



Applications of Artificial Intelligence : An Overview

Dr. Tushar Bhardwaj
Applied Research Center
Florida International University

FLORIDA INTERNATIONAL UNIVERSITY

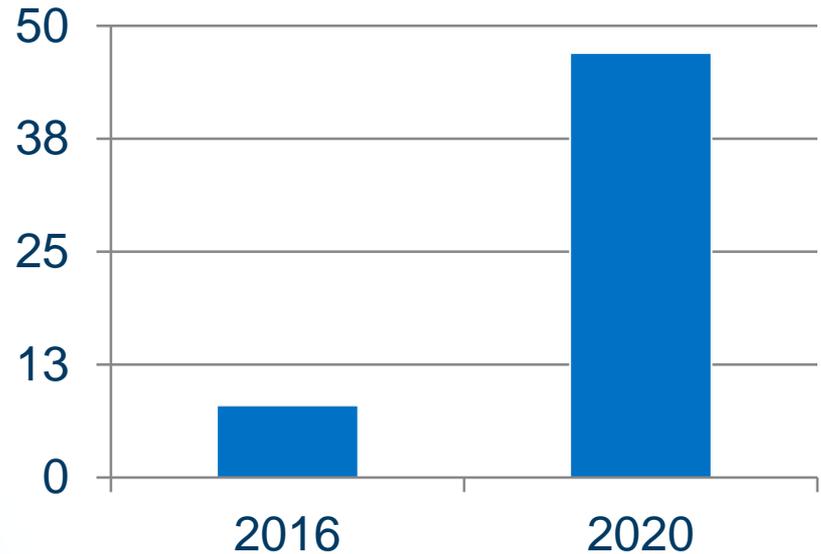


AI Is The New Electricity

“About 100 years ago, electricity transformed every major industry. AI has advanced to the point where it has the power to transform...every major sector in coming years.”

