The AI Revolution: Toward a New Kind of Thinking

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- The Clark School is ranked **12th** (25th overall) in the nation among all peer public universities. --- *US News*
- The University of Maryland is **15th** overall in terms of innovation. --- *US News & World Report Global World Ranking*
- The University of Maryland is ranked **10th** for undergraduate and **15th** for graduate Programs --- *Entrepreneurship Magazine*
- The University of Maryland CS ranked **16th** in USA --- *US News*

The Institute for Systems Research

Since 1986, the leading center for interdisciplinary research in systems science and engineering (60+ faculty, 4 colleges)
Core areas: control, autonomy/AI, robotics, design & fabrication (nano-to-micro, medical, bio, supply chains)

**Faculty Highlights**

- 16 members of the National Academies
- 80 NSF Young Investigator / CAREER Awards
- 9 Presidential Early Career Awards (PECASE)
A new type of thinking is essential if mankind is to survive and move toward higher levels.

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Albert Einstein
writing in the New York Times
25 May 1946
DARPA’s Three Waves Progress in AI

- **DESCRIBE**: Handcrafted knowledge
- **PREDICT**: Statistical learning
- **EXPLAIN**: Contextual adaptation

1960s → 1989 (AI Winter)  ~1995 → Present (AI Summer)  Present → Future (Future)

For more info, check out DARPATV
John Launchbury @ https://www.youtube.com/watch?v=-O01G3tSYpU and
Brian Pierce @ https://www.youtube.com/watch?v=b9Z0cdi-V5U
DARPA’s Three Waves Progress in AI

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Expert systems  Planning tools
DARPA’s Three Waves Progress in AI

**DESCRIBE**  
Handcrafted knowledge

**PREDICT**  
Statistical learning

**EXPLAIN**  
Contextual adaptation

Source: gobelluno.it

Source: windsorstar.com

Source: wikimedia.org

Source: thrillist.com

**AlphaGo**

Source: windsorstar.com
DARPA’s Three Waves Progress in AI

DESCRIPT Handcrafted knowledge
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DARPA’s Three Waves Progress in AI

**Describe**
- Handcrafted knowledge

**Predict**
- Statistical learning

**Explain**
- Contextual adaptation

“Deep Neural Networks are Easily Fooled: High Confidence Predictions for Unrecognizable Images”. A. Nguyen et al., CVPR 2015

Credit: Andrej Karpathy, Li Fei-Fei
A Personal Perspective

Vast acceleration of industry investment in autonomy
Where do we even begin to focus?

Many autonomy opportunities in security and defense
They are problem-specific, operationally “disruptive”

Autonomy/Robot is not a replacement for a person
Its about Humans and Machines working together.
Human Thinking

From: US Army Knowledge Management Community of Practice
Human + Machine Thinking

- Information
- Knowledge
- Understanding
- Wisdom

Increasing Value / Decreasing Entropy
Increasing Context / Decreasing Noise

Sapience
(processing/cognitive ‘load’/ complexity)
Human + Machine Thinking

Increasing Value / Decreasing Entropy
Increasing Context / Decreasing Noise

Humans
Wisdom
Understanding
Knowledge
Information

Machines
Sapience
(processing/cognitive ‘load’/ complexity)
Human + Machine Thinking

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Information

Knowledge

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Understanding

Sapience

(processing/cognitive ‘load’/ complexity)

AI of today…
Enabling Wisdom

Can I understand it?
How do I communicate with the AI?

Can I work with it?
What does my job look like now?

Can I trust it?
How can I be sure?
University of Maryland: Initiative on Resilient and Trusted Autonomy

A university-wide initiative… key aspects:

**Systems-of-Systems Autonomy Engineering**
Autonomy in a systems context; as a systems component.

**Human-Machine Symbiotic Systems**
Human-systems integration; ethics, society, human-social systems.

**Autonomous Software Engineering Methodology**
Development of design patterns for autonomy.

**Empirical-Scientific Approach**
Hypothesis-driven verification and validation; build appropriate simulations & mathematical models; test fundamental limits
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