Intelligent User Interfaces

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CS 376

If you wanted a smart doorbell...

- To automatically control entrance to your room
- To let in possible donors for your Stanford education
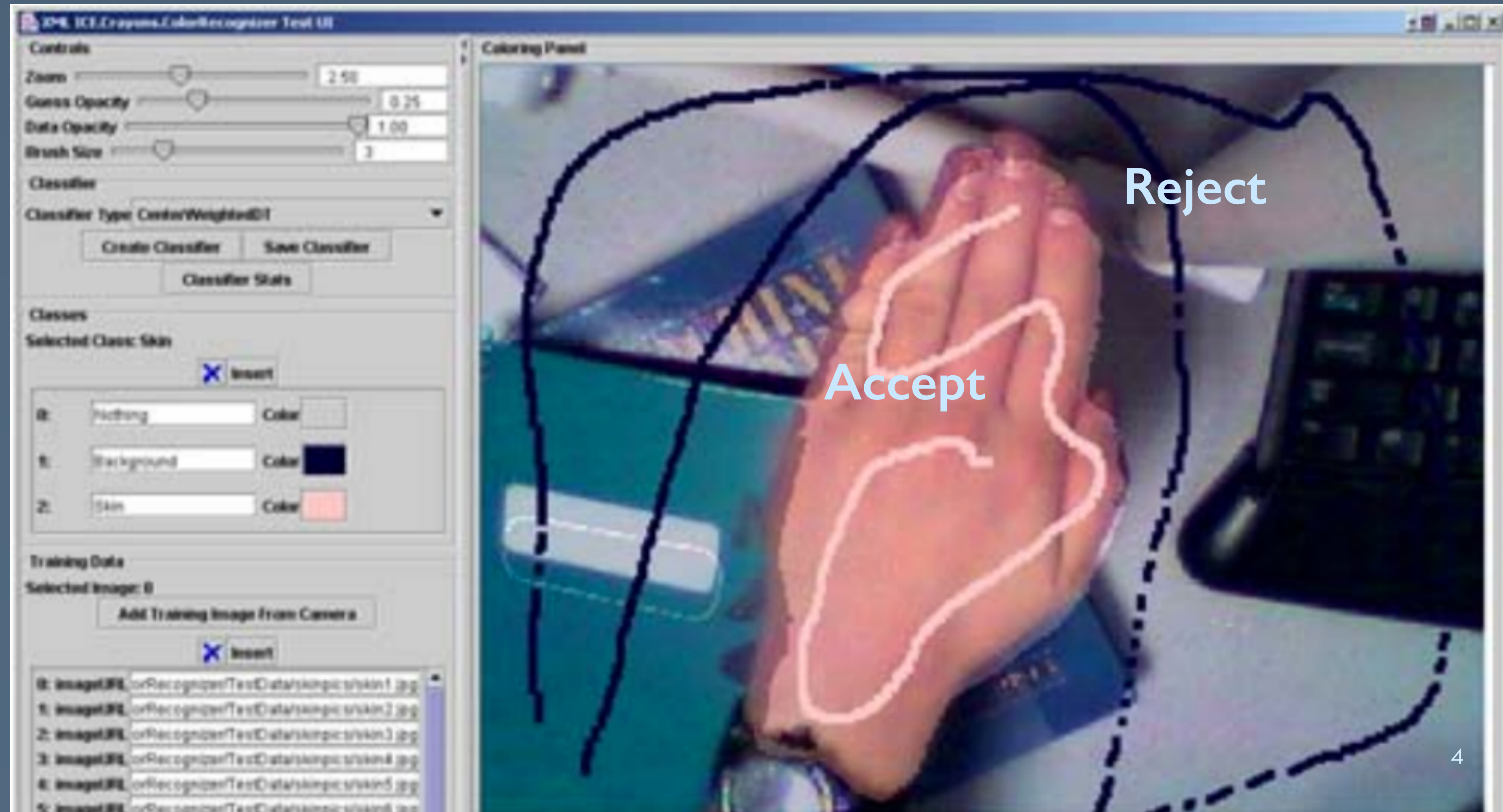

