

Artificial Intelligence (R)evolution

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Slide Source Acknowledgement: DARPA Perspectives on AI, 2017 Siemens Corporate Research ECCV 2010 Presentation on Real-time Vision

Overview



- Objective of Talk:
 Provide an evolutionary perspective of artificial intelligence
- Key Points in Talk:
 - A Personal Intellectual Journey
 - Waves of AI and Paradigms
 - Al Trends
 - Integrative AI research in Frankfurt



A Personal Intellectual Journey

Personal Intellectual Journey





'Holistic Systems Thinking in Science, Technology, Management and Education'

Present A

2011

1994

1987

1984

Systems Engineering for Intelligence (GU) Systems Engineering Applied in Practice (Siemens Corporate Research)

Systems Engineering for Vision (U of Washington)

Computer Engineering (Breadth, Virginia Tech)

Electronics & Communication Engineering (India)

Competence

Key Al Scientists who influenced me...



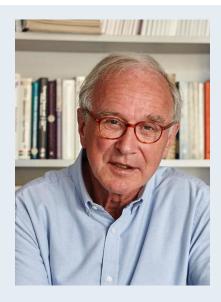




Prof. Robert Haralick
IAPR K.S.Fu Award, 2016
(Pattern Recognition, Image
Processing, Vision, AI)



Prof. Thomas Binford
Fellow, AAAI
(Father of Computer Vision,
Model based Perception in
Robotics)



Prof. Christoph v. d. Malsburg Fellow, International Neural Network Society (NeuroInformatics)

Vision Research at Siemens (2010)





- Initiated research programs in mid 90's
- Department formed in 2002
- Grew to a Global Center for Excellence in Vision-centric multimodal intelligence by 2007
- Integrative Platform strategy leveraged systems engineering principles.
- Balanced emphasis on systems science and engineering
- Numerous patents, products, solutions

Industrial Research in Vision: Security/Safety/Automation/Energy/Medical



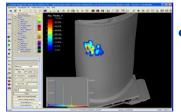












- System configuration is a function of:
 - Context
 - Tasks
 - Requirements
- Cognitive Architecture related to dual-system models in psychology
 - Hybrid designs –
 leveraging both machine
 learning, model based
 design by human
 experts

Framework addresses:

Predictability, Scalability, Modularity and Extensibility

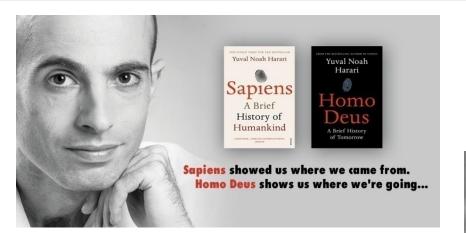


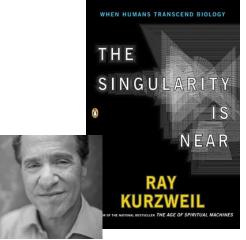
Waves of Al

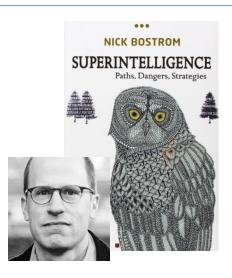
Promise and Risks of Al(R)evolution











Human and Technology Evolution, Singularity, Super Intelligence – Existential risk from Al

What is Intelligence?

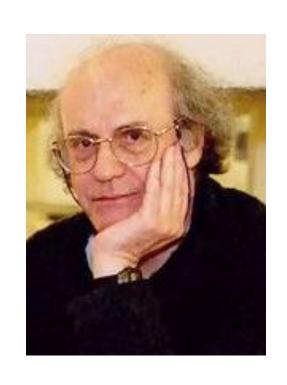


Prof. Aaron Sloman:

(Philosopher of AI, U. Birmingham, UK)

"If you force me to answer, it is Lazy-Productiveness"

Personal conversation – 'Philosophy of Al' conference in 2011



Source: DARPA, 2017

Three Waves of Al



John Launchbury:

(Director, I2O, DARPA)



First Wave: Second Wave: Third Wave: Handcrafted Knowledge Statistical Learning Contextual Adaption

