



How to Make Smarter Decisions with Big Data, IoT and Machine Learning.

Joe Raio
Microsoft Technical Evangelist

William Hahn, PhD
FAU, MPCR, VoxelRx



Joe Raio

Senior Technical Evangelist

DX Audience

joe.raio@microsoft.com

joeraio.com

@joescars

About Me: Based in Miami, FL.

Recently Married. Passions are Music,
Aviation and all things Technology





William Hahn

- Guilford College: Mathematics/Physics
- UNC Greensboro: AI
- FAU: PhD Research in Machine Perception
- Co-Director Machine Perception Cognitive Robotics Lab
- Lab Projects: Neural Networks for Computer Vision, Self Driving RC Cars, Self Driving Golf Cart.
- CEO VoxelRx Deep Learning Medical Imaging



*“I need our systems to think.
I need them to learn and
I need them to present issues
and problems and anomalies
to the employees, to the managers.”*

Adam Coffey

President and CEO
WASH Laundry Systems

What is Machine Learning?

Computing systems
that become smarter
with experience

“Experience” =
past data + human input

Big Data is Getting Bigger

- ARGUS-IS imager
 - 1.8 GP camera
 - 770 Gb/sec
 - 1M TB/day
- Currently 6B people access mobile phones
- Microelectrode array
 - 100 channels
 - 30 kHz
 - 2 TB/day



(Baraniuk 2012)

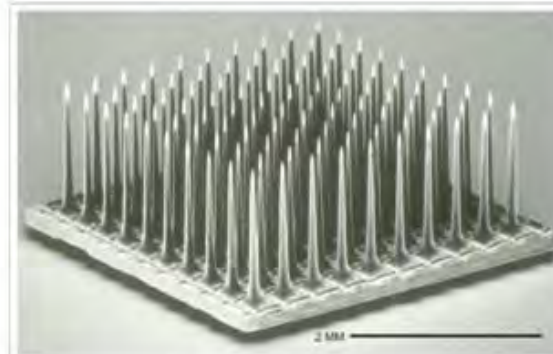


PERSPECTIVES

NEUROSCIENCE

The Brain Activity Map

A. Paul Alivisatos,^{1*} Miyoung Chun,² George M. Church,³ Karl Deisseroth,⁴ John P. Donoghue,⁵ Ralph J. Greenspan,⁶ Paul L. McEuen,⁷ Michael L. Roukes,⁸ Terrence J. Sejnowski,^{9*} Paul S. Weiss,¹⁰ Rafael Yuste^{11*}

