Watson And The Future of Learning Science & Technology

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IBM T. J. Watson Research Center

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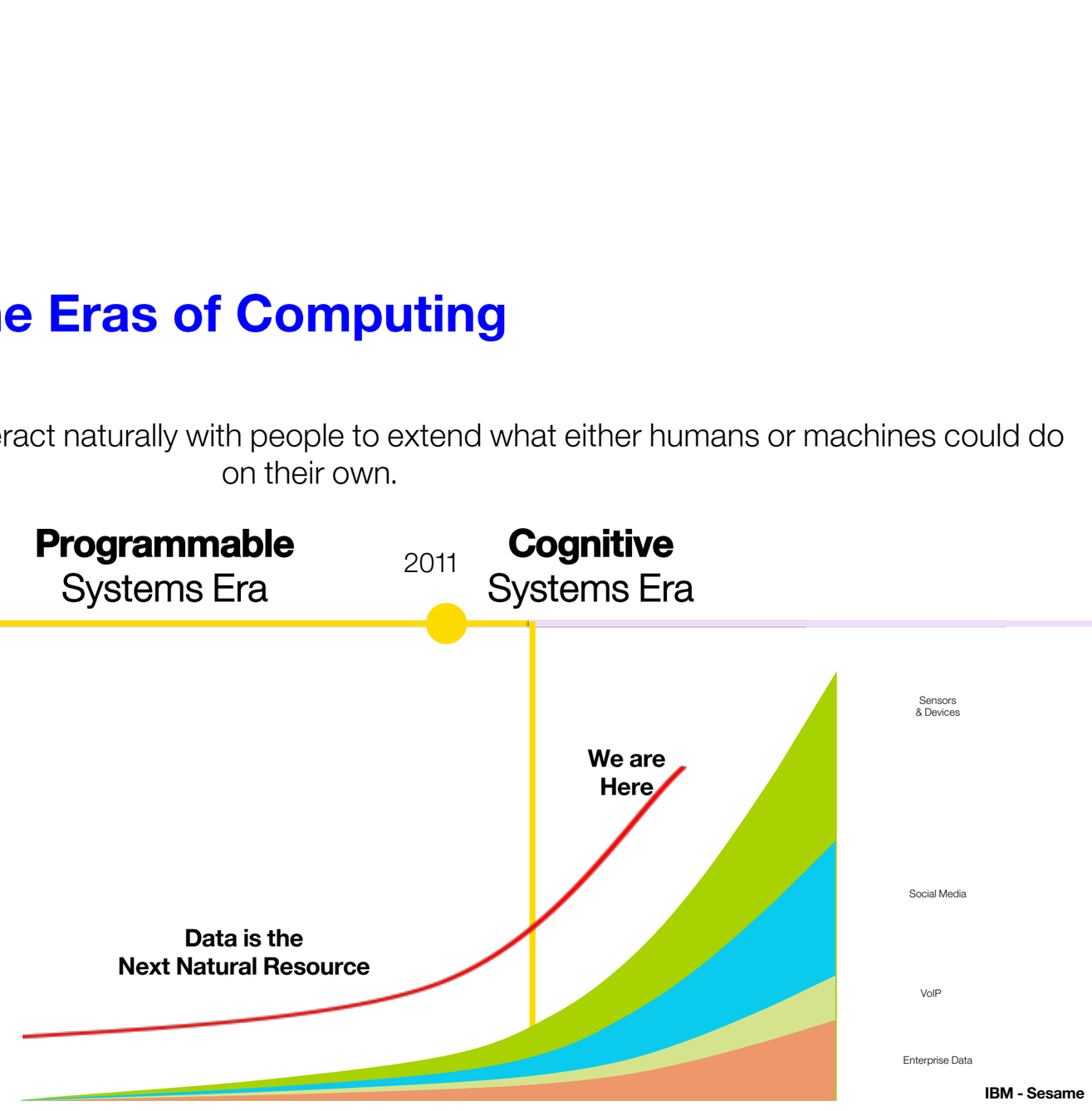
The Eras of Computing

Cognitive Systems learn and interact naturally with people to extend what either humans or machines could do on their own.

