

COMPUTING VISIONS 2025 ROUNDTABLE DISCUSSIONS

Signposts for the Future



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INTERACTING WITH THE COMPUTERS ALL AROUND US

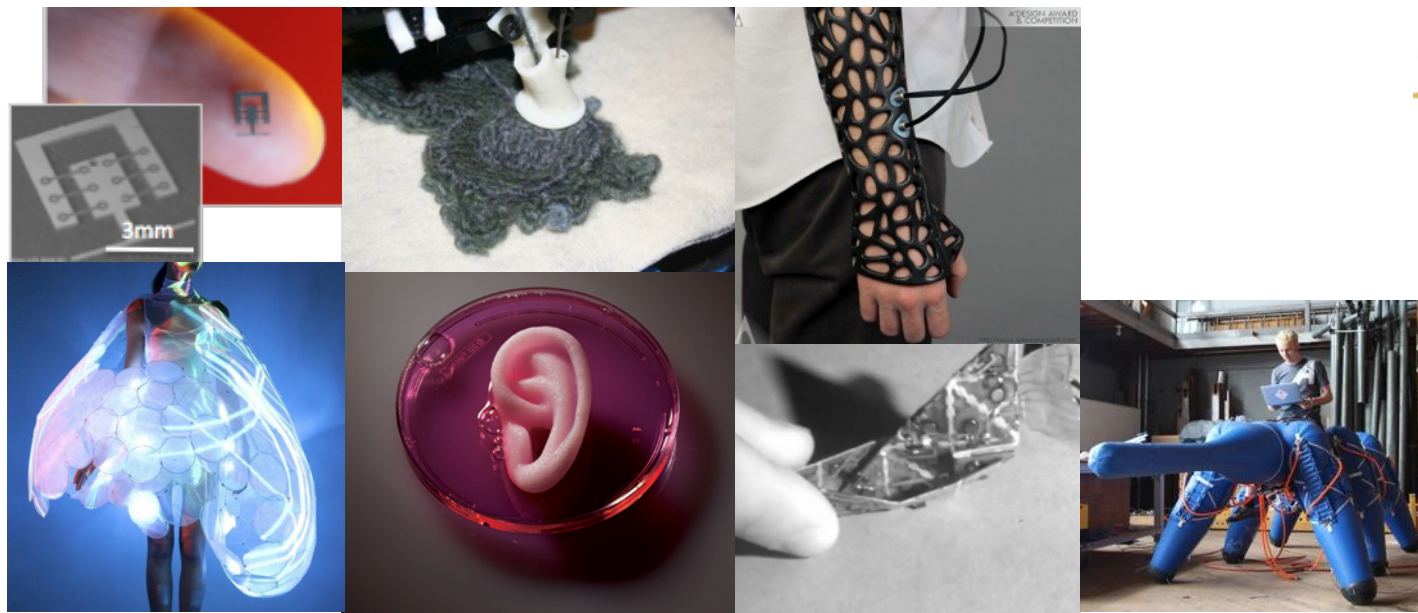
The future of **interaction among humans, computers, and the physical world**:

- ***Assist people and empower communities:*** Communicate, collaborate, organize, for better sustainability and quality of life, in daily life
- ***Heterogeneous combinations of assistants:*** cognitive, physical and social; these tools are networked (Internet of things) and collaborative
- ***Challenges:*** real-time interaction, perception (user, context, environment), recognition (state, activity), modeling (user, situation, interaction dynamics), natural multimodal communication, ubiquitous interfaces, trust, engagement, personalization, privacy, reliability
- ***Exciting threads/highlights:*** broaden beyond the 1st world (well beyond convenience), focus on children (education, health), connect communities through funding to accelerate progress (HCI-HRI, vision-robotics, social & cog sci, design, ethics... to computing)