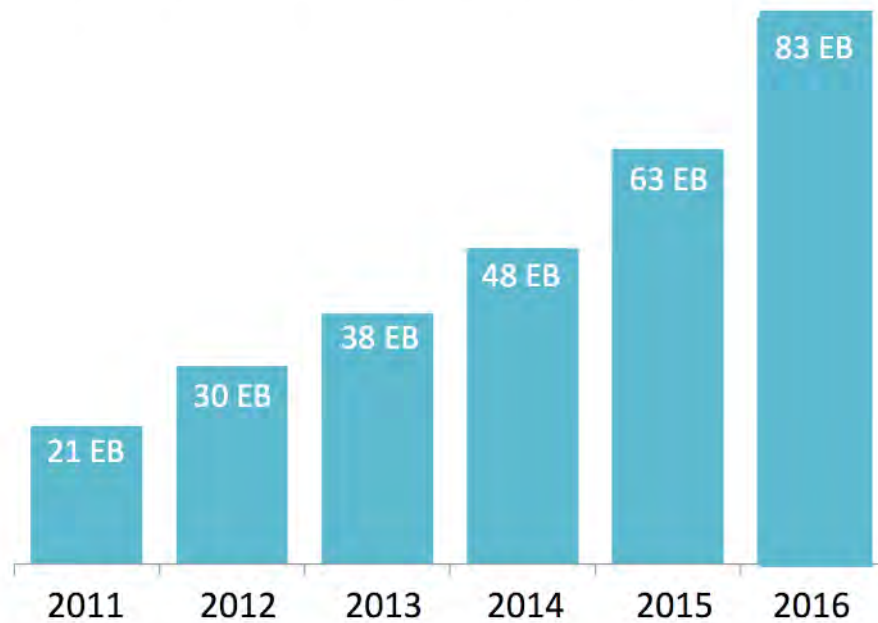


Data Tsunami



Big Data

Global Consumer Internet Traffic Per Month

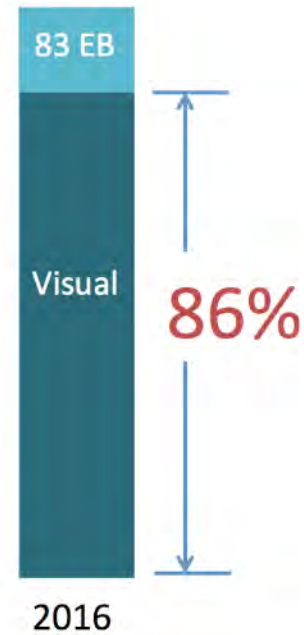


Source: Cisco

Big Data

You Tube™ **72** hours of videos / min

facebook **300** million images / day

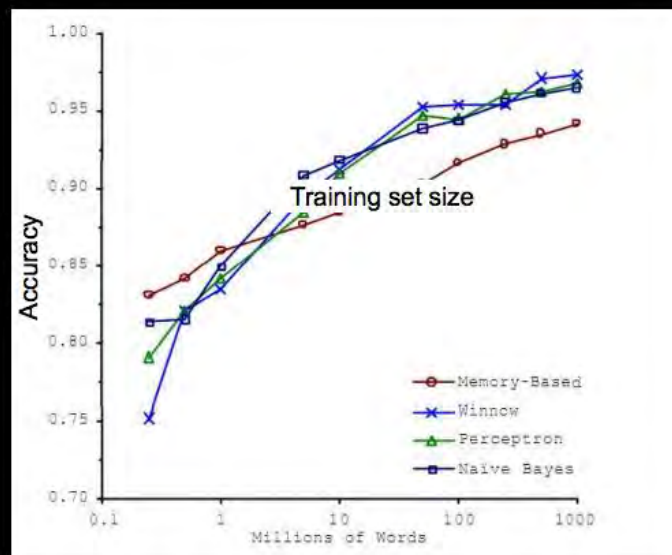


Source: Cisco

Big Data and Machine Learning

Supervised Learning

- Choices of learning algorithm:
 - Memory based
 - Winnow
 - Perceptron
 - Naïve Bayes
 - SVM
 -
- What matters the most?



[Banko & Brill, 2001]

“It’s not who has the best algorithm that wins.
It’s who has the most data.”

Machine Intelligence LANDSCAPE

CORE TECHNOLOGIES

ARTIFICIAL INTELLIGENCE

IBM WATSON MetaMind
Numenta ai-one
Cycorp Research nora
Reactor SCALED INTELLIGENCE

DEEP LEARNING

vicarious Vision Factory
facebook Google SKYMIND
LiftIgniter ersatz SignalSense

MACHINE LEARNING

rapidminer context
Oxdata H2O DATARPM
LiftIgniter SHORELINE
AQUA ML what WISE Sense
GraphLab ALPINE 42000

NLP PLATFORMS

cortical.io idibon
LUMINOSO wit.ai
Maluba

PREDICTIVE APIS

AlchemyAPI MINDOPS
Google bigm Indico
ALGORITHMIA Expect Labs
PredictionIO

IMAGE RECOGNITION

clarifai MADBITS
DNNresearch DEXTRO
VISENZE lookflow

SPEECH RECOGNITION

GRIDSPACE
popUP archive
NUANCE

RETHINKING ENTERPRISE

SALES

Preact AVISO
RelateIQ NGDATA
CLARABRIDGE FRAMED
infer ATTENTIVY causata

SECURITY / AUTHENTICATION

CROSSMATCH CONJUR
EYEVERIFY BITSIGHT
CYLANCE AREAS bionym

FRAUD DETECTION

sift science SOCURE
ThreatMetrix feedzai
Brighterion VERAFIN

HR / RECRUITING

TalentBin entelo
predikt Connectifier
gild hiQ CONNEXTOR

MARKETING

brightfunnel bloomreach
CommandIQ AIRPR
RADIUS Tell apart
people pattern

PERSONAL ASSISTANT

Siri Google now
Cortana cleversense
tempo Robinlabs
KASIST fuse machines
VIV CLARA LABS

