

Advanced Analytics

Case-study Approach to Understanding Data-Science Applications

Japan Innovation Day - Tokyo

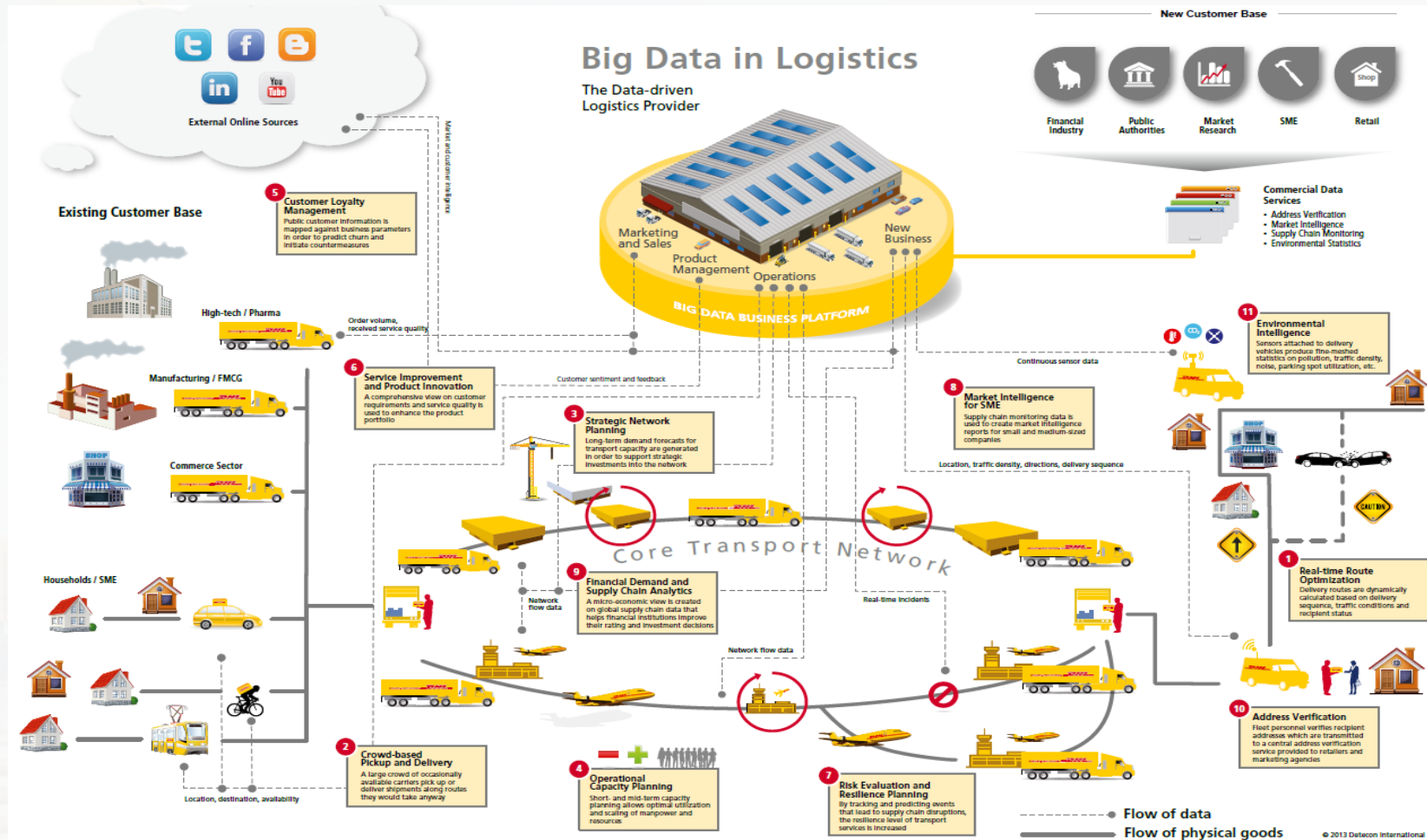
23 May 2019



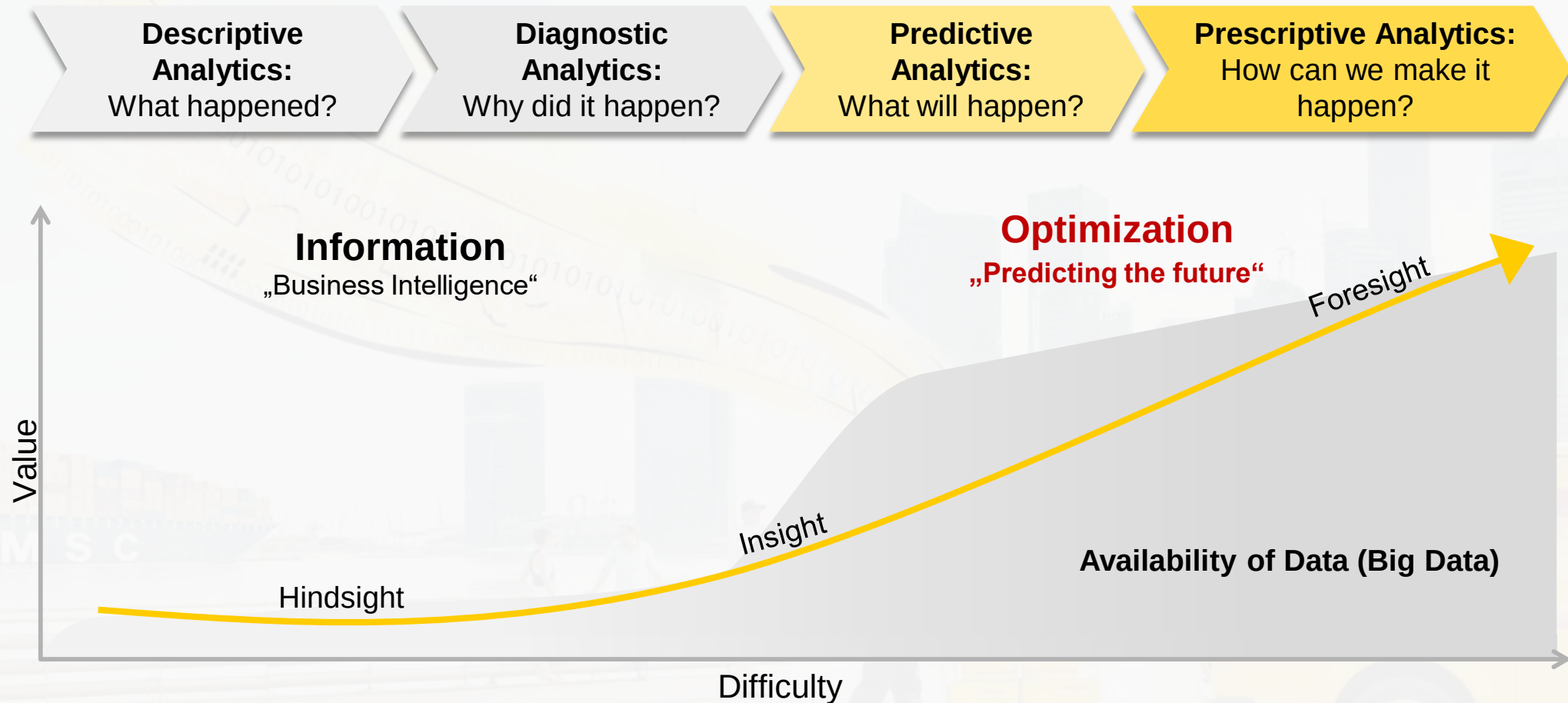
AGENDA

- 1 Introductions
- 2 DHL – Case Studies in Supply Chain
- 3 Fujitsu – Smart Mobility

A NEW ENGINE OF GROWTH



ANALYTICS VALUE CHAIN

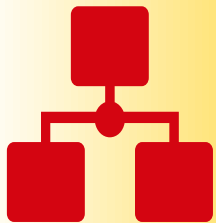


DHL ADVANCED ANALYTICS



Founded in 4Q 2016

- Data Scientist x10
- Collaboration with Singapore Management University



Analytics-as-a-service

- Business intelligence mining across large data sets
- Predictive & prescriptive analytics solutions
- Process automation

Approach

- Customized development
- Rapid prototyping
- Commercial-value focused
- Proactive R&D: 2nd supplier surge economics models; Warehouse automation Digital Twin

