VM global leadership SUMMIT 2017

AIEye

Artificial Intelligence
Supercharging Knowledge and Decision Making

VM global leadership SUMMIT 2017

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Principal Research Staff Member
IBM TJ Watson Research Center
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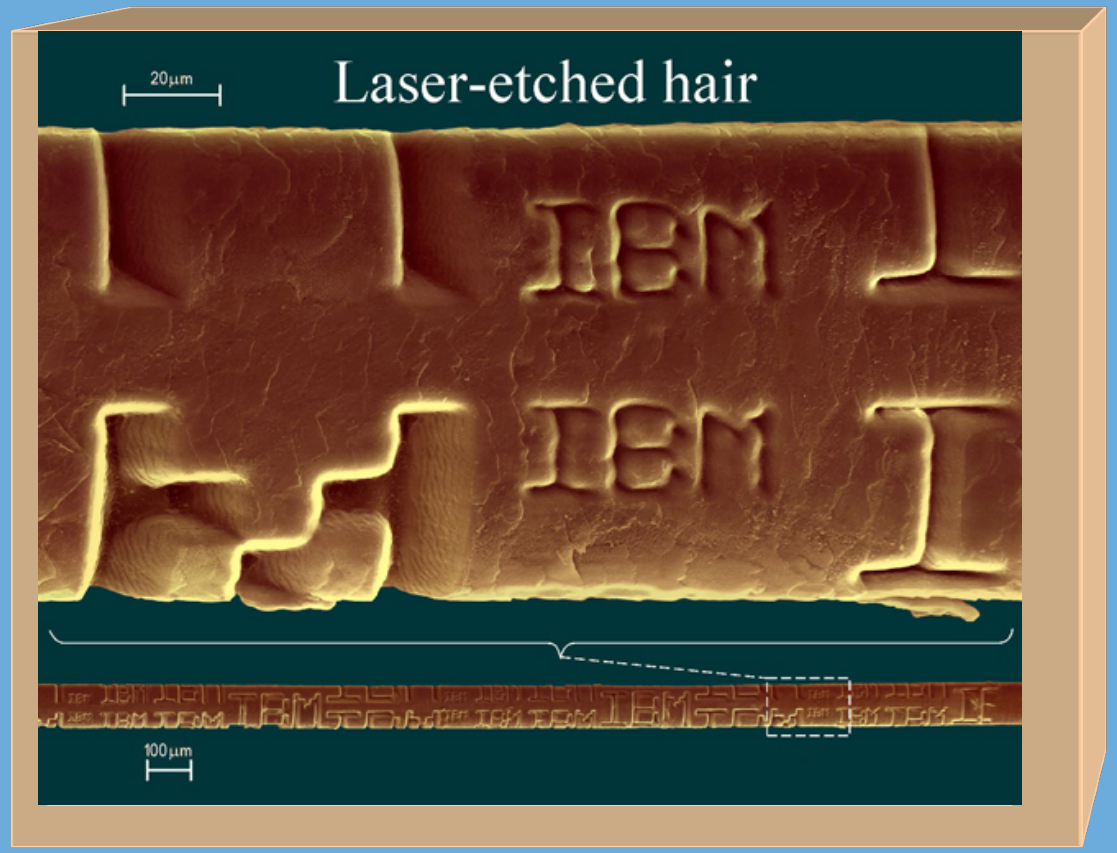
AIEye
Artificial Intelligence
Supercharging Knowledge and Decision Making

Laser Excimer Surgery



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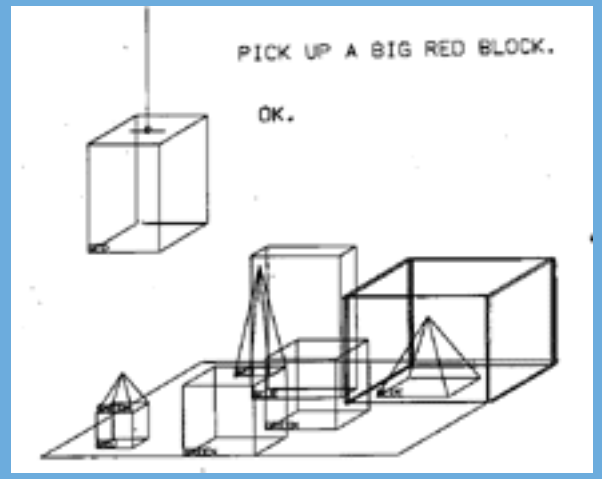
IBM Researchers:
Samuel E. Blum,
James Wynne, Rangaswamy Srinivasan

Early AI systems were pretty impressive

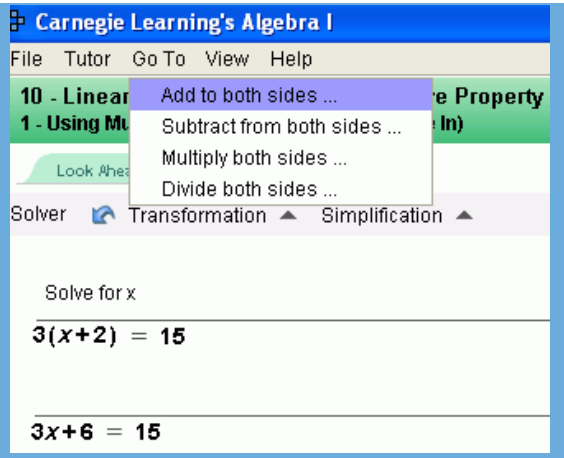


SHRDLU: A program for understanding natural language, (Terry Winograd, MIT) in 1968-70 that carried on a simple dialog with a user, about a small world of objects on a display screen.

http://hci.stanford.edu/~winograd/shrdlu/

AARON - The First Artificial Intelligence Creative Artist (Harold Cohen, UCSD) 1973–present)
The Aaron system composes and physically paints novel art work.
It is a rule-based expert system using a declarative language.

http://www.viewingspace.com/genetics_culture/pages_genetics_culture/gc_w05/cohen_h.htm



Carnegie Learning's Algebra Tutor (1999–present): This tutor encodes knowledge about algebra as production rules, infers models of students' knowledge, and provides them with personalized instruction.