INTELLIGENCE TOOLS

ADATAD Palantir
Quid Digital Reasoning
FirstRain

RETHINKING INDUSTRIES

ADTECH

METAMARKETS distillery
rocketfuel YieldMo
ADBRAIN

AGRICULTURE

BLUE@RIVER Terraviva
care imaging HOME@COMB
THE CLIMATE CORPORATION tule

EDUCATION

Declar@ coursera
KNEWTON kidaptive

FINANCE

Bloomberg FinGenius
alphasense KENSHC
Dataminr minitebrook
BINATIX

LEGAL

Lex Machina brightleaf
COUNSELYTICS RAVEL
JUDICATA Brevia
OlligenceEngine

MANUFACTURING

SIGHT MACHINE
MICROSCAN
IVISYS

MEDICAL

Parzival transcriptic
Genescent ZEPHYR
grandroundtable bina TUTE

OIL AND GAS

kaggle AYASDI
TACHYUS biota
Flutura

MEDIA / CONTENT

Outbrain newsle ARRIA
SAILTHRU wavii
NarrativeScience vscad
Prismatic

CONSUMER FINANCE

affirm iVenture
BILL GUARD LendUp
LendingClub Kabbage

PHILANTHROPIES

DataKind thorn
DATA GUILD

AUTOMOTIVE

Google @nternational
TECA MOBILE CRUISE

DIAGNOSTICS

enlitic 3SCAN
