If you wanted a smart doorbell...

- To automatically control entrance to your room
- To let in possible donors for your Stanford education
If you wanted a smart doorbell...

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

No way
If you wanted a smart doorbell...

- To automatically control entrance to your room
- To let in possible donors for your Stanford education
Paint the areas of interest
Crayons: designing for 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
SUPPLE: automatically generating user 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
Accelerating information extraction on the web

[Hoffmann et al., CHI ’09]

1. Automatically extract structure from text
2. Ask web site users to verify or correct
Conveying incomplete input to a finished result

[Chen et al., SIGGRAPH Asia ’09]
Conveying incomplete input to a finished result  [Chen et al., SIGGRAPH Asia ’09]
Developing intelligent software
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
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
Gestalt: IDE support for ML implementation and analysis
[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
Play-along learning
[Fiebrink, Cook, and Trueman, ICMC ‘09]
Who’s in charge?
Software agents

- Delegate to proactive software and artificial intelligence

Direct manipulation

- Users should always have full control

Pattie Maes, MIT Media Lab

Ben Shneiderman, U. Maryland
Mixed-initiative interaction

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

- **Software proposes**, user decides
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Mixed-initiative interaction

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User agency

AI agency
Mixed-initiative interaction

- **Software proposes**, user decides
- Removes the risk that the system may be incorrect, reduces user effort
Multimodal interaction
Using multiple simultaneous input sources

- Sensor fusion can help disambiguate multiple noisy signals
Using multiple simultaneous input sources

- Sensor fusion can help disambiguate multiple noisy signals

Quickset [Oviatt, CHI ’99]

<table>
<thead>
<tr>
<th>Speech N-best</th>
<th>Gesture N-best</th>
<th>Multimodal N-best</th>
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<td>Zoom out</td>
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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?
Software that knows you

- User modeling attempts to build a predictive model of the user’s **state** or **knowledge**
  - State: is the user interruptible?
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- 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