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THE NEW MAKING RENAISSANCE

Programmable Matter and Things

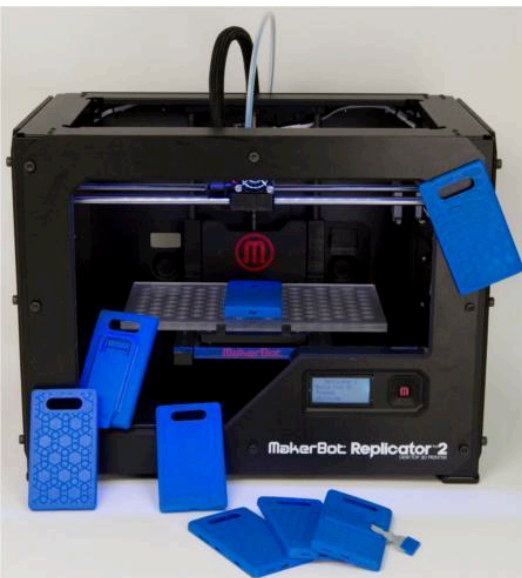
NSF / CRA Vision 2025 Vision Workshop
held 2-4 June 2014

Eric Paulos, UC Berkeley
Prabal Dutta, University of Michigan

David Culler, UC Berkeley
James Landay, Cornell Tech / Stanford

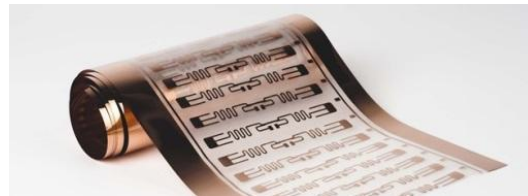
NEW MAKING RENAISSANCE: A REVOLUTION?

Creativity and change unleashed could fundamentally change how society operates



DIGITAL
FABRICATION

+



FLEXIBLE
ELECTRONICS

+



UBIQUITOUS
PROGRAMMING

Return to craftsmanship with precision and ability to mass customize/produce

LIGHTNING INTRODUCTIONS

2 MINUTES
2 SLIDES

Who are you?
What do you do?

