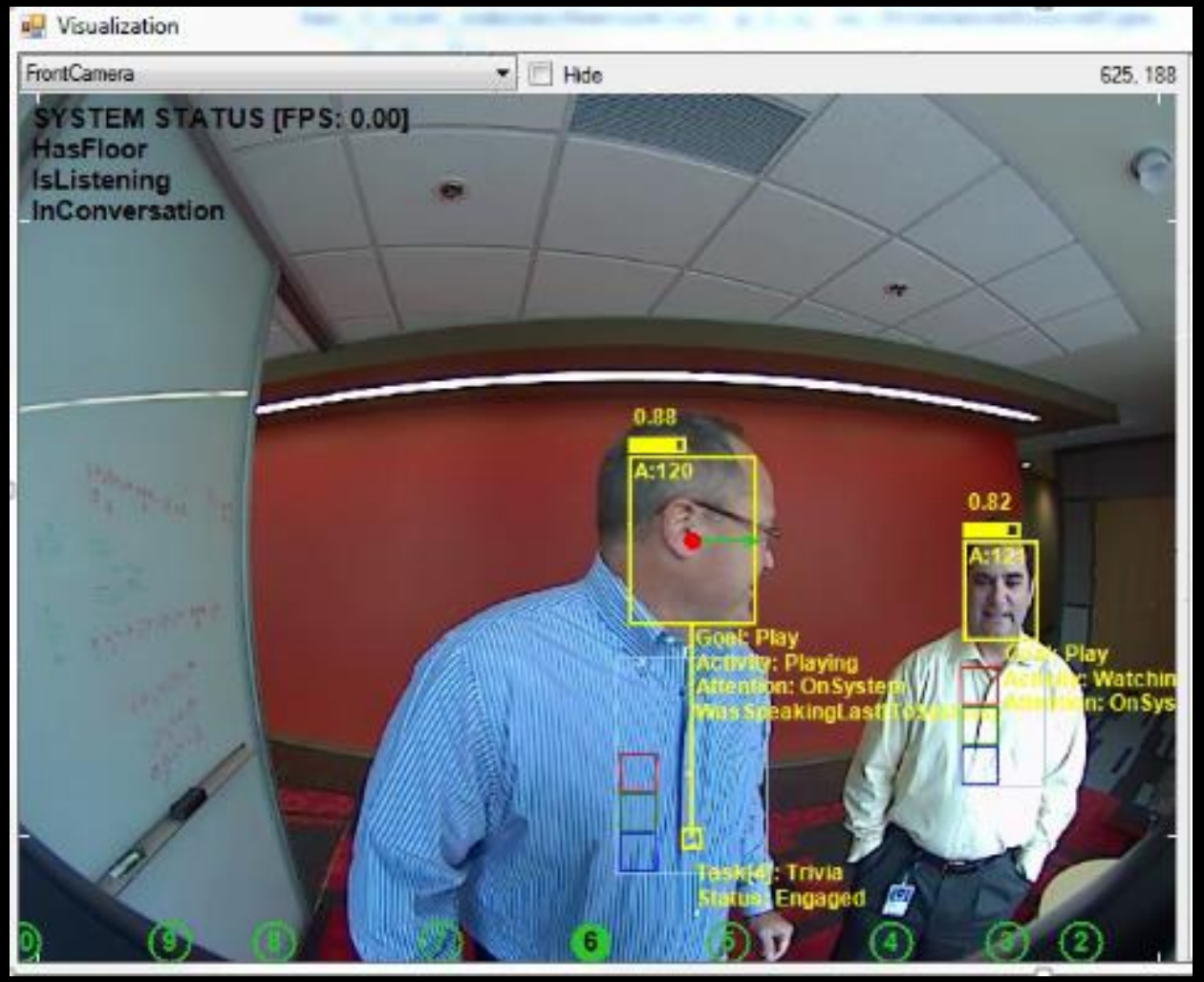
Studies of Engagement

Video: Multiparty engagement



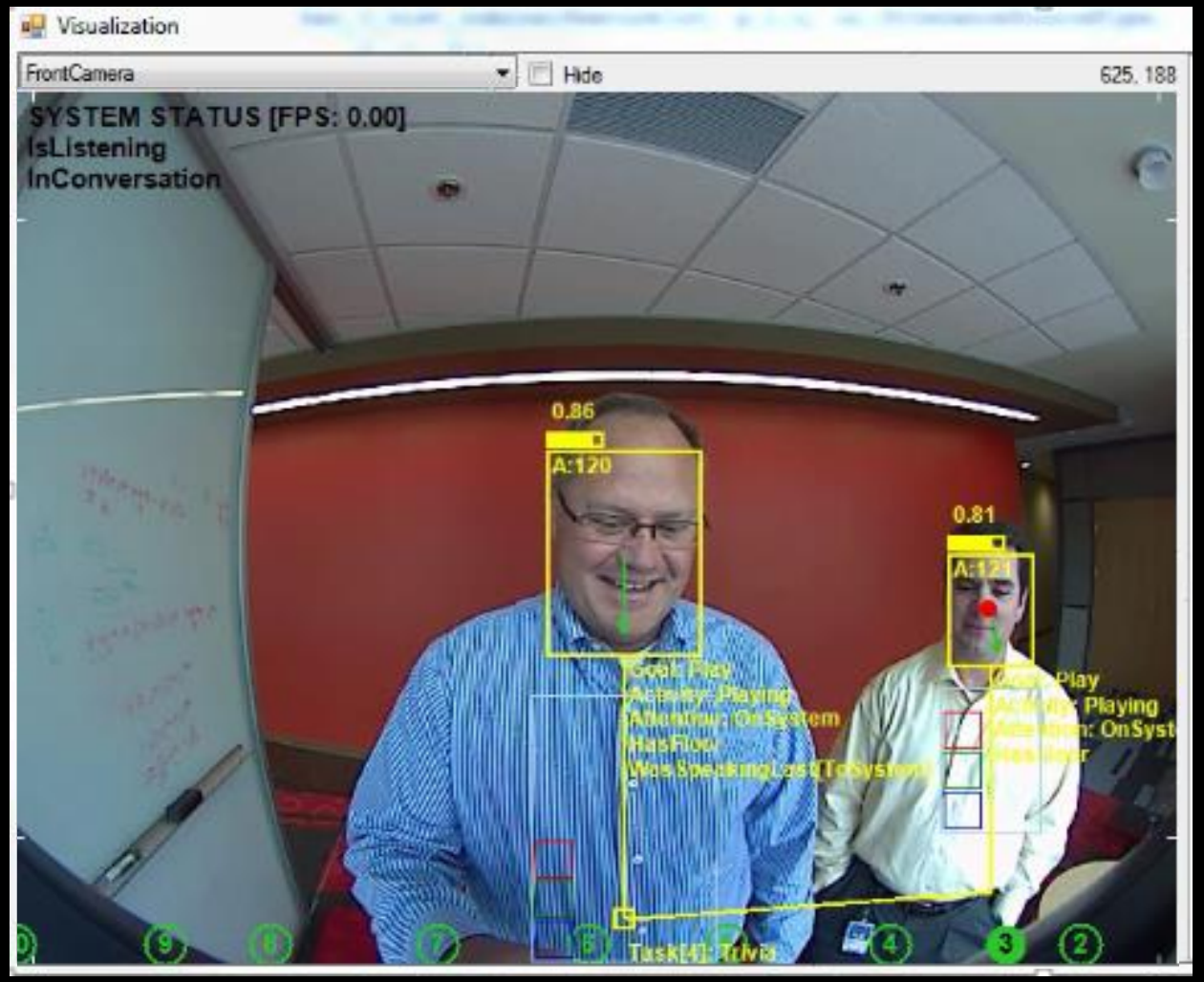
Bohus, H. Models for Multiparty Engagement in Open-World Dialog, SIGDIAL 2009.

Studies of Engagement …in the Open World



Bohus, H. Models for Multiparty Engagement in Open-World Dialog, SIGDIAL 2009.