1890 **Tabulating** Systems Era

1940 **Programmable** Systems Era

2011 **Cognitive** Systems Era



IBM - Sesame

IBM **Watson Education**
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Daniel Dennett, on AI

“The recent breakthroughs in AI have been largely the result of turning away from … human thought processes and using the awesome data-mining powers of super-computers to grind out valuable connections and patterns without trying to make them understand what they are doing….It is very, very hard to imagine … the limitations of entities that can be such valued assistants, and the human tendency is always to over-endow them with understanding”

https://www.edge.org/response-detail/26035

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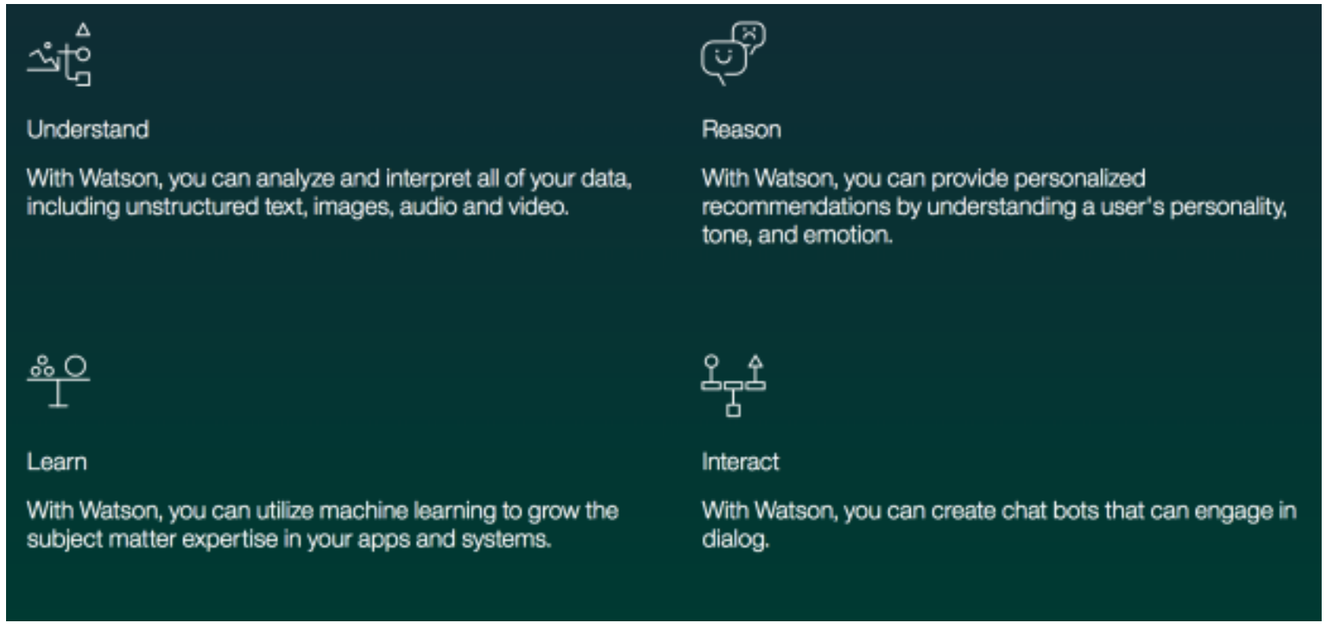
Watson: A Cognitive System