First two Waves of Al





Handcrafted Knowledge

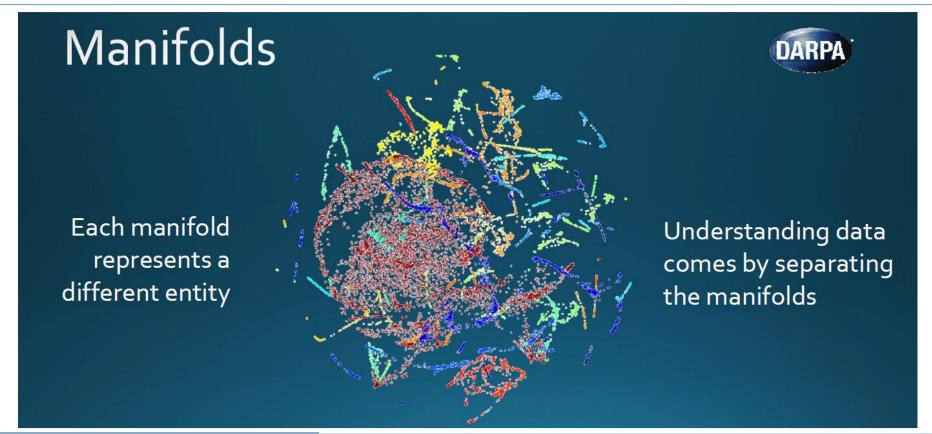


Statistical Learning

Natural data in high dimensions



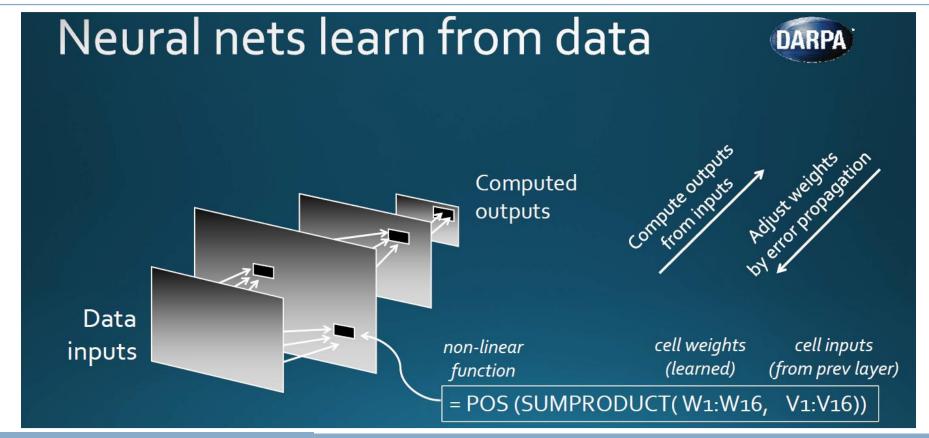




Back Propagation based Learning

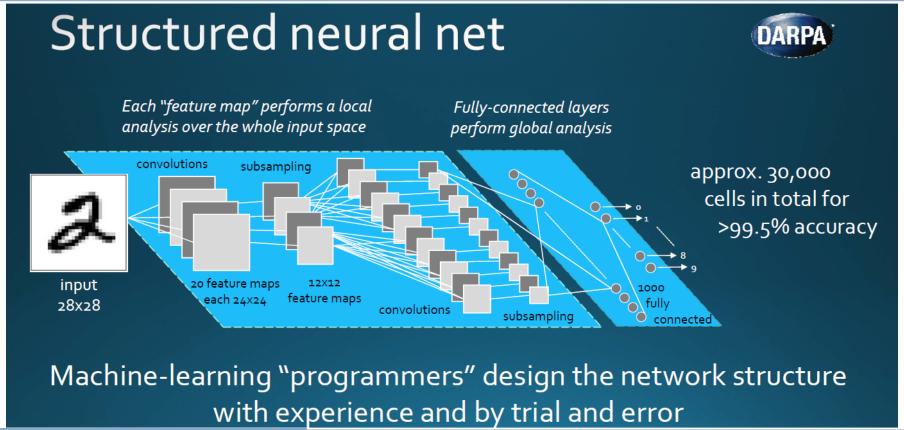






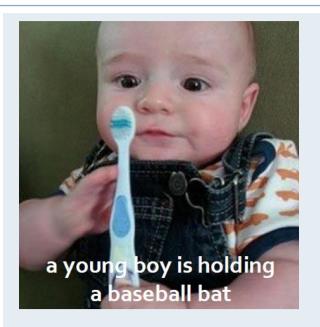
Neural Network Design



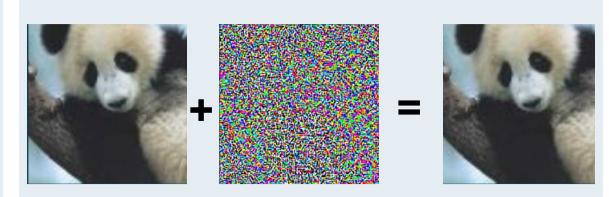


Limitations – Second Wave





Statistically impressive, but individually unreliable



Slight adversarial perturbations lead to misclassification.