Studies of Engagement …in the Open World

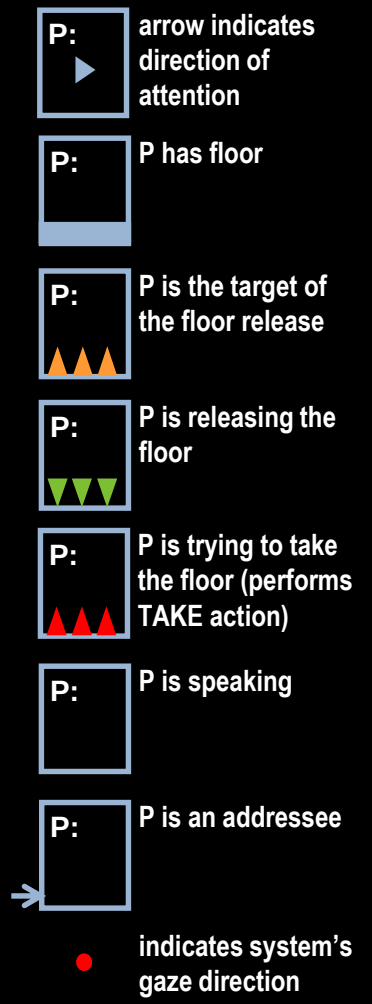


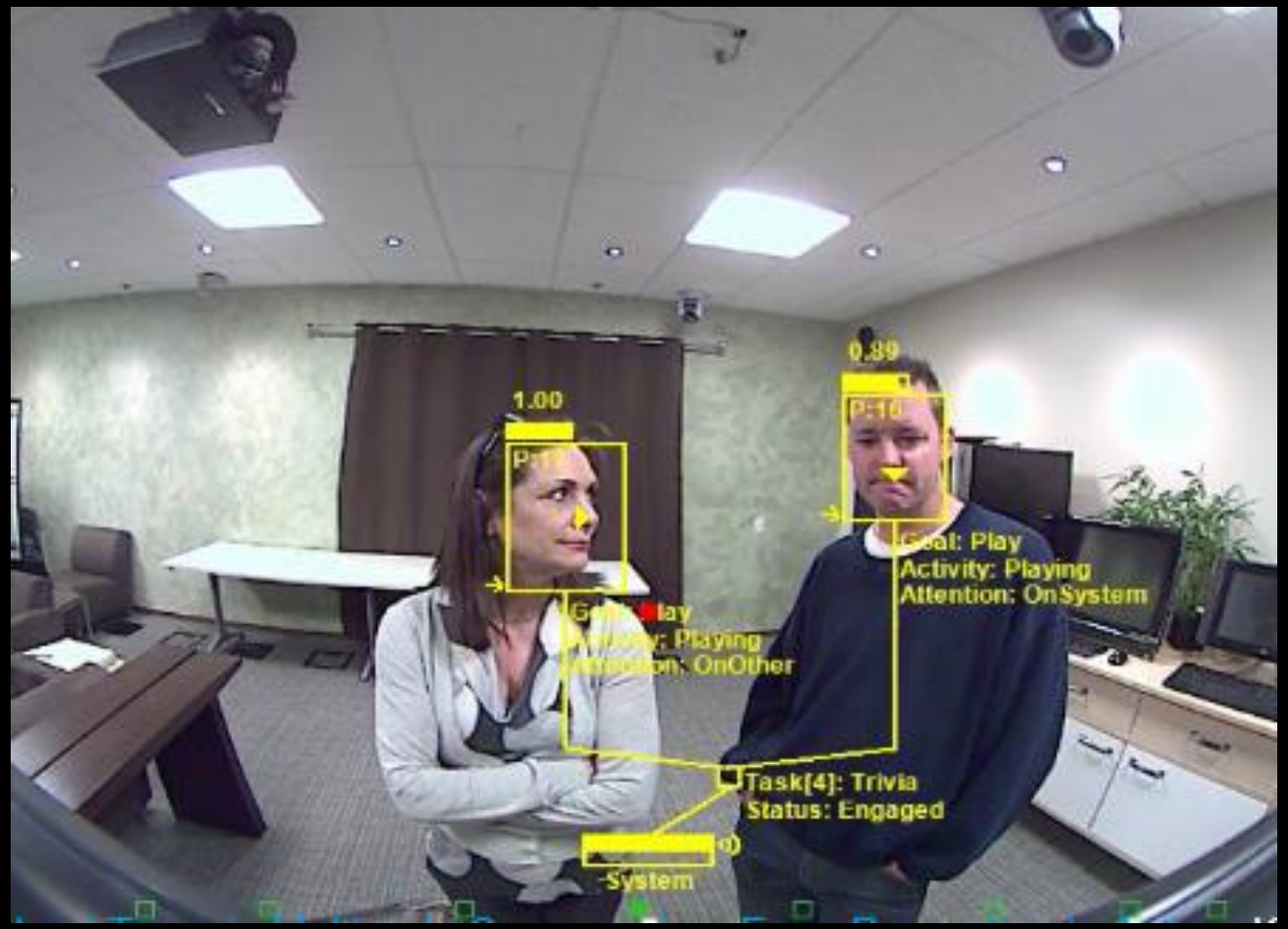
Bohus, H. Models for Multiparty Engagement in Open-World Dialog, SIGDIAL 2009.

Decisions about Turns in Multiparty Collaboration

Bohus, Horvitz. Decisions about Turns in Multiparty Conversation: From Perception to Action, ICMI 2011.

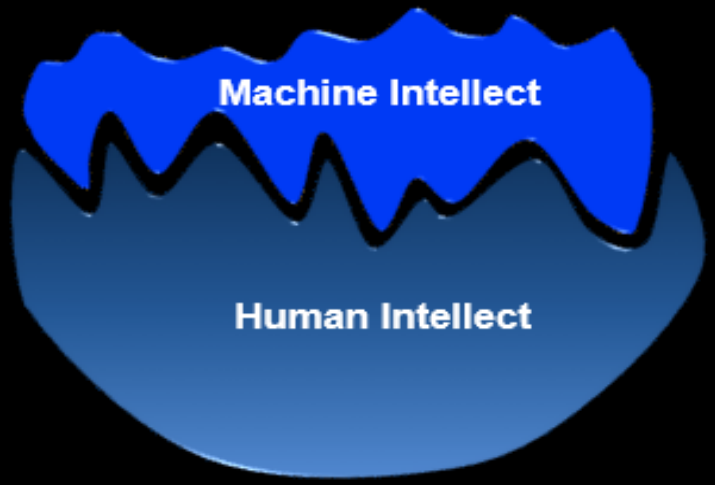
Decisions about Turns in Multiparty Collaboration

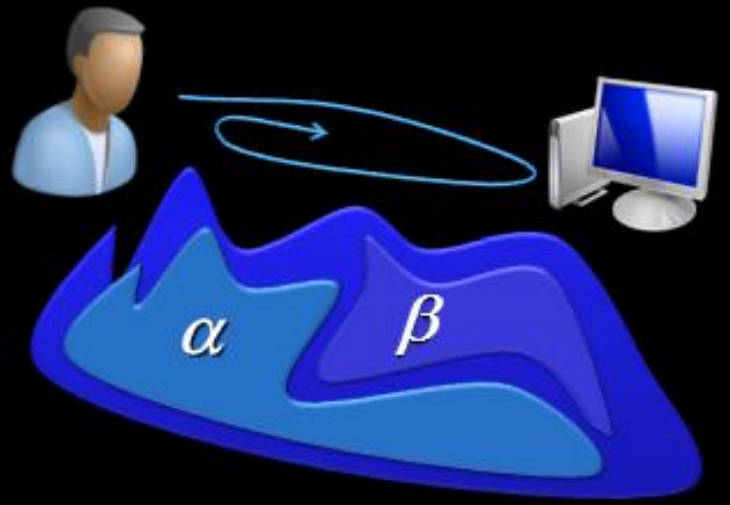


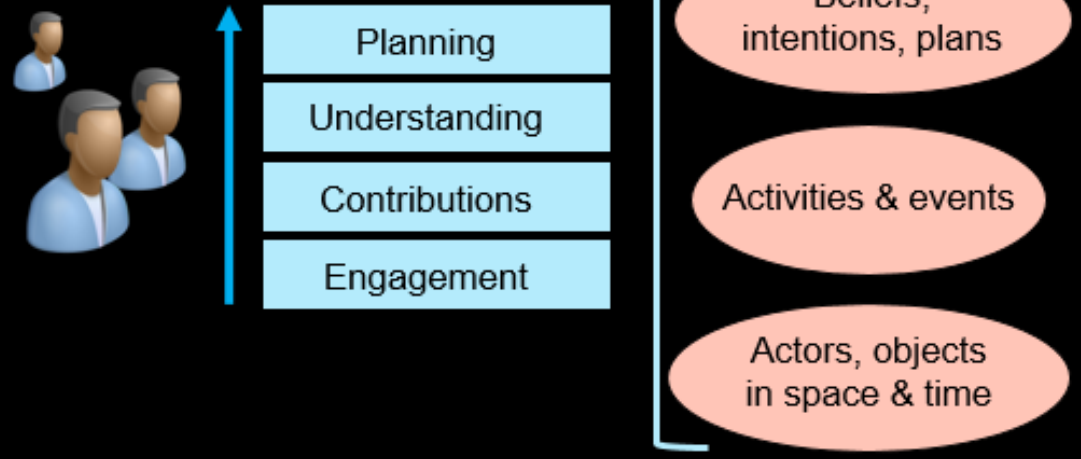


Bohus, Horvitz. Decisions about Turns in Multiparty Conversation: From Perception to Action, ICMI 2011.

Looking to the Future: Directions







New Applications & Services

The Assistant

Face ID | Vmail | Calendar

Room acoust. | Email | Location

Multiparty Engagement & Dialog

Prediction about *presence*

Prediction of *cost of interruption*

Prediction about *forgetting*

Prediction of *message urgency*

The Assistant

Video: Approaching the Assistant

The Assistant …in the Open World

Video

Ecosystem of Collaborating Intelligences

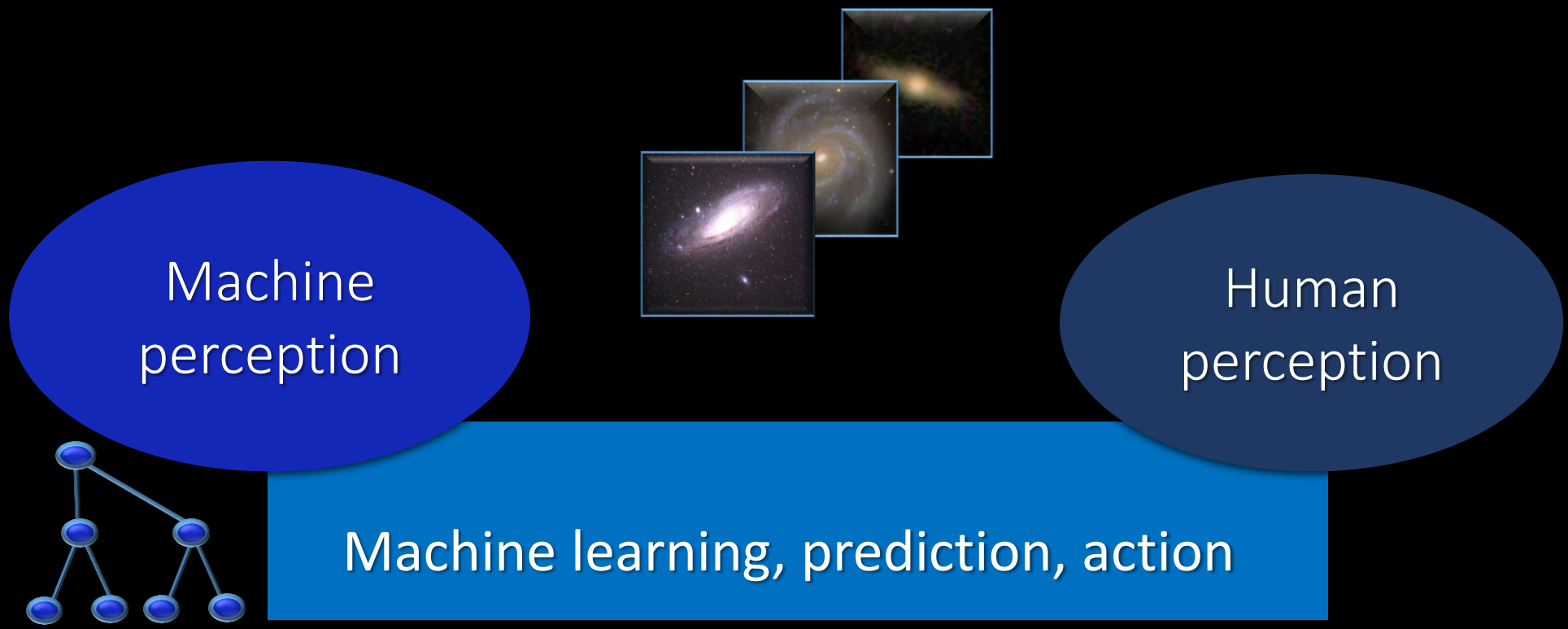
Video

Bohus, Saw, H. Directions Robot: In-the-Wild Experiences and Lessons Learned, AAMAS 2014.

