Information 4.0 and Deep Learning

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Recent research in the deep learning field has produced a plethora of new architectures and techniques. At the same time, a growing number of groups are applying deep learning to new applications. This talk presents a conceptual framework for understanding few developments. You can leverage this framework to understand how deep learning technology will affect the future.

Sources:  [www.deeplearningpatterns.com](http://www.deeplearningpatterns.com)  
[www.medium.com/intutionmachine](http://www.medium.com/intutionmachine)
Objective of this Talk

Present a high-level conceptual framework to understand the Deep Learning.

Present the latest Deep Learning research and attempt to predict where it is heading.

Relate developments with a focus on context and Information 4.0
What is Deep Learning Made of?
1. Classification Only (C)

2. Classification - Memory (CM)

3. Classification - Explicit Knowledge (CK)

4. Classification - Imperfect Knowledge (CIK)

5. Collaborative Classification - Imperfect Knowledge (CCIK)
Ilities

- **Expressibility** — This quality describes how well a machine can approximate functions.

- **Trainability** — The other kind of research that gets published is on how well can a machine learn.

- **Generalizability** — This is a quality that describes how well a trained machine can perform predictions on data that it has not seen before.

Others: interpretability, transferability, latency, adversarial stability
Generalization

- Definition 1: Error Response to Validation and Real Data
- Definition 2: Sparsity of Model
- Definition 3: Fidelity in Generating Models
- Definition 4: Effectiveness in Ignoring Nuisance Features
- Definition 5: Risk Minimization
Supervised Learning
Reinforcement Learning

- Reinforcement Learning
  - Policy Optimization
    - Derivative Free Optimization/Evolution
    - Policy Gradients
  - Dynamic Programming
    - Policy Iteration
    - Value Iteration
      - Actor Critic Methods
      - Q-Learning
Unsupervised Learning (aka Predictive)
Current Trends

- Hardware will accelerate doubling Moore’s law (i.e. 2x in 2017).
- Convolution Networks (CNN) in Different Contexts
- Meta-Learning
- Reinforcement Learning
- Adversarial and Cooperative Learning (GANs)
- Transfer Learning and Domain Adaptation
- More Applications will use Deep Learning as a component rather than end-to-end.
- Engineering will outpace Theory
Modularity
Game Theoretic Coordination
Meta Learning

- Policy Gradient RL
- Weight Initialization
- Hyper-Parameters
- Layers
- Connections
- Weights

Neural Architecture Search LSTM
Handcrafted Knowledge—Where programmers craft sets of rules to represent knowledge in well defined domains.

Statistical Learning—Where programmers create statistical models for specific problem domains and train them on big data.

Contextual Adaptation—Where systems construct contextual explanatory models for classes of real world phenomena.
Late-Binding

Figure 1: Matching Networks architecture
Context vs Information

Diagram:
- Contextual Adaptation
- Zero-Shot Learning
- One-Shot Learning
- Few-Shot Learning
- Active Learning
- Semi-Supervised Learning
- Supervised Learning
- Transfer Learning
- Unsupervised Learning
- Reinforcement Learning
Re-inventing the Cognitive Stack

- Logical
- Interpersonal
- Verbal
- Intrapersonal

Reasoning
- Visual Spatial
- Musical Rhythmic
- Naturalistic
- Kinesthetic

Intuition
- Acting Fast
- Memory Limits
- Lack of Meaning
- Too Much Information

Instinct
Dimensions of Intelligence
Deep Learning Playbook

https://gumroad.com/products/WRbUs