http://www.carnegielearning.com

Games Provide a Laboratory for Reasoning

Checkers, 1956

Chess, 1997

AlphaGo

Go, 2016

Backgammon, 1984

Jeopardy, 2011

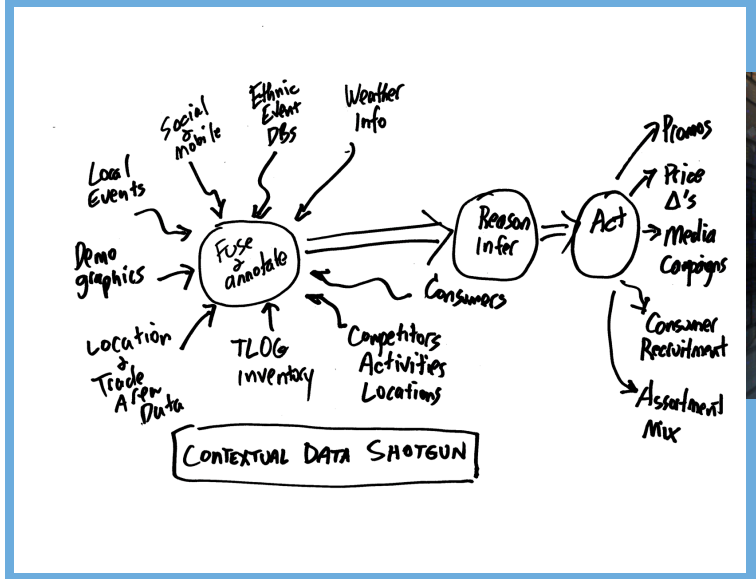
Poker, 2017

Poker- https://www.cmu.edu/news/stories/archives/2017/january/AI-tough-poker-player.html

Watson (2011): Deep Foundations in Computer Science

- Natural Language Processing
- Question Answering Technology
- High Performance Computing
- Knowledge Representation and Reasoning
- Machine Learning
- Unstructured Information Management

