Deep LeArnIng Use Cases
(the art of the possible)

Presenter Name
IBM Cognitive Systems
E-mail.Address@ibm.com

Location, Date

IBM

The Addressable Market

AUTOMOTIVE
ADAS
Maintenance

LAW & DEFENSE
Threat analysis - social media monitoring

CONSUMER GOODS
Sentiment analysis

FINANCIAL SERVICES
Risk analysis
Fraud detection

RESEARCH
Physics
Modeling

MANUFACTURING
Line inspection,
Defect analysis

LIFE SCIENCES
Sequence Analysis,
Radiology

MEDIA/ENTERTAINMENT
Advertising effectiveness

CUSTOMER SERVICE
Chatbots, Helpdesk
Automated Expenses

HEALTH CARE
Patient sensors, monitoring, EHRs

OIL & GAS
Exploration, sensor analysis

RETAIL
Reco. Engines,
Precision Mktg

TRANSPORTATION
Optimal traffic flows, Route planning

UTILITIES
Smart Meter analysis, Capacity planning

OTHERS
Agriculture,
Remote Sensing

Banking Industry
Use Cases

Deep Learning in Banking Industry

- Predictive Chat Boots for Support (customers, partners and employees)
- Customer recommendations
- Fraud Detection
- Algorithmic trading
- Credit Risk Management
- Financial Risk Management
- Improved ATM operation experience
- Stock Prediction

http://ieeexplore.ieee.org/document/7359417/

Contextual Chat Boot

What is provided:
- Ability to search for customer financial data
- Provide excellent answers to the top 5 customer support questions
- Handle other questions reasonably well
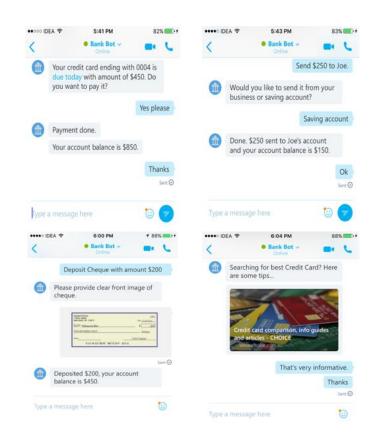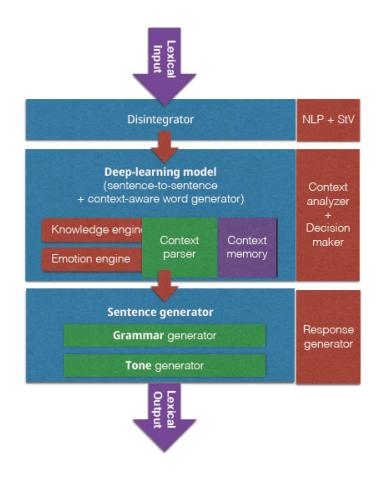- Small talk on a basic level

Attributes:
- Enhance
- Understand
- Knowledge
- Decide

Contextual Chat Boot

Fraud Detection – Masked Face Detection at ATMs

Challenge
- Unattended ATMs are targets of crime
- Masked face detection can help recognize potential criminal actions and then trigger an alarm or limited functions
- Traditional pattern identification algorithms are not so effective to resolve so many diversified and changing possibilities

Benefits
- Masked face detection for ATMs are production-ready and significantly improve the security of ATMs and banks

Solution
- A cluster of IBM Minsky servers (S822LC) with Nvidia P100 GPU and NVLink 1 or AC922 with V100 and NVlink 2
- PowerAI stack for the deep learning framework, running over Spectrum Conductor with Spark and Spectrum Scale
- Modeling services of face occlusion detection thru Caffe
- Sampled 150+ face occlusion videos to generate 1500+ images as the training and testing dataset
- Real time video recording and auto-detect face occlusion, support multiple ways of recognition simultaneously
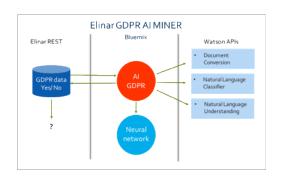
EU GDPR discovery using Deep Learning

Use Case: *How to find and identify GDPR data of single individuals from multiple data sources?*

Addressable Market: In general (a) public authorities, (b) organisations that engage in large scale systematic monitoring, or (c) organisations that engage in large scale processing of sensitive personal data. GDPR not only applies to companies located within the EU, but also applies to companies located outside of the EU if they offer goods or services to, or monitor the behaviour of, EU data subjects. Relevant for all companies processing and holding the personal data of data subjects residing in the European Union - regardless of the company's location.

Solution: ELINAR / PowerAI based solution for GDPR discovery, using text mining and Deep Learning

http://on-demand.gputechconf.com/gtc-eu/2017/presentation/23120-ari-juntunen-gdpr-discovery-using-text-mining-and-deep-learning.pdf
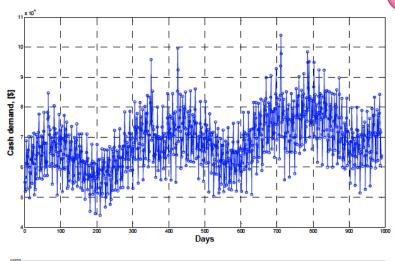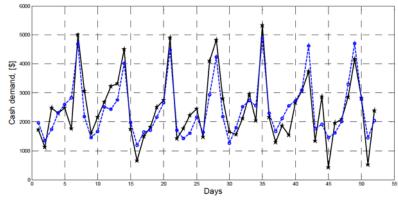
ATM Cash Demand Forecasting

Challenge
- Serving the ATMs network is a costly task: it takes employees' time to supervise the network and make decisions about cash management and involves high operating costs (financial, transport, handling, insurance)
- Cash demand forecasting for ATMs is based on linear regression models with seasonality coefficients. The development of such models is relatively complicated and differs for various ATMs (ie ProCash Analyser)

Benefits
- Provides the opportunity for a bank to lower its operational expenses and improve the return on its cash assets

Solution:
- The general idea behind the use of Neural Networks in cash forecasting is to allow the network to map the relationship between various factors affecting the cash withdrawal and the actual cash withdrawal
- IBM AC922 system with NVMe and PowerAI Basd / PowerAI Enterprise

Insurance Industry
Use Cases

>.