What is the primary
Opportunity
Challenge
Open Question
in next 10-20 years



FUTURE HEADLINES ... 15-20 YEARS OUT



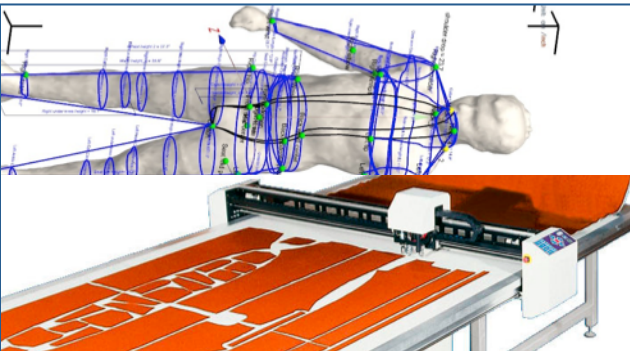
HEADLINE BREAKOUT GROUPS



TOP HEADLINE TOPICS

Robot Termite Builders

Genetic Algorithm Wins Furniture Competition



Bespoke Digital Tailors



Spinal Column Grows with Child



Internet of Things Fatigue



Bioluminescent Trees

KEY CROSSCUTTING TOPICS

Science, Education & Design are Intertwined

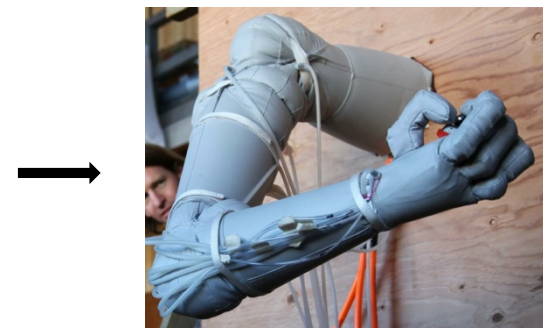
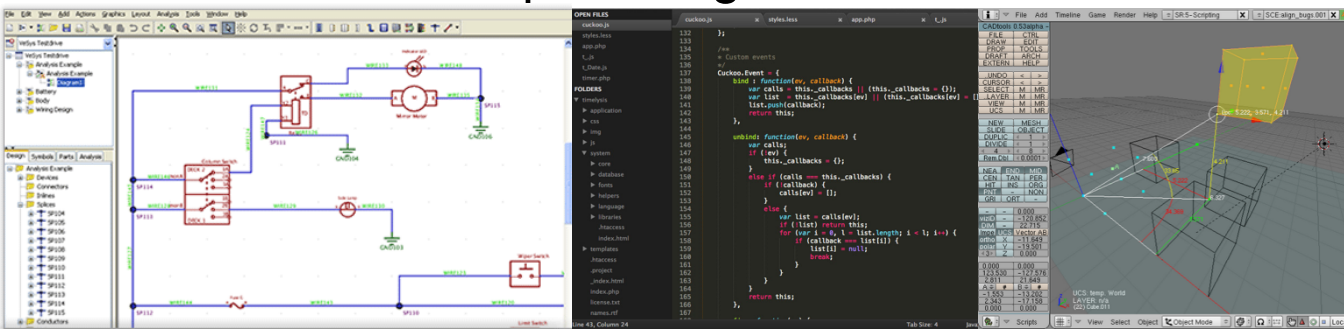
- come at solutions differently, but all are required for innovation
- just-in-time, lifelong learning & project-based learning key
- where does higher ed fit in this?



<http://bouncingideas.wordpress.com/2011/11/12/design-engineering-science-their-differences-through-the-lens-of-biomimicry/>

Design Tools are essential to accelerating innovation & productivity

- tools must work across electronics, physical form & software
- need tools to promote creativity
- need tools to help leverage new materials



KEY CROSSCUTTING TOPICS

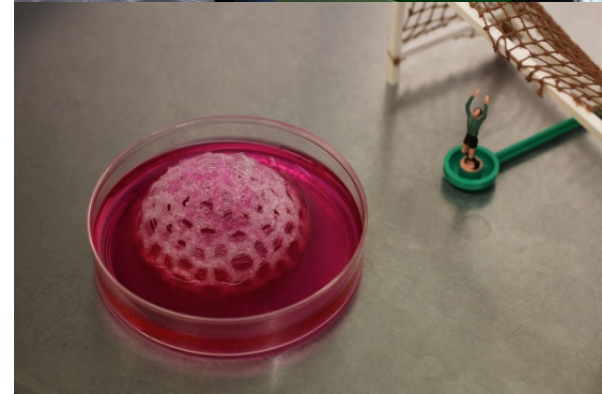
Micro-manufacturing that scales from small to large to empower small businesses

Sustainable infrastructure is necessary

- make outputs that are recyclable & reusable
- how to augment the natural world?

Health/Bio applications need modular devices

- interface w/ bio parts
- “bio foundries”
- *abstraction barriers* allow designers to focus on their area of expertise
- shape changing implants



FRAMING THE AGING IN PLACE (TECHNOLOGY) RESEARCH CHALLENGE

Elizabeth D. Mynatt

Professor, Interactive Computing, Georgia Tech
Vice-Chair, Computing Community Consortium