New Types of Coordination

Ideal Fusion of Human & Machine Intellect

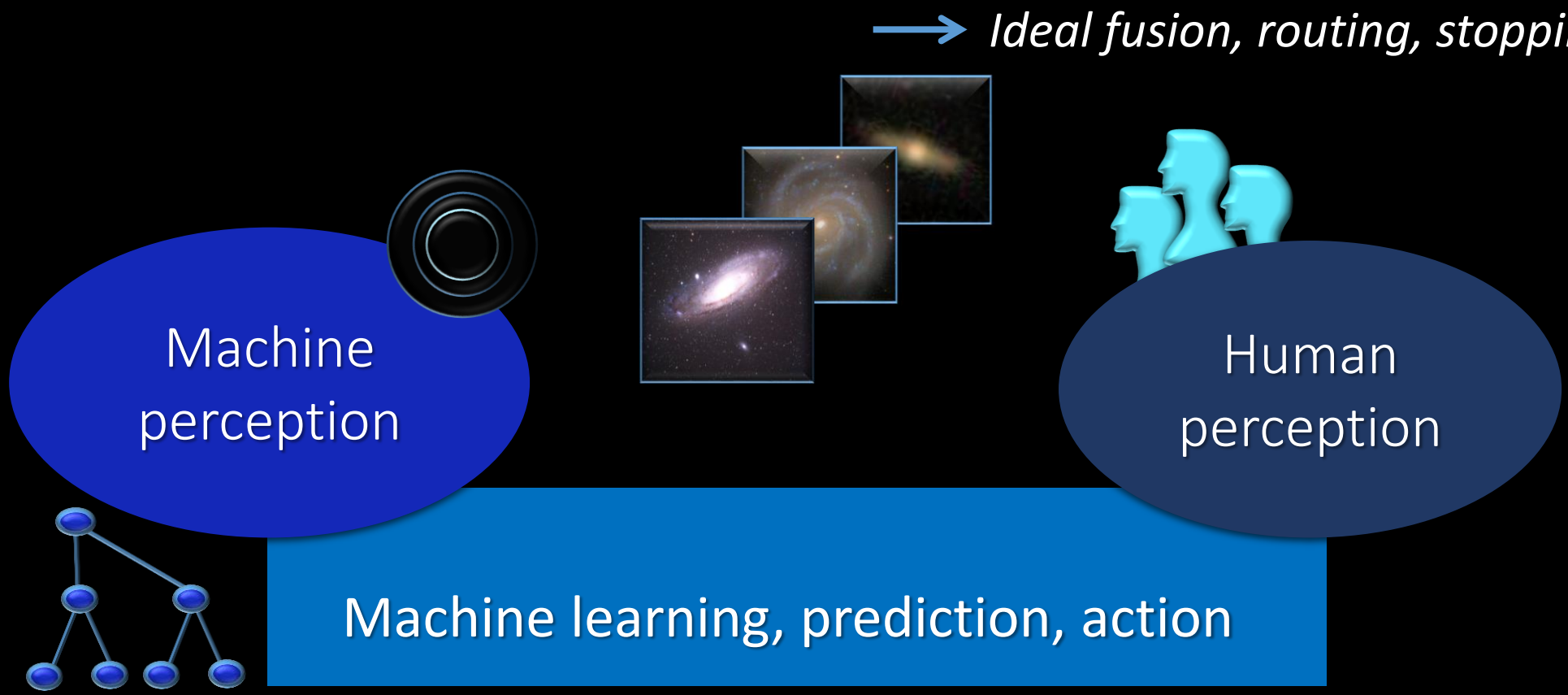
Example: Labeling Sloan Digital Sky Survey



Kamar, Hacker, H. Combining Human and Machine Intelligence in Large-scale Crowdsourcing, AAMAS 2012.

Ideal Fusion of Human & Machine Intellect

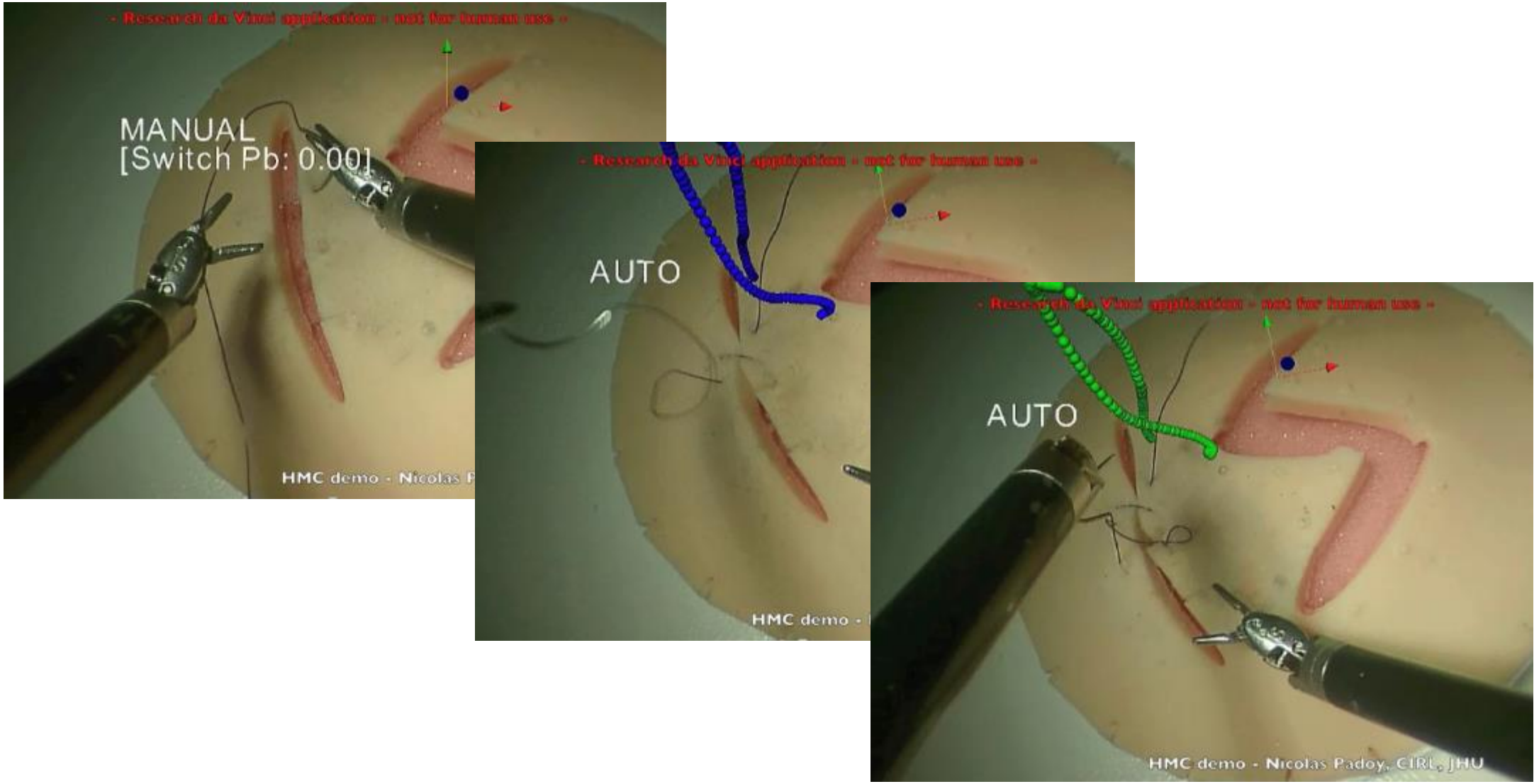
Example: Labeling Sloan Digital Sky Survey



Kamar, Hacker, H. Combining Human and Machine Intelligence in Large-scale Crowdsourcing, AAMAS 2012.

Mix of Initiatives on Physical Tasks

Mix of Initiatives in Surgery



Padoy and Hager. "Human-machine collaborative surgery using learned models." ICRA 2011

Mix of initiatives on road

Example: Tesla Autosteer

Mix of initiatives on road

Example: Tesla Autosteer

Autosteer is no longer steering Model S confidently.
Take over steering immediately.

Advances in Perceptual Capabilities, Competencies, and Pipelines

Advances in Perceptual Capabilities & Pipelines

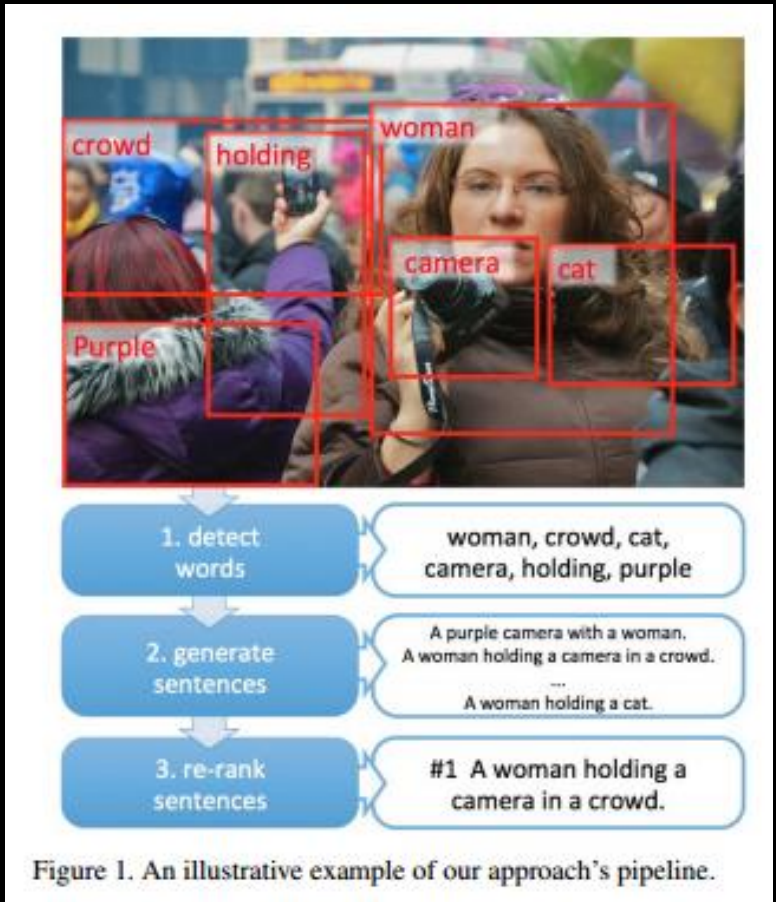
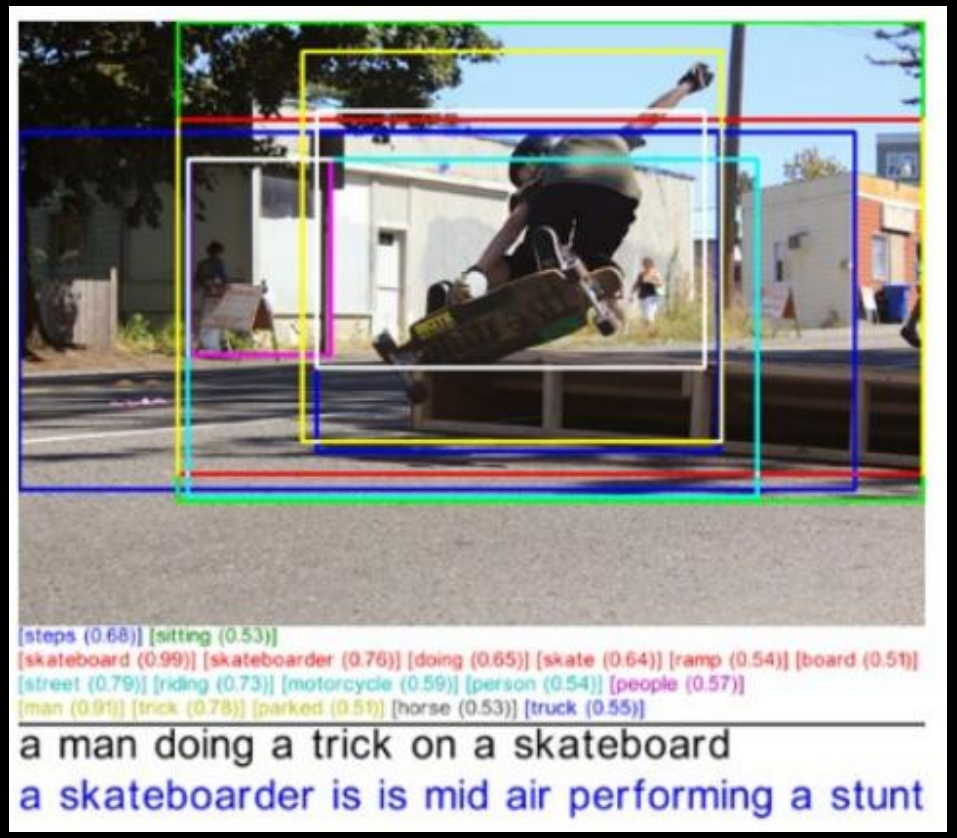


Figure 1. An illustrative example of our approach's pipeline.



