how will learning change
with always-on, aware devices
connecting us to
all the world’s knowledge, experts & peers?
Evolution of learning

1. Classroom

[Diagram showing the process of learning and applying]
Evolution of learning

2. **Online** (e.g. Kahn, MITX)

![Image of two students working on laptops]

**MITx** MIT's new online learning initiative
Evolution of learning

3. Embedded

Integrated in life & personalized based on current context, user’s history, etc.
Why?

1. because it is possible:
   – devices increasingly are always with us & are increasingly aware of our current context, interests & expertise
today’s cellphone => tomorrow’s cellphone

blind  perceptive
passive proactive
disruptive seamlessly integrated
we are increasingly becoming “cyborgs”, relying on devices to augment our memory, decision making, learning, etc
Google Effects on Memory: Cognitive Consequences of Having Information at Our Fingertips

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ABSTRACT

The advent of the Internet, with sophisticated algorithmic search engines, has made accessing information as easy as lifting a finger. No longer do we have to make costly efforts to find the things we want. We can “Google” the old classmate, find articles online, or look up the actor who was on the tip of our tongue. The results of four studies suggest that when faced with difficult questions, people are primed to think about computers and that when people expect to have future access to information, they have lower rates of recall of the information itself and enhanced recall instead for where to access it. The Internet has become a primary form of external or transactive memory, where information is stored collectively outside ourselves.
Why?

2. because it is possible:
   – All knowledge, all experts are within reach all the time
   – Shift from *know what* to *know where/who* or *know how*
     • offloading to technology
     • offloading to others
Why?

3. Because **it is a necessity**:
   - a person needs to know more before she can become productive or generate new knowledge in an area
   - “half-life” of knowledge/skills is becoming shorter
   - all of us will have many careers, will need to keep learning
Why?

4. Because it may yield **better results**:  
   - More engaged & motivated learner  
   - Intrinsic vs. extrinsic motivation  
   - Small real successes & reflection lead to wanting to learn more  
   - Connected learning – social relationship
Evolution of learning: from detached/disconnected to relevant to me here and now

1. **Classroom**: Teacher -> 300 students
2. **Online**: audience of 1 but not personalized nor contextualized
3. **Embedded**: Customized to current problem, context, user’s expertise and history
“just-in-time” learning:
knowledge delivered in visual, 
auditory or haptic form 
based on problem/opportunity 
facing the user 
as well as their prior expertise
applicable to
many domains & ages
Education - kids
Mechanical
Historical
Medical and other professionals
knowledge presented can be information or a connection to peer/expert (live or asynchronous)
Quora’s mission is to share and grow the world’s knowledge.
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Faye Wang added an answer: Travel and Tourism in China:Where should I visit in China during the winter?

Quora, D’Angelo, 2009, crowdsourced Q&A
WikiHow, Herrick & Hannah, 2005
Stack Overflow (& StackExchange), Atwood & Spolsky, 2008
Duolingo, Von Ahn, 2011
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- Japanese (638 / 0)
- Mandarin (514 / 5)

Exam Prep
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- SAT (455 / 5)
- ACT (243 / 0)
- GRE (229 / 0)
- GMAT (103 / 0)

Other
- Reading (6741 / 0)
- Mathematia (1824 / 4)
- Education (538 / 0)
- Writing (648 / 0)
- Science (427 / 1)
Serlo

a crowd sourced Khan academy

Knowmia

Khan-like videos but sourced from teachers for teachers

MentorMob

Step by step learning through the Internet's best content, ordered by people like you.

Learning materials curated by others
Synchronous - Live

Figure 2: Six questions asked by participants, the photographs they took, and answers received with latency in seconds.

VizWiz, Biham, 2010, crowdsourced “real time” vision iphone app for the blind
going a step further: proactive recommendations for learning from others
Yenta (MIT Media Lab)

agent (user profile)
What would they think - Hugo Liu, 2004
they may not be interested in it. For example, the text could already be known, or the user might not wish to be distracted at that particular time. It is therefore vital to provide an interface that has as low a cost as possible for false positives.

The amount of information to show in a suggestion is always a trade-off. To avoid distracting users from their primary task, it is important to display a minimal amount of information, but at the same time, the whole point is to provide the user with a rich alternative information source. Furthermore, the very existence of a suggestion places an increased cognitive and perceptual load on the reader just to evaluate whether to get more information.