- **In the old world:** Financial models were once dependent upon statistical sampling of past performance to forecast future outcomes.

- **Today:** Data Science has enabled predictions based on real events, in real time, using large datasets, rather than samples to make the best guess

- **In the old world:** Insurance carriers relied on risk pools constructed using statistical sampling

- **Today:** Sensors allow insurance carriers to price coverage based on real events, in real time, using data linked to individuals, rather than samples of data linked to groups

In each industry we are moving from proxy data (about categories) to source data (about individuals).

Common Use Cases

- **Chatbots/AI Assistants:** Responding to internal agent inquiries and providing guidance on business protocols

- **Driver performance monitoring:** Machine learning algorithms are being applied to client data to help inform the development of products for insurance clients

- **Insurance market analytics:** Machine learning algorithms are being applied to interpret driver data in an effort to monitor market trends and identify business opportunities

Distracted Driver Detection

Use Case

Many car accidents are caused by distracted drivers.
Insurance companies are looking to detect such events, in order
to personalise insurance policies

Solution

Perceived behavior of each driver using a list of 10 categories, including:

- safe driving
- texting - right
- talking on the phone - right
- texting - left
- talking on the phone – left

- operating the radio
- drinking
- reaching behind
- hair and makeup
- talking to passengers

Required infrastructure:

- A small cluster of IBM Newell servers (AC922) with Nvidia V100 GPU
  and NVMe's

- PowerAI Vision and PowerAI Inference Engine

Insurance Price Optimization

Use Case

Approximately 7-10% of AXA's customers cause a car accident every year.

Most of them are small accidents involving insurance payments in the hundreds or thousands of dollars, but about 1% are so-called large-loss cases that require payouts over $10,000. As you might expect, it's important for AXA adjusters to understand which clients are at higher risk for such cases in order to optimize the pricing of its policies.

Solution

At the right, you can see there are about 70 values as input features including the following.
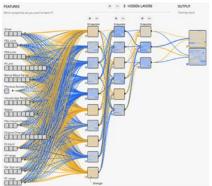
- Age range of the driver
- Region of the driver's address
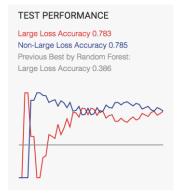- Annual insurance premium range
- Age range of the car

AXA entered these features into a single vector with 70 dimensions and put it into a deep learning model. The model is designed as a fully connected neural network with three hidden layers, with a ReLU as the activation function. This use case has an accuracy of 78%

TEST PERFORMANCE

Large Loss Accuracy 0.783
Non-Large Loss Accuracy 0.785
Previous Best by Random Forest:
Large Loss Accuracy 0.386

https://cloud.google.com/blog/big-data/2017/03/using-machine-learning-for-insurance-pricing-optimization

Car Damage Classification

Image based vehicle insurance processing is an important area with significant scope for automation

Use Case

In the car insurance industry, a lot of money is wasted due to claims leakage (the difference between the actual claim payment made and the amount that should have been paid if all industry leading practices were applied)
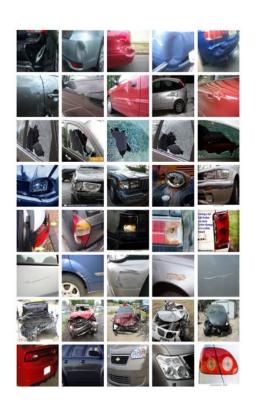
Visual inspection and validation have been used to reduce such effects. However, they introduce delays in the claim processing. Automation is required to process the claims faster and with better accuracy, reducing the leakage.

Solution

Expedite the personal auto claims process with Computer Vision and Deep Learning.

Identified damage location and severity with high level of accuracy, comparable to human performance.

- A small cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVMe's
- PowerAI Vision (one training server and few of inference servers)

Insurance transformation with ADAS

> **Risk is shifting from the driver to the auto manufacturer and the companies that design smart technologies in the adoption of autonomous cars**

Today's challenges:
- New types of data
- Adapting business models
- Adapting infrastructure to fully embrace AI
- New skills are required

Deep Learning in Retail
Use Cases

Deep Learning in Supermarkets

Object Detection, Segmentation, Counting

Challenge

- Number of people entering a supermarket on a daily basis
- Detect customers behavior and satisfaction
- Experience of the consumers, during and after shopping
- "Out-of-stocks" account for over $129 billion in lost retail sales in North America (~4% of revenue), or $1.1 trillion globally. A retail industry analysis commissioned by OrderDynamics and run by IHL showed that a majority of the issues driving out-of-stocks were bad processes, people problems, and data/systems issues.