Fang, Gupta, Iandola, et al., From Captions to Visual Concepts and Back, CVPR 2015.

Advances in Perceptual Capabilities & Pipelines

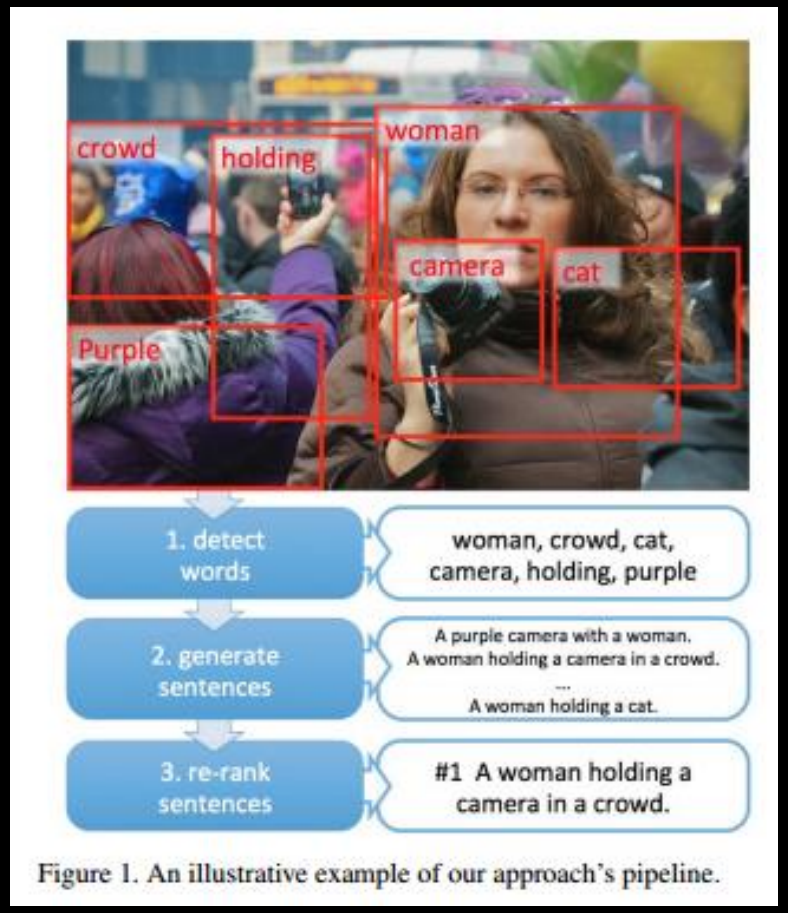
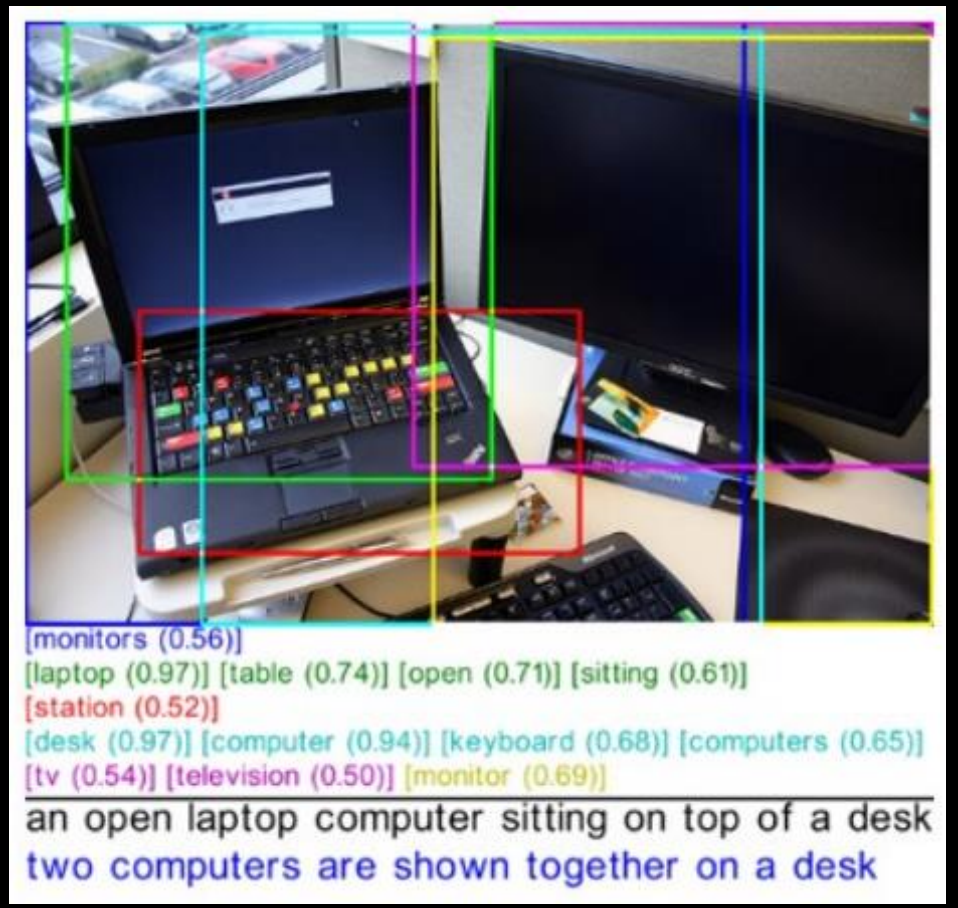


Figure 1. An illustrative example of our approach's pipeline.



Fang, Gupta, Iandola, et al., From Captions to Visual Concepts and Back, CVPR 2015.

Advances in Perceptual Capabilities & Pipelines

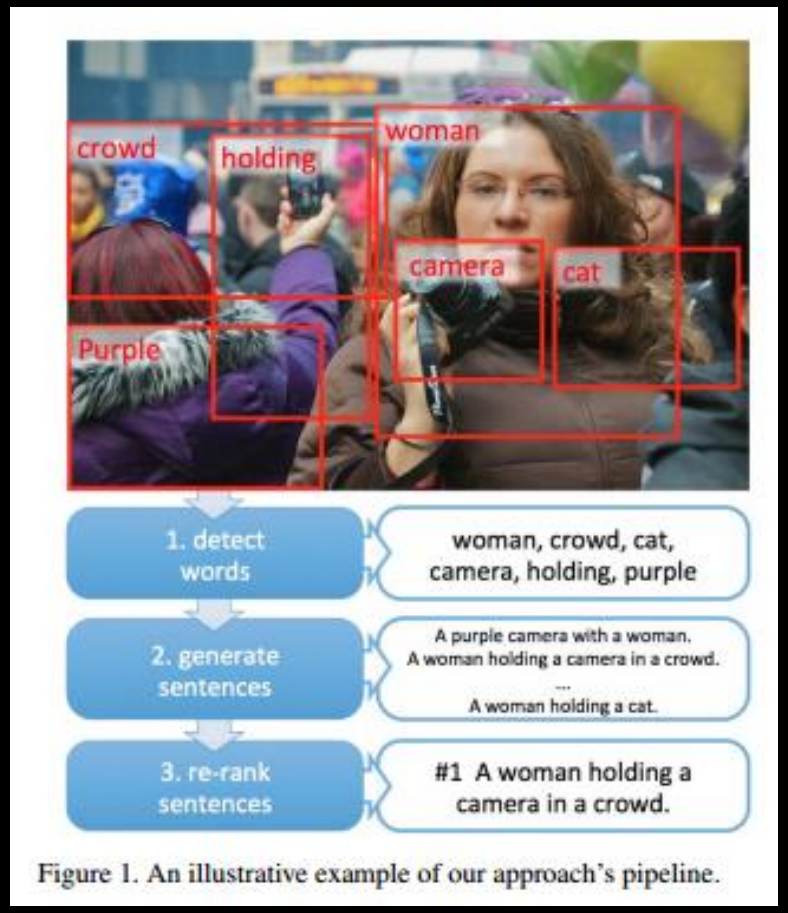
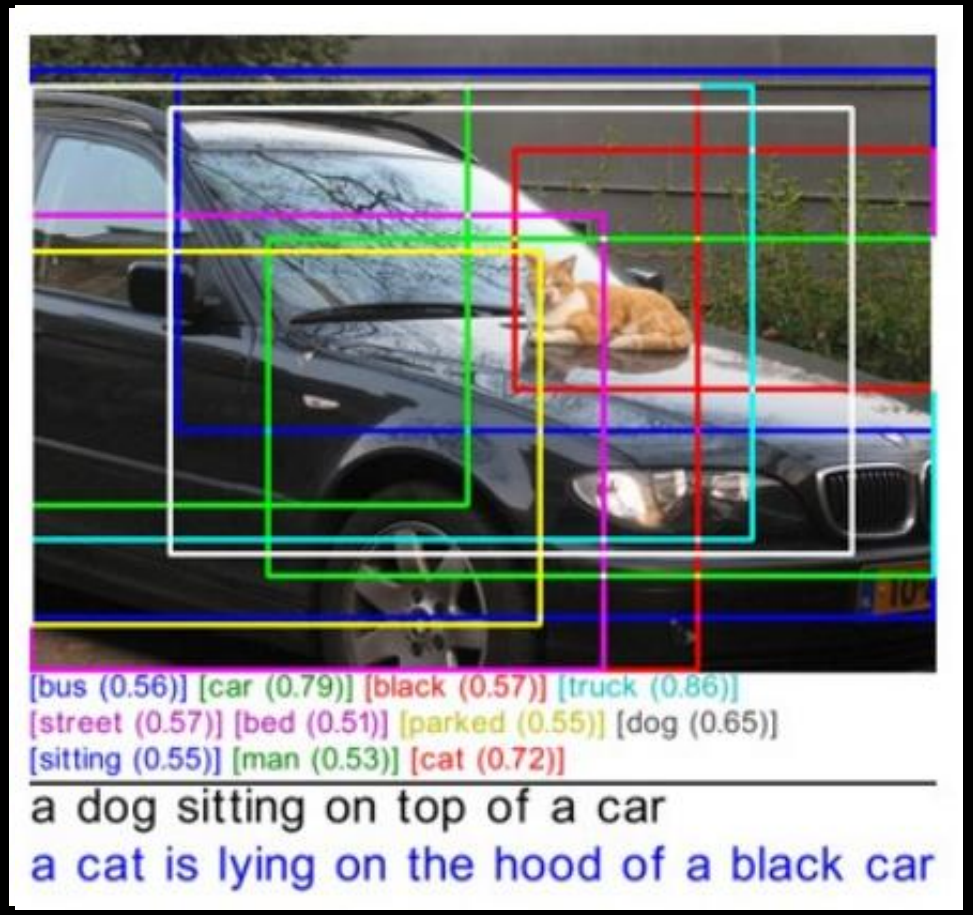