No way

Let him in

Paint the areas of interest

Crayons: camera-based interaction
[Fails and Olsen, CHI '03]

Direct-manipulation training

Intelligent user interfaces

- Goal: fashion powerful, easy-to-use interactive systems that draw on artificial intelligence and machine learning
- Challenges
  - Training
  - Development
  - Applications
  - User control

IUI applications

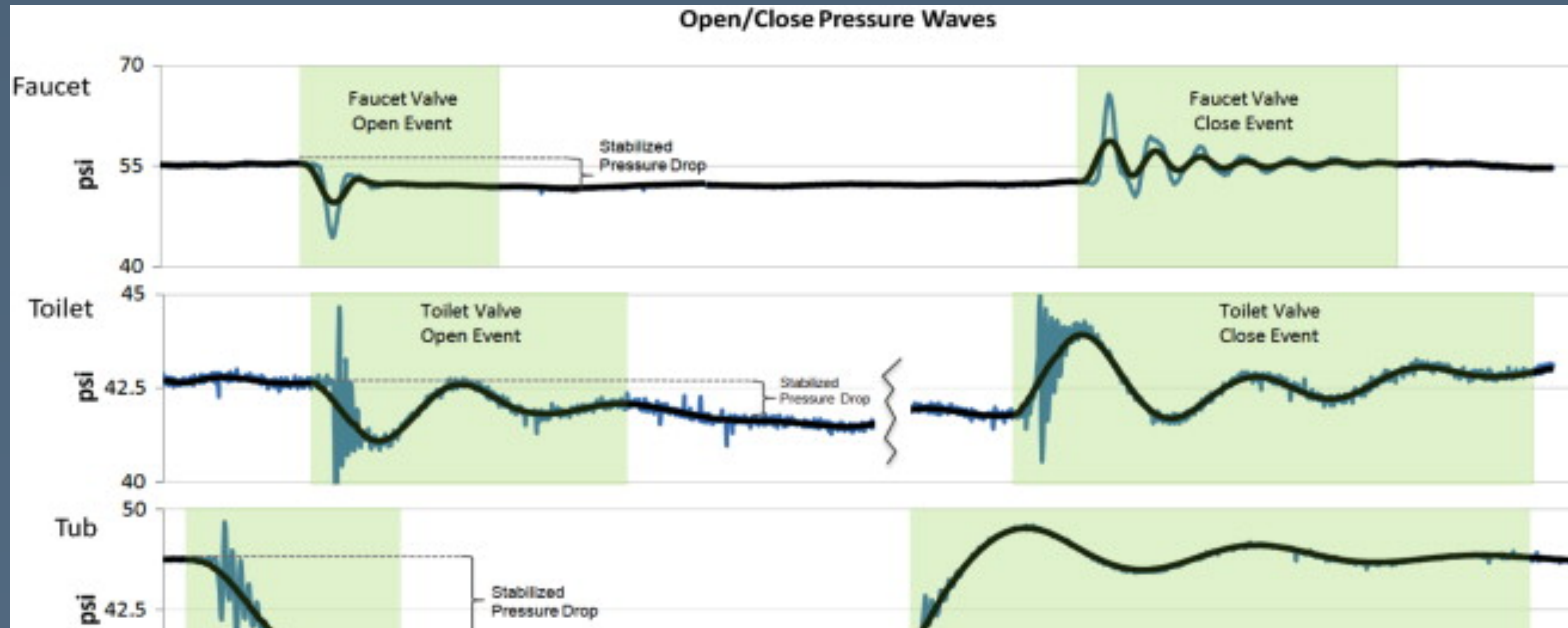# Recall: programming with screenshots

[Yeh, Chang, and Miller, UIST '09]