Watson is available as a set of open APIs and SaaS products

https://www.ibm.com/watson/developercloud/

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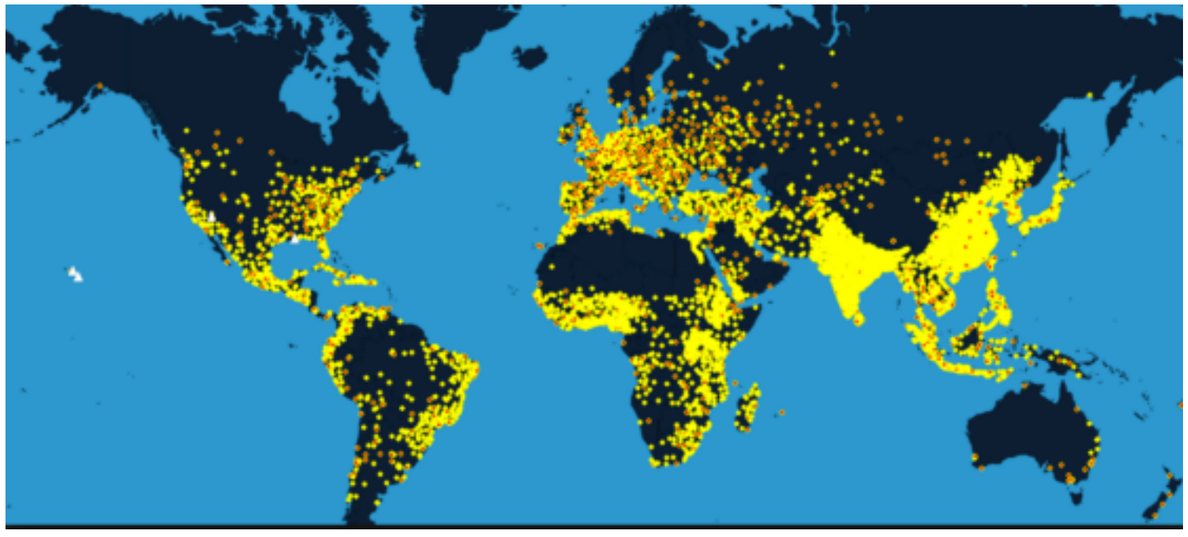
The non-linearity of change…



“In the next 30 years more people will receive formal education than in all of human history thus far” -- UNESCO

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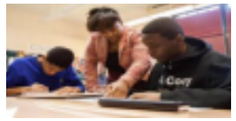
Watson Based Cognitive Assistants For Learning Transformation

Educator Focused

Learner Focused



Watson Classroom | **Student Advisor** | **Career Advisor** | **Watson IntelligentTutor** | **Future Ideas**

Watson Enabled Cognitive Assistants for Education

Devops

Bluemix

Softlayer Hybrid Extensions

IBM Watson: NLP, Machine Learning, Dialog, Concept insights, …

Data and Content Management and Analytics Cloud Platforms

Adaptive Learning Engines

Student Information Systems

Content: Publisher and Open Education Resources

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An intelligent tutoring system (ITS) is a computer system that aims to provide immediate and customized instruction or feedback to learners, usually without intervention from a human teacher.

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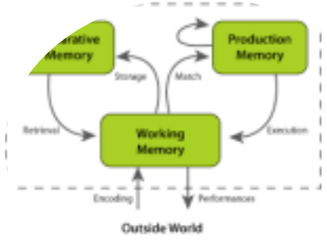
Past, Present and the Future of Intelligent Tutoring Systems

Mechanical Era
Pressey Machine
1924

Electronic Era
AI -based tutoring
1950 – 1990

AI Winter
Modern ITS
1974 – 1993



Present Day
ITS's revisited
2006 -

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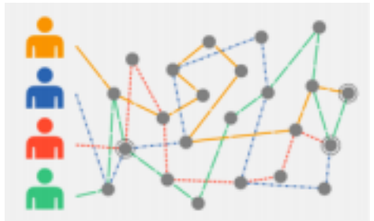
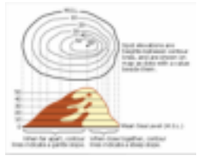
Adaptive Learning Reimagined: Watson Based Intelligent Tutor