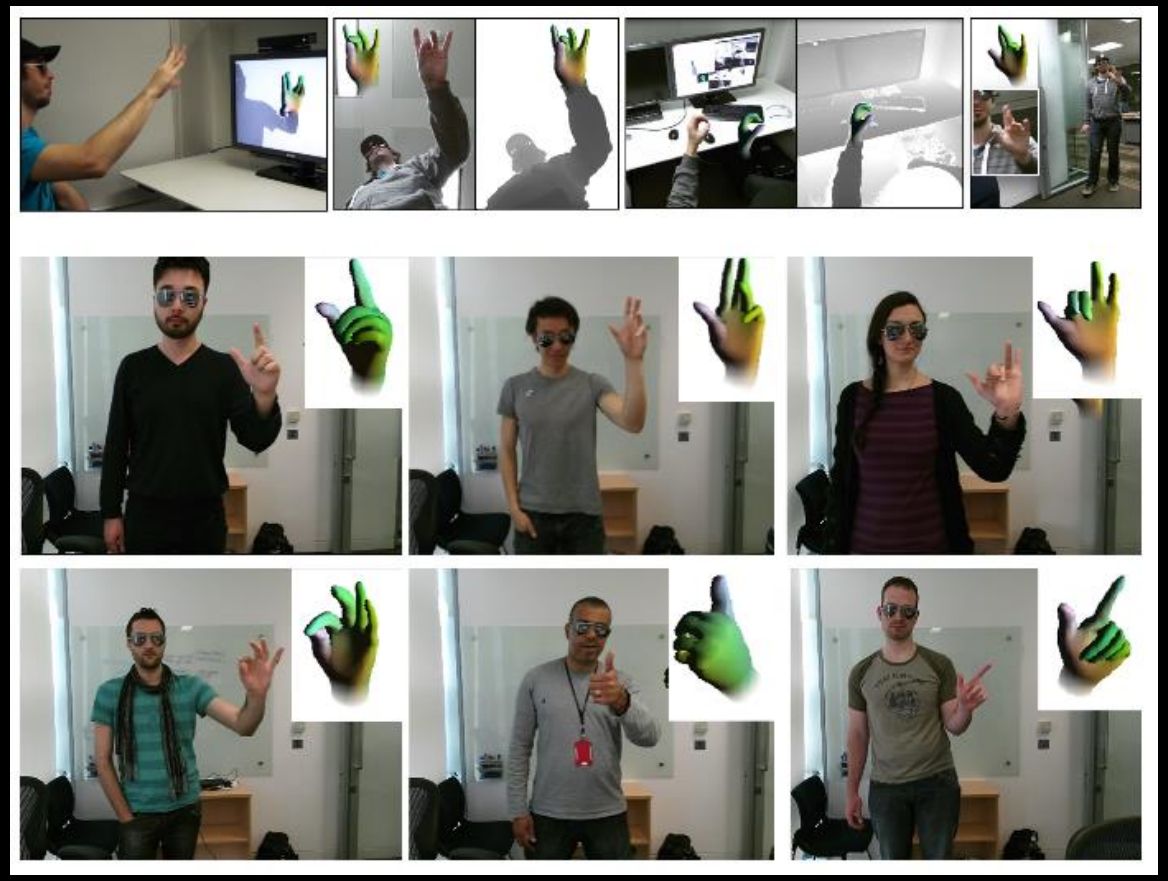
Figure 1. An illustrative example of our approach's pipeline.



Fang, Gupta, Iandola, et al., From Captions to Visual Concepts and Back, CVPR 2015.

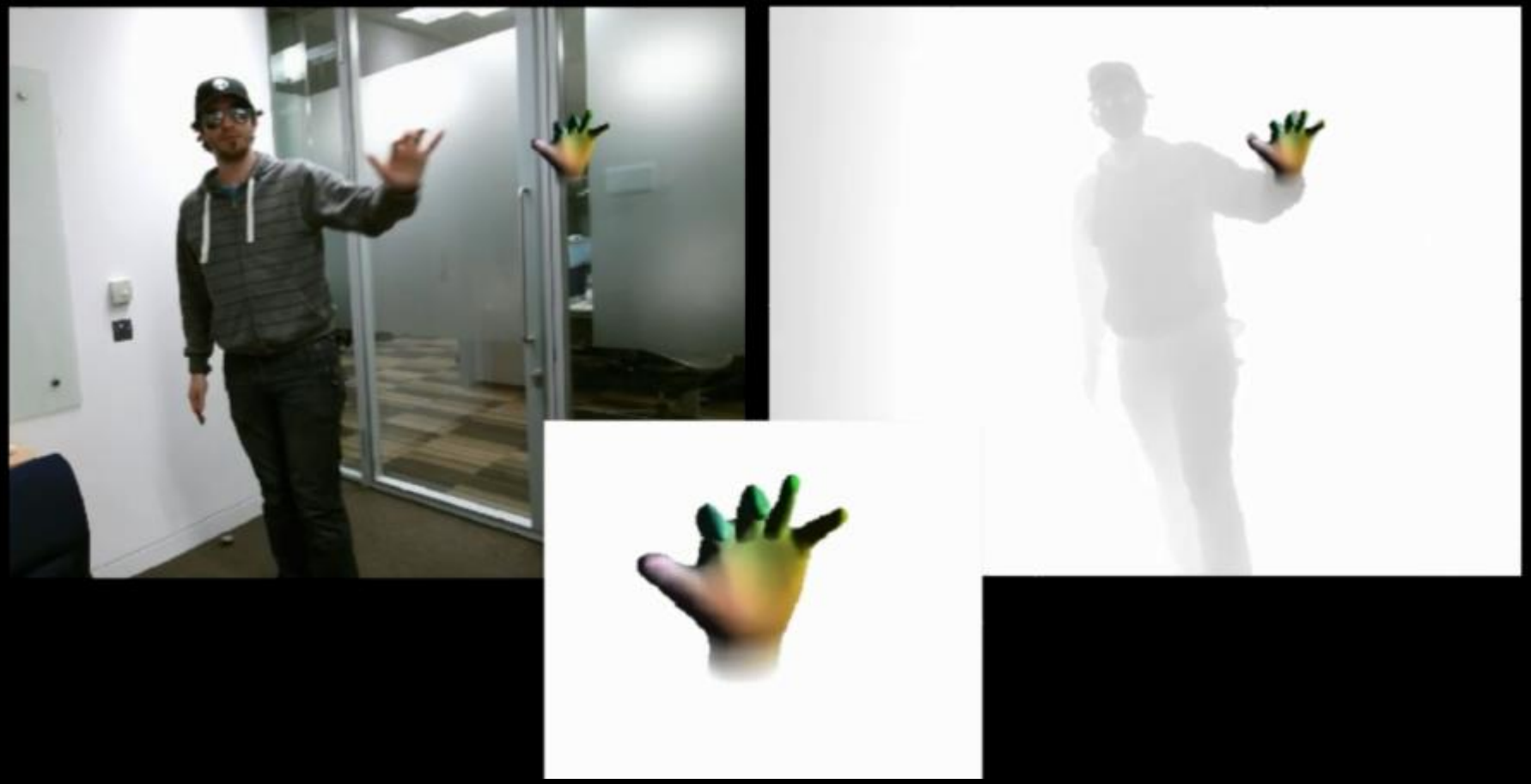
New Interactive Sensing & Capabilities

Example: Real-time hand tracking



T. Sharp, C. Keskin, D. Robertson, et al. Robust, and Flexible Real-time Hand Tracking, CHI 2015

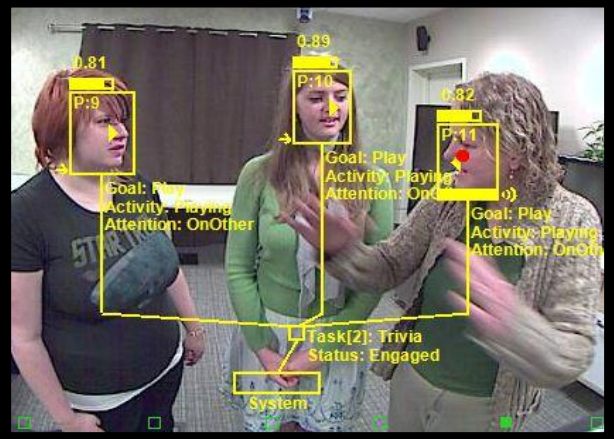
Video: Recognizing Subtleties of Hand Pose