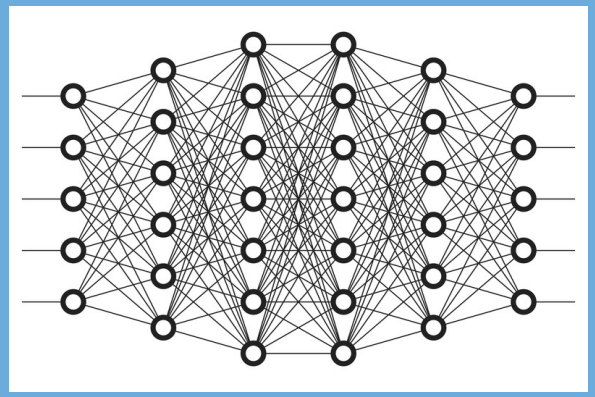
An AI Renaissance



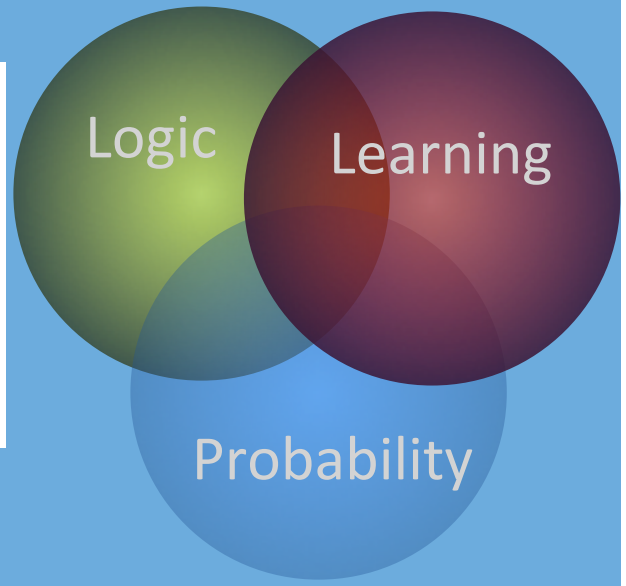
Data

(c) Can Stock Photo

Cloud

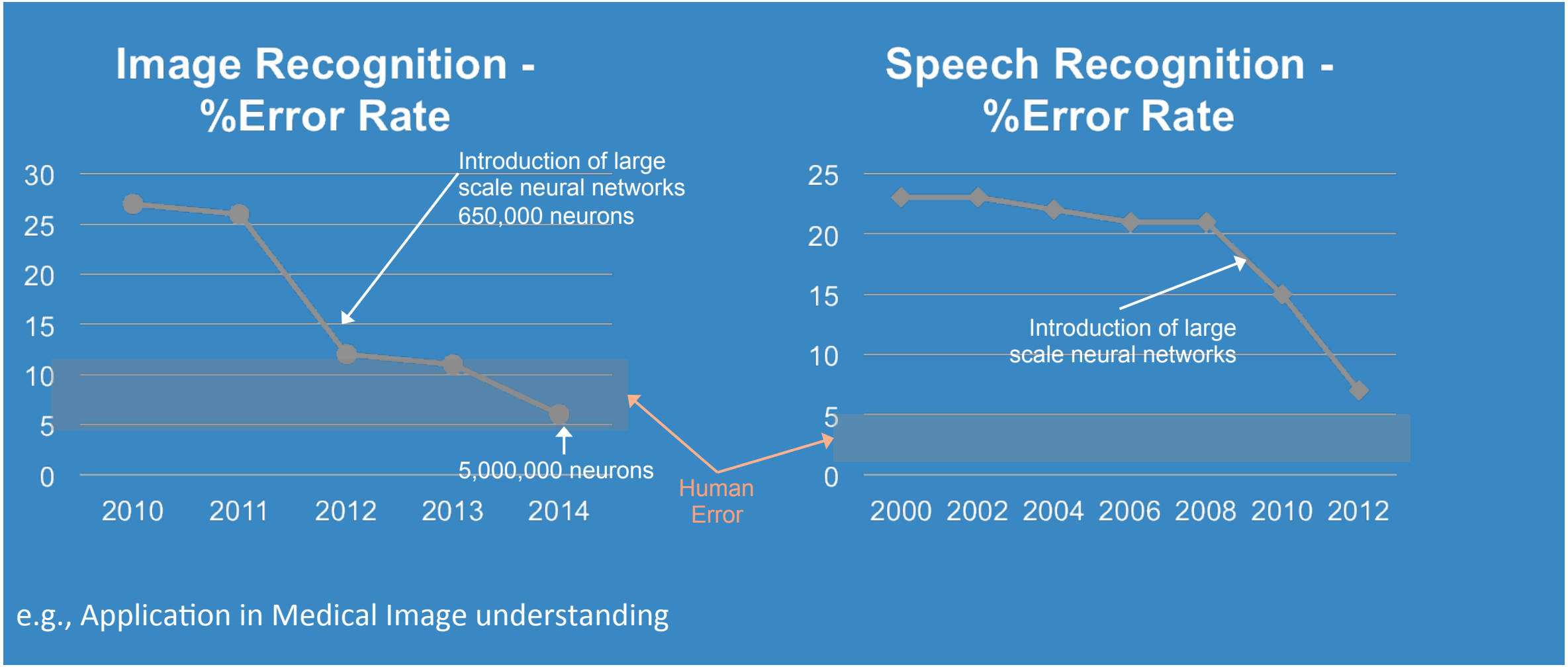


Deep Learning



Probabilistic Reasoning

Trend: Neural Networks Approach Human Accuracy



Trend: Cognitive Workloads Put New Demands on Computing

DATA Volume

COMPUTATION Cost

PB

TB

GB

MB

HPC

HADOOP

$O(N^3)$

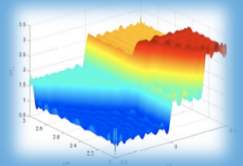
$O(N^2)$

$O(N)$

Simple DB queries

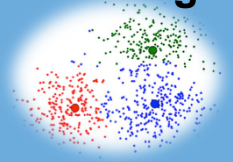
Information Retrieval

Uncertainty Quantification

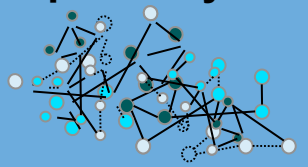


Kernel Methods

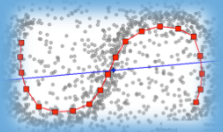
Clustering



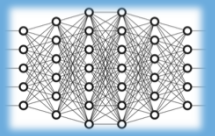
Graph Analytics



Dim. Reduction



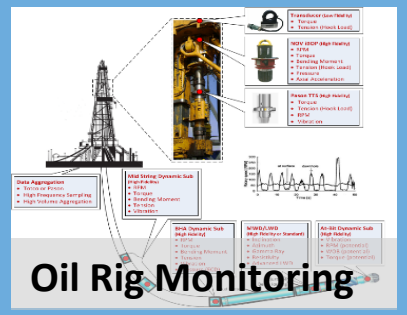
DNN Training

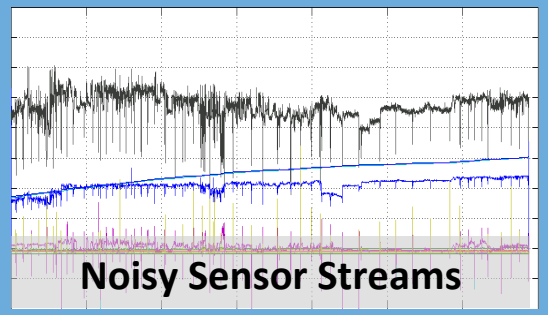


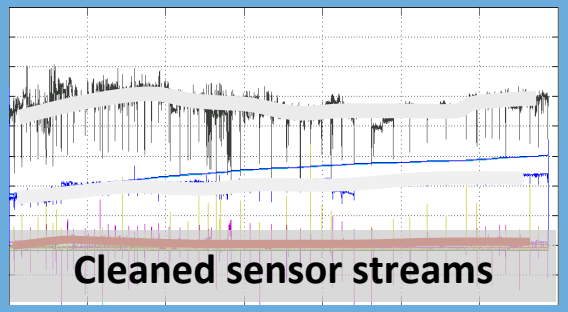
Complexity of Task

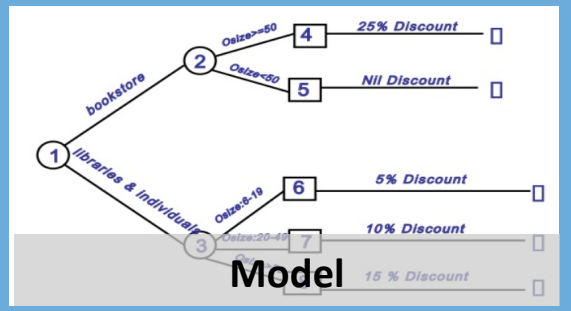
"analytic decision overload" for Data Scientists

Ingestion	Selection	Preparation	Generation	Transform	Model	Operations
•Retrieval •Storage •Formatting •…	•Data Source Selection •Data Composition •Data Linkage •Concept Extraction •Filtering •…	•Missing Values •Smoothing •Normalization •…	•Aggregation •Construction •Labelling •Data Augmentation •…	•Feature selection •Feature space transformation •…	•Regression •Classification •…	•(Re)-Deployment, Re-Training, Monitor •Explanations •Written Report •Best-Worst case scenarios •…


Oil Rig Monitoring


Noisy Sensor Streams


Cleaned sensor streams



Model

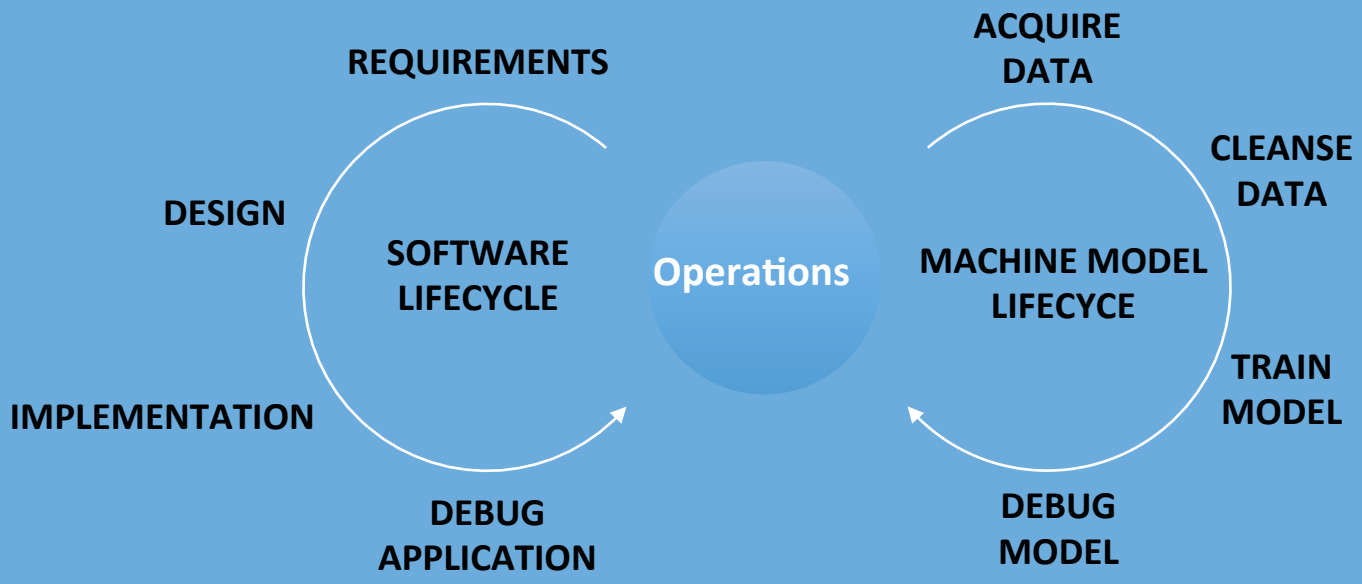
- Combinatorial Explosion in choices of algorithms (and implementations/platforms), their parameters and their compositions
- Long, complex, tedious and sometimes artful process requiring substantial time + effort