lumiata

RETAIL

BAY SENSORS
PRISM SKYLABS
celelect euclid

RETHINKING HUMANS / HCI

AUGMENTED REALITY

search intelligence
APX blippar
META layar

GESTURAL COMPUTING

THALMICLABS omek
LEAP
eyeSight 3Gear
GestureMilk nod

ROBOTICS

intel LIQUID ROBOTICS
iRobot SoftBank
jibo Boston Dynamics
anrl

EMOTIONAL RECOGNITION

affectiva
EMOTIENT
cogito

SUPPORTING TECHNOLOGIES

HARDWARE

NVIDIA XILINX
QUALCOMM NERVANA
Tegre Artificial Learning
rigetti

DATA PREP

TRIFACTA Paxata
tamr Alation

DATA COLLECTION

diffbot kimono
CrowdFlower Cognito
WorkFusion import.io

Data and intelligence

Power decisions & apps with insights

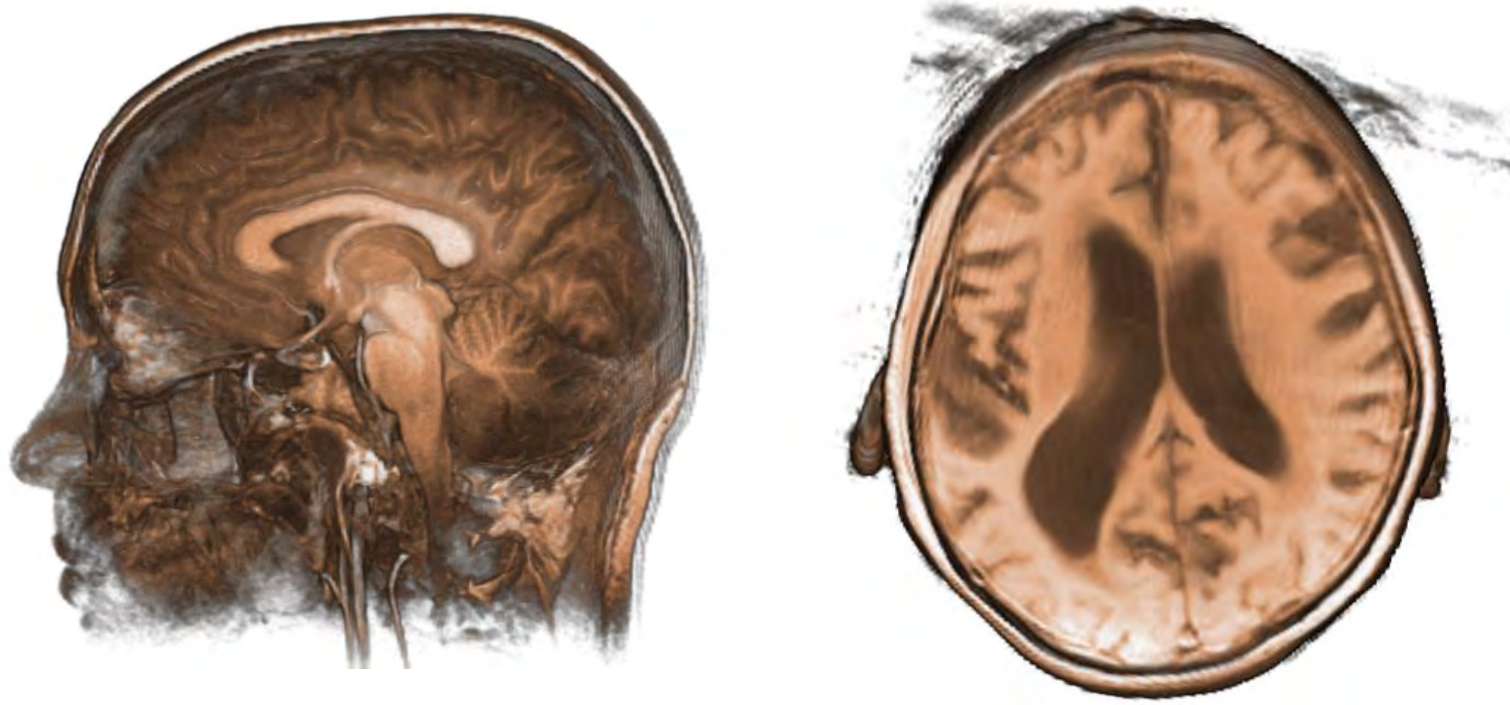


Support business strategy with any data

Predict and respond proactively

Learn and engage with artificial intelligence

Deep Learning for Medicine

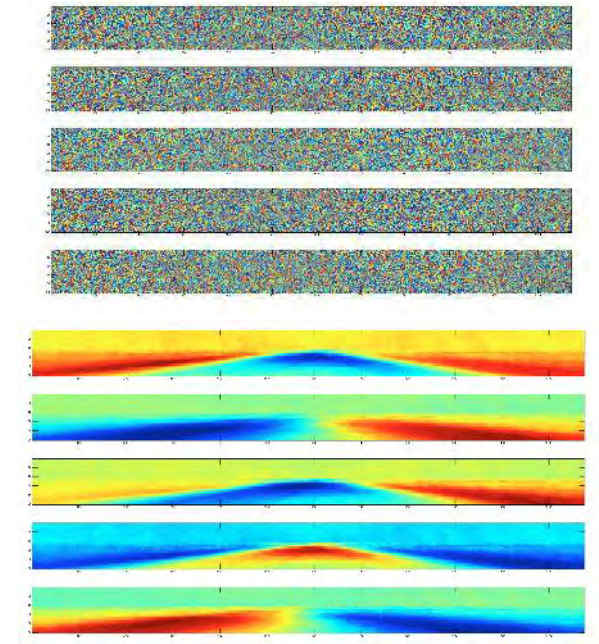
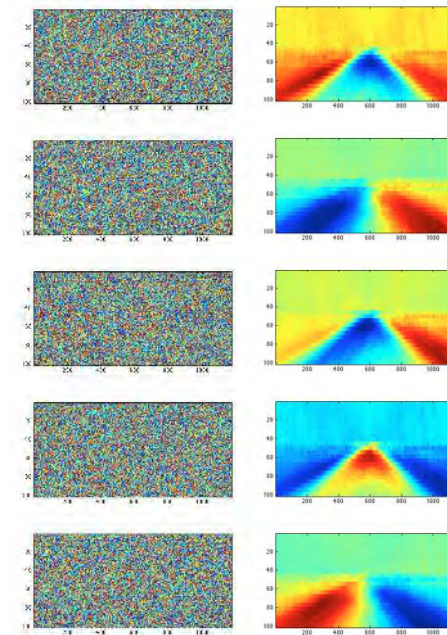