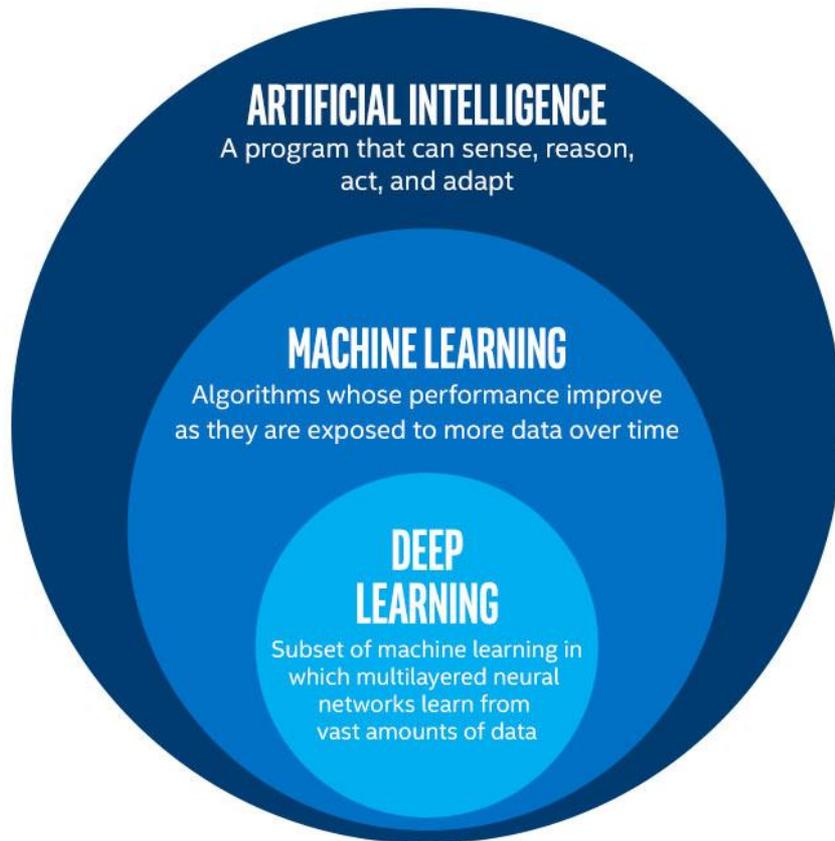
-Andrew Ng, Stanford University

*Projected Revenue (in billions USD)
Generated from AI, 2016-2020 (IDC)*



Definitions

- Artificial Intelligence
- Machine Learning
- Deep Learning



Artificial Intelligence

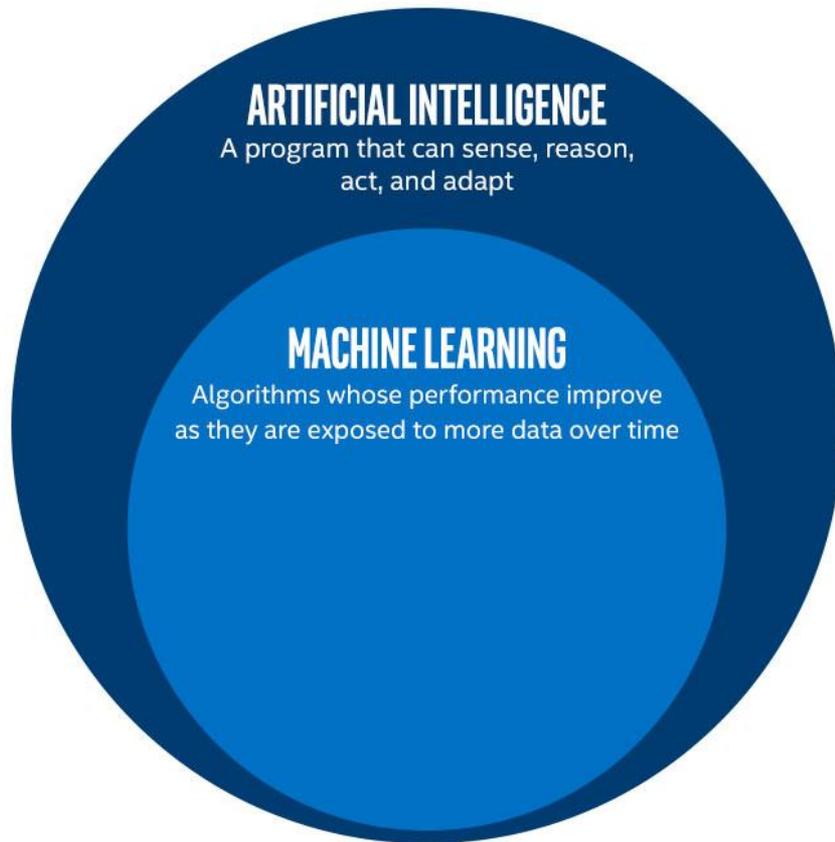
“A branch of computer science dealing with the simulation of intelligent behavior in computers.” (Merriam-Webster)

“A program that can sense, reason, act, and adapt.” (Intel)

“Colloquially, the term ‘artificial intelligence’ is applied when a machine mimics ‘cognitive’ functions that humans associate with other human minds, such as ‘learning’ and ‘problem solving’.” (Wikipedia)

Machine Learning

“The study and construction of programs that are *not explicitly programmed*, but learn patterns as they are exposed to more data over time.” (Intel)



Machine Learning

These programs learn from repeatedly seeing data, rather than being explicitly programmed by humans.



Machine Learning Example

- Suppose you wanted to identify fraudulent credit card transactions.
- You could define features to be:
 - Transaction time
 - Transaction amount
 - Transaction location
 - Category of purchase
- The algorithm could learn what feature combinations suggest unusual activity.



Machine Learning Limitations

- Suppose you wanted to determine if an image is of a cat or a dog.
- What features would you use?
- This is where **Deep Learning** can come in.