Cognitive Systems Lifecycle

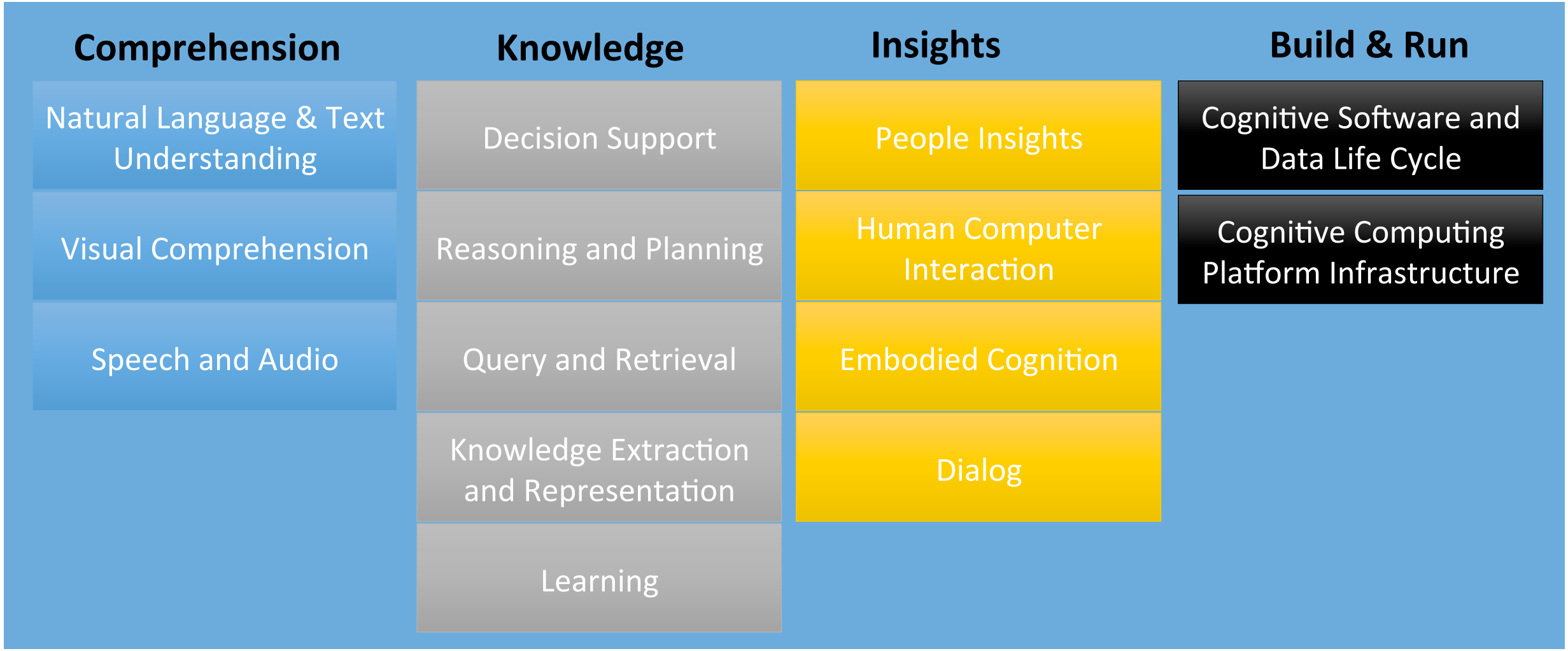
Cognitive systems are *more challenging to develop*, *deploy*, and *manage* because a critical component (model) is *created from data* and *requires domain expertise*

Areas of interest:

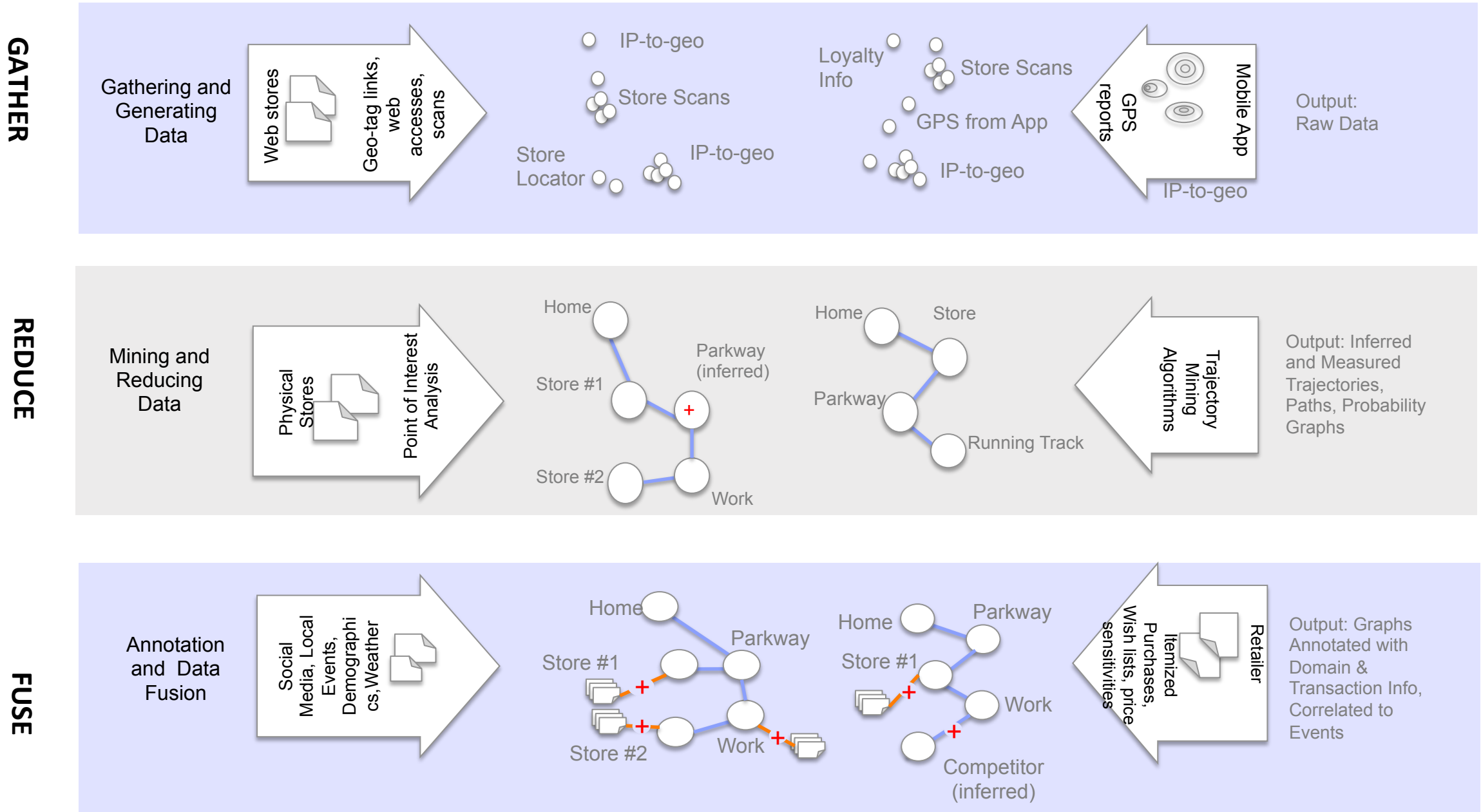
- Higher level programming models for dialog
- Increase productivity of cognitive application creation, integration, and management
- Context-based search and recommendations
- Provenance for data analytics