- Template search in desktop scripting

Recall: infrastructure-mediated sensing

- Learning to classify in-home events

Open/Close Pressure Waves

Faucet
70 psi — 55 — 40

Faucet Valve Open Event
Stabilized Pressure Drop
Faucet Valve Close Event

Toilet
45 psi — 42.5 — 40

Toilet Valve Open Event
Stabilized Pressure Drop
Toilet Valve Close Event

Tub
50 psi — 42.5

Stabilized Pressure Drop

Automatically generating interfaces

[Gajos and Weld, IUI '04]

- Reactive design: remaps to output affordances
- Minimize a cost function derived from navigating between widgets in user traces
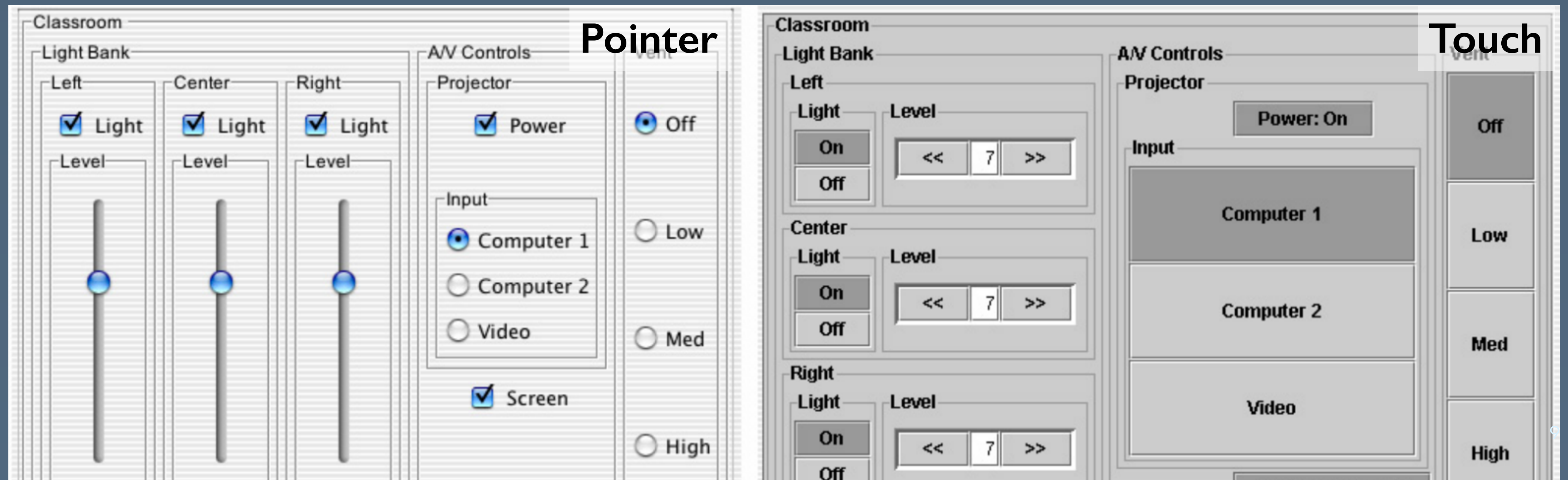
Ability-based interfaces

[Gajos et al., CHI '08]

- Rather than adjust to the device, adjust to the person

- Motor tests measure abilities of disabled individuals

- 25% faster, 73% fewer errors with automatic SUPPLE adjustment

Default (a)