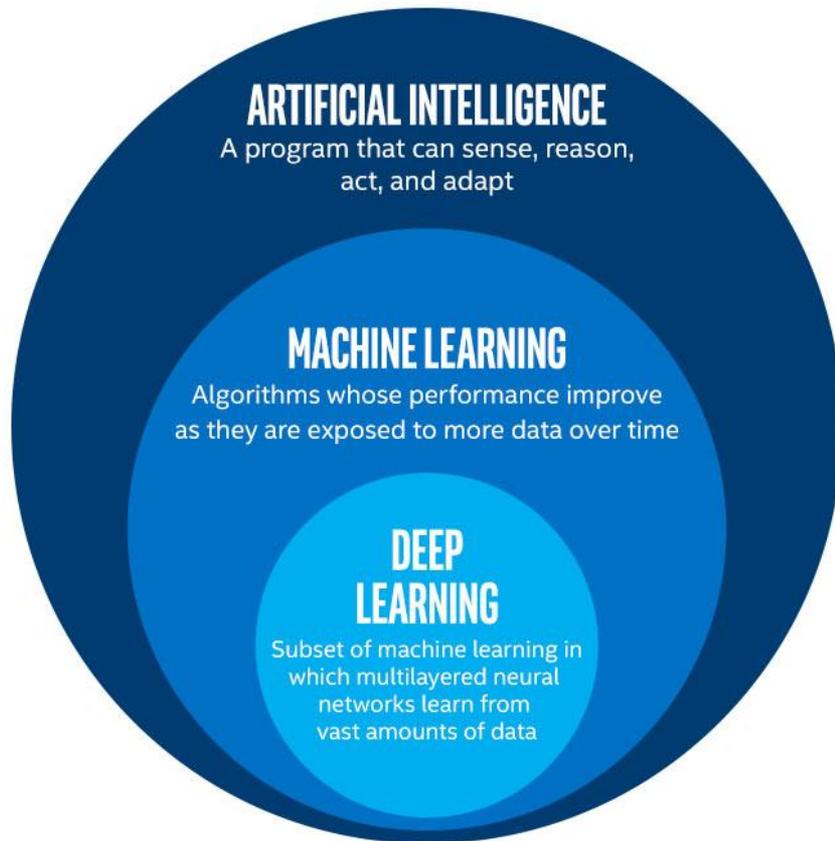


Dog and cat recognition

Deep Learning

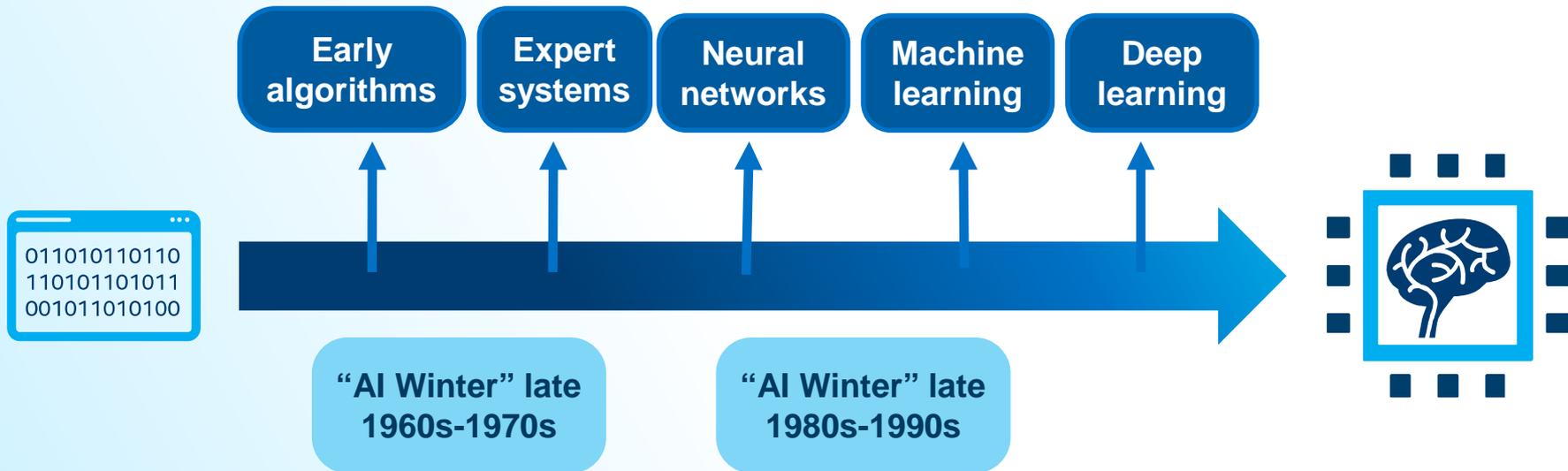
“Machine learning that involves using very complicated models called “deep neural networks”.” (Intel)

Models determine best representation of original data; in classic machine learning, humans must do this.