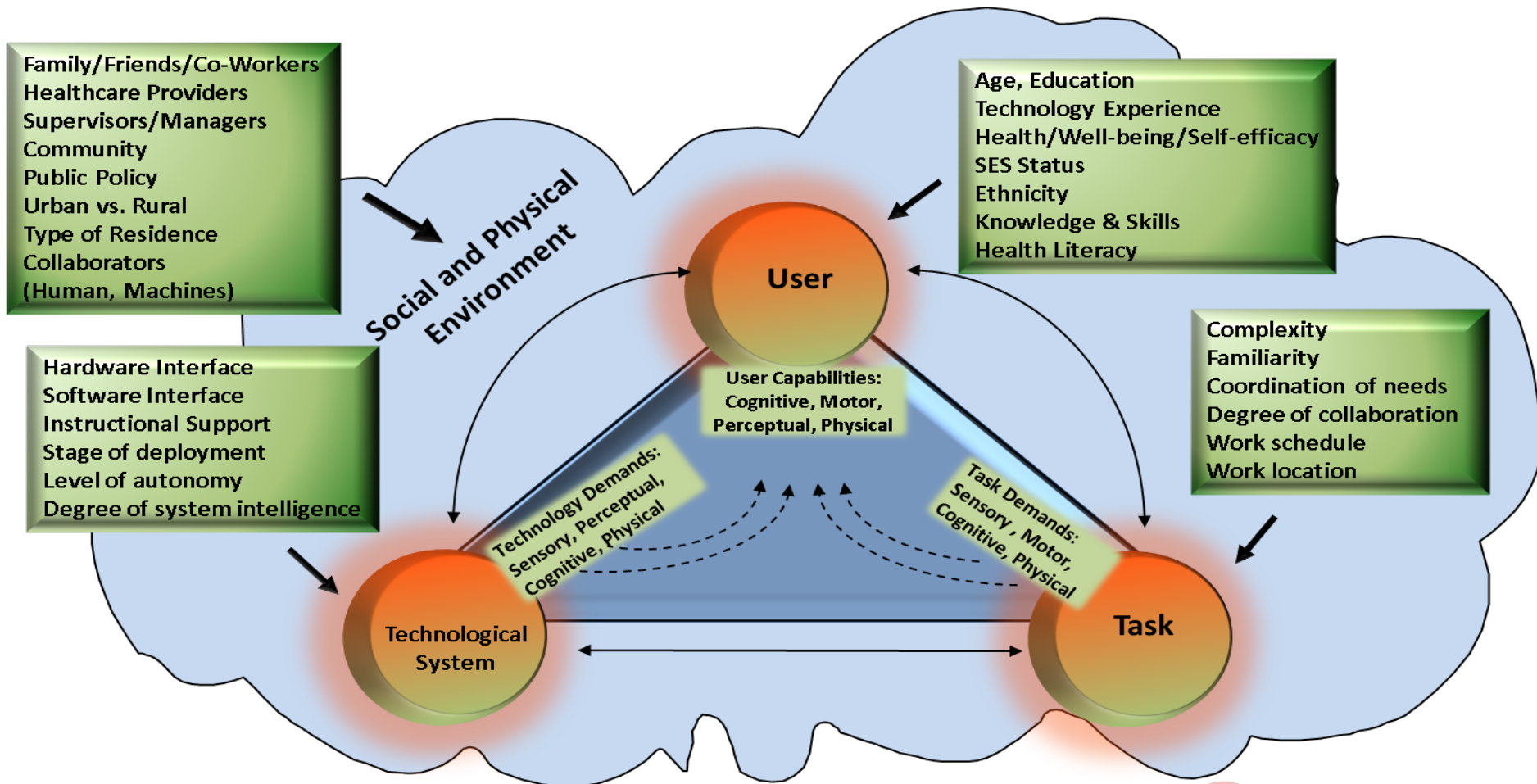
*Comments based on Sept 2014 NIH CCC Workshop led
by Alice Borrelli, Sara Czaja, Jeff Kaye,
Dan Sierwiorek, John Stankovic, Elizabeth Mynatt,
Erin Iturriaga, Wendy Nielsen*



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CREATE MODEL OF HUMAN / TECHNICAL SYSTEM

