ARTIFICIAL INTELLIGENCE

ICDPPC 2018 Side Event
Digital Data Flows Master Class: Emerging Technologies in Association with

Oliver Grau
Intel Deutschland GmbH
Chair ACM Europe TPC,
Visiting Professor Surrey University, UK
What is AI?

How AI works

Challenges
Artificial Intelligence

.. Is the study of the computations that make it possible to perceive, reason and act. (Winston1992)

.. is the ability of machines to learn from experience, without explicit programming, in order to perform cognitive functions associated with the human mind.
MACHINE LEARNING
Algorithms designed to deliver better insight with more data

Regression (Linear/Logistic)
Classification (Support Vector Machines/SVM, Naïve Bayes)
Clustering (Hierarchical, Bayesian, K-Means, DBSCAN)
Decision Trees (RandomForest)
Extrapolation (Hidden Markov Models/HMM)
More...

DEEP LEARNING
Neural networks used to infer meaning from large dense datasets

Image Recognition (Convolutional Neural Networks/CNN, Single-Shot Detector/SSD)
Speech Recognition (Recurrent Neural Network/RNN)
Natural Language Processing (Long-Short Term Memory/LSTM)
Data Generation (Generative Adversarial Networks/GAN)
Recommender System (Multi-Layer Perceptron/MLP)
Time-Series Analysis (LSTM, RNN)
Reinforcement Learning (CNN, RNN)
More...

REASONING
Hybrid of analytics & AI techniques designed to find meaning in diverse datasets

Associative Memory
Rule-based Reasoning (deductive, inductive reasoning)
See also: machine & deep learning techniques
More...
AI is the driving force.

The path to deeper insight.

- **Operational Analytics**
  - Descriptive Analytics
  - Diagnostic Analytics
  - Insight
    - What Happened and Why?
  - Foresight
    - What Will Happen, When, and Why?
  - Hindsight
    - What Happened?

- **Advanced Analytics**
  - Predictive Analytics
  - Prescriptive Analytics
  - Forecast
    - How Should I Proceed?

- **Cognitive Analytics**
  - Self-Learning
    - How Do I Proceed?
What is AI?  How AI works  Challenges
Building block: Classification for decisions making

Linear separator = Perceptron neural network

\[ f(a,b) = \begin{cases} 1 & \text{if } x_1w_1 + x_2w_2 + b > 0; \\ 0 & \text{otherwise} \end{cases} \]

Extension of data-set causes bias

Multi-layer neural networks for more complex data distributions

x1

x2

0

1
MACHINE VS. DEEP LEARNING

**MACHINE LEARNING**
How do you engineer the best features?

\[ \begin{array}{c}
N \times N \\
\end{array} \]

- \((f_1, f_2, \ldots, f_K)\)
- Roundness of face
- Distance between eyes
- Nose width
- Eye socket depth
- Cheek bone structure
- Jaw line length
- etc.

**CLASSIFIER ALGORITHM**
- SVM
- Random Forest
- Naïve Bayes
- Decision Trees
- Logistic Regression
- Ensemble methods

**DEEP LEARNING**
How do you guide the model to find the best features?

\[ \begin{array}{c}
N \times N \\
\end{array} \]

**NEURAL NETWORK**

**Arjun**

**Arjun**
DEEP LEARNING BREAKTHROUGHS

Machines able to meet or exceed human image & speech recognition

**IMAGE RECOGNITION**

- Human: 97% person
- Present: 99%

**SPEECH RECOGNITION**

- Human: 99% “play song”
- Present: 99%

**Example Applications**

- Tumor Detection
- Document Sorting
- Oil & Gas Search
- Voice Assistant
- Defect Detection
- Genome Sequencing

Deep Learning Basics

Training

Lots of labeled data!

Human

Bicycle

Strawberry

Inference

Forward "Strawberry"

Backward

Error

Model weights

Forward "Bicycle"?

Did You Know?

Training with a large data set AND deep (many layered) neural network often leads to the highest accuracy inference.
What is AI?  How AI works  Challenges
Challenges in Automated Driving

- Biggest question: Is it safe?
- Neural networks are not deterministic! How do they work?
- Would you learn a driving policy? From whom?

Detect objects

- Camera image
- AI
- Semantic segmentation

AI?

Automated Control–driving policy
Understanding Deep Networks

Learning Deep Features for Discriminative Localization

Bolei Zhou, Aditya Khosla, Agata Lapedriza, Aude Oliva, Antonio Torralba
Massachusetts Institute of Technology
Societal Challenges

- AI need lots of data to work: **Privacy** if data from public required
- **Trust** of AI methods in general because of lack in understanding the underlying principles
Summary

• ML-based AI methods, in particular neural networks rely on training data
  + perfectly adapt to a task
  + outperforms many traditional methods
  - problems with biased data
  - lack of explainability

• Societal and commercial challenges
  • Unbiased data
  • Privacy vs. Rich data sets of everything
  • New products must solve: Trust, regulatory obligations, Safety
Further reading


Thank you!

Contact: Oliver.Grau@intel.com