Semiconductor Research Corporation

Intelligent Cognitive Assistants: How SRC is shaping the future of AI research

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Science Director
Semiconductor Research Corporation
Dec 7, 2018

Because the future can't wait, we bring the best minds together to achieve the unimaginable

SRC: 35 years of mission excellence:

What we do in a nutshell!

- **Conduct university research on industry-relevant topics**
  - Transfer results to industry
  - Create the Next Wave of Leaders and Innovators
- **Facilitate collaboration between Industry and Government**
  - Collaborative Industry-Government university research programs
- **Explore potentially important new technologies**
- **Recognized World Leader in Industry Driven Research**

- **7 of the Top 10 Semiconductor Manufacturers are SRC Members**
- **Leaders in Semiconductor Technology, IP, Software, and Big Data Systems**
- **21 Commercial Members, 3 Government Agency Partners, SIA affiliation**

$2B Invested

500 Patents

10,000 Students

2,000 Faculty

250 Universities

25 Countries

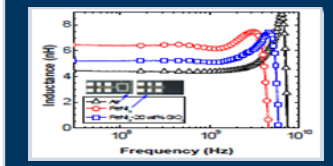
The SRC Model –Solving Challenges since 1982

SRC Member Companies

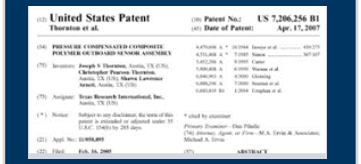
Universities

Government Agencies

Research

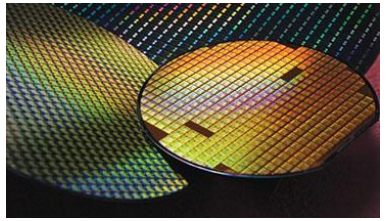


IP



New Talent

Commercial Products



- Industry Relevant Challenges
- Competitors with Common Goals
- Coordinated Research

- *Technology Transfer*
- *Best and Brightest*
- *Generate Innovative Solutions*

A mechanism for effective public-private partnership & pre-competitive research

SRC - International Member-Driven Organization

- 7 of the Top 10 Semiconductor Manufacturers are SRC Members
- Leaders in their fields
  - Semiconductor Technology
  - IP
  - Software
  - Big Data Systems
- Membership
  - 21 Commercial Members
  - 3 Government Agencies
  - SIA affiliation

SRC's Vision for Industry Growth

Disciplinary Focus
Device Driven
Deterministic Computing
Extending Moore's Law

Evolving to Include

Multi-disciplinary Focus
Increasing System Focus
Novel Computing
Mid/Edge
Autonomous Systems
5G/IoT

Performance
Scaling

Energy Efficiency
Applications

Addressing Societal Goals:

- Independent living for an aging population
- Affordable medical care with better outcomes
- Secure financial services and transactions
- Efficient generation, distribution and use of electricity
- Autonomous transportation
- Etc…..

SRC is Aligned to NSF's Ten Big Ideas Vision

- An industry-government initiative is envisioned that is inspired by the NSF's Ten Big Ideas vision, namely:

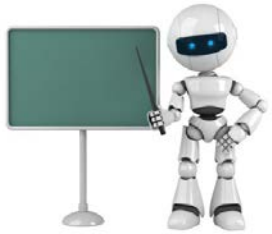
1. NSF INCLUDES: Enhancing Science and Engineering through Diversity
2. NSF 2026: the Integrative Foundational Fund
3. Understanding the Rules of Life
4. ✓ The Future of Work at the Human-Technology Frontier
5. Mid-scale Research Infrastructure
6. Windows on the Universe: The Era of Multi-messenger Astrophysics
7. Navigating the New Arctic
8. ✓ Harnessing Data for 21st Century Science and Engineering
9. The Quantum Leap: Leading the Next Quantum Revolution
10. ✓ Growing Convergent Research at NSF

Laura Hitt / NSF

What is ICA (Intelligent Cognitive Assistant)?