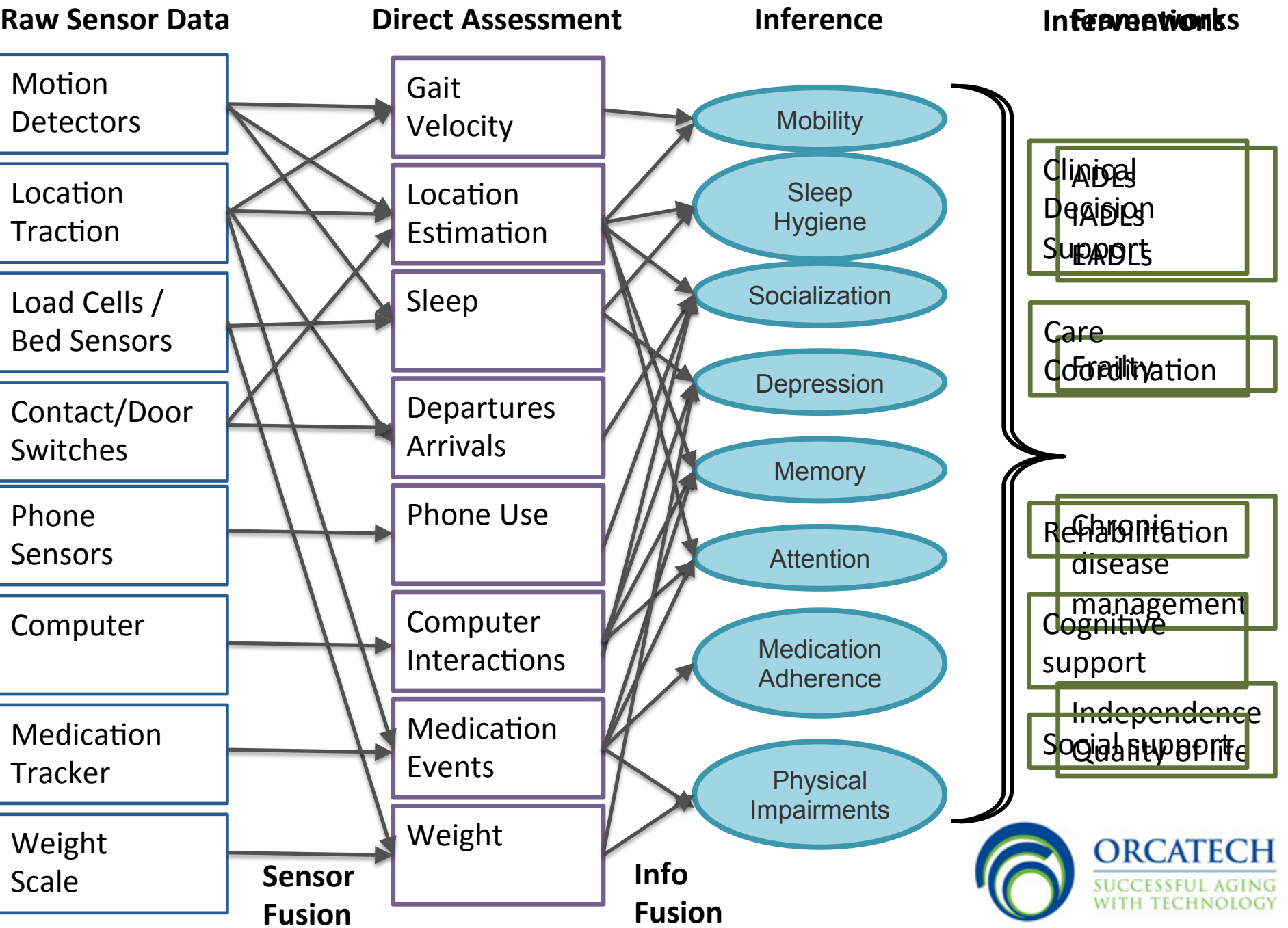


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Fisk, Rogers, Charness, Czaja & Sharit (2009)