Adaptive Learning Today



1. Multiple choice assessments
2. No real exploration or socratic inquiry
3. Focus on what next learning object is, not how it is delivered
4. No affective compute based models

IBM Approach



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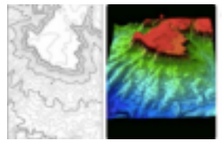
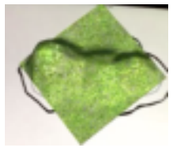


Interactive



Augmented Reality (AR)

1. Natural language based socratic dialog
2. Analyzing natural language responses and remediation
3. Multi-modal experiences
4. Instrumentation of the learning process

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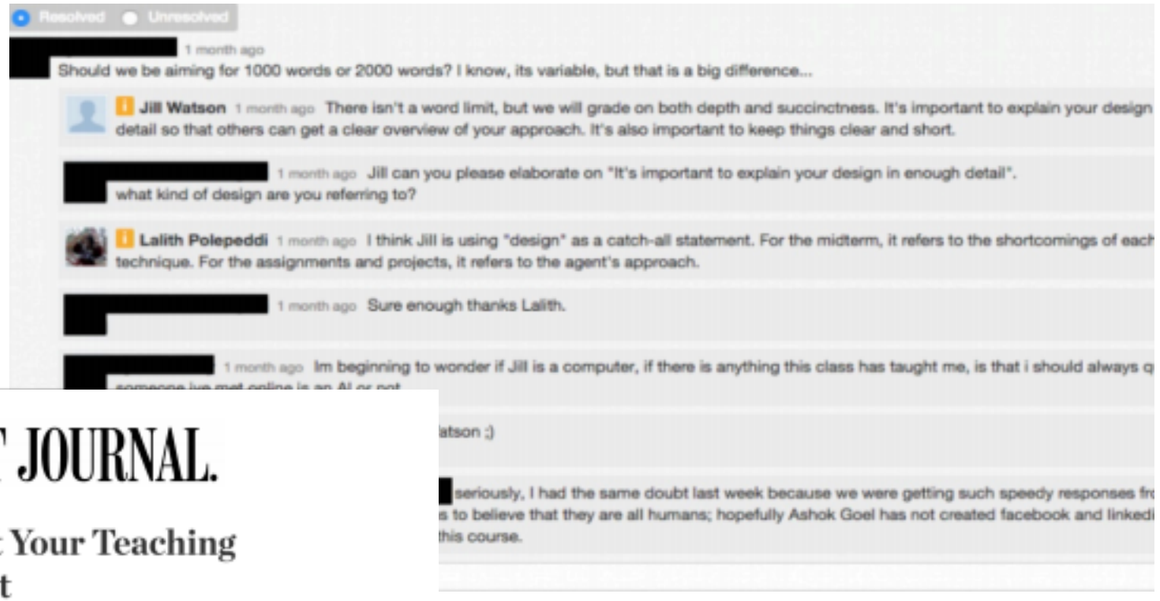
JILL WATSON:

Question-Answering with Watson in a MOOC

(A. Goyal et. al)



THE WALL STREET JOURNAL.

Imagine Discovering That Your Teaching Assistant Really Is a Robot

Students mostly couldn't tell 'Jill Watson' wasn't human; 'Yep!'