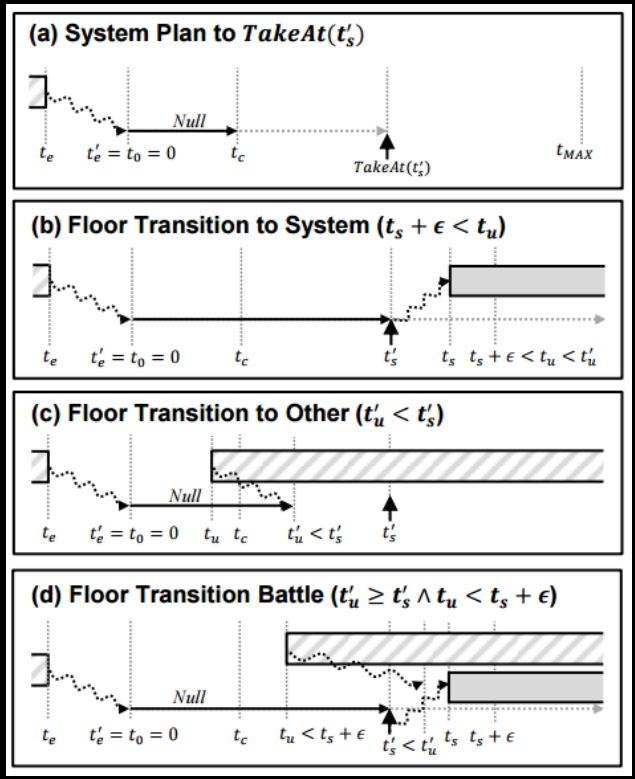


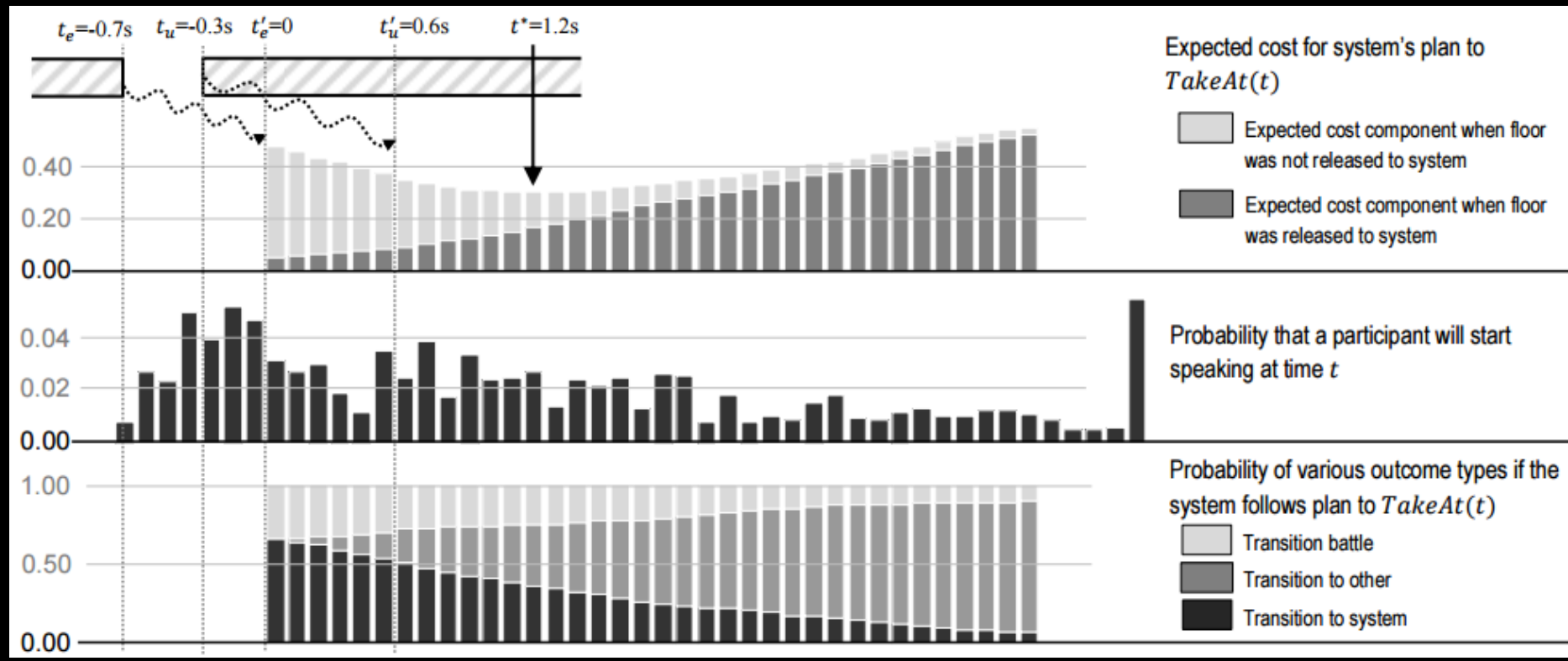
Toward Fluid Natural Dialog & Coordination

Challenge: Timing of Dialog Actions

Dialog decisions under uncertainty







Bohus, H. Decisions about Turns in Multiparty Conversation: From Perception to Action, ICMI 2011

Challenge: Natural Backchannel

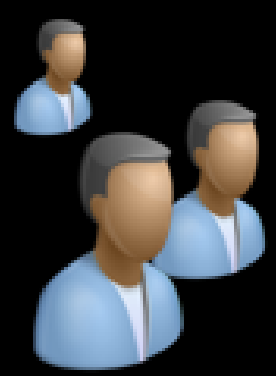
Video

ICMI 2014

Pejsa, Bohus, Cohen, Saw, Mahoney, H. Natural Communication about Uncertainties in Situated Interaction, ICMI 2014