Benefits

- Real time people counting, object detection, sentiment analysis from people's faces, using Deep Learning CNNs

Solution

- A cluster of IBM Minsky servers (S822LC) with Nvidia P100 GPU and NVLink, PowerAI
- AI Vision stack for the Deep Learning framework with Spectrum Scale
- Modeling services of object detection thru Caffe or TensorFlow

Deep Learning for e-Commerce Platform compliance

Use case: Many large providers are operating e-commerce platforms, offering a wide range of products. In addition to their existing platform, many other third parties are selling various products and therefore using the provided platform to sell new products and create virtual mini-stores. However, end end-to-end responsibility for the provided content and products belongs to the owner of the e-commerce platform.

One of the key elements is to control quality of the product images that are uploaded every day (500k – 1M of images per month) on the e-commerce platform.
Challenges in automatic detection of following product image characteristics are:
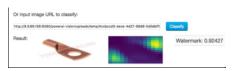- White background detection
- Image production detection, e.g. shading, reflections, lighting
- Watermarks
- Product in image is unclear, or out of focus, or blurred
- Images contain text, symbols, numbers
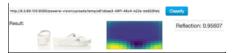- Explicit content detection

Addressable Market: Global retail e-commerce industry

Solution
- A small cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVMe's
- PowerAI Vision (one training server and few inference servers)

Optimizing Warehouse Operations

number pick lists	OCaPi	CPU network	GPU network
1	5.369	2.202e-3	1.656e-3
10	1.326	1.991e-4	1.832e-4
100	0.365	6.548e-5	5.919e-5
1000		3.086e-5	2.961e-5
10000		2.554e-5	2.336e-5

Use case: Two schematics of a rope ladder warehouse zone with picks. The blue shelves denote shelves with items to be picked. The goal is to find the shortest possible route that allows a worker to visit all blue shelves, while starting and ending at the depot. A Neural Network can estimate the pick route length

Solution
- One or two IBM Newell servers (AC922) with Nvidia V100 GPUs and NVMe's

https://www.youtube.com/watch?v=Z5clvMYFuPs

Safety and Security with Deep Learning
Use Cases

Detect Threats from X-Ray Images

Use Case: Automatically read X-Ray images (RGB or single-energy) and detect threats (Small Metallic Threats (SMTs) etc without any human intervention at:
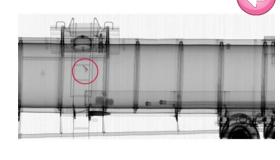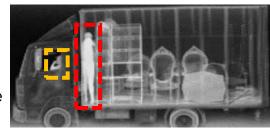- Airports
- Highways
- Harbors
- Highways

Addressable Market
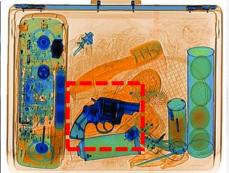Airports Security, Cargo inspection, Truck inspection, Airplane Inspection etc
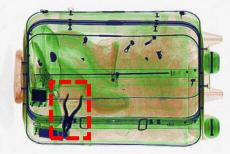
Solution
PowerAI DDL & PowerAI Vision for complete solution from image labeling, training & inference
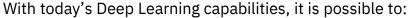
Automatic Handgun Detection in Videos Using Deep Learning

Use case: Current surveillance and control systems still require human supervision and intervention to detect handguns. Traditional gun detection focuses on detecting concealed handguns in X-ray or millimetric wave images at luggage control in airports and some public institutions with high security requirements. These systems are based on metal detection and cannot detect non metallic guns. In addition, they are expensive to use in many places, as they need to be combined with X-ray scanners and Conveyor belts, interfering with the normal pedestrian traffic flow.

With today's Deep Learning capabilities, it is possible to:
- Detect people carrying guns, in less then 1 second
- Detect people with guns in their hand, in less then 1 second
- Triger an alarm when guns are identified
- Record events only when guns are detected for law enforcement

Addressable Market: Global Retailers, Banking industry, etc

Solution
- A small cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVMes
- PowerAI Vision (one/two training servers and a few inference servers) and/or PowerAI Inference Engine when detection is performed on edge devices, using FPGAs

AI Vision - Personal Protective Equipment (PPE)

Use Case

Enterprises thrive to ensure the safety of workers in the field and impose compliances of employees towards PPE

Addressable Market

The Personal Protective Equipment (PPE) market size is forecast to hit $67.6 billion by 2023 as per a new research report by Global Market Insights, Inc.

Solution

Manufacturers have adopted surveillance cameras to monitor enforcement of certified PPE among their workers. PowerAI Vision provides capabilities to model on Power Systems and infer anywhere, including cloud and cameras

Detect & Classify Drones in restricted areas with Deep Learning

Use Case

Millions of drones are flying every day and as they become more advanced, they can carry heavier objects, such as chemicals, jammers, cameras, etc.

With this increased potential threat, there is a need to identify and locate drones in restricted areas. For many modern radars, it is difficult to distinguish between a drone and a bird.

With Deep Learning from IBM, it is possible to detect drones in the air in less than 1 second, classify them and provide their approximate location.

Addressable Market
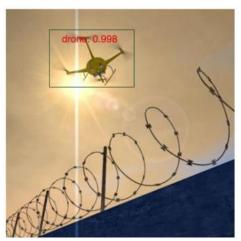
Airport Security, Government Facilities, Refineries

Solution

PowerAI Vision for an end-to-end solution, from image labelling, training and inference, as well as IP Cameras with night vision technologies.