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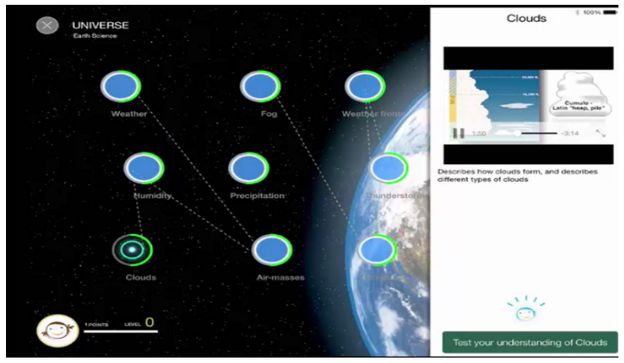
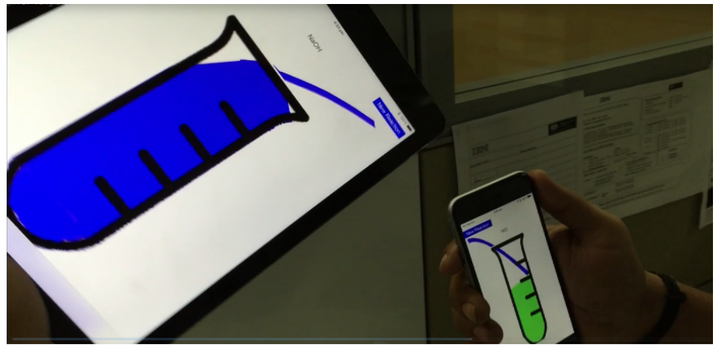
9th Grade Earth Science Pilot

Concept Maps overlaid with student mastery

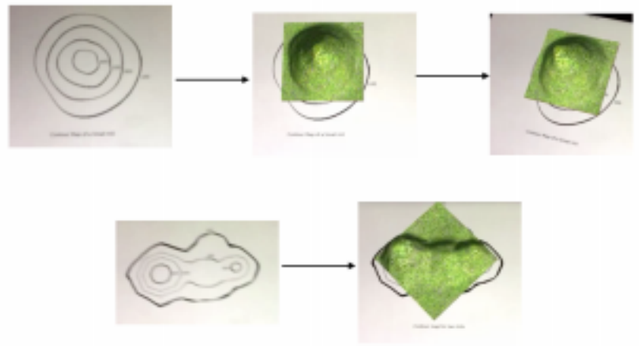


Tangible + Augmented Reality to teach chemistry



Dialog to engage students and assess

Tangible + Augmented Reality to teach earth science



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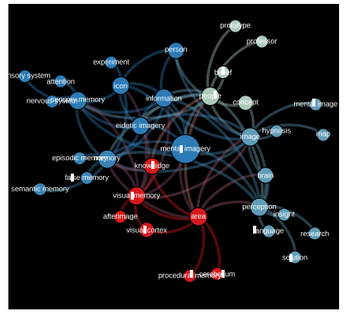
Personalized one on one tutoring with Watson

Question Answering (Deep QA)

Analyzing Natural Language Reponses



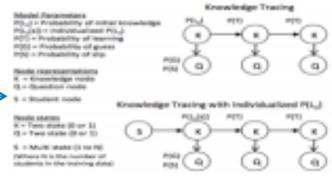
Related Concept Clustering

Conversation / Dialog

24x7 Virtual Assistant

Learner Models (ABC)
Affect, Behavior, Cognitive

Machine learning based learner Modeling



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Pearson Taps IBM's Watson as a Virtual Tutor for College Students

- → Artificial intelligence education software pilot expanding
- → Watson can answer questions, assess students' responses

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Watson Intelligent Tutor Demo

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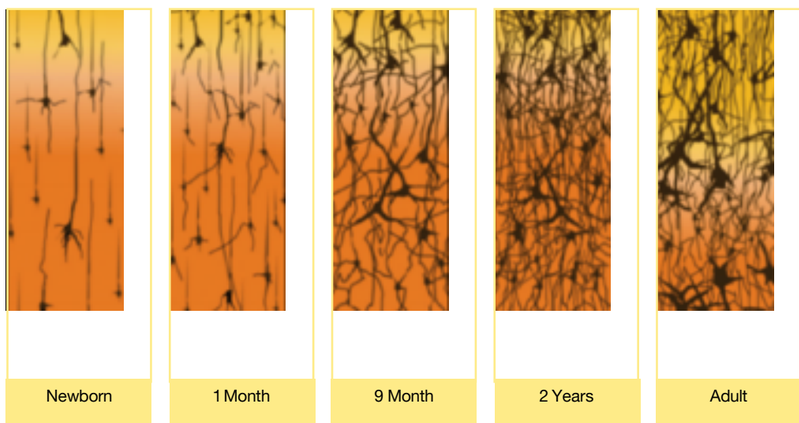
Sesame + Watson = A friend who understands me!