Limited motor dexterity
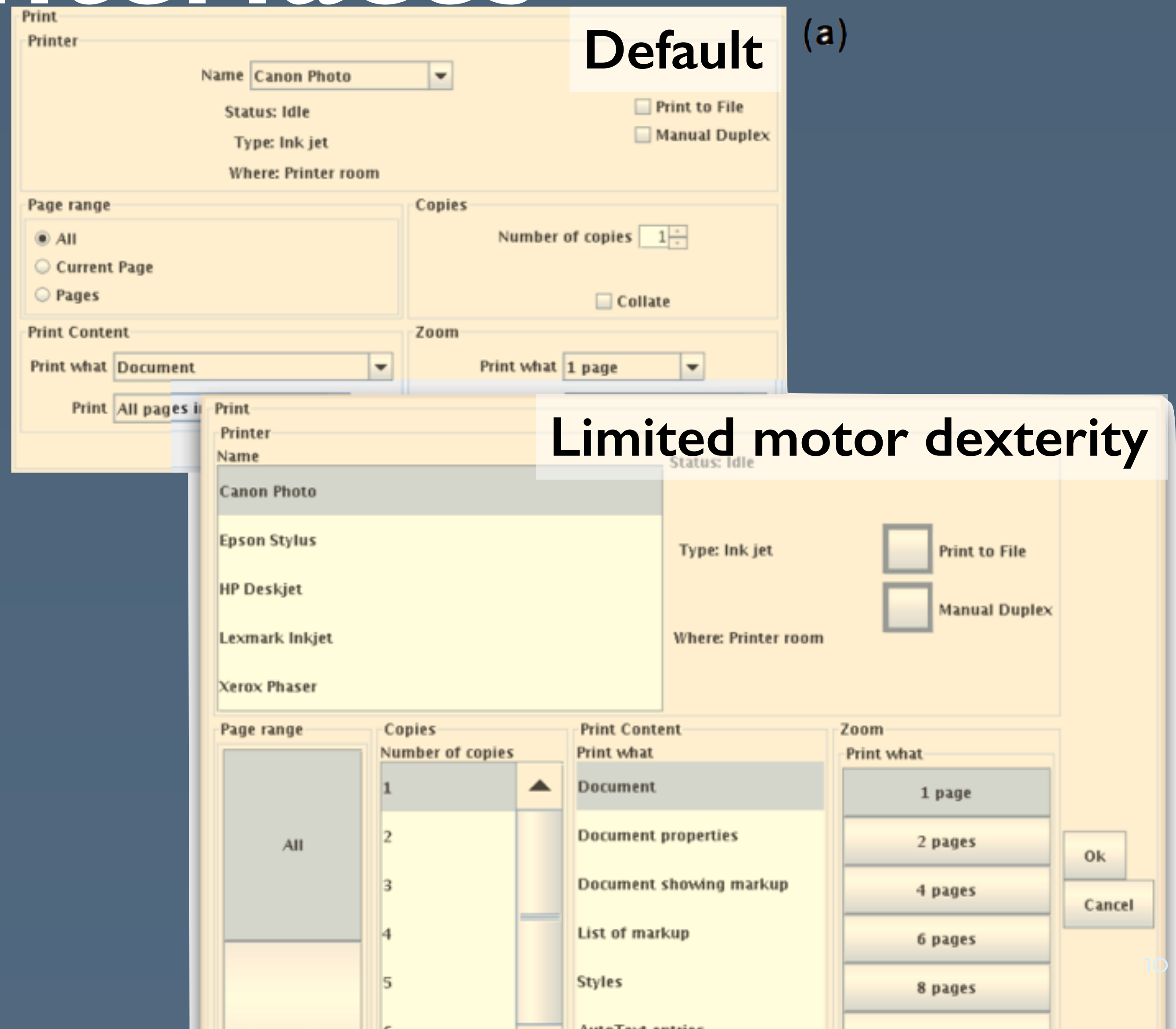
Accelerating information extraction

[Hoffmann et al., CHI '09]