History of AI

AI has experienced several hype cycles, where it has oscillated between periods of excitement and disappointment.



Deep Learning Breakthroughs (2012 – Present)

- In 2012, deep learning beats previous benchmark on the ImageNet competition.
- In 2013, deep learning is used to understand “conceptual meaning” of words.
- In 2014, similar breakthroughs appeared in language translation.
- These have led to advancements in Web Search, Document Search, Document Summarization, and Machine Translation.



Google Translate

Deep Learning Breakthroughs (2012 – Present)

- In 2014, computer vision algorithm can describe photos.
- In 2015, Deep learning platform TensorFlow* is developed.
- In 2016, DeepMind* AlphaGo, developed by Aja Huang, beats Go master Lee Se-dol.



Modern AI (2012 – Present): Deep Learning Impact

Computer vision



Self-driving cars:
object detection



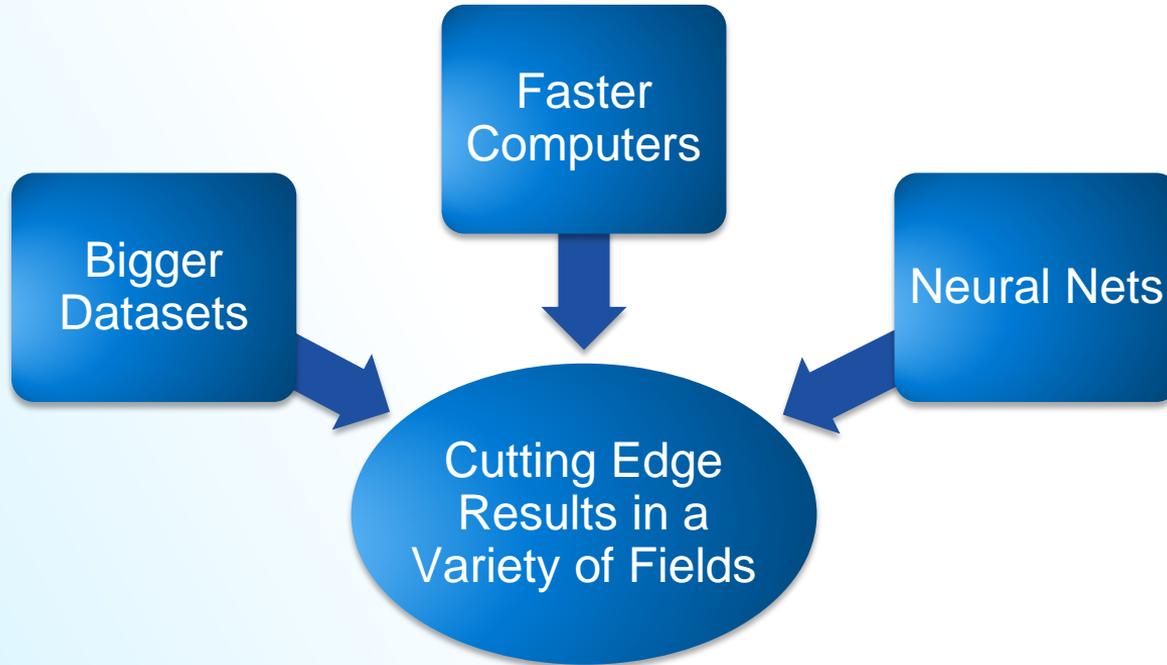
Healthcare:
improved diagnosis

Natural language



Communication:
language translation

How Is This Era of AI Different?