A Grand AI Challenge: General Situated Collaboration

General Situated Collaboration



Planning

Understanding

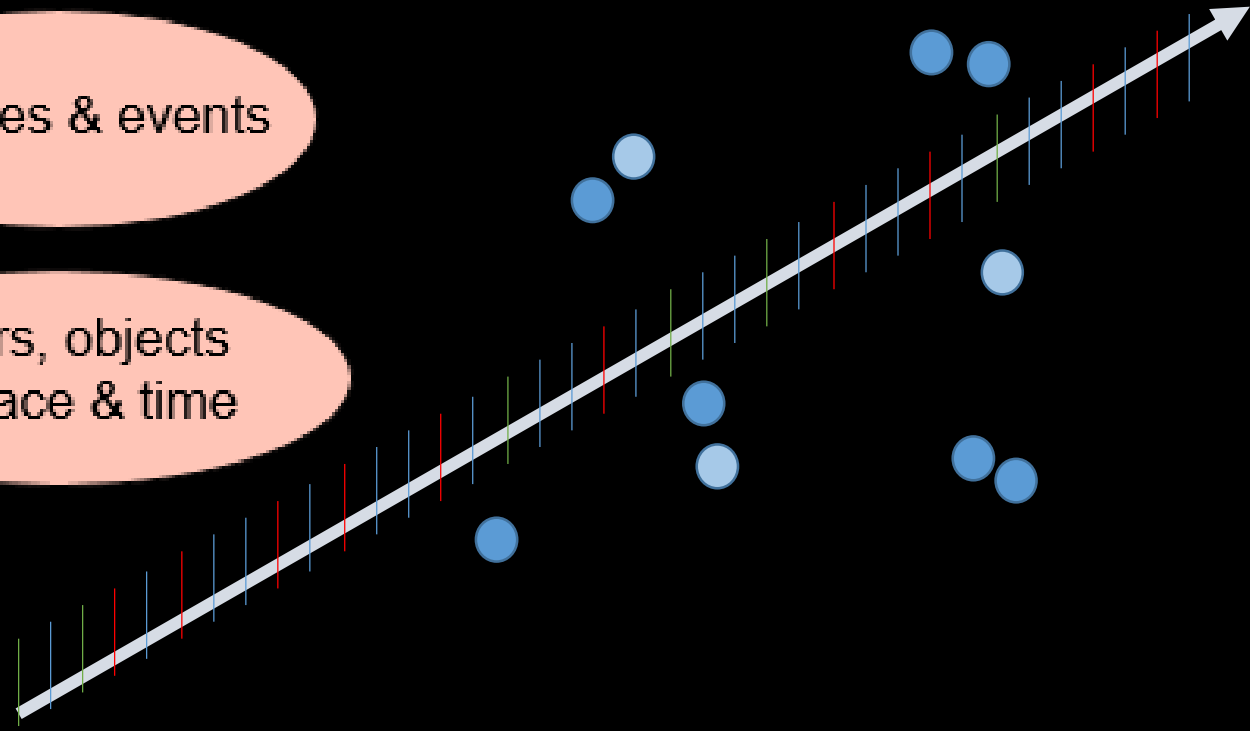
Contributions

Engagement

Beliefs, intentions, plans

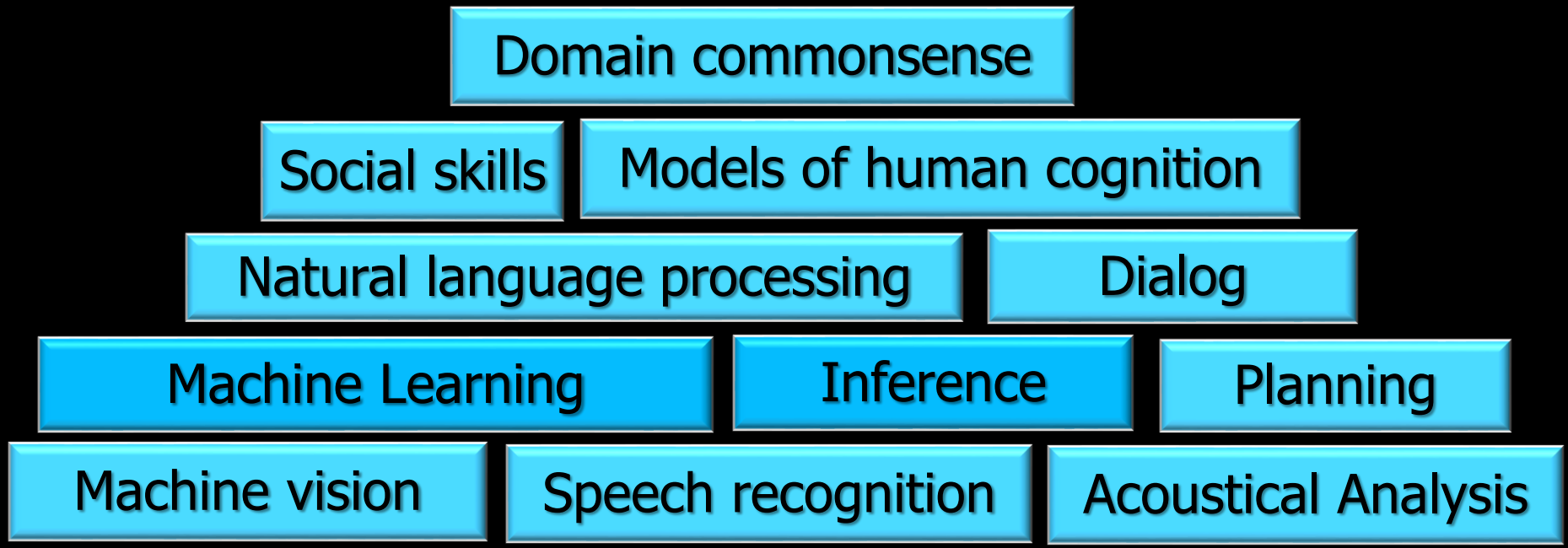
Activities & events

Actors, objects in space & time

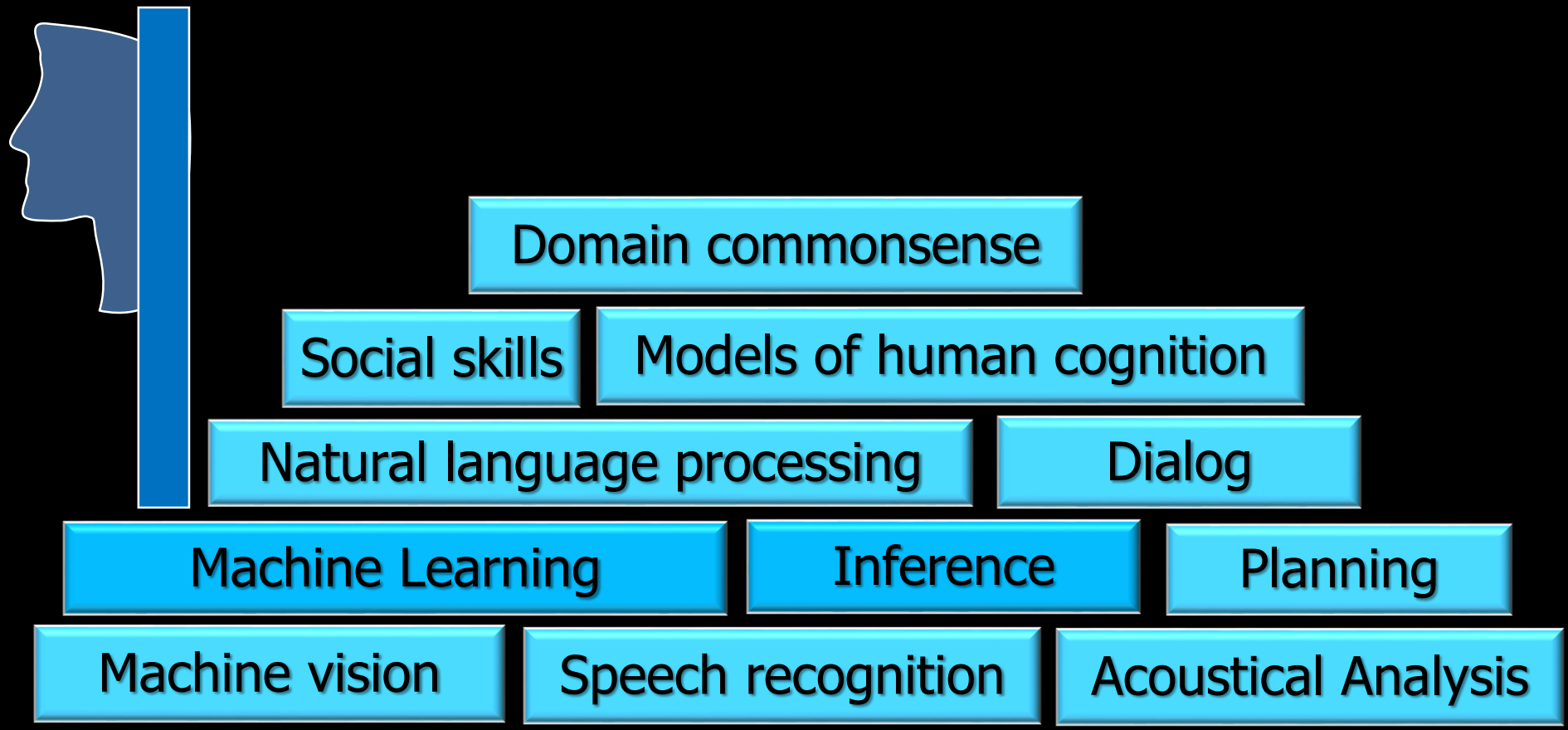


Bohus, Kamar, H. Towards Situated Collaboration, NAACL 2012,.