Main Areas of a Cognitive Computing Platform



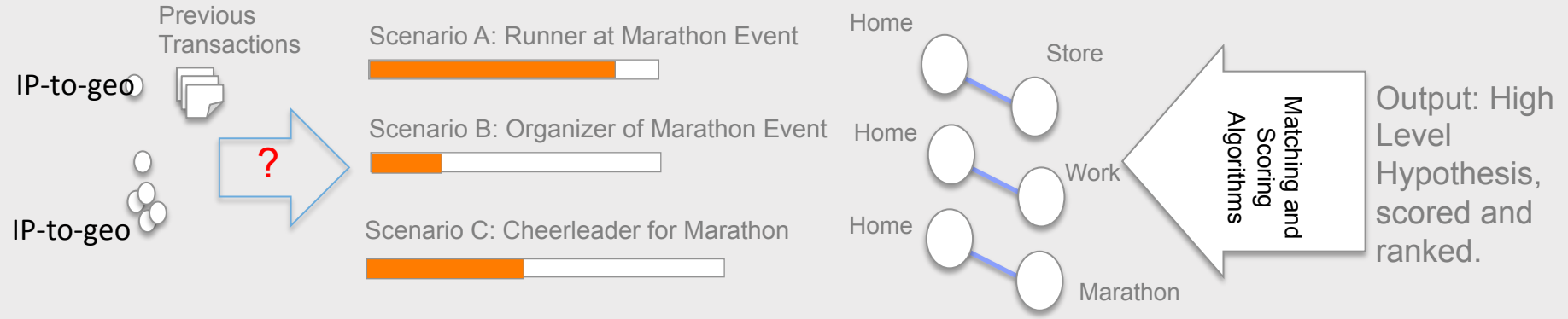
Cognitive Local Events Pipeline – Promotions to Shopper Example