Id	Usage	Categories	Accuracy
23a89bf9-e4f9-4444-8ecf-d26f6d2a3aa2	Object Detection	Drone	0.92879
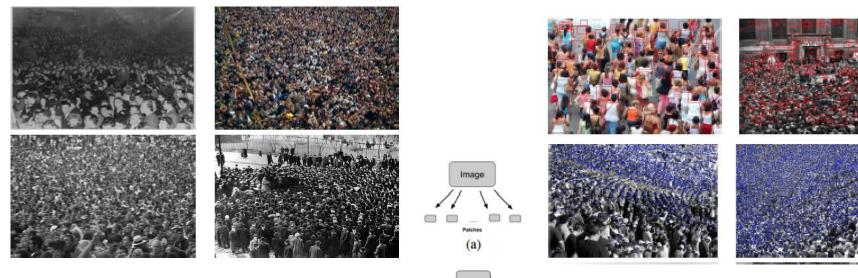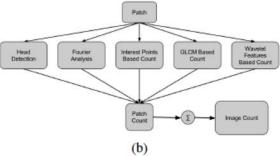
People Counting in High Density Crowds from Still Images

(a)

(b)

Examples of high density crowds. On average, each image in a crowd counting dataset contains 870 people with a minimum of 81 and maximum of 4,633

Urban Sound Classification
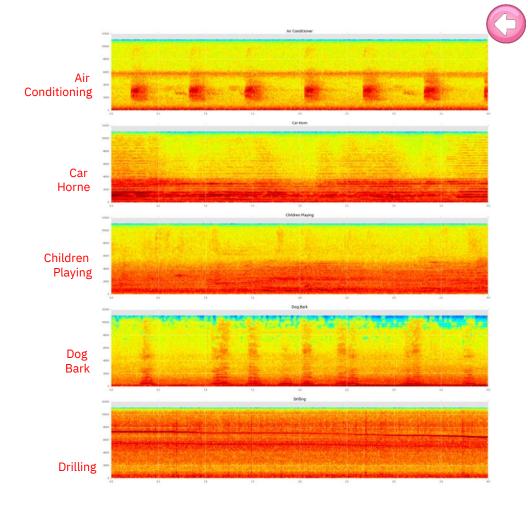
Use Case

- Identify urban acoustic environment:
  - Human
  - Nature
  - Medical
  - Music
- Identify sound pollution sources and intensity
- Law enforcing

Solution

- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVLink 2
- PowerAI stack for the deep learning framework with IBM DDL

Air Conditioning

Car Horne

Children Playing

Dog Bark

Drilling

Medical Imaging with Deep Learning
Use Cases

Radiologists

Overloaded with medical imaging data.

Eye Fatigue.
Missed Diagnoses.
Radiologists are **scarce**.

Histological Classification of Breast Cancer
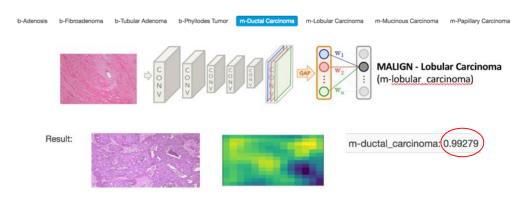
Use Case

Breast cancer is a heterogeneous disease, comprising multiple entities associated with distinctive histological and biological features, clinical presentations and behaviours and responses to therapy. Essentially, breast cancer histology evaluation is the microscopic analysis of the chemical and cellular properties of the **cells of a suspicious breast tumor**. The pathologist will also confirm the size of the breast tumor where necessary for breast cancer staging purposes. Breast cancer **histology is essential to determine the most effective approaches to hormone and chemotherapy treatments** when necessary. We can accelerate the work of histologists by using Deep Learning (CNNs) to **classify the type of breast tumor in less then a second with a high confidence level**.

Solution

- A small cluster of IBM Newell servers (AC922) with Nvidia V100 GPUs and optional IBM Spectrum Scale storage system
- IBM PowerAI Vision and IBM PAIE

AI Vision Health Care radiology analysis

Use Case

Imbed AI into scanning machines to diagnose Cervical Carcinoma
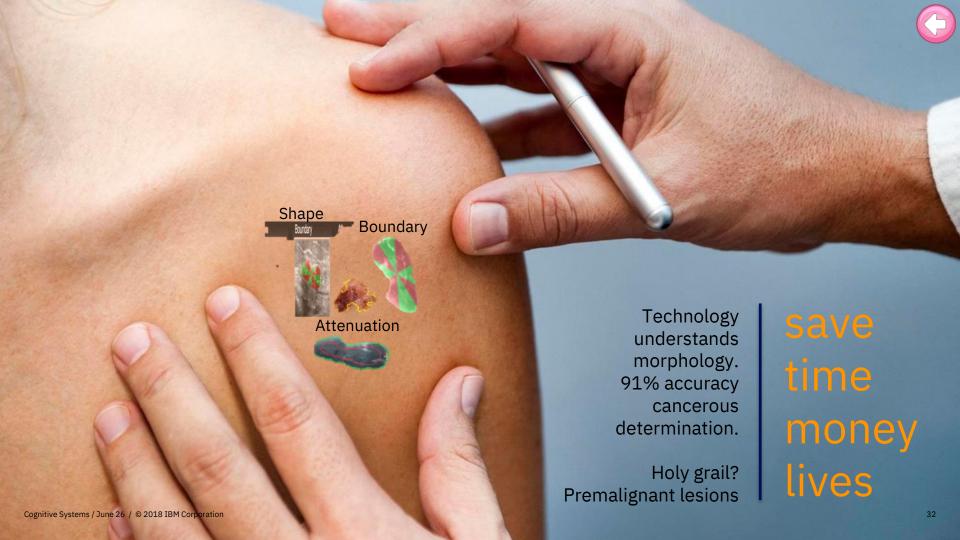
Client Validations

In partnership with Southern Medical University (China) to jointly develop models for detecting Cervical Carcinoma.