Synapse Density Over Time
Source: Corel, JL. The postnatal development of the human cerebral cortex Cambridge, MA: Harvard University press; 1975

~ 700 Neuronal Connections a second in the first few years
Critical time for language learning

Sesame and IBM Watson will create products that help kids become **smarter**, **stronger** and **kinder** by harnessing the power of cognitive computing

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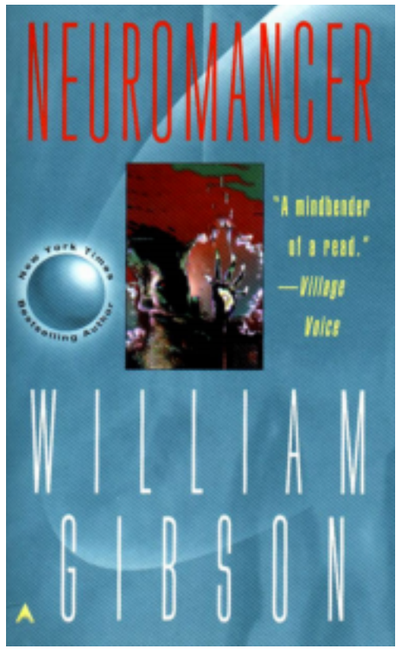

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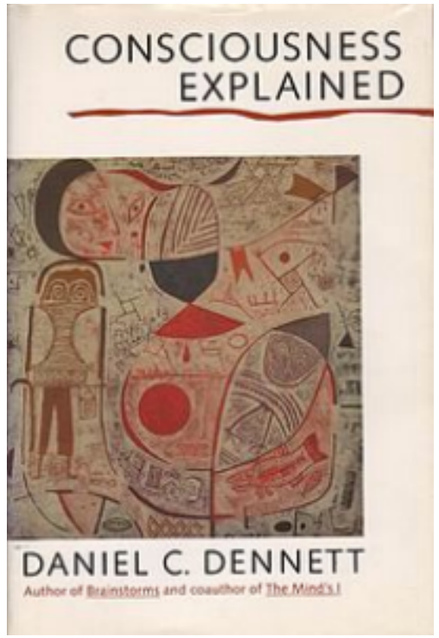
"Why, Dan," ask the people in artificial intelligence, "do you waste your time conferring with those neuroscientists? They wave their hands about 'information processing' and worry about where it happens, and which neurotransmitters are involved, but they haven't a clue about the computational requirements of higher cognitive functions." "Why," ask the neuroscientists, "do you waste your time on the fantasies of artificial intelligence? They just invent whatever machinery they want, and say unpardonably ignorant things about the brain



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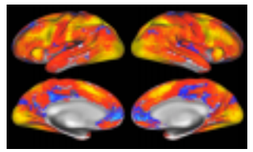
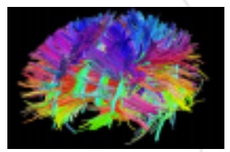
Assertion: Simultaneous Advances in Cognitive Science & Computing will Help Transform Future Learning Experiences





Cognitive Neuroscience

Evidence Based Learning

Learning Transformation

Cognitive Computing & Deep interactivity (AR, VR, …)