Rovers



<http://home.wlu.edu/~levys/software/roverpylot/>

Python Rover Module

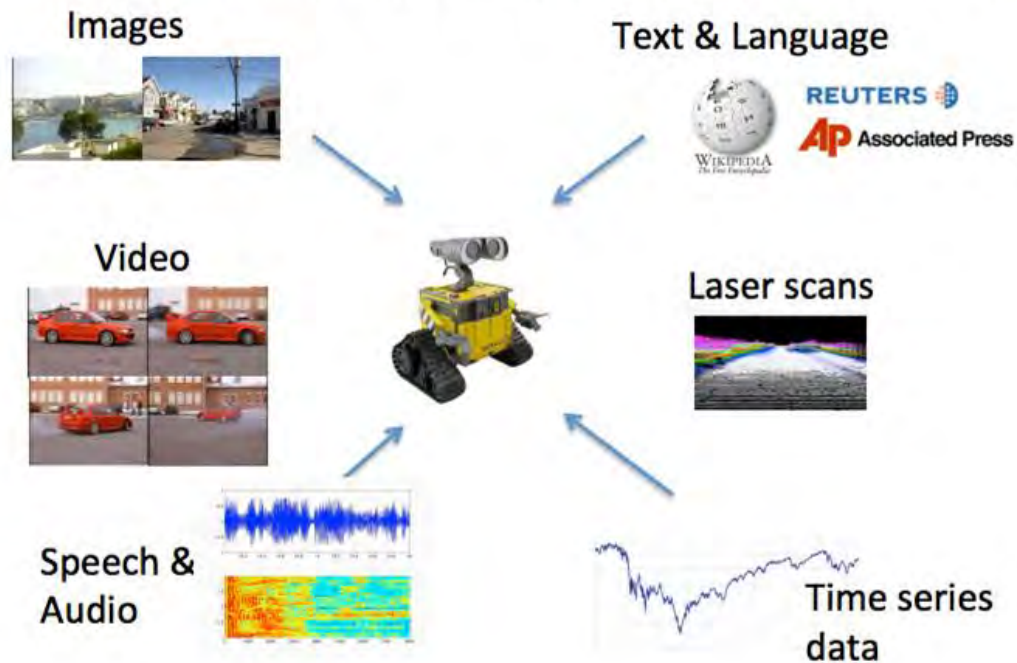


Deep Learning in Rovers



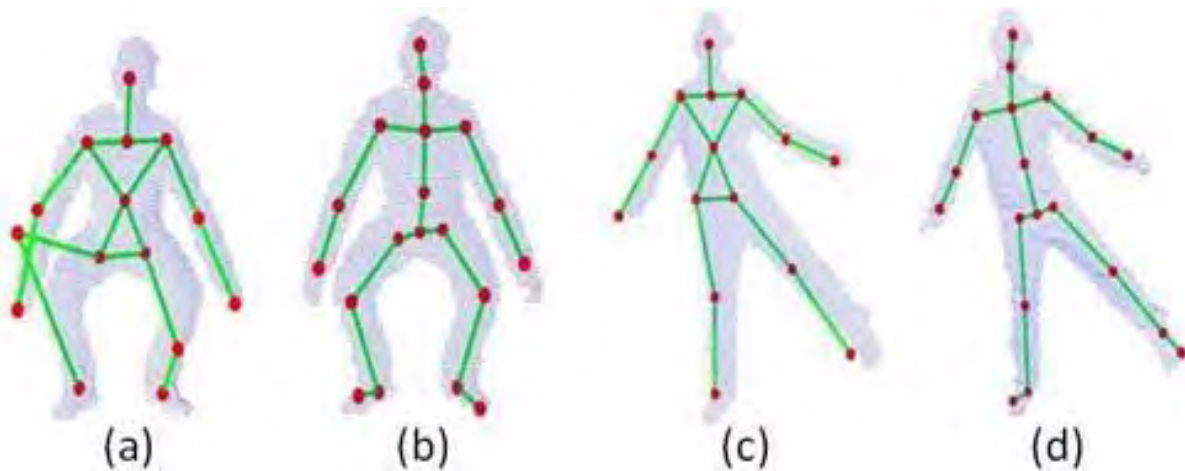
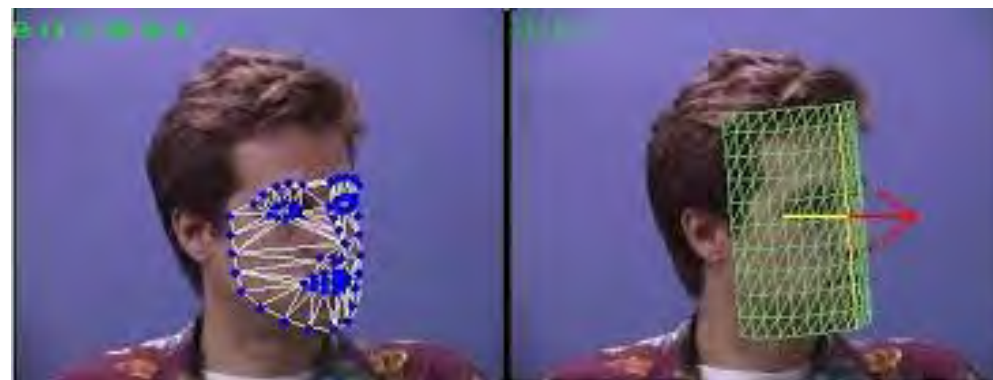
Multi-Modal Input

Learning systems that combine multiple input domains



Develop learning systems that come closer to displaying human like intelligence.