<1% targeted

distortion

"Panda"

"Gibbon"

99.3%

confidence

Pioneers of Second Wave:



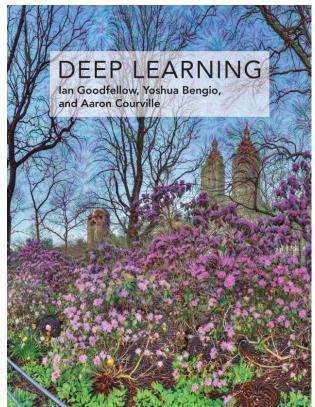




Yann Lecun Facebook Al



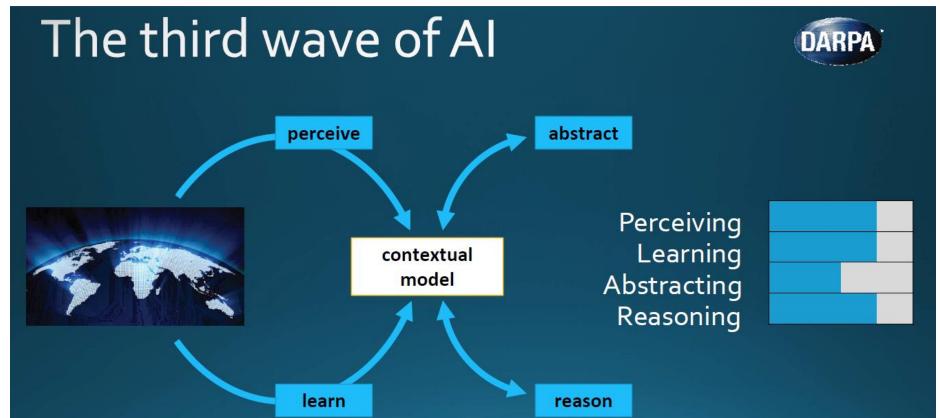
Yoshua Bengio U. Montreal



Geoff Hinton, U. Toronto/Google

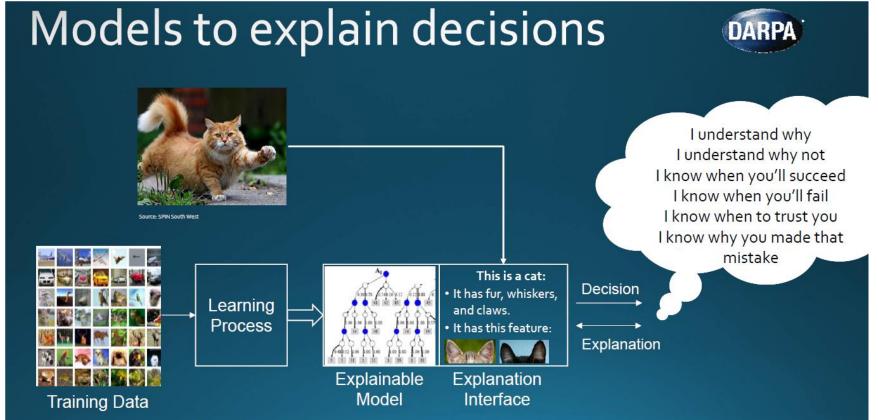
Third Wave





Explainable Al





Explainable Al



Models to drive decisions

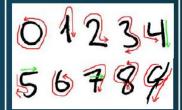


Probable number of strokes: 1 - 4
Each stroke: probable trajectory
Each trajectory: probable shift in
shape and location

Seed model

Generative model
Generates explanations of how a test
character might have been created