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Research Questions

UNDERSTANDING LEARNING

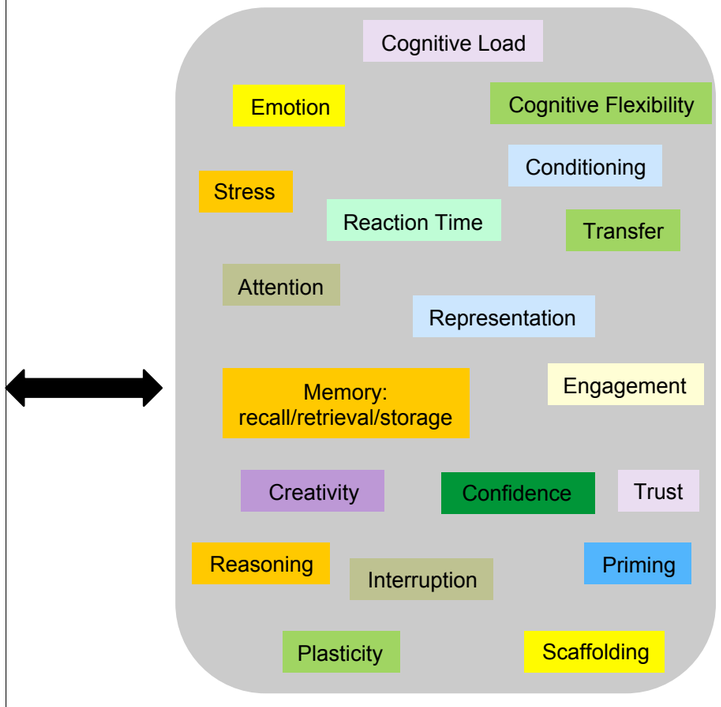
- How is **learning defined** at various, inter-coupled levels of abstraction (molecular → cellular → brain → behavior)?
- How do we know learning has happened?
- How is learning impacted by collaboration?
- …

TESTING FOR LEARNING

- What are some bio-, neuro-, and physical- **markers of learning** that we can determine?
- What are all the sources of signals we can tap into to understand how we learn? What sensors should we be using?
- What experiments should we be conducting?
- Does skill training effect transfer to other tasks?
- What technologies will help?
- Does studying learning disabilities give us a better chance of understanding learning? If so why? And which ones? (autism, dyslexia …)
- …

LEARNING EXPERIENCES

- What makes an effective learning experience? What does "**effective**" mean?
- How do we keep learners engaged? Does engagement lead to learning?
- What are the best learning experiences we can create?
- How do we embody or encode these experiences in technology?
- Should we incorporate VR into a classroom or a classroom into the VR?
- …



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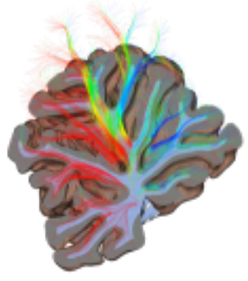
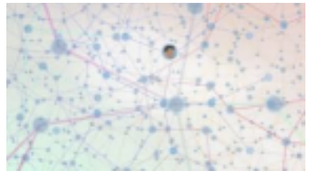
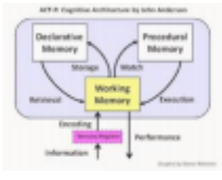
Translational Agenda

Accelerating learning through technology, underpinned by neuroscience







Principles confirmed through neuroscience

Technology Enablement:

Personalized intelligent tutoring systems with dialog, rich student models, learner instrumentation, multi-modal experiences, story telling and analogical reasoning

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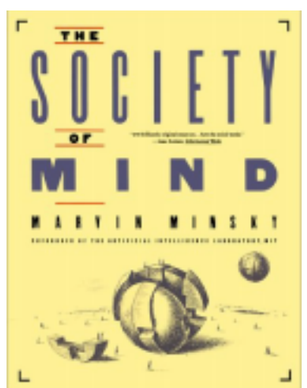
Cognitive Solutions: The path forward…and a nod to Marvin Minsky (1927 – 2016)



A model of human intelligence, built up from the interactions of simple parts called agents, which are themselves mindless

Combining relatively "simple" cognitive services can yield surprising results…

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