One way to address this trade-off is by creating a "ramping interface" where information is conveyed in stages. Each stage of a ramping interface provides a little

Figure 1: A screenshot of the web version of this paper, annotated by Margin Notes. The database used for this example is a subset of the INSPEC database of paper abstracts. The suggested document, listed in the black margin to the right, is a paper from SigCHI Bulletin that discusses the display of information and cognitive load. The suggested document was previously unknown by the author, but is now being added to his thesis reading list.

MarginNotes, Rhodes, 2000
**Expert Finder - Vivacqua, 2000**

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**Table 1: Jon’s areas and levels of expertise**

The agent communicates with other users’ Expert Finder agents calculating their “suitability” by verifying which libraries and classes they know how to use. It picks out David (Table 2), because he has used the “java.sql” library and its objects.

<table>
<thead>
<tr>
<th>Area</th>
<th>Usage</th>
<th>Expertise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>java.io</td>
<td>45</td>
<td>Intermediate</td>
</tr>
<tr>
<td>java.util</td>
<td>45</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Connection</td>
<td>11</td>
<td>Advanced</td>
</tr>
<tr>
<td>InputStream</td>
<td>5</td>
<td>Intermediate</td>
</tr>
<tr>
<td>CallableStatement</td>
<td>10</td>
<td>Intermediate</td>
</tr>
</tbody>
</table>

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**Table 2: David’s areas and levels of expertise. Note that the levels of expertise are obtained through a comparison with others in the community.**

His expertise is higher, but not too distant from Jon’s. Jon takes a look at David’s published profile, checks his “halo factor” (an indicator of how helpful he is to the community), and sends him a message:

Dear David,

I’m a novice Java programmer and have some problems regarding database connections and manipulations. I have created a series of stored procedures and now need to access them from my serveram. Is there a way to do that?

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**Approach**

In our approach, each user has his or her own Expert Finder agent, which builds that user’s profile from Java source code files. When necessary, the user can query the agent, which then communicates with other like agents, looking for a user with the appropriate expertise to assist with this problem.
Hard Issues in building systems that facilitate learning from peers

• incentive mechanism?
• modeling & qualifying expertise?
• detecting user’s current needs?
• matchmaking, load distribution?
JIT content recommended can be multi-media as well as integrated in physical experience (Augmented Reality, Augmented Human)
Wearable “Remembrance Agent” - Bradley Rhodes, 1998

Offers context-specific reminders of notes previously taken and information previously viewed based on keywords, location, people present, day, time, etc.
**Radius**

The radius is the bone of the forearm that extends from the lateral side of the elbow joint to the wrist. It is situated on the lateral side of the arm, which is opposite to the humerus. The radius is a long, slender bone with a roughened end that articulates with the distal end of the ulna.
Smarter Objects
Valentin Heun, 2012
Invisible Media, David Merrill, 2005
Sixth Sense
Pranav Mistry
SixthSense for remote collaboration (directing someone else) - Pranav Mistry
LuminAR bulb -
Natan Linder,
Rony Kubat - 2010
manufacturing use
EyeRing -
Roy Shilkrot &
Suranga Nanayakkara
But the little old woman said, in a sweece:

They paused and whispered ane
The FreeD parts

FreeD · Amit Zoran 2012
Possessed Hand - Rekimoto, 2011
Nobody likes being alone, and Japanese researchers from Yamagata University are developing a robot to make sure you'll never have to be alone again: the MH-2 wearable miniature humanoid lives on your shoulder and can be remotely inhabited by your friends from anywhere in the world.
GOAL:
live & learn
Technical challenges

- Monitor user, infer goals and context
- Recommend relevant information, knowledge, peers, experts
- Seamless presentation
- Capturing skills & knowledge in situ
- Transferring skills & knowledge among people with similar goals & context
- Introducing peers who can learn from one another
- Encouraging reflection, analysis, generalization
Open Questions

• what should be the distribution of knowledge between our brain and our personal devices?
• what do we still have to learn?
• when is the best time to learn that information?
• dependency problem “every extension is an amputation” M. McLuhan
• how do we make people smarter???
Project ideas/areas

• JIT encouraging curiosity, reflection, making connections
• connecting people with physical/situated problems & learning (mobile remote collaboration)
• looking into the future: what should we still learn ourselves? what are some possible futures?
• crowd-sourced Khan like efforts...
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