A Research Program To

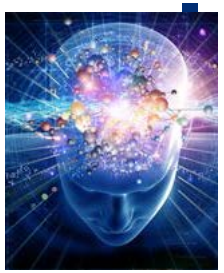
1. Enhance human capabilities with intelligent digital agents
2. Adapt with flexibility to dynamic, real-world environments
3. Cultivate trust among humans and machines
4. Facilitate “natural” interactions with social and emotional awareness
5. Create Intelligent Agents that interact with you



Working Group Proposed ICA Topics of Research (also session topics for ICA Workshop)

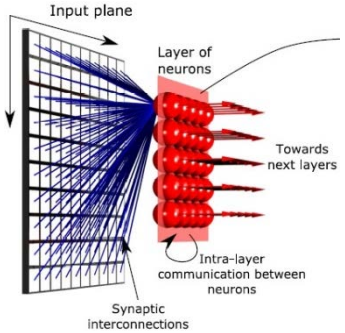
- **Cognitive Psychology**
  - Perception vs Cognition
  - Case Studies of Existing Digital Assistants
  - Increasing Emotional Intelligence

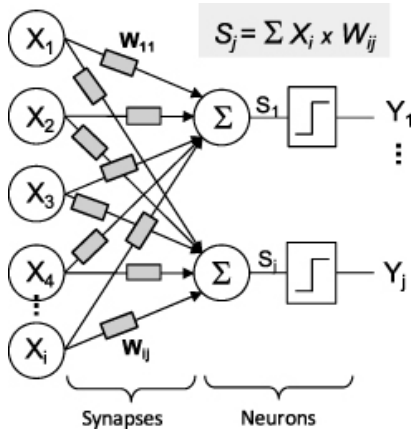
- **Natural Interfacing**
  - Natural Language Processing
  - Gestures, Perception, Vision, Sound, etc.
  - Mixed-initiative Interaction
  - Augmented Reality to increase trust



- **Approaches to Artificial Intelligence**
  - Beyond Five Tribes of Machine Learning
  - Cognitive AI
    - Complementary Learning & Real-World Systems
    - Better Understanding of Essence of Things
  - Data Selection for Reinforcement Learning

- **System Architectures**
  - Beyond von Neumann Computing Architecture
    - Energy Efficiency, High Performance
  - Algorithms and Architectures
    - Local Preprocessing for Speed, Security, Context, and Personal History
  - Adaptable, Scalable, and Flexible
    - Modular System Designs
    - Neuromorphic Engineering Approaches





- **Data and Modeling**
  - Data Capture and Privacy
  - Accurate, non-biased
    - Or Sources of Biases are Modeled and Encoded
  - APIs and Toolkits
    - Different Data Types and Usages
    - Handling sparse/incomplete data sets

Joint NSF/SRC Workshop on ICA

- 68 Attendees at ICA Workshop on Nov 14-15, 2017
  - 17% government
  - 25% academia
  - 58% industry
- Strong government interest:
  - NSF (ENG, CISE, EHR, SBE, BIO)
  - DARPA
  - NIH
  - DOD
- Strong industry Interest with 18 unique companies at workshop
- Strong academia support with 15 unique universities at workshop

Dates : November 14-15, 2017
Location : IBM Almaden Research Center
San Jose, CA

Review Executive Summary of ICA Workshop

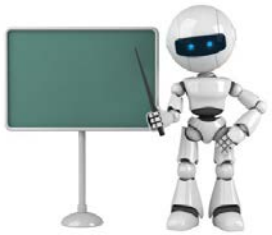
- Five different themes identified in Research Needs document:

https://www.src.org/program/ica/research-needs/ica-research-needs-20180207.pdf
https://www.nsf.gov/crssprgm/nano/reports/ICA2_Workshop_Report_2018.pdf

1. **Contextual knowledge:** Contextual knowledge is the key to aggregating the ever-growing volume of stimuli and limiting feedback to the user. Contextual knowledge is also temporal meaning context can change quickly over time. Need to develop a common 'world model' of knowledge.
2. **Holistic AI:** Cognitive AI must have a combination of long-term, machine learning and fast, one-shot learning. Future "Holistic AI" systems will combine different reasoning and learning methods with end-to-end intelligence.
3. **Social Science:** Humans are complex, emotional, and dynamic; any future Intelligent Agent will need to be adaptable to a given user. Enhancing human physico-cognitive capabilities is a main goal.
4. **Natural Human-ICA interfacing:** Future human-computer interfacing needs to be seamless, comfortable, empathic, and trustworthy. New paradigms are need beyond screen and keyboards.
5. **Edge Processing:** Future Intelligent Agents will need to do much more locally, which requires significant improvements in low power, edge processing. New computing architectures will be needed.