Cognitive Local Events Pipeline – Promotions to Shopper Example

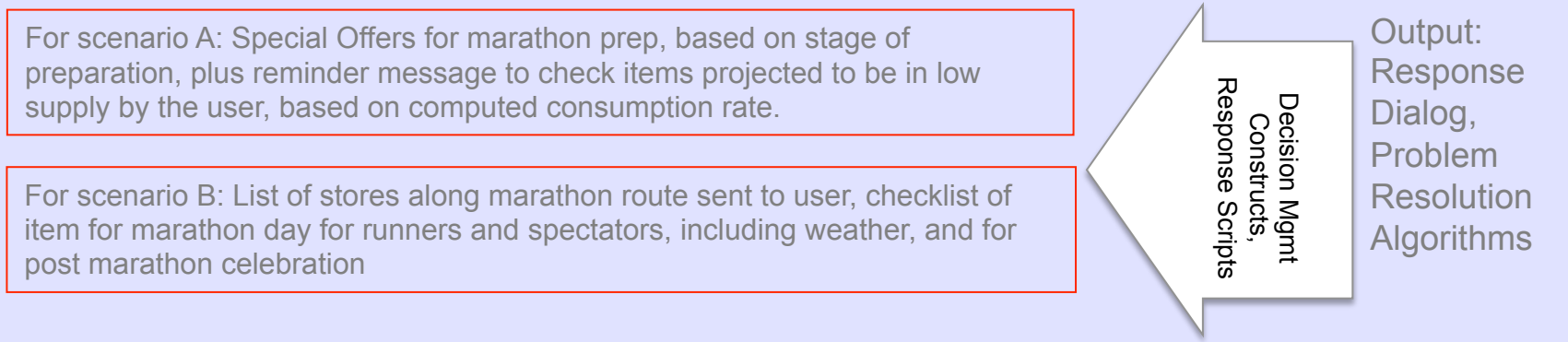
REASON

Inferring, Scoring, Deducing, Learning



ACT

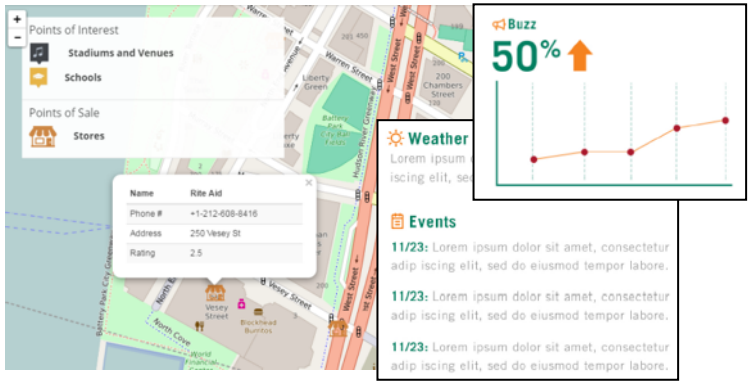
Responding and Acting

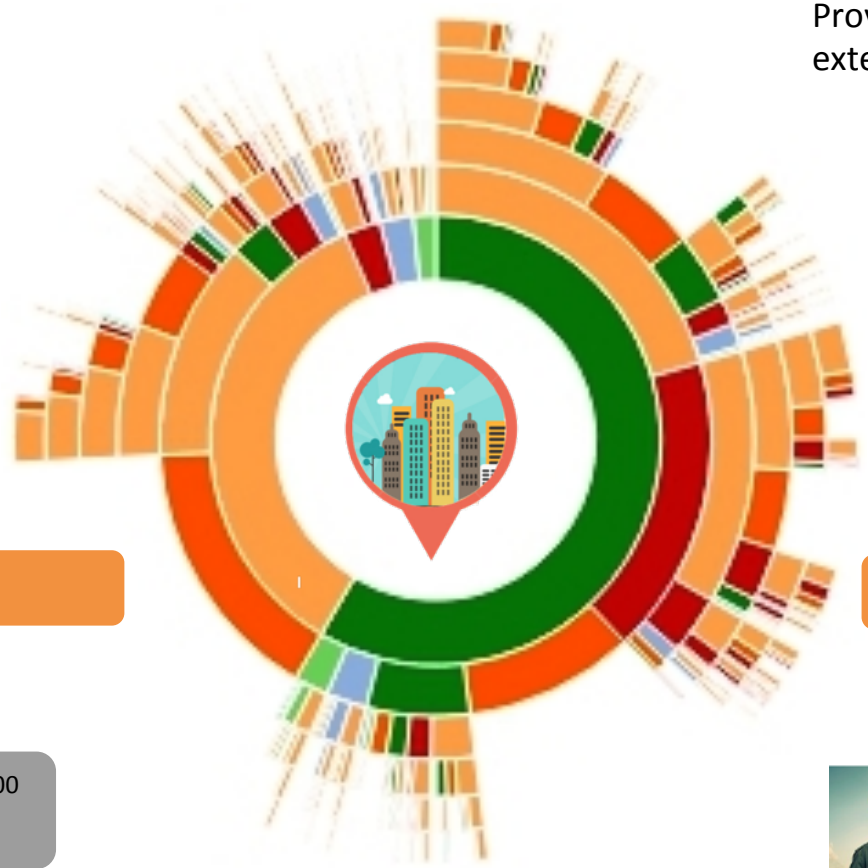


Metropulse - Powered by Watson

1. Merchant Neighborhood Insights

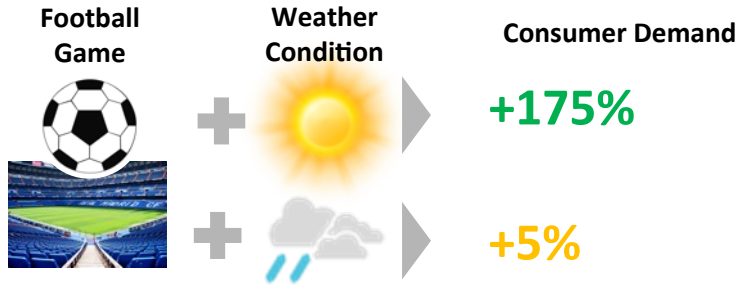
Provide merchants relevant hyper-local information to drive performance at the PoS





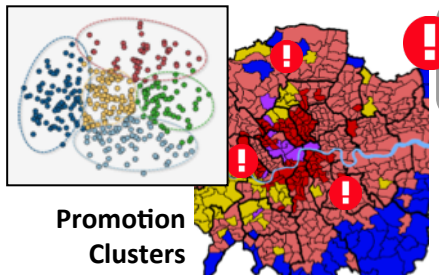
2. Product Demand Signals

Provide demand alerts for certain categories based on external events (weather, concerts, social media, …)



4. Marketing/Promotion Effectiveness

Tailor marketing content and promotions based on local events and personality traits of customers



Promotion Clusters

Upper East Side families: $100 for opening a new brokerage account

East Village young professionals: $150 bonus for opening a credit card

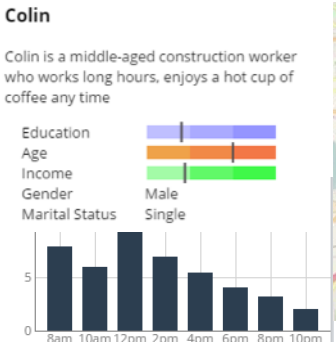
3. Shopper Personas

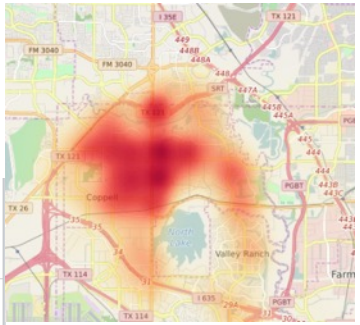
Leverage location data to create detail shopper personas by time of day and demand space

Colin

Colin is a middle-aged construction worker who works long hours, enjoys a hot cup of coffee any time