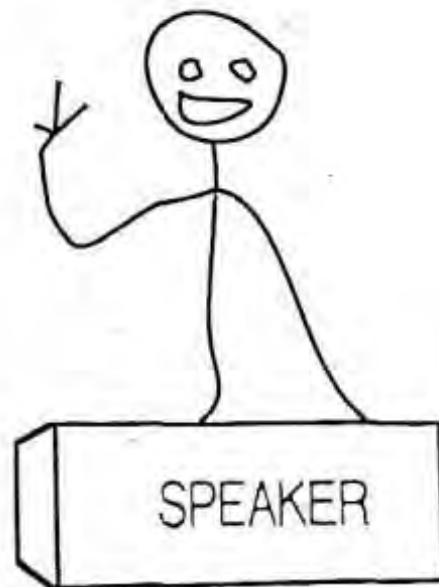
Gesture and Pose Recognition



Vision

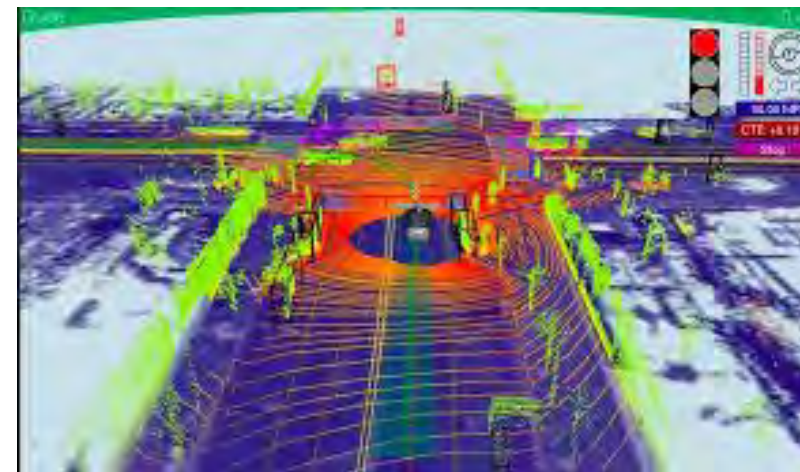


**What we think
we see**

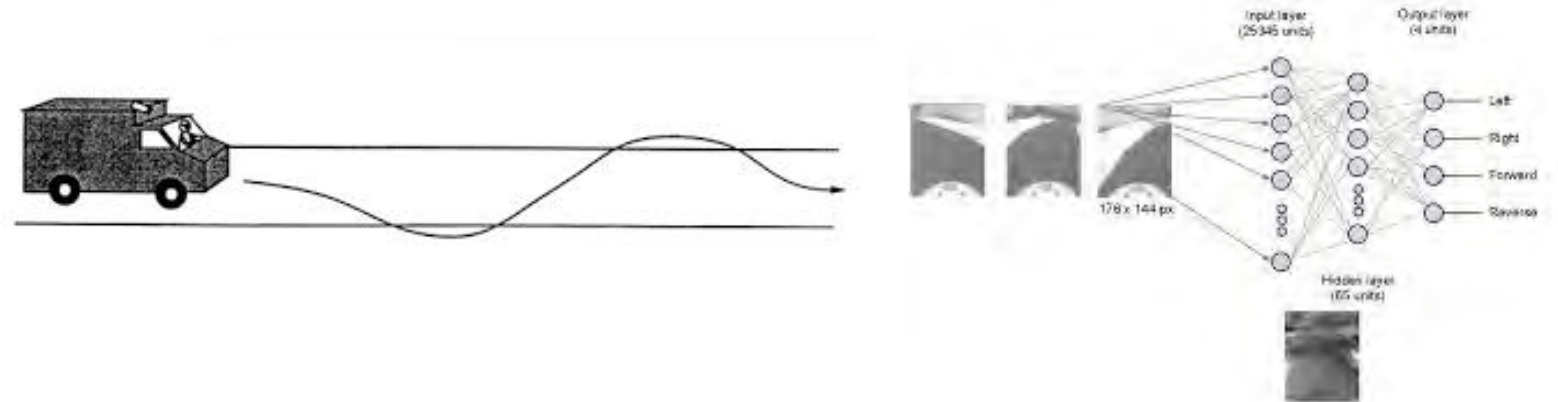


**What we really
see**

Machine Perception

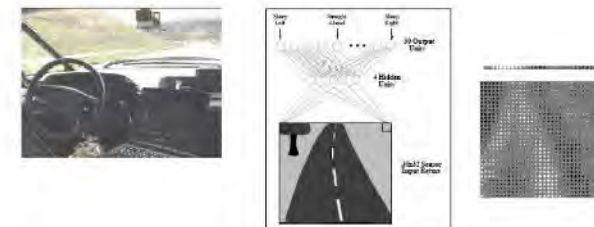


ALVINN



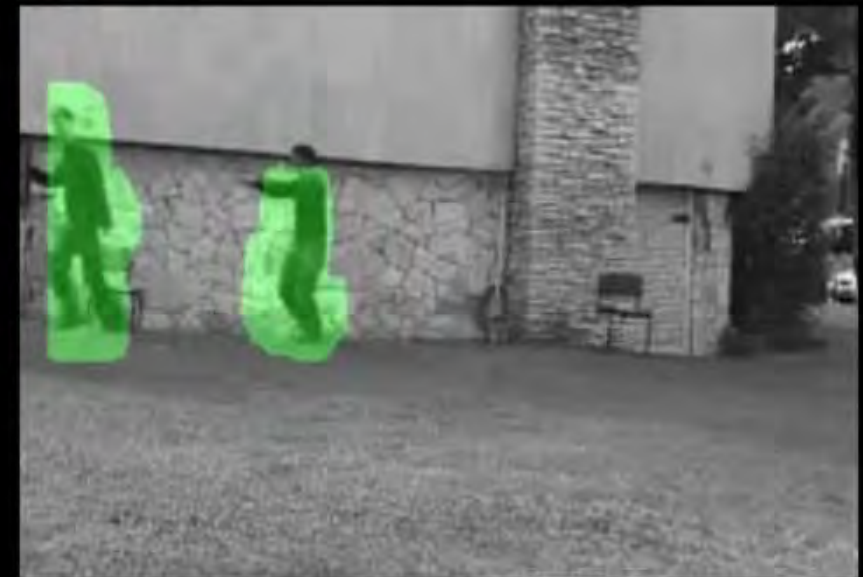
2 Problems Too Difficult to Program by Hand

- **Autonomous Land Vehicle in a Neural Network (ALVINN) drives 70 mph on highways**
 - Perception system which learns to control the NAVLAB vehicles by watching a person drive