Suggested ICA Applications

- **Personal Adaptive Tutor**
  - Adapts to each individual students/employees
  - Awareness to things such as mood, surroundings, situation, etc
  - Leverage traits such as response time to assess knowledge absorption



- **Cognitive Assistants in Smarter Communities**
  - Address social and ethical aspects of cities and communities
  - Team Assistant to support collaborative work environments

- **Context-aware Assistant (E.g. Nail gun training)**
  - Seeing it would make basic information available in AR/HUD - where is the handle, safety, etc.
  - Pointing at others would display warnings
  - Automatic counting of nails, time, etc.

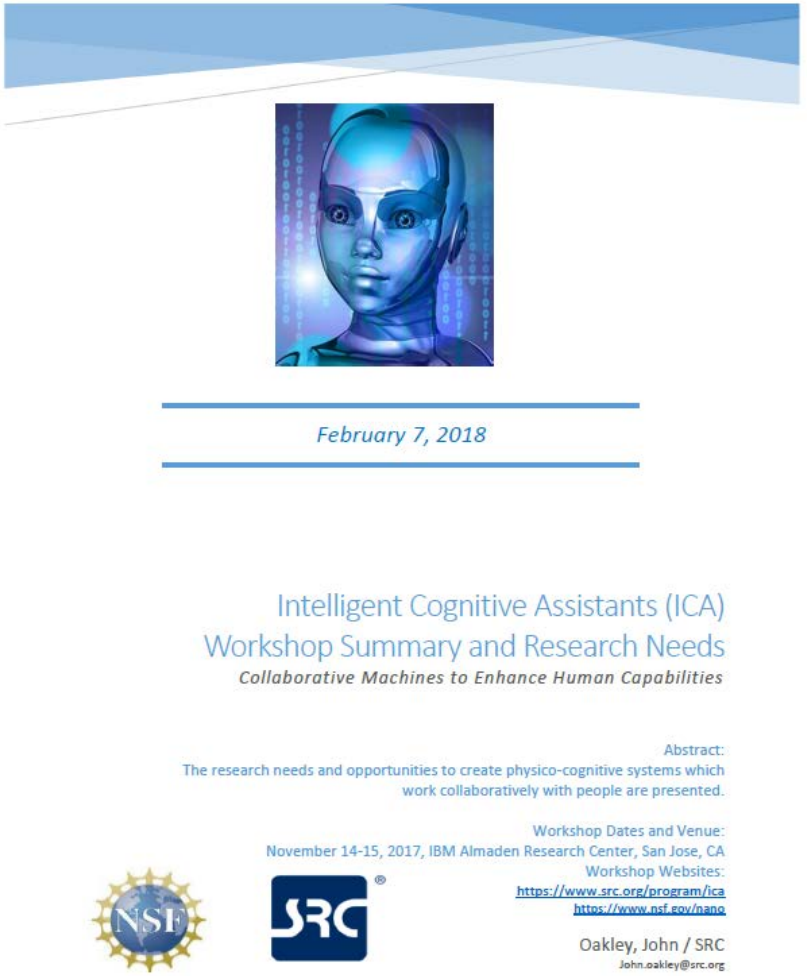
- **Elder Care**
  - Personal/Healthcare assistant to support specific needs
  - Knowledge of medicine habits and connections to doctors

- **Behavioral Models for Autonomous Vehicles**
  - Model the behavior of drivers and pedestrians in the context of “Intention and Negotiation”

- **Other Applications for consideration**
  - Global Instability
  - Environmental sustainability
  - Climate Change
  - Augment factory workforce to reduce repetitive tasks

Building the ICA Program

- Proven collaboration model
- 3 to 8 industrial sponsors
- Launch in 2019
- Research Projects
  - Cover one or more themes from workshop
  - Target an ICA application
- Target $3M/yr for 3 years
- 20+ research projects



February 7, 2018

Intelligent Cognitive Assistants (ICA)
Workshop Summary and Research Needs
Collaborative Machines to Enhance Human Capabilities

Abstract:
The research needs and opportunities to create physico-cognitive systems which work collaboratively with people are presented.

Workshop Dates and Venue:
November 14-15, 2017, IBM Almaden Research Center, San Jose, CA
Workshop Websites:
https://www.src.org/program/ica
https://www.nsf.gov/nano

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THANK YOU!

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