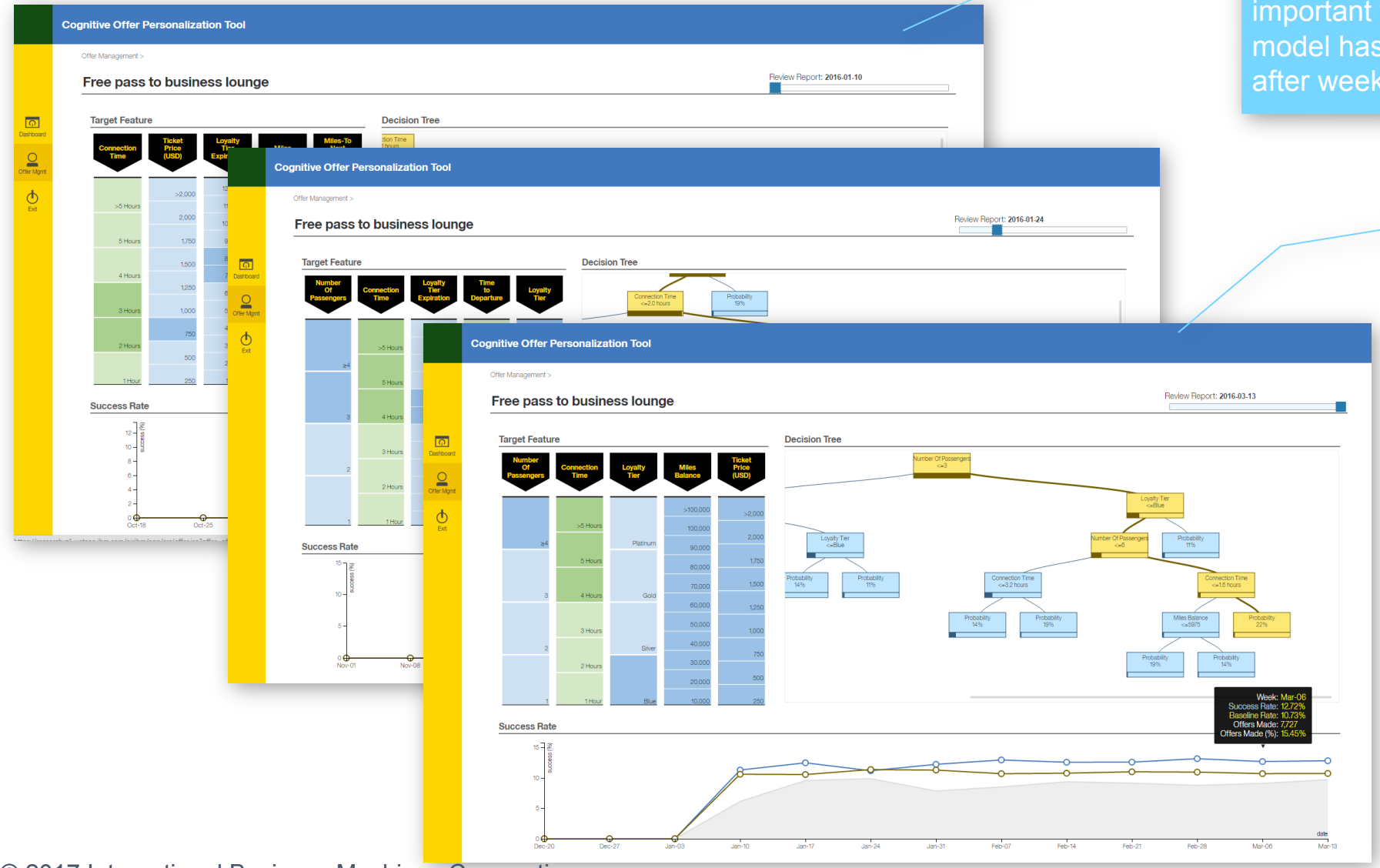
Education
Age
Income
Gender Male
Marital Status Single





Airline offers - Speed of learning

SPEED OF LEARNING (BUSINESS LOUNGE PASS)



Week 1:
Connection time and ticket price are the 2 most important features, but model has low confidence after week 1.

Week 3:
Model learns and starts converging to “number of passengers” and “connection time” as the truly important features for successful conversions.

Week 13:
Model reinforces the learning and solidifies the features and sweet spot ranges in the heat map.

Cognitive Eye Care/Wear

Care

- Diabetic Retinopathy { Glucose monitoring
- Macular Degeneration
- Glaucoma
- Cataracts { Location, Weather-> UV Exposure, Steroid use
- Iritis { Steroid use

Diseases, Analysis & Monitoring

Wear

- Frames – Personalization, Fashion Trends/Celebrity Style, Activity Matched, Outfit Matching/Cognitive Mirror
- Frames/Lenses – Omnichannel Engagement, Supply Chain - Inventory positioning, Logistics – Same day delivery, Recycling
- Smart Glasses – Auto focus, UV msmt, corneal msmt, retinal imaging, Augmented Reality,

Frames, Lenses, Electronics

Which frame comes next?

1986
1988
1991
1992
1993
1995
1997

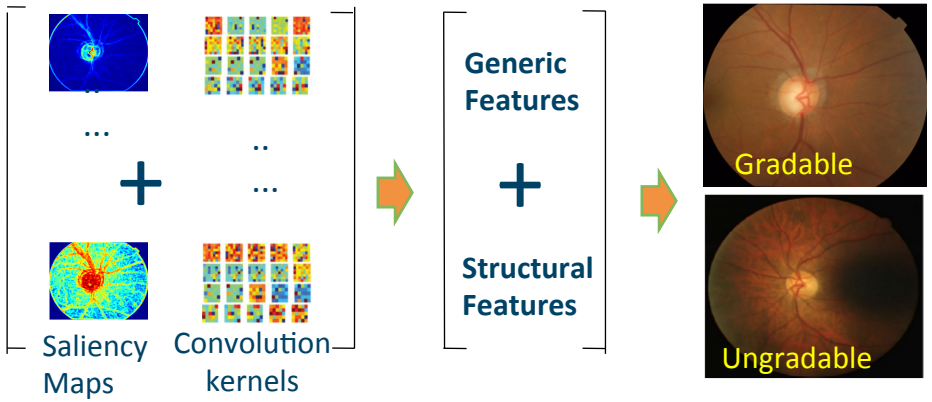
1998
1999
2001
2003
2005
2005

2007
2009
2009
2012
2015

Power Progression, Insurance/Economic, Contact lenses, Fashion, Family, Bifocals, Computer Use

IBM Research: Ophthalmology Image Analytics using Deep Learning

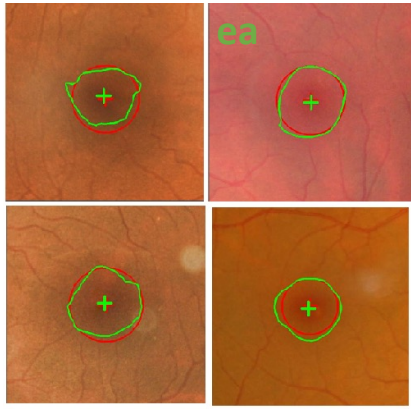
Retina Scan Quality Assessment



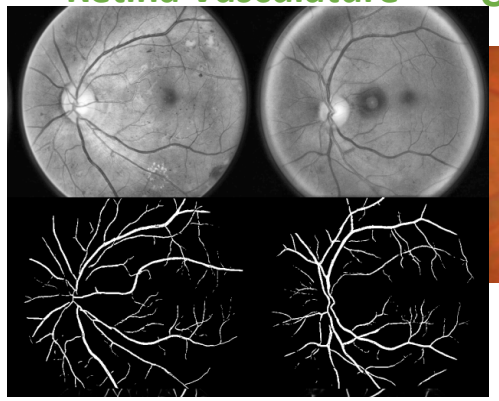
98% Accuracy in less than a millisecond!