Other Modern AI Factors

- Continued expansion of open source AI, especially in Python*, aiding machine learning and big data ecosystems.
- Leading deep learning libraries *open sourced*, allowing further adoption by industry.
- Open sourcing of large datasets of millions of labeled images, text datasets such as Wikipedia has also driven breakthroughs.



Transformative Changes



Health

Enhanced
Diagnostics
Drug Discovery
Patient Care
Research
Sensory Aids



Industrial

Factory
Automation
Predictive
Maintenance
Precision
Agriculture
Field
Automation

Source: Intel forecast

Transformative Changes



Finance

Algorithmic Trading
Fraud Detection
Research
Personal Finance
Risk Mitigation



Energy

Oil & Gas Exploration
Smart Grid
Operational Improvement
Conservation

Source: Intel forecast

Transformative Changes



Government

Defense
Data
Insights
Safety &
Security
Engagement
Smarter
Cities



Transport

Autonomous
Cars
Automated
Trucking
Aerospace
Shipping
Search &
Rescue

Source: Intel forecast

AI Omnipresence In Transportation

Navigation



Google & Waze find the fastest route, by processing traffic data.

Ride sharing



Uber & Lyft predict real-time demand using AI techniques, machine learning, deep learning.

AI Omnipresence In Social Media

Audience



Facebook & Twitter use AI to decide what content to present in their feeds to different audiences.

Content



Image recognition and sentiment analysis to ensure that content of the appropriate “mood” is being served.

AI Omnipresence In Daily Life

Natural language



We carry around powerful natural language processing algorithms in our phones/computers.

Object detection

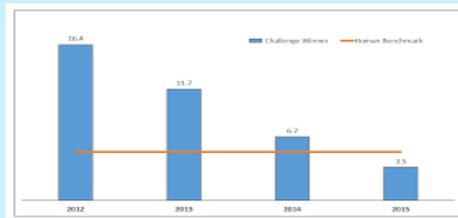


Cameras like Amazon DeepLens* or Google Clips* use object detection to determine when to take a photo.

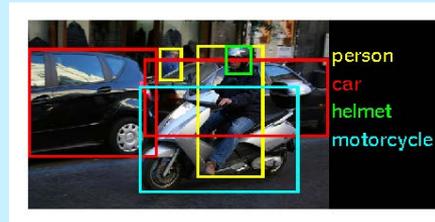
Latest Developments: Computer Vision



Deep Learning
“proven” to work for
image classification.



Models outperform
humans on image
classification.



Object detection
models beat previous
benchmarks.

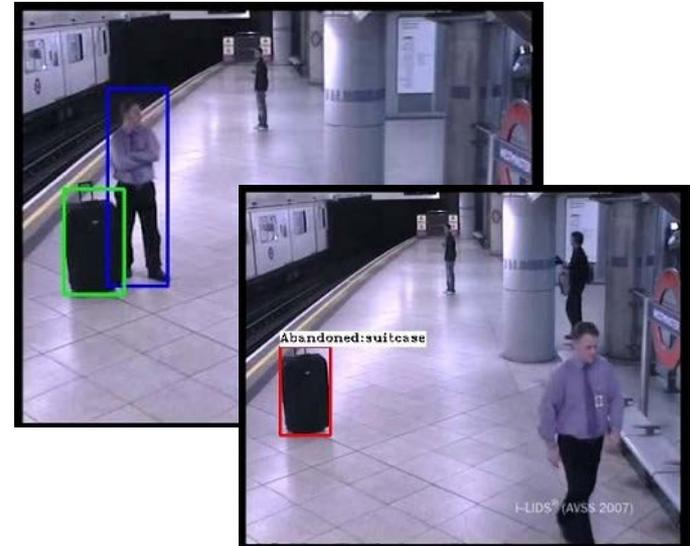
2012

2015

2016

Application Area: Abandoned Baggage Detection

- We can automatically detect when baggage has been left unattended, potentially saving lives.
- This system relies on the breakthroughs we discussed:
 - Cutting edge object detection.
 - Fast hardware on which to train the model (Intel® Xeon® processors in this case).