1. Automatically extract structure from text
2. Ask web site users to verify or correct

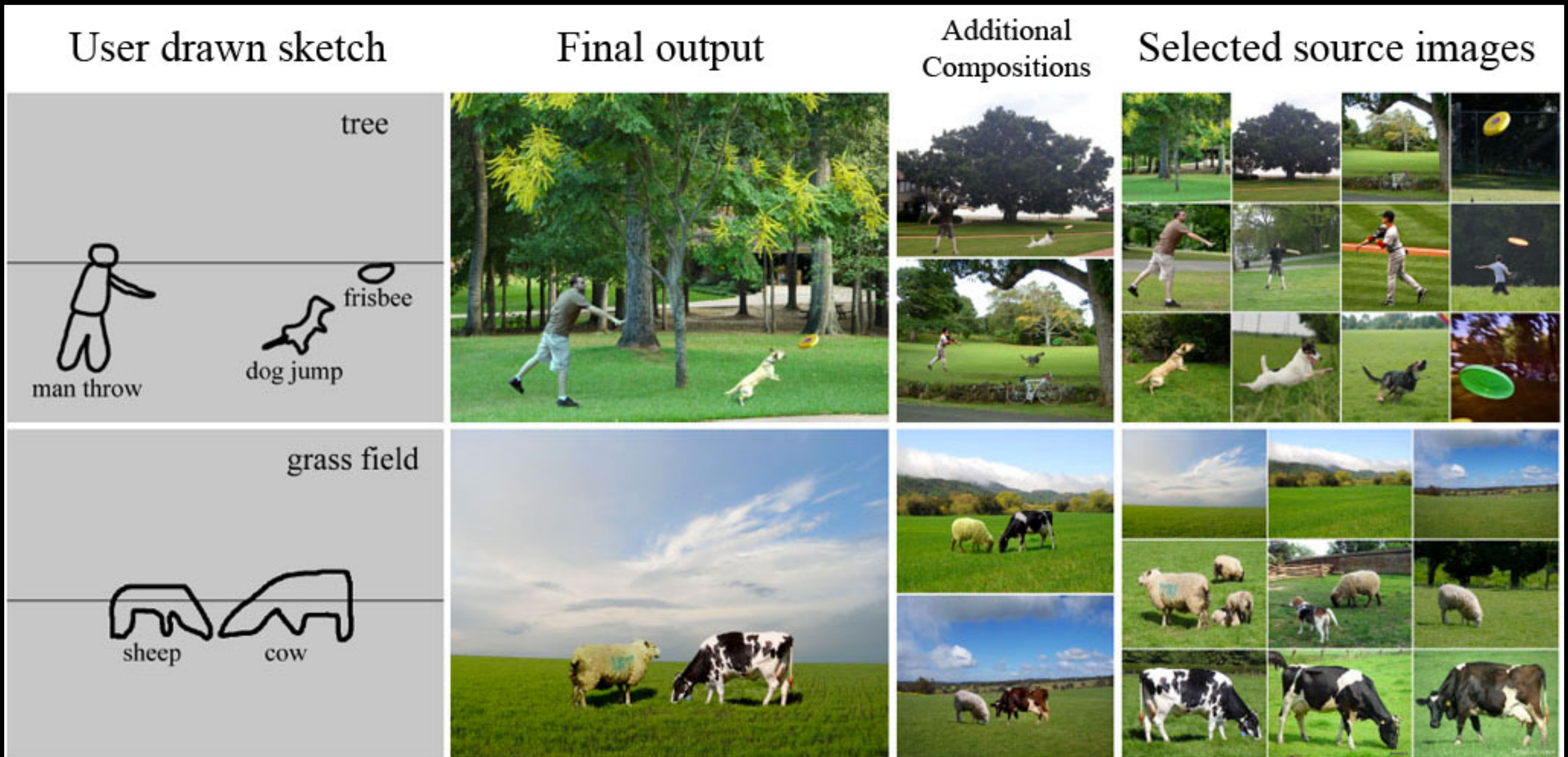# Completing sketched input

[Chen et al., SIGGRAPH Asia '09]

# Completing sketched input

[Chen et al., SIGGRAPH Asia '09]

User drawn sketch	Final output	Additional Compositions	Selected source images

Developing intelligent software

Development challenges with ML

[Patel et al., CHI '08]

- Software development benefits from modularity, but machine learning is iterative and nonlinear
- Difficulty understanding the statistical process underlying machine learning algorithms
- Evaluation of progress is difficult