Eye Anatomy Segmentation

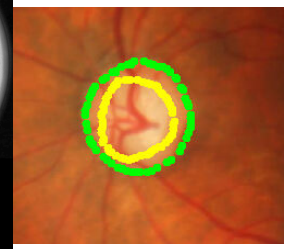
- Fovea



Retina Vasculature

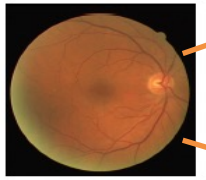


Optic Cup & Disc



CDr: **Optic cup to disc ratio one of the indicators of Glaucoma**

Left/Right Eye Identification



Deep Learning based feature extraction

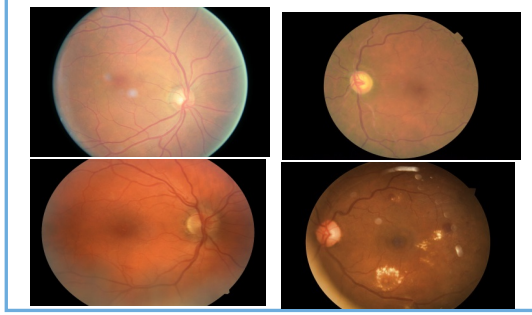
Anatomical knowledge based feature extraction

Classifier → Eye type

Method	Accuracy	AUC	# Test Images
Our method	**%98**	**0.98**	**17742**
Baseline	%77	--	2000

Diabetic Retinopathy Severity Assessment

Evaluation is performed on 35 K retina images from EyePACS Dataset



Method	Kappa-score
State-of-the-art (Baseline)	0.81
Our method	**0.86**

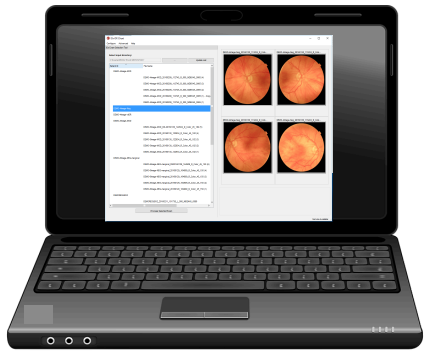
AI-based DR Screening Available in Europe

IBM Watson Health

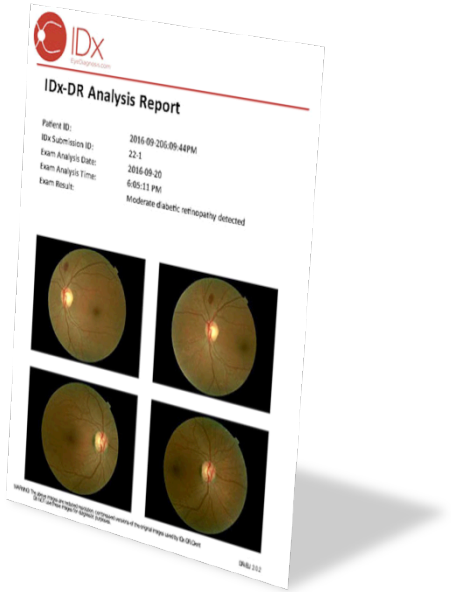
IBM

Patient Imaging in 5 min. Procedure

Images processed on secure server



Point of Care Results in < 20 sec.



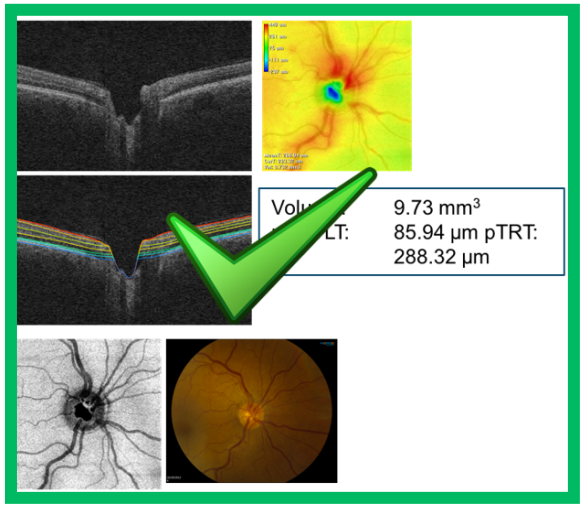
IDx and IBM Watson Health Forge Alliance for Eye Health: *IBM Watson Health to Distribute IDx-DR Offering in European Economic Area:* http://www-03.ibm.com/press/us/en/pressrelease/51833.wss

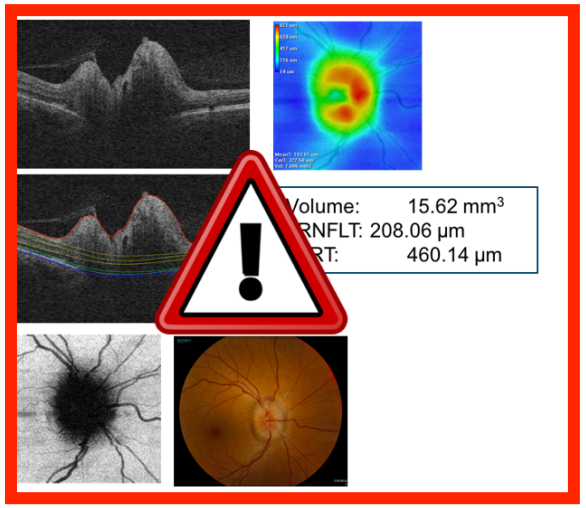
IDx is currently conducting a U.S.-based clinical trial of IDx-DR scheduled for completion this summer.

Please note that IDx products have not been cleared by the FDA and are not currently for sale in the United States. IDx-DR is an investigational device and is limited by Federal law to investigational use in the United States.

Computer image: https://pixabay.com/en/laptop-notebook-computer-black-158648/
Wi-fi image: https://pixabay.com/en/wi-fi-internet-connection-1646475/

OCT-Based AI
Full Spectrum Disease Screening and Management





OCT device independent

- Automated Image Quality Check
- Automated Retinal Layer Segmentation
- ***Glaucoma*** Screening and Progression
- ***AMD*** Screening and Progression
- ***Visual Field*** Prediction from OCT
- Automated detection of brain swelling (papilledema)

"…IBM and IDx to work together to jointly develop and deploy new eye-related offerings leveraging each company's expertise and assets." – IBM News Release, 3/16/17

- Green check mark image: https://pixabay.com/en/mark-green-tick-symbol-sign-35780/
- Warning sign image: https://pixabay.com/en/warning-danger-dangerous-sign-36073/

Thank you