Abandoned baggage

Healthcare: Medical Diagnosis

Traditionally : Medical Diagnosis was a challenging process.

- Many symptoms are nonspecific
- Process of elimination was used to determine root cause (neither efficient nor exact)



Healthcare: Medical Diagnosis

Now with AI : Doctors can provide diagnoses more efficiently and accurately, with the availability of:

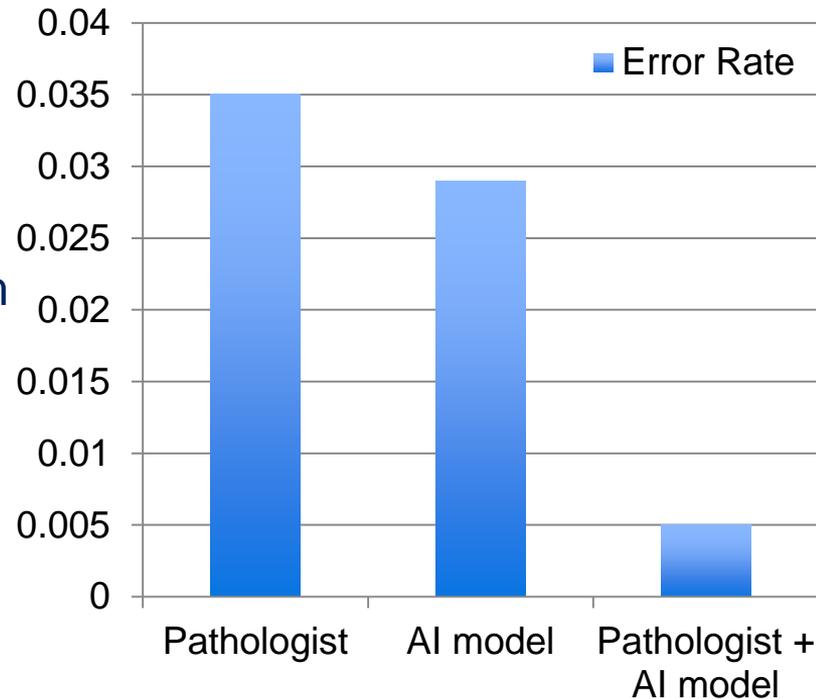
- Large medical datasets
- Computer vision algorithms



Healthcare: Medical Diagnosis

Example: Breast Cancer, 2016, Harvard Medical School researchers

- Used DL to identify cancer in lymph node images
- Used Convolutional Neural Nets and custom hardware
- AI model combined with humans achieved lower error than either one individually



Healthcare: Treatment Protocol

Traditionally : Doctors would diagnose a condition and recommend a treatment based on what historically worked for most people.

- Some considerations for population/demographics
- Difficult to create custom treatments without extensive research/cost



Healthcare: Treatment Protocol

Now with AI : Doctors can tailor treatments to individual patients.

- Large medical datasets
- ML and DL algorithms
- Population/demographics analysis/simulations



Healthcare: Drug Discovery

Traditionally : Each new drug approval costs over a billion dollars in Research and Development.

- The cost has been doubling every 9 years since 1970
- The drug discovery process can take decades
- 9 out of 10 drug approval attempts fail
- There are currently only 1,500 approved drugs



Healthcare: Drug Discovery

Now With AI : Companies are leveraging structured and unstructured data with AI, to establish a pipeline of new drug discovery.

- There are 10^{20} possible drug-like molecules
- Massive space for potential discovery



Healthcare: Surgery

Traditionally : Every type of surgery poses possible risks to the patient.

- Adverse anesthesia effects
- Operational complications



Healthcare: Surgery

Now with AI : Semi-intelligent computer systems predict surgical steps, identify complications, and warn surgeons about pending challenges.

- Computer “vision” leverages data from laparoscopic and arthroscopic cameras
- Smart systems automate dictation by generating notes during the surgery
- Surgeons can send point-of-view live feeds of the operative site to experts anywhere in the world for real-time advice.



Transportation: Autonomous Cars

Traditionally : Despite having safer cars, the number of deadly car accidents have been on the rise the last few years.