Machine-learning algorithms



Neural
Networks



Random
Forest



K-Means
Clustering



Support
Vector
Machine

Open-source tools



python™



neo4j



mongoDB



hadoop



MySQL



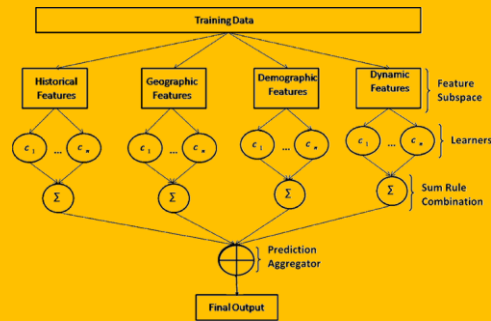
Power BI

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USE CASE OPPORTUNITIES

Event Prediction



Demand Prediction

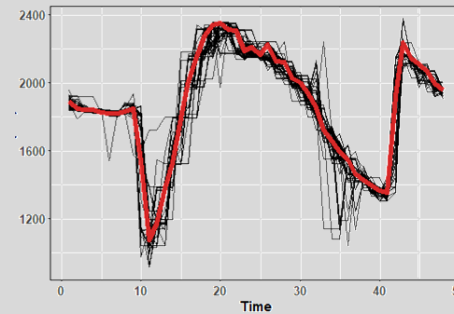


Image Recognition



USE CASE 1: AIR FREIGHT DELAYS



Predicting potential shipment delays

- Facilitate proactive mitigation, e.g. alternative routing; Route optimization / planning
- Leveraged machine learning to achieve advance notice
- Identifying top influencing factors

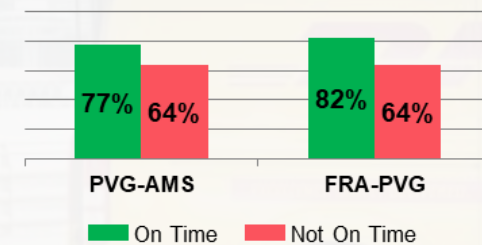
Predicting next Sunday's airfreight transit time delay risk on Monday

Mon Tues Wed Thu Fri Sat Sun

On time?