Original Image (125x125) → Normalized Image (20x20) → Features → Model → Digit
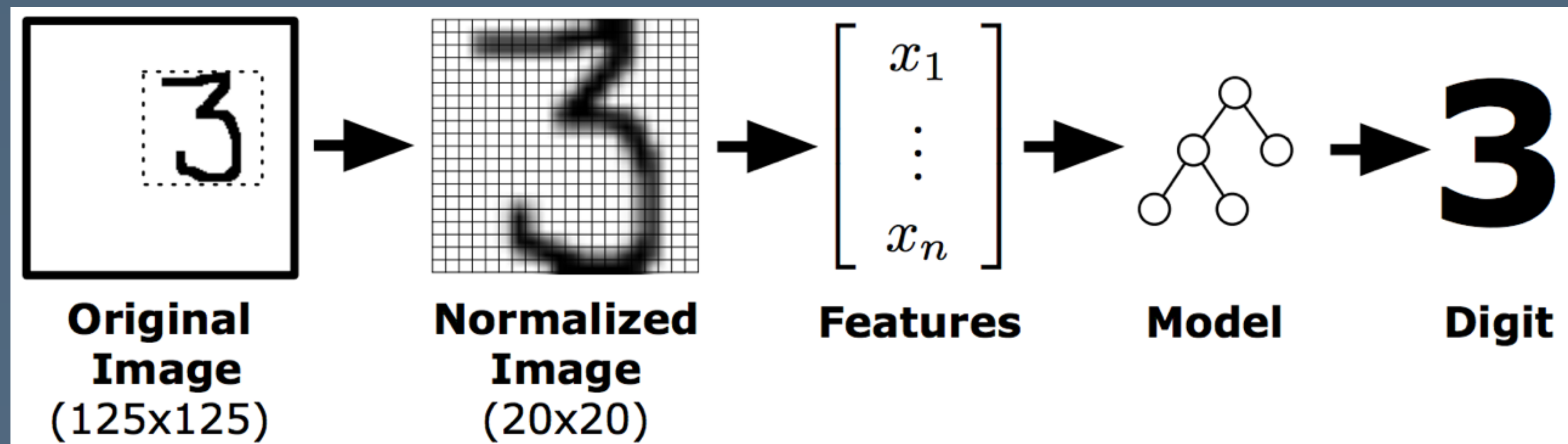
Papier-Mâché: toolkit support for tangible input

[Klemmer et al., CHI '04]

- Monitoring window, wizard-of-oz input, listeners, designed and evaluated as a user interface

IDE support for ML development

[Patel et al., UIST '10]

- Explicit support for each step: feature extraction, model generation, training and testing

Play-along learning

[Fiebrink, Cook, and Trueman, ICMC '09]

- Create the output (sounds) you desire
- "Play along" and demonstrate the input that should generate that output

Who's in charge?