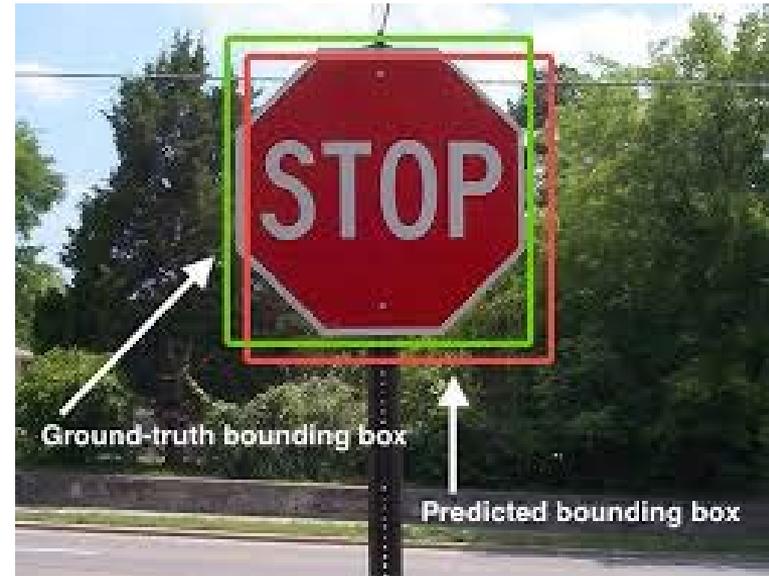
- The leading cause of automobile accidents is human error
- One of the primary sources of traffic jams is each driver acting out of self-interest, that prevents traffic flow
- Part of the population who can't drive: children, the elderly, and the disabled



Transportation: Autonomous Cars

Now with AI : Self-driving cars are enabled by the latest AI breakthroughs in computer vision.

- Cars identify stop signs, lane lines, and other landmarks via DL tools
- Mapping technology can use computer vision to detect addresses
- Cars triangulate and can use other 3D-sensing technologies, such as LIDAR and RADAR



Transportation: Autonomous Cars

Example: Waymo, the autonomous vehicle division of Alphabet Inc.

- Waymo has been operating self-driving minivans without a safety driver since October 2017
- Waymo's Carcraft* software accelerated the car's development, with 2.5 billion simulated miles driven in 2016
- The system used DL together with massive data sets collected from self-driving cars on public roads



Transportation: Automated Trucking

Traditionally : There is a shortage of 48,000 drivers nationwide.

- Driver turnover rates at some companies reach 300%
- Truck drivers are twice as likely as other workers to be obese and/or have diabetes
- Truckers are half as likely to have health insurance
- The number of accidents and fatalities have increased in recent years



Transportation: Automated Trucking

Now with AI : Autonomous trucks can coordinate movements with other trucks.

- Save on fuel, and reduce wind-drag and the chance of a collision
- Video, LIDAR, and accelerometers are used to collect detailed data about the truck's surroundings
- Guidance algorithms provide feedback for braking, steering, and throttling commands, based on incoming and historical data



Retail : AI in Supply Chain and Customer Experience

Traditionally : Americans are shifting their spending from material goods to experiences.

- The “Amazon effect”: there have been nine major retail bankruptcies in 2017
- Retailers need to become competitive or risk obsolescence
- Balancing “out-of-stock” with “over-stock” trade-off requires great finesse



Retail : AI in Supply Chain and Customer Experience

Now with AI : Companies bring experience and optimization to retail shopping.