WORKSHOP RECOMMENDATIONS

Complex Needs	Designing for Health Transition Trajectories	Sensing, Actuation and System Integration Technology
Adaptable systems	Engagement	Monitoring
Human-Centric Design	User Modeling	System Resilience
Care-Networks	Privacy and User Acceptance	Predictive and Decision Analytics
Future-Proofing		

Barriers

- The need for actionable evidence
- The need for information dissemination that bridges the gap between research and practice
- The need for effective trans-disciplinary collaboration
- The need for far-reaching test beds



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UNCERTAINTY AND COMPUTATION

Bill Thompson

Ross Whitaker

University of Utah



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WE LIVE IN THE AGE OF DATA

- Science, technology, and politics permeated by information that comes from people, measurements, or computational processes
- Most important decisions based on data processed and presented by computers
 - Data is inevitably imperfect: incomplete, corrupt, lacking in accuracy and precision
 - Explicit consideration of uncertainty rarely part of the computational and decision making pipeline



UNCERTAINTY IS A FACT OF LIFE



“When all is said and done, the weather and love are the two elements about which one can never be sure.”

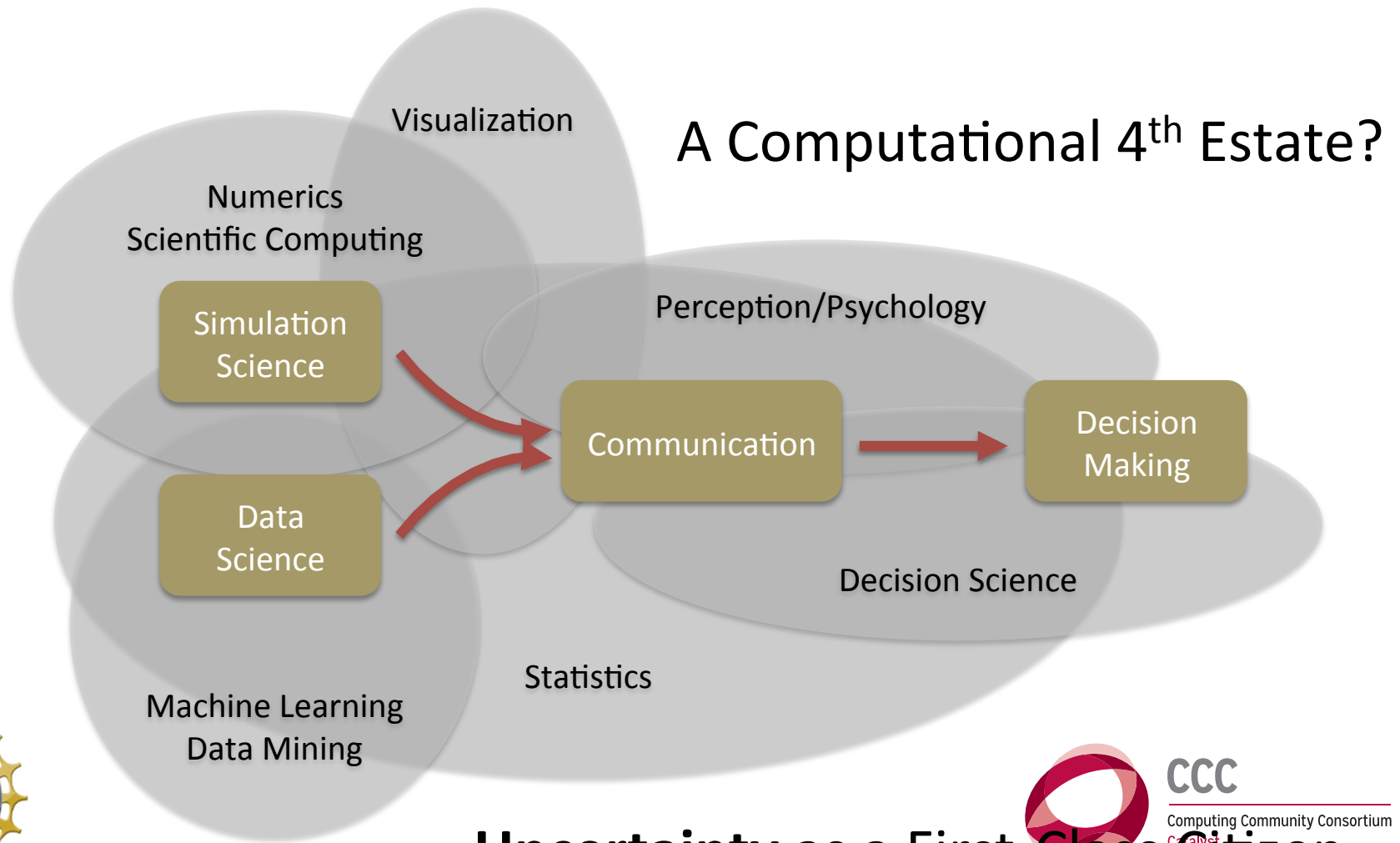
— [Alice Hoffman, *Here on Earth*](#)