Training data

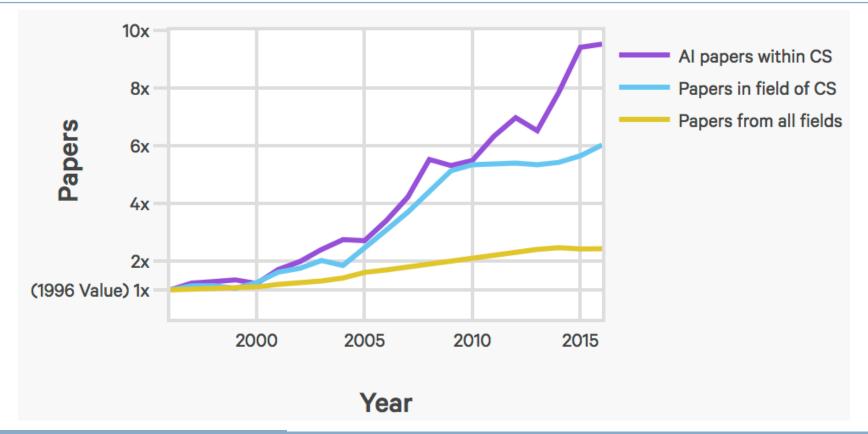


Trends

Scientific research in AI: Growth of Annually Published Papers







Rapid Al prototyping is enabled by Open Source Platforms









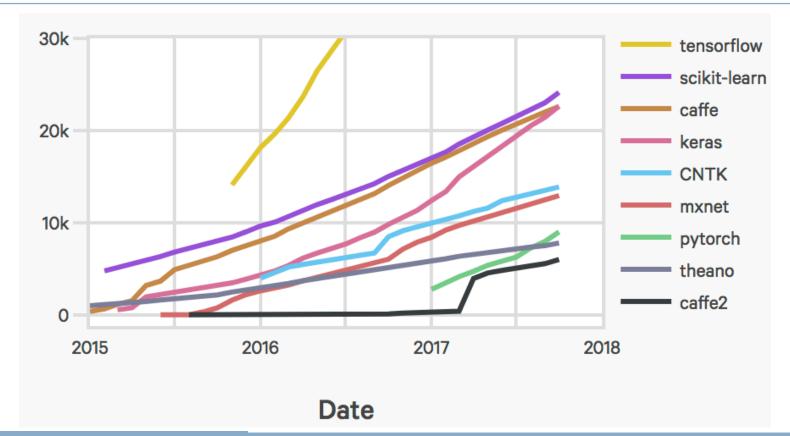




GitHub Stars of Al Software Libraries







Sampling of Current ML Research



- Cognitive Architectures and Learning Paradigms
 - Hybrid AI architectures
 - Predictive Learning
 - Probabilistic Programming
 - Meta-learning for End to End system training
- Generative Adversarial Networks
- Formal theory for Deep learning



Integrative AI in Frankfurt

Integrative-Al at Frankfurt

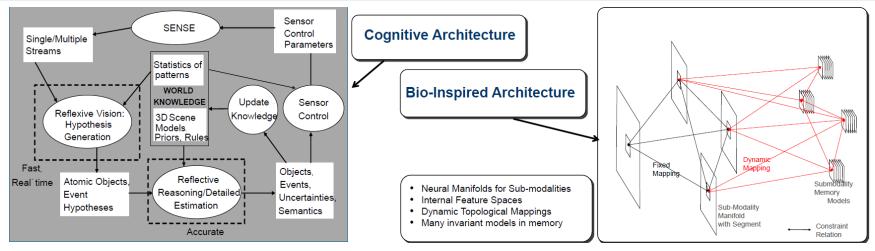


- Model-based Design for Vision: Exploration of scientific questions at systems level (what architectures, representations, what granularity at module level, cue fusion strategies)
- Fusion of model-based thinking with data-driven learning minimizing user involvement in design (autonomous learning of structure and parameters, continuous learning)
- Design Automation for Al

BFNT-Frankfurt Initiative: Outcomes



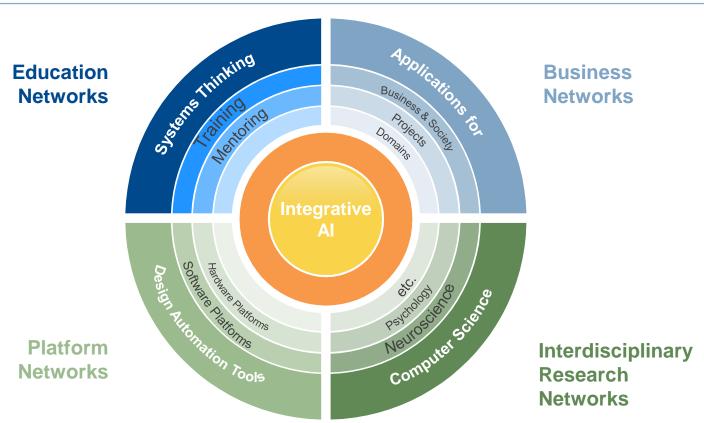




- Platforms: Architecture, integration, simulation tools and case study for rapid prototyping.
- Demonstrators: video surveillance and automotive domains.
- Education: Structured curriculum for Integrative-Al
- Seeding of International Research Network for Systems Engineering for Intelligence

Core Elements for Integrative-Al









Thank you!