Addressable Market: Markets&Markets estimate that the market for artificial intelligence (AI) in healthcare is expected to grow up to USD 8 billion by 2022, growing at a CAGR of 52.68% during the forecast period (from 2016).
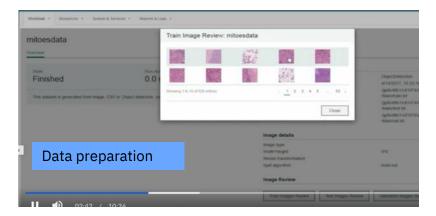
Solution: Manufacturers of scanning machines are in the process of embedding AI to diagnose images for abnormalities at the source. PowerAI Vision provides capabilities to model on Power Systems and infer anywhere including datacenters, cloud and scanning machines.

Shape

Boundary

Attenuation

Technology understands morphology. 91% accuracy cancerous determination.

Holy grail? Premalignant lesions

save time money lives
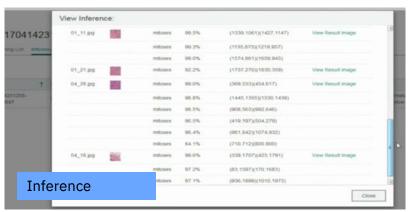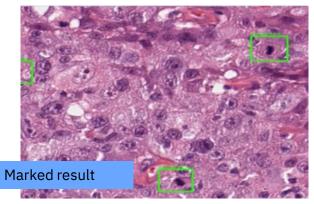
Tumor Proliferation using PowerAI

Data preparation

Model training/tuning

Inference

Marked result

Tumor Proliferation Assessment. Mitosis detection images from electron-microscope

Size of image - 70K * 60K

97% Accuracy for Melanoma Detection for Dermoscopic Images

Use Case
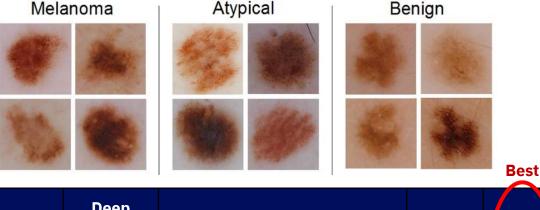
Automatic skin lesion image analysis for melanoma detection with Memorial Sloan Kettering (MSK-CC)

Visual modeling techniques:

- Deep Residual Networks
- Conv. Neural Networks
- Ensemble Models

Top Performance
= 97% Accuracy!!!

Melanoma	Atypical	Benign

Best

	Human*	Deep Features	Ensembles			CNN	DRN
	Doctor/ Expert	ImageNet	+ Sparse Coding	+ Low-level	+ Auto-Encoder	Deep Learning	Deep Residual Learning
Melanoma vs. Atypical & Benign	0.84	0.91	0.92	0.93	0.94	**0.95**	**0.97**
Melanoma vs. Atypical	-	0.73	0.73	0.74	**0.77**	-	-

* Estimated human expert performance
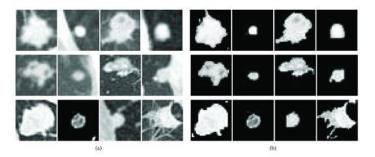
Deep Learning for Lung Cancer Detection
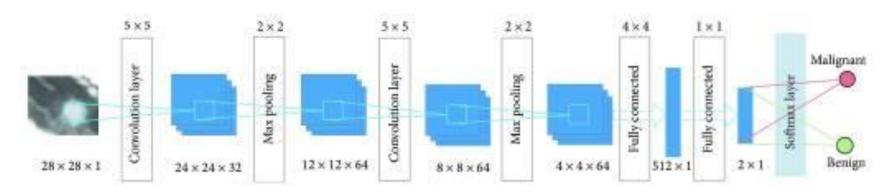
Use Case

Lung cancer is a serious health problem. In the United States alone, approximately 225,000 people each year are diagnosed with lung cancer. Early detection is a crucial part of giving patients the best chance of recovery. Deep Learning gives us an opportunity to increase the accuracy of the automated initial diagnosis

Solution

- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPUs and IBM Spectrum Scale storage system
- PowerAI or PowerAI Vision

Energy and Utilities with Deep Learning
Use Cases

Deep Learning for Wind Turbine Inspection

Use Case

- When it comes to using an UAV to collect imagery for wind turbine inspections, maneuvering a drone around a huge turbine isn't the only challenge involved.
- We also need to ensure the quality of the capture while in the field, to avoid the costs associated with having to re-fly
- Finally, there is the time and rigor required to analyse all the data to identify and locate damage and other abnormalities on turbine blades

Solution

- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVLink 2 to help in image processing for automating type and location of damages
- PowerAI Vision stack for the Deep Learning framework

Energy and Utilities
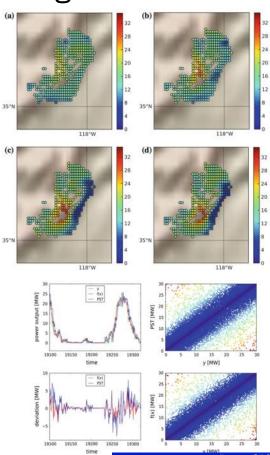
Wind Power Prediction with Machine Learning