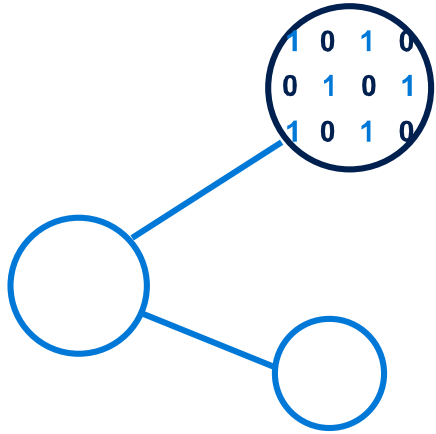


Human Activity Recognition From RGBD & Abnormal Event Detection

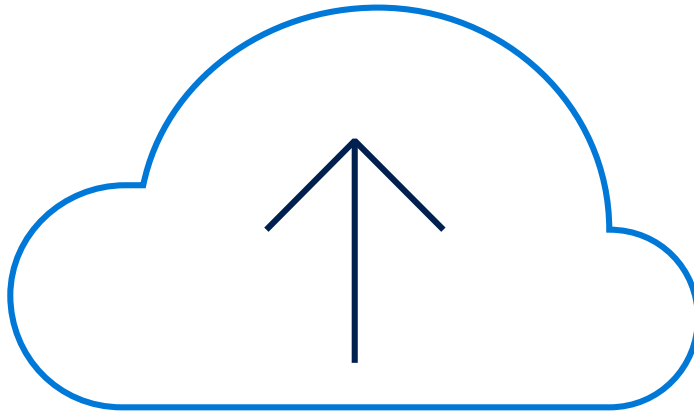
<http://pr.cs.cornell.edu/humanactivities/>



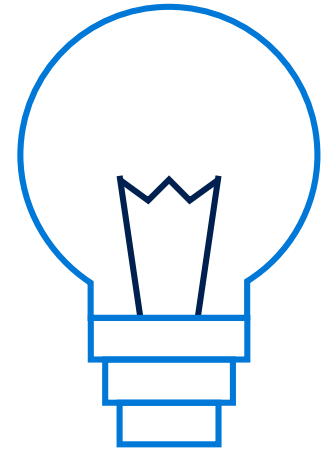
Three major trends are converging



Big Data & IoT



Cloud



Artificial Intelligence

Data is a key strategic asset



10%

Percent of organizations expected to have a highly profitable business unit specifically for productizing and commercializing their data by 2020

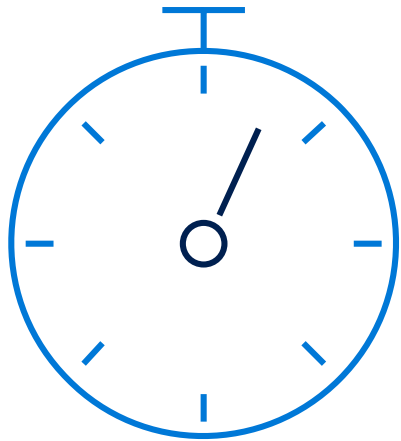
Source: Gartner, 2016

\$100M

The most digitally transformed enterprises generate on average \$100 million in additional operating income each year

Source: Keystone Strategy 2016

The cloud offers limitless computing power



Speed



Scale



Economics

Here is how successful companies are staying ahead



**Improving visibility
and making
accurate predictions**
with remote
monitoring



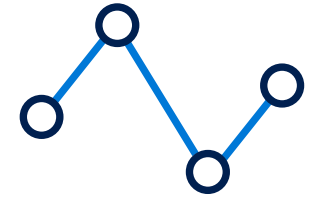
**Getting the right
products to the right
places** with inventory
management



**Offering customers
exactly what they want,
when they want it**, with
personalization



**Fixing problems
proactively before they
start** with predictive
maintenance



**Exploring new
business opportunities**
with data-driven
services

Opportunities exist across functional areas

EXAMPLE SOLUTIONS

Marketing	Sales	Service	Finance	Operations	Workforce
Customer Insight	Customer Acquisition	Service Analytics	Financial Analytics	Demand Forecasting	Employee Insight
Customer Feedback Analytics	Cross sell & Upsell	Contact Center Analytics	Financial Forecasting	Inventory Optimization	HR Insight
Churn Analytics	Lead Generation & Opportunity Scoring		Fraud Management	IT Operations Insight	Pay for Performance
Product Innovation			Risk Management	Operational Efficiency	
Personalization				Procurement Insight	
Product Recommendation				Spend Insight	
Marketing Optimization				Supplier Insight	

“We wanted to go beyond the industry standard of preventative maintenance, to offer predictive and even preemptive maintenance.”