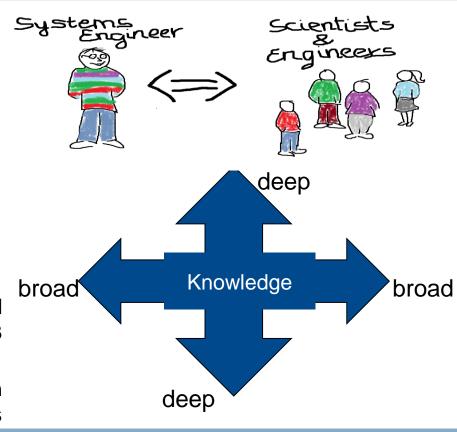
Backup Slides



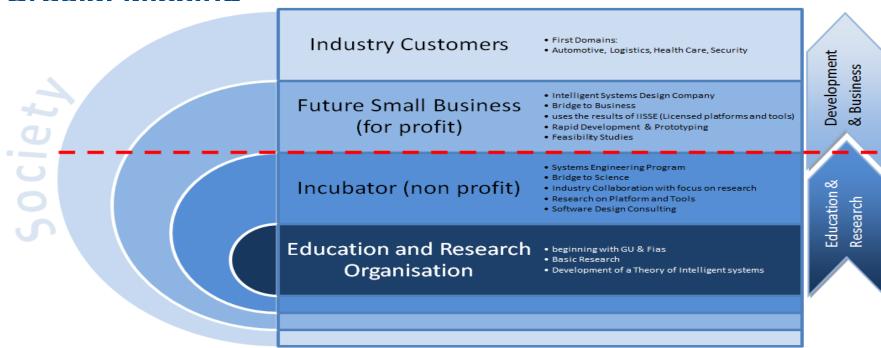
Education and Technology Transfer Initiatives



- Complex data analytics systems require Findless in the first systems require
- > for Complex Systems Res vno:
 - > Can work in large teams and projects
 - Lead and manage distributed, global (multicultural) teams
 - Have depth in specific areas as well as sufficient breadth to bridge across disciplines
- Training "Systems Thinkers" with required breach" Harlie idepth requires after diplom/masters education.
- Further training is needed for experts who can design, implement and validate Al solutions



Crucial Missing





Open Innovation Networks for Safe-Al



·R Seciuring Competitive news Arequire:

(*seurge: Boston Consulting, 2017)

- In Human ways of working
- Machine Learning
- Flexibility to embrace continuous change
 - Adaptive organizations
 - Al-driven job adaptation, continuous training, and Education
- Business Differentiation via
 - Talented workforce



IISSE



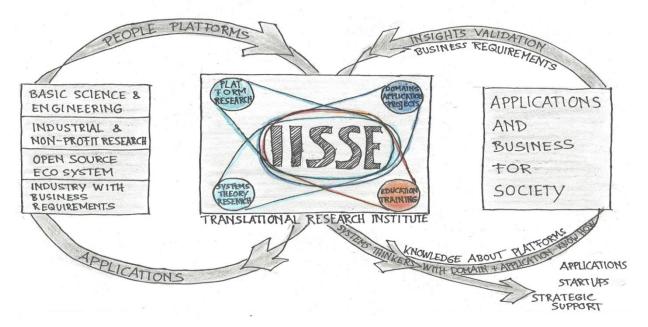




An Open Innovation Network for Systems Science and Engineering for Safe-Al

IISSE – A Catalyst for Safe Al Innovations





Agile, Flexible Organization and Management for rapid Al innovation:

(People, Technology Platforms, Processes, Societal Needs) →

(Al startups, R&D organizations for Al, Accelerated Al products)

Activities towards Achieving Goals





- Intelligent Systems Science and Engineering Program
 - Foundations laid by, recently concluded, BMBF funded Bernstein Focus in Neuro Technology, Frankfurt
- Interdisciplinary Scientific and Industrial Research network within Frankfurt area
- International research, education and industrial network (India, UK, North America)
- Industrial Customers (Startups, Medium, Large companies))