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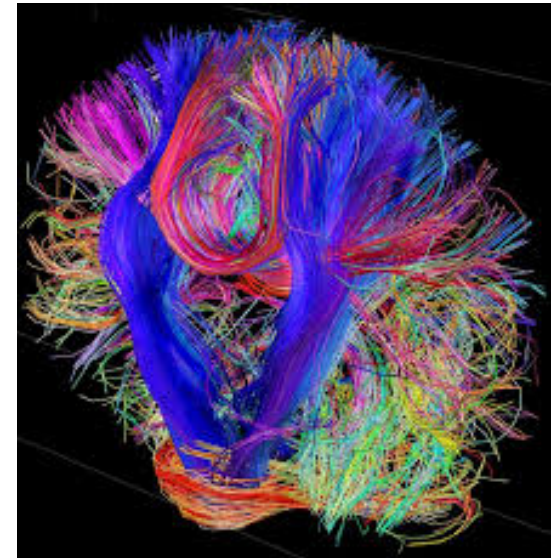
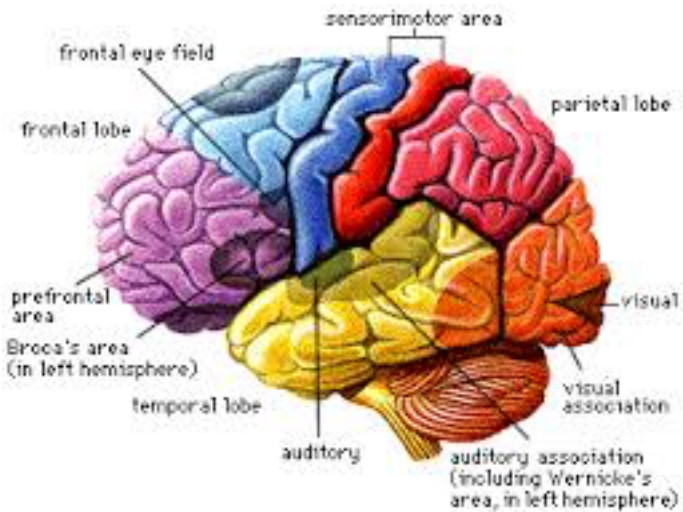
FROM ANSWERS TO INFORMED DECISIONS



Uncertainty as a First-Class Citizen



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*Papadimitriou, Rabin, Hager, Whang, Schaal,
Golland, Koch, Pfister, Tennenbaum*



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BRAIN

Human brain:

18 billion cortical neurons

1-10 thousand connections/neuron

5 million cortical columns ?

500 areas and nuclei?

12000 inter-areal connections?



- How does the brain do what it does?
 - Architectural motifs -> functional motifs
- Can we build meaningful reference models that unite different scales/modalities/communities
- Can we scale this to be meaningful?
- What does this teach us about computation?