Andreas Schierenbeck

CEO, ThyssenKrupp Elevator

Machine Learning in action

Competitive differentiation
through accessibility



“At Pier 1 Imports, we’ve embraced the cloud. It helps us operationalize technology quickly and react to our ever-evolving business needs”

Andrew Laudato

Pier 1 Imports

Personalized offers

Retailer Pier 1 Imports wanted to offer a connected, personal experience both online and in store



Improve visibility and make accurate predictions

Dartmouth-Hitchcock revolutionizes personalized healthcare

Scenario Static treatment plans | Outdated, generic data

Solution ImagineCare collects and analyzes real-time and historical data from across devices and records, then surfaces metrics in clinical dashboards and mobile apps for a consumer-focused, personalized treatment plan.

Result

- Empowered, healthier patients with personalized, evidence-based treatment plans
- The ability to identify issues like heart attacks before they happen
- Millions of dollars saved in readmission costs, unnecessary ER and doctor visits, and less missed work
- Improved quality of life with 360° views of patient health
- More effective population health management



"This system is really transforming how we can deliver health and wellness to the population. Despite all of the technology involved, ImagineCare does not lose that human touch, which is so important."

*Nathan Larson,
Director of Remote Medical Sensing*

Get the right products to the right places

JJ Food Service optimizes their supply chain

Scenario Outdated legacy systems | Manual processes | Lack of supply chain visibility

Solution Dynamic AX end-to-end with Azure Machine Learning analyzing real-time and historical customer data to create predictive shopping lists and provide product recommendations based on cart contents

Result

- Accurate predictions of customers' needs
- IoT-enabled cab sensors
- Arrival of foods in peak condition
- Increase in basket value through upsell with decreased checkout times




"With Azure Machine Learning, the wow factor is huge. Customers are amazed that we can predict so accurately what they need."

*Mushtaque Ahmed,
COO, JJ Food Service*

Next Gen Machine Learning

GPGPU
FPGA
ASIC
Memristors
Stochastic
Processors
D-Wave Annealing
Quantum

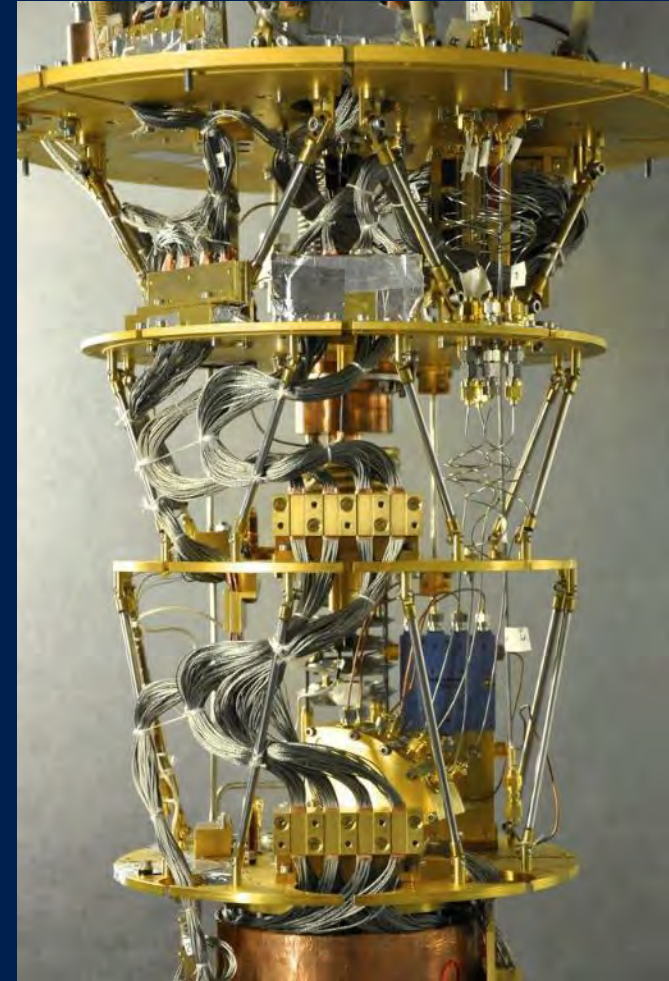

(Extremely hard) optimization problem!
Find \bar{D}_m and \bar{w}_j that minimize the difference between ground truth and reconstructions



$\bar{D}_1 \quad \bar{D}_2 \quad \bar{D}_3 \quad \bar{D}_4 \quad \bar{D}_5 \quad \bar{D}_6 \quad \bar{D}_7 \quad \bar{D}_8 \quad \bar{D}_9 \quad \bar{D}_{10}$

$$\hat{I}_j = \sum_{m=1}^K \bar{D}_m \bar{w}_j$$

$\bar{w}_j = [0, 1, 0, 1, 0, 0, 1, 0, 0, 0] \longrightarrow$



Contact us

- Contact Joe

- Joe.Raio@Microsoft.com
- <http://joeraio.com>
- @joescars

- Contact Will

- WilliamEdwardHahn@Gmail.com
- <http://voxelrx.com>
- @will_hahn