Use Case

- Predict the power production of an entire wind park
- There is no standard for measuring the performance of wind energy prediction models, which has often been criticised in literature
- Since the power output of a single turbine is generally not high enough to cause relevant effects on the electric grid, analyzing the power output of an entire wind park, with high accuracy prediction, requires Machine Learning

Solution

- A precise short-term wind power prediction is important for a safe and sustainable balancing of the electricity grid
- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVLink 2
- PowerAI stack for the deep learning framework with IBM Snap.ML that can accelerate machine learning on GPU's

Energy and Utilities

Deep Learning for Traffic Management
Use Cases

PowerAI Vision for Assisting Drivers

Use Case
Advanced Driver Assistance System (ADAS) for cars delivers safety and efficient travel. The same technology forms the back bone of Autonomous Driving (AD)

Client Validations: Engaged in PoCs with auto manufacturers (GM, Shanghai Motors) to differentiate their vehicles

Addressable Market: Gartner predicts, by 2025, assisted driving will be available in approximately 30% of passenger vehicles in mature markets. Bain analysis claims, the global market for assisted driving will grow to $26 Billion by 2025

Solution: PowerAI Vision provides a platform with tools tailored for non-data scientists to train & deploy models on FPGA cards. Engage auto manufacturers in technology previews, emphasising features on Power Systems that bring GPU acceleration and innovation for performance, scale and accuracy

PowerAI Vision Smarter City Initiative

(Traffic management)

Use Case

Ensure the safety of citizens by detecting parking violators; enforce traffic regulations; monitor busy intersections for near-miss incidents and detect suspicious / unclaimed objects in busy districts

Client Validations: Engaged in PoCs with City of Atlanta and with Cities in China to adopt AI technologies

Addressable Market: Currently at $450 Billion opportunity, Markets&Markets predict a $1.2 Trillion global market by 2022

Solution: Smarter cities have adopted datacenters on the cloud and surveillance devices to monitor behavior. PowerAI Vision provides capabilities to model on Power Systems and infer anywhere, including the Cloud and Edge devices

PowerAI Vision Smarter City Initiative
(Dangerous Goods Recognition on roads)

Use Case

Trucks with dangerous goods have restricted access to a certain road segment. To prevent the access of those trucks, we need to recognize the signs of danger on those vehicles using the traffic CCTV cameras installed in the City perimeter or highways.

Solution: Smarter cities have adopted datacenters on the cloud and surveillance devices to monitor behavior. PowerAI Vision provides capabilities to model on Power Systems and infer anywhere, including the Cloud and Edge devices

Deep Learning in Oil and Gas
Use Cases

Data Analytics / Deep Learning Matrix in Oil and Gas
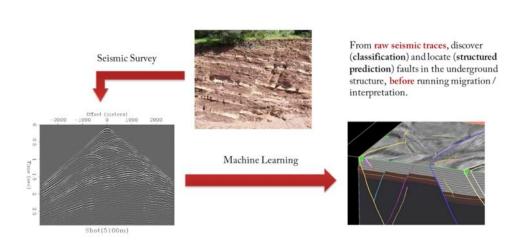
Exploration	Production	Midstream	Refining	Marketing	Chemicals
Anomaly detection in seismic data analysis	Advanced analytics to enhance reservoir management and maximize ultimate field production	Crude and products trading advanced analytics	Preventative Maintenance	Demand forecasting	Preventative Maintenance
Lease block bidding optimization	In-fil drilling optimization	Inventory optimization	Predictive Maintenance	Fuel and lubricant sales analytics and visualization	Preventative Maintenance
Drill site optimization	Determining optimcal hydraulic strategy		Predictive Failure Analytics	C-store analytics	Predictive Failure Analytics
Mapping seismic attributes to reservoir properties			Machine learning applications	Price optimization	Predictive Failure Analytics
Computing surface seismic statics			Operations Dashboards	Competitive market analysis	Operations Dashboards
			Capacity optimiztion	Marketing campaign analysis	Capacity optimization
				Fraud detection analysis	Demand forecasting
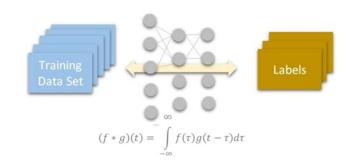
https://www.onepetro.org/search?q=deep+learning&peer_reviewed=&published_between=&from_year=&to_year=
http://www.sciencedirect.com/science/article/pii/S1674987115000821

Automatically detect subsurface from seismic traces
Exploration at Shell using Deep Learning

Seismic Survey

From **raw seismic traces**, discover (**classification**) and locate (**structured prediction**) faults in the underground structure, **before** running migration / interpretation.

Machine Learning

Offset (meters)
-2000 -1000 0 1000 2000
Time (sec)
Shot(5100m)

Training Data Set

Labels

$$(f * g)(t) = \int_{-\infty}^{\infty} f(\tau)g(t - \tau)d\tau$$
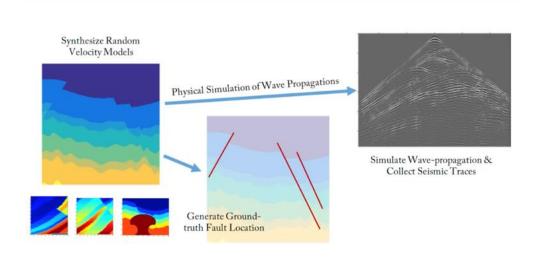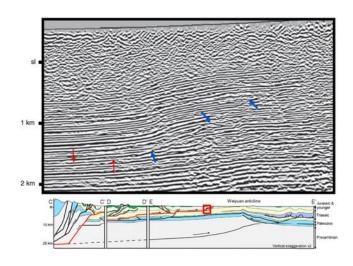
http://3ddl.cs.princeton.edu/2016/abstracts/dahlke_abstract.pdf