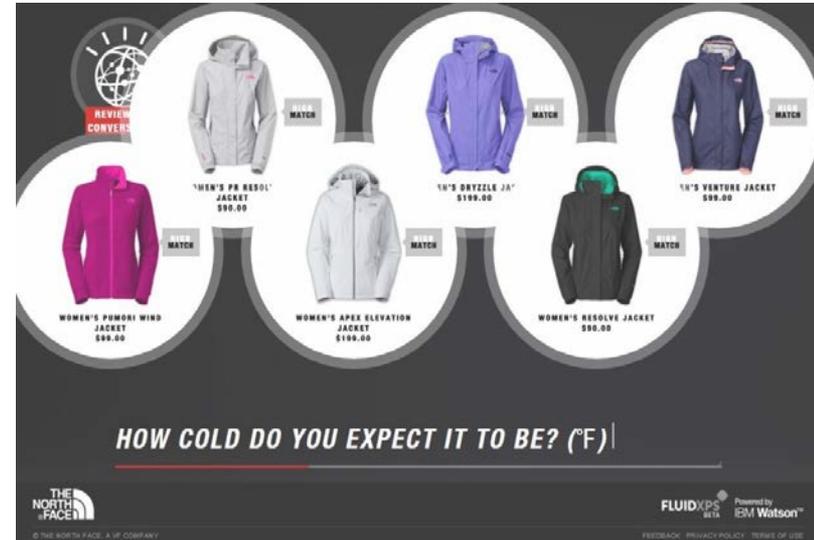
- AI-powered gift concierge learns your preferences as you engage, and can help predict the appropriate gift to buy
- Leveraging ML-trained agents, companies are providing recommendations via natural language
- Companies using AI via Watson* to monitor factors from weather to consumer behavior, to optimize consumption rate predictions



Retail : AI in Customer Experience

Example: The North Face and Watson* are combining massive datasets and AI, to bring the brick-and-mortar experience to e-commerce.

- The North Face, with Fluid and IBM Watson*, has launched XPS* - an AI-enabled digital expert that uses a natural language interface to help shoppers.
- XPS curates and filters the available options, so shoppers are more likely to make a purchase



Finance: Fraud Detection

Traditionally : Fraud is on the rise, but fraud detection is a challenging problem to solve correctly.

- Historically, a predefined rule-set was used for fraud identification, but this approach misses much of the nuance that surrounds fraud
- 1/3 of falsely identified fraud events result in lost customers
- In the US, this loss is worth 13 times the cost of actual fraud



Finance: Fraud Detection

Now with AI: With ML techniques, banks can predict fraud based on a behavioral baseline to compare against.

- Uses historical shopping data and shopping habits of customers
- Compares new data to baseline to determine likelihood of fraud



Finance: Fraud Detection

Example: Sift Science

- Established a fraud data consortium developed from over 6000 websites to leverage large-scale real-time ML
- Autonomously learns new fraud patterns based on billions of user actions



Finance: Risk Management

Traditionally : New regulations force tighter control on financial institutions.

- New business model disruptions
- Increasing pressure on costs and returns



Finance: Risk Management

Now with AI : ML can help discern the credit worthiness of potential customers

- Tailor a financial portfolio to fit the goals of the user using ML algorithms.
- Financial institutions can develop early warning systems for automated reporting, portfolio management, and recommendations based on ML.



Finance: Management

Example: ZestFinance

- Traditional underwriting systems make decisions using few data points.
- Those with a limited credit history are often denied credit, ultimately leading to loss of revenue for lenders.
- ZestFinance leverages thousands of data sources together with ML to more accurately score borrowers, even people with a small credit history.



Finance: Stock Trading

Traditionally : The speed and volume of information is daunting.

- The market is reactionary.
- It's difficult to remain competitive while relying on traditional trading methods.
- Fundamental analysis is unable to show the entire financial picture.



Finance: Stock Trading

Now with AI : Companies use massive datasets together with DL methods for better forecasting.

- Data pulled from financial, political, and social media
- Analyst reports combined.



Finance: Stock Trading

Example: Sentient Technologies, and Learning Evolutionary Algorithm Framework (LEAF*)

- Manages millions of data points to find trends and make successful stock trades.
- AI algorithms identify and combine successful trading patterns.
- Successful strategies are tested in the real world, evolving autonomously with LEAF.
- Sentient has received more funding than any other AI company.



Legal Disclaimers

No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.

Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.

Copies of documents which have an order number and are referenced in this document may be obtained by calling 1-800-548-4725 or by visiting www.intel.com/design/literature.htm.

Intel and the Intel logo are trademarks of Intel Corporation in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others

Copyright © 2018 Intel Corporation. All rights reserved.