Software agents

- Delegate to proactive software and artificial intelligence

  Pattie Maes, MIT Media Lab
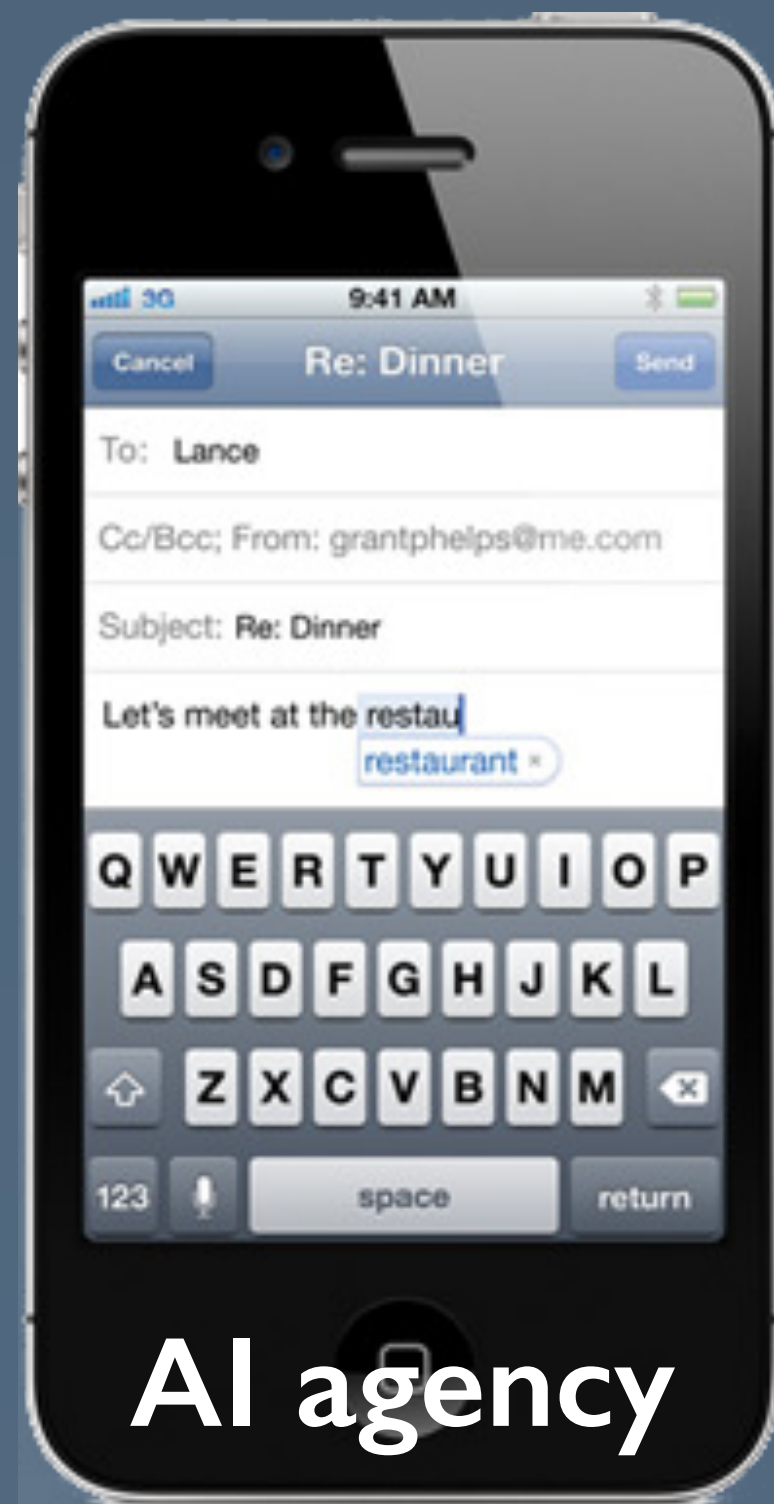

Direct manipulation

- Users should always have full control

  Ben Shneiderman, U. Maryland

Mixed-initiative interaction

- Software proposes, user decides
- Removes the risk that the system may be incorrect, reduces user effort

AI agency

User agency

Flickr tim.la

Mixed
initiative

Multimodal interaction

Using simultaneous inputs

- Sensor fusion can help disambiguate multiple noisy signals

Put That There

| Speech N-best	Gesture N-best	Multimodal N-best
Zoom in	Checkmark	Zoom out
Show info		
Show all		
Zoom out		

Quickset
[Oviatt, CHI '99]