Automatically detect subsurface from seismic traces for
Exploration at Shell using Deep Learning

Synthesize Random Velocity Models

Physical Simulation of Wave Propagations

Simulate Wave-propagation & Collect Seismic Traces

Generate Ground-truth Fault Location
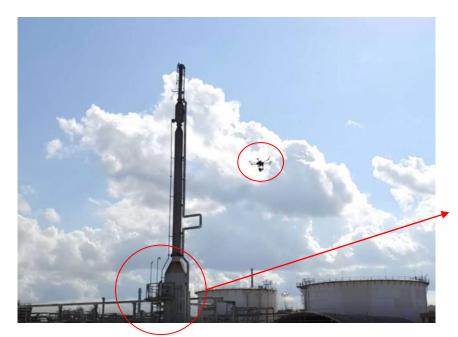
Routine Inspection

Use Case

Routine inspections are an easy place to start. They're generally considered slow, expensive and dangerous. Data collected manually can take weeks to process and analyse.

https://www.slideshare.net/DroneResearch/oil-57646926
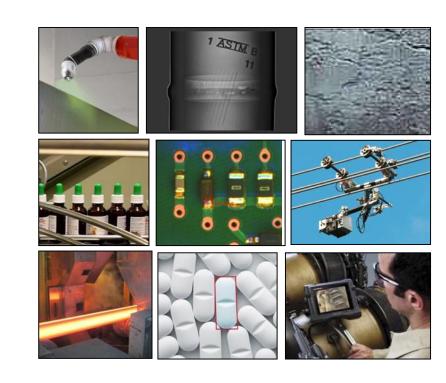
Deep Learning in Manufacturing
Use Cases

Visual Inspection for Industries and Maintenance

- Automotive
- Aerospace & Defense
- Chemicals & Petroleum
- CPG
- Electronics
- Energy & Utilities
- Industrial products
- Life Sciences
- Maintenance

Cognitive Process and Operations

Improve quality and yield of your manufacturing operations from design through support

Cognitive processes and operations

Cognitive operations and processes bring more certainty to business by analyzing a variety of information from workflows, context and environment to drive quality, enhance operations and decision-making.

Visual Inspection for Quality

- Detect defects and classify them
- Show developing quality trends
- Enable better understanding of product and process quality issues and defect types

Lithography Defects
Inspect images of photoresist openings

Use Case: We need to inspect images of photoresist openings after having been exposed and developed. The central opening (the bright core) measures approximately 20 microns in diameter. The outer disk measures approximately 130 microns:

We must classify the image in 4 classes:
- No defect
- Presence of a dark spot
- Presence of a bright spot
- Presence of a scratch

Here are a few samples of the defects:

Solution
PowerAI Vision / PAIE for complete solution from image labeling, training and inference as well as IBM AC922 system

Counting metal pipes in manufacturing

Use Case:
- Counting the number of pipes produced or loaded into the trucks at the factory
- Identifying the type of the pipes loaded and related weight

Solution
- Two IBM Newell servers (AC922) with Nvidia V100 GPU and NVMe adapters
- IBM PowerAI Vision and PowerAI Inference Engine
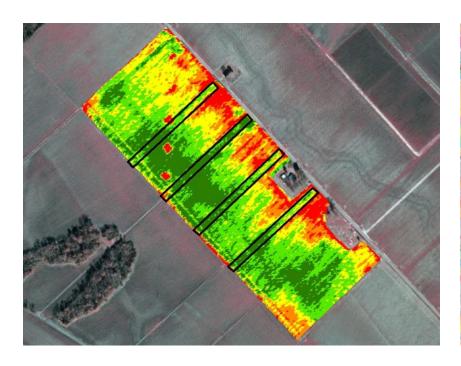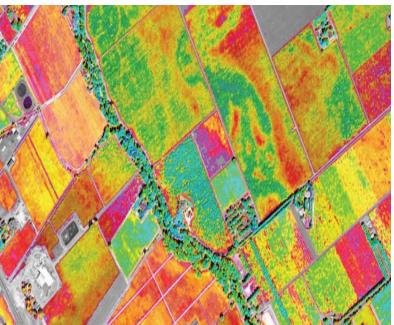
Other Use Cases
Agriculture, Remote Sensing etc

Crop Status Identification from Satellite Images
using Sentinel-2 ESA
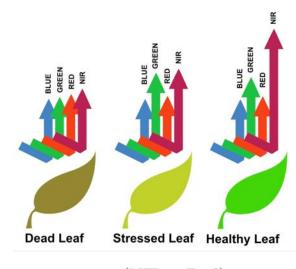
Graphical Indicators in Remote Sensing

- Normalized difference vegetation index (NDVI)

- Perpendicular Vegetation Index

- Soil-Adjusted Vegetation Index

- Atmospherically Resistant Vegetation Index

- Normalized difference water index

Dead Leaf   Stressed Leaf   Healthy Leaf

$$NDWI = \frac{(Xnir - Xswir)}{(Xnir + Xswir)}$$

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

- -1 to 0 - Bright surface with no vegetation or water content
- +1 - represent water content

- NDVI itself thus varies between -1.0 and +1.0

Other Use Cases possible for agriculture using Satellite Images

- Water identification on the crop parcels

- Crop Identification

- Segmentation

Solution

- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVLink 2
- ESS GL2S storage system attached via InfiniBand to AC922
- PowerAI stack for the deep learning framework with IBM DDL
- Data preparation & DL algorithm creation by Systems LAB Services and IBM Research