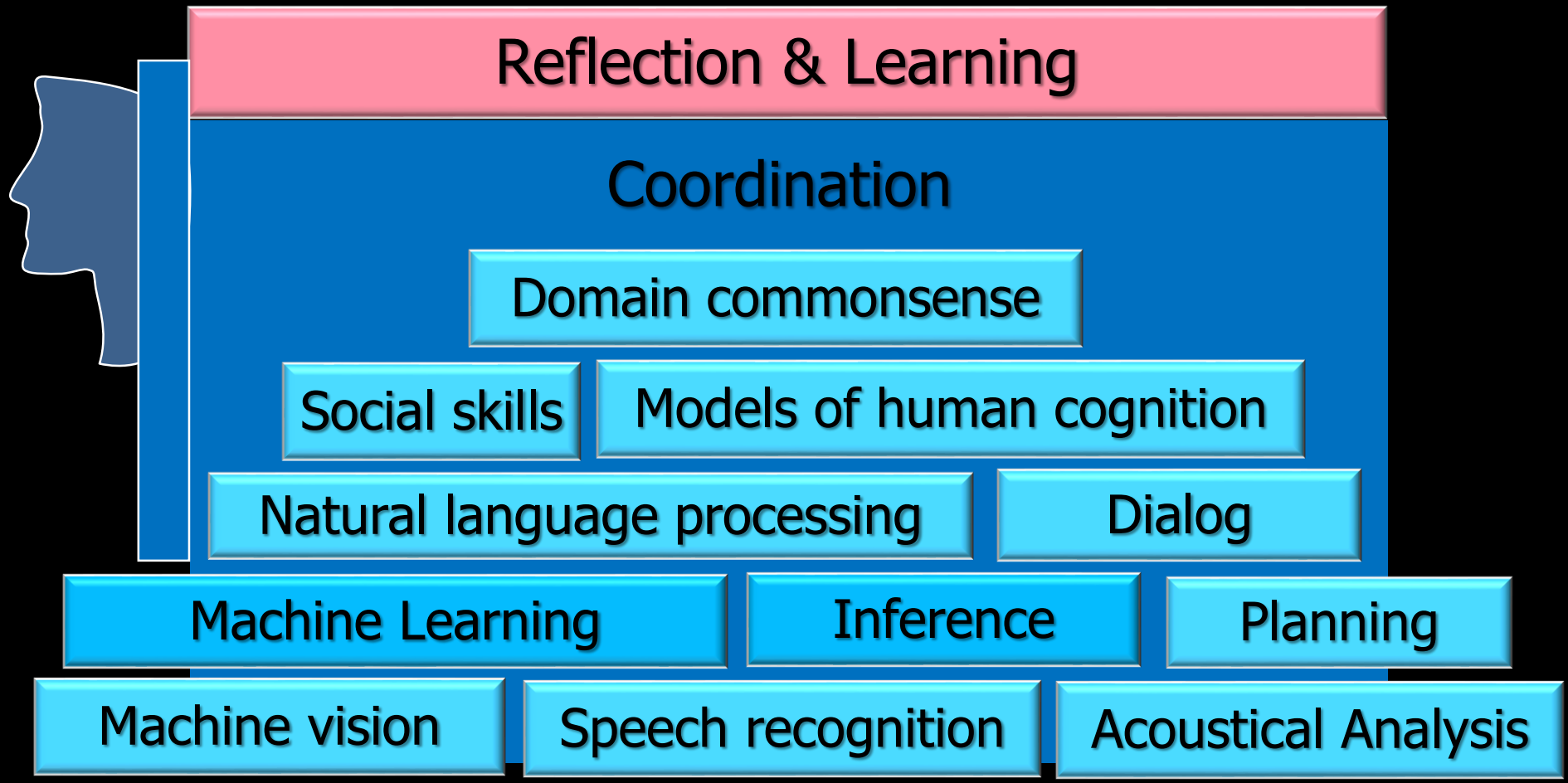
General Situated Collaboration



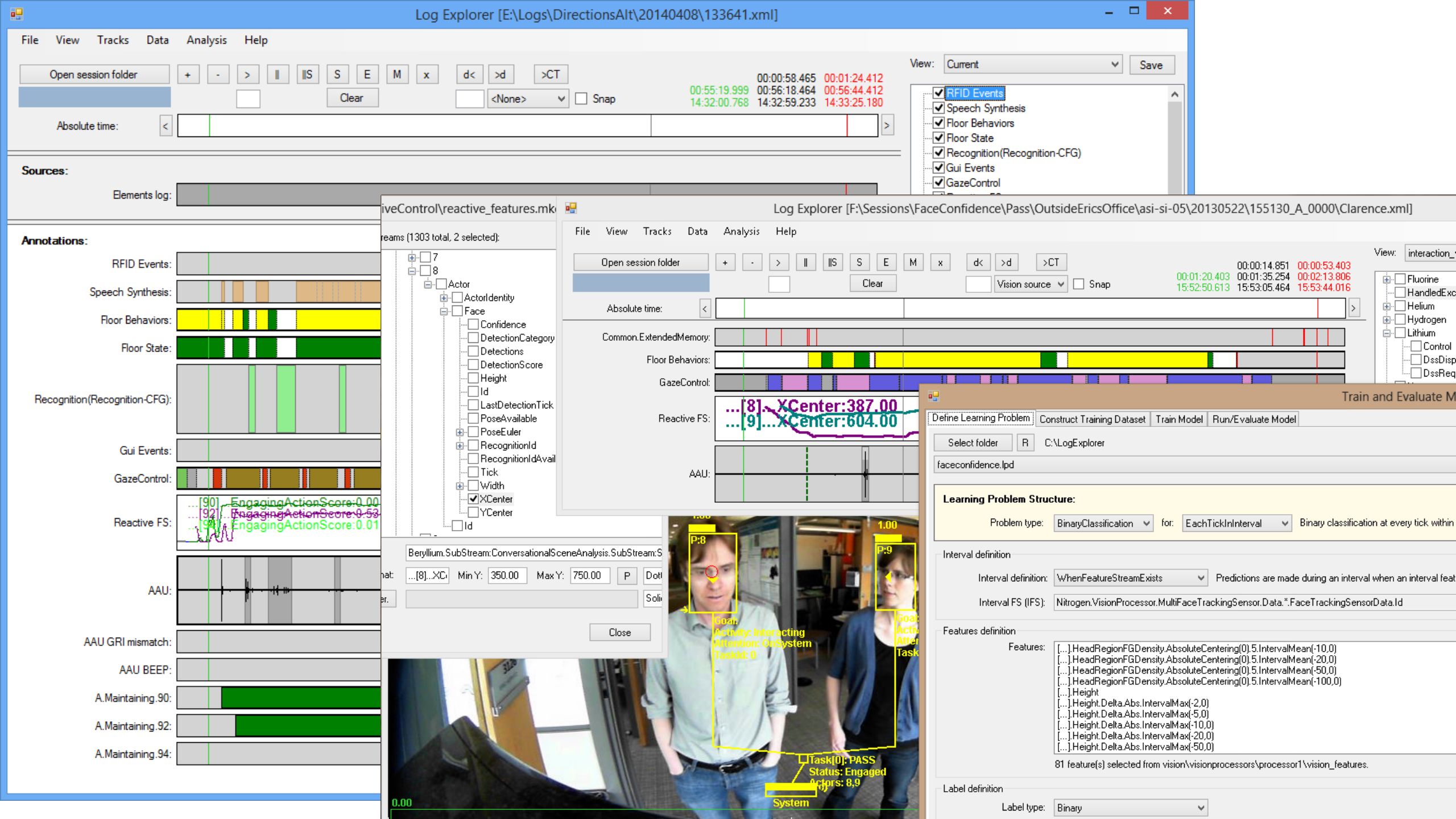
General Situated Collaboration



General Situated Collaboration



Critical Enablers:
Tools, Platforms, Infrastructure


Log Explorer [E:\Logs\DirectionsAlt\20140408\133641.xml]
File View Tracks Data Analysis Help
Open session folder
Clear
Snap
Absolute time:
View: Current
Save
RFID Events
Speech Synthesis
Floor Behaviors
Floor State
Recognition(Recognition-CFG)
Gui Events
GazeControl
Sources:
Elements log:
Annotations:
RFID Events:
Speech Synthesis:
Floor Behaviors:
Floor State:
Recognition(Recognition-CFG):
Gui Events:
GazeControl:
Reactive FS:
[90] EngagingActionScore:0.00
[92] EngagingActionScore:0.53
[94] EngagingActionScore:0.01
AAU:
AAU GRI mismatch:
AAU BEEP:
A.Maintaining.90:
A.Maintaining.92:
A.Maintaining.94:
iveControl\reactive_features.mk
reams (1303 total, 2 selected):
Actor
ActorIdentity
Face
Confidence
DetectionCategory
Detections
DetectionScore
Height
Id
LastDetectionTick
PoseAvailable
PoseEuler
RecognitionId
Tick
Width
XCenter
YCenter
Min Y: 350.00
Max Y: 750.00
Close
Log Explorer [F:\Sessions\FaceConfidence\Pass\OutsideEricsOffice\asi-si-05\20130522\155130_A_0000\Clarence.xml]
Vision source
Common.ExtendedMemory:
Floor Behaviors:
GazeControl:
Reactive FS:
...[8]...XCenter:387.00
...[9]...XCenter:604.00
AAU:
Train and Evaluate M
Define Learning Problem
Construct Training Dataset
Train Model
Run/Evaluate Model
Select folder
C:\LogExplorer
faceconfidence.lpd
Learning Problem Structure:
Problem type: BinaryClassification
for: EachTickInInterval
Binary classification at every tick within
Interval definition
Interval definition: WhenFeatureStreamExists
Predictions are made during an interval when an interval feat
Interval FS (IFS): Nitrogen.VisionProcessor.MultiFaceTrackingSensor.Data.*.FaceTrackingSensorData.Id
Features definition
Features:
[...].HeadRegionFGDensity.AbsoluteCentering(0).5.IntervalMean(-10,0)
[...].HeadRegionFGDensity.AbsoluteCentering(0).5.IntervalMean(-20,0)
[...].HeadRegionFGDensity.AbsoluteCentering(0).5.IntervalMean(-50,0)
[...].HeadRegionFGDensity.AbsoluteCentering(0).5.IntervalMean(-100,0)
[...].Height
[...].Height.Delta.Abs.IntervalMax(-2,0)
[...].Height.Delta.Abs.IntervalMax(-5,0)
[...].Height.Delta.Abs.IntervalMax(-10,0)
[...].Height.Delta.Abs.IntervalMax(-20,0)
[...].Height.Delta.Abs.IntervalMax(-50,0)
81 feature(s) selected from vision\visionprocessors\processor1\vision_features.
Label definition
Label type: Binary
P:8
P:9
Task[0]: PASS
Status: Engaged
System

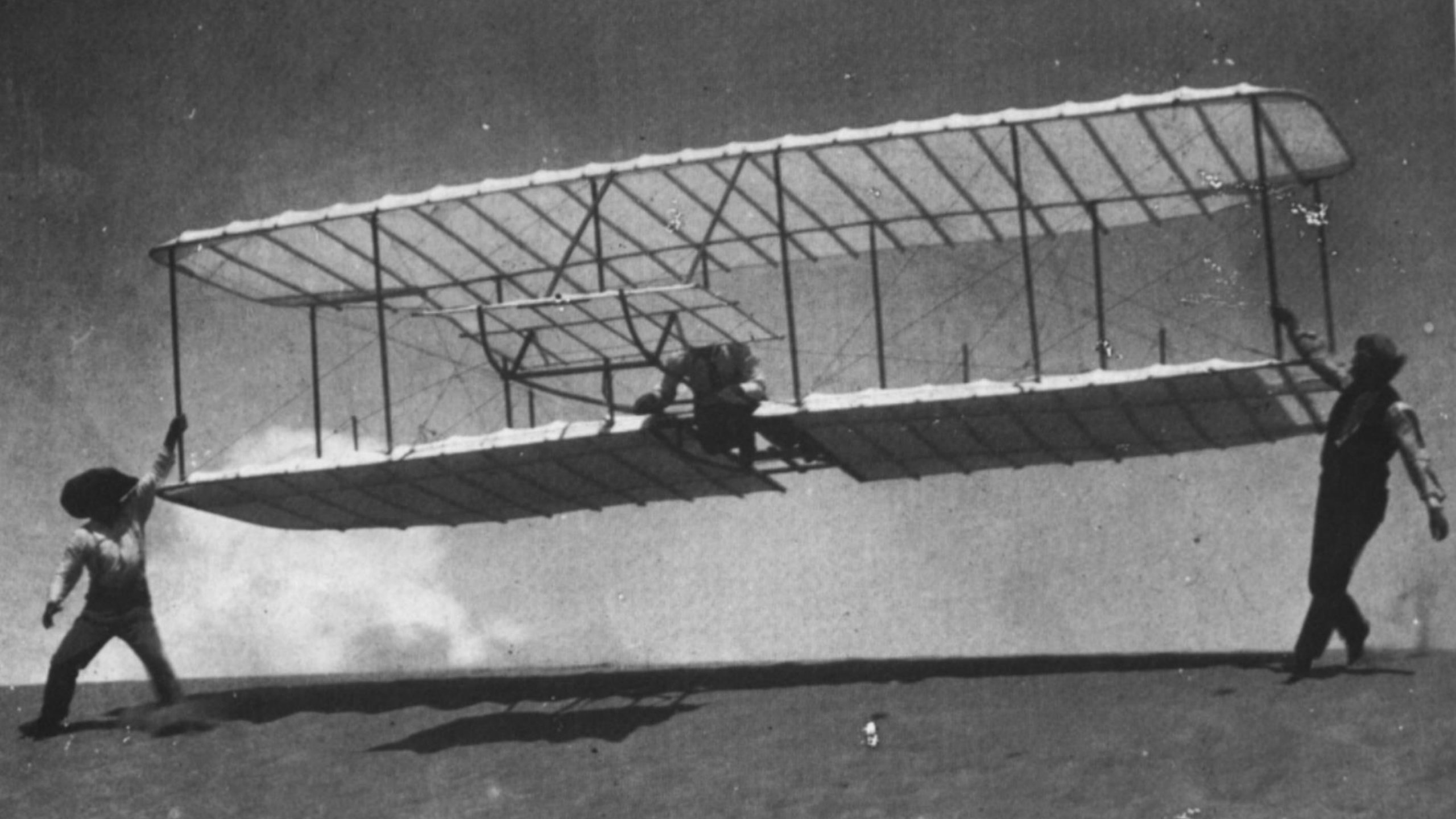
Enabling Fast-Paced Prototyping

Video: Hackathon project on sight for the blind

Tools enable fast-paced exploration and prototyping

Getting off the ground

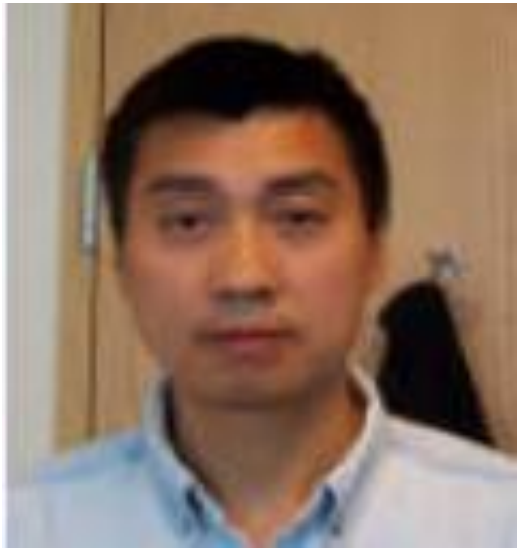
Critical Connections & Collaborations



Dan Bohus

Tim Paek

Ece Kamar

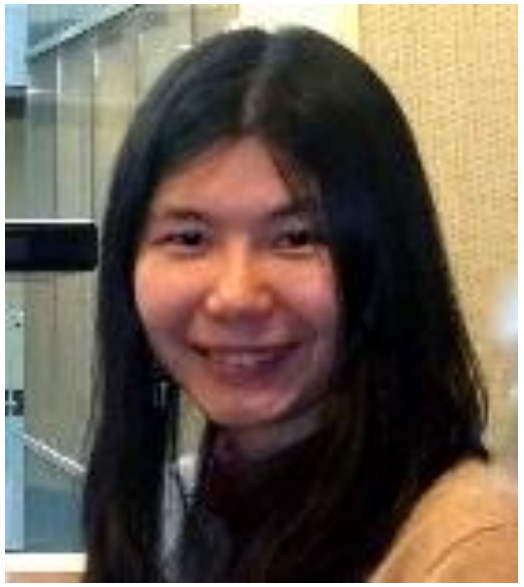


Zicheng Liu

Stephanie Rosenthal

Tomislav Pejsa

Sean Andrist



Zhou Yu

Nuria Oliver

Ashish Kapoor

Kentaro Toyama

John Krumm

Meg Mitchell

Jamie Shotton

Jack Breese

David Heckerman

Susan Dumais

Merrie Morris

Ed Cutrell

Tessa Lau

Ken Hinckley

Andy Wilson

Hrvoje Benko

Jeff Peirce

Anne Loomis Thompson

Paul Koch

Raman Sarin

Mihai Jalobeanu

Nick Saw

Richard Hughes

Carl Kadie

David Hovel

Andy Jacobs

Johnson Apacible

Michael Shwe

Matthew Barry

George Robertson

Shamsi Iqbal

Mary Czerwinski

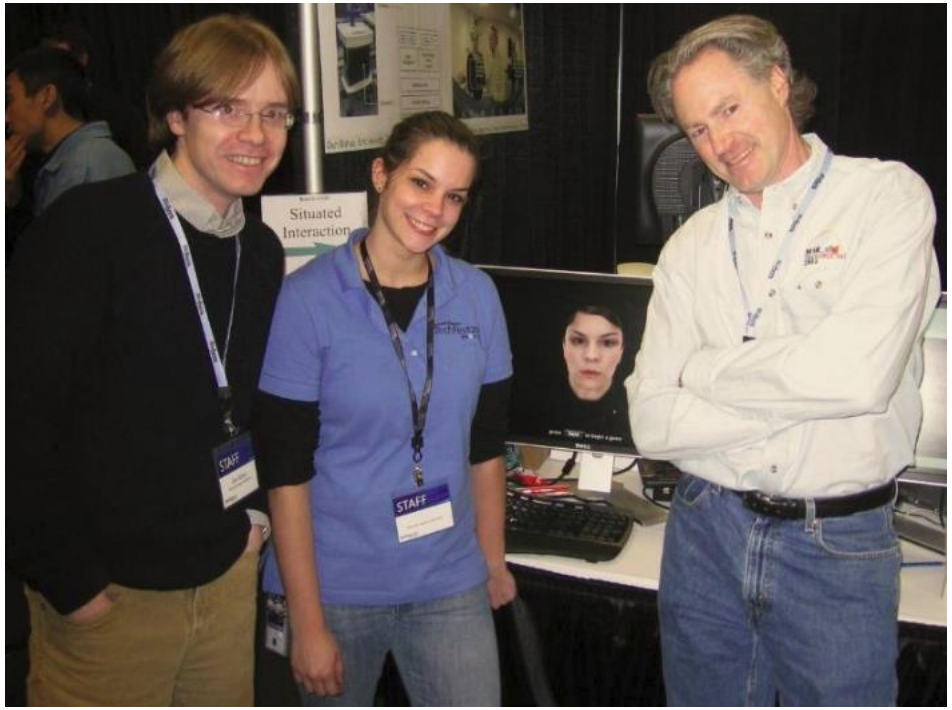
Dan Robbins

Joe Tullio

Andrea (and Monica & Chad)

Michael Cohen

James Mahoney




QANTAS