User modeling

Software that knows you

- User modeling attempts to build a predictive model of the user's state or knowledge
    - State: is the user interruptible
    - Knowledge: would the user know how to use this tool in Photoshop already?
- Challenges
    - Where does it get this information
    - What if it's wrong?
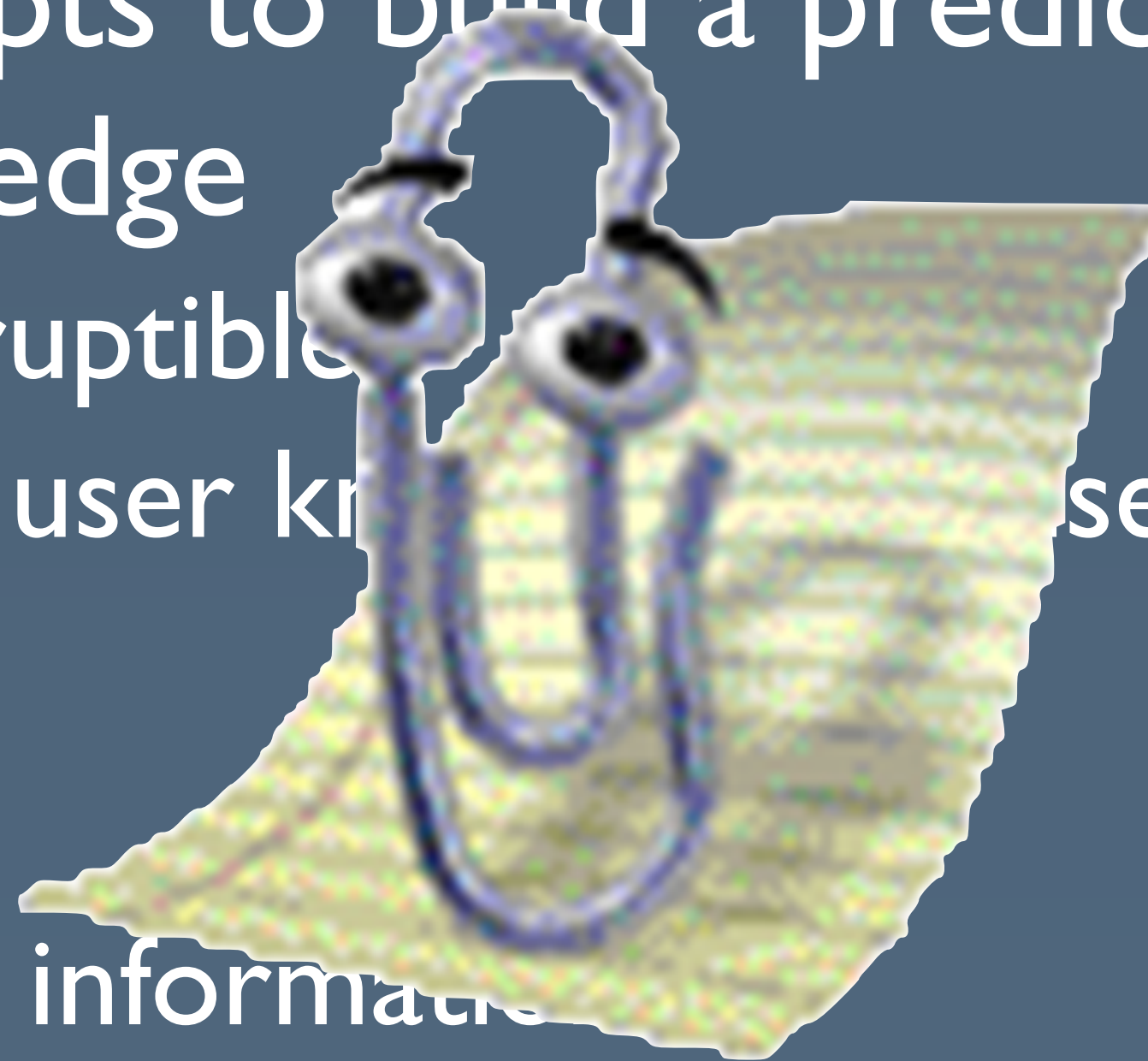
IUI research: next steps

- Opportunities
  - IUI research can drive new insights in machine learning research
  - Machine learning skills may enable interactive systems that others cannot envision
- Challenges
  - System behavior can be unpredictable
  - Difficult to build user trust