NOTE:

- AI Vision can be used as long as the data preparation is performed on different containers and from there images can be send to AI Vision for training or inference

Deep Learning for Remote Sensing Classification

Use Case
Classifying satellite images for particular coordinates (GPS, GLONAS etc)

Addressable Market
Multiple industries (defense, insurance, agriculture, real estate etc)

Solution

- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVMe's
- Optional: ESS GL2S storage system attached via InfiniBand to AC922
- PowerAI Vision
- Data preparation creation by Systems LAB Services

Anomaly Detection - high-speed rail infrastructure

Use Case: The Pantograph–Catenary (PAC) system is the dominant form for supplying the vital power to railway electrical trains. A pantograph is an apparatus mounted on the roof of an electric train to collect power through contact with an overhead catenary equipment called the Overhead Catenary System (OCS). The steel rails on the tracks act as the electrical return. The OCS is a high voltage system consisting of contact wire and catenary wire suspended via supports primarily on poles placed along the railway. The OCS includes messenger wire, contact wire, droppers, and supporting structure, which consists of metallic poles, cross-arms, and running rails.

With the help of Deep Learning (CCN's) it is possible to detect:
- defects of pantograph-catenary system
- bird nests in overhead catenary system
- arc detection

Using automatic video inspection and issue warnings to maintenance control center

Solution
- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVMe's
- Optional: ESS GL2S storage system attached via InfiniBand to AC922
- PowerAI Vision
- Data preparation creation by Systems LAB Services
- Edge cameras with FPGA's
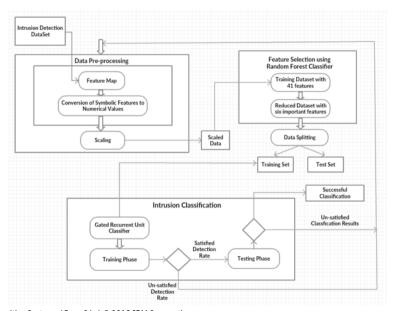
Deep Learning for network infrastructure security

Use Case:
- Recognising unique patterns of unauthorized behavior to detect and predict future similar attempts
- Finding any event of the system falls outside of a predefined set of normal behaviors is the goal of anomaly detection

Solution
- A cluster of IBM Newell servers (AC922) with Nvidia V100 GPU and NVMe adapters
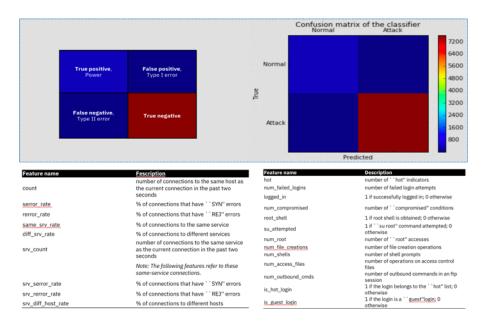- Optional: HDP on Power cluster where AC922 is installed as edge device

Intrusion Detection DataSet

Data Pre-processing
Feature Map
Conversion of Symbolic Features to Numerical Values
Scaling
Scaled Data

Feature Selection using Random Forest Classifier
Training Dataset with 41 features
Reduced Dataset with six important features
Data Splitting
Training Set
Test Set

Successful Classification
Un-satisfied Classfication Results

Intrusion Classification
Gated Recurrent Unit Classifier
Training Phase
Satisfied Detection Rate
Testing Phase
Un-satisfied Detection Rate

	True positive, Power	False positive, Type I error
	False negative, Type II error	True negative

Confusion matrix of the classifier

Feature name	Fescription
count	number of connections to the same host as the current connection in the past two seconds
serror_rate	% of connections that have ``SYN'' errors
rerror_rate	% of connections that have ``REJ'' errors
same_srv_rate	% of connections to the same service
diff_srv_rate	% of connections to different services
srv_count	number of connections to the same service as the current connection in the past two seconds
	Note: The following features refer to these same-service connections.
srv_serror_rate	% of connections that have ``SYN'' errors
srv_rerror_rate	% of connections that have ``REJ'' errors
srv_diff_host_rate	% of connections to different hosts

Feature name	Description
hot	number of ``hot'' indicators
num_failed_logins	number of failed login attempts
logged_in	1 if successfully logged in; 0 otherwise
num_compromised	number of ``compromised'' conditions
root_shell	1 if root shell is obtained; 0 otherwise
su_attempted	1 if ``su root'' command attempted; 0 otherwise
num_root	number of ``root'' accesses
num_file_creations	number of file creation operations
num_shells	number of shell prompts
num_access_files	number of operations on access control files
num_outbound_cmds	number of outbound commands in an ftp session
is_hot_login	1 if the login belongs to the ``hot'' list; 0 otherwise
is_guest_login	1 if the login is a ``guest''login; 0 otherwise

General Remarks

For some of the use cases we have created internal datasets with related pre-trained neural networks that can be demonstrated.

There are more use cases where IBM Cognitive Systems is involved, but for confidential reasons, are not shared in this material.

If you have questions or remarks please contact the Geo team.

This is a live document, expect updates on a regular basis.

AI and Autonomous Machines will help revolutionise every single industry, making us more productive, making us more efficient and enable us to do things that today are impossible

Thank you

Presenter Name
Job Role
—
E-mail.Address@ibm.com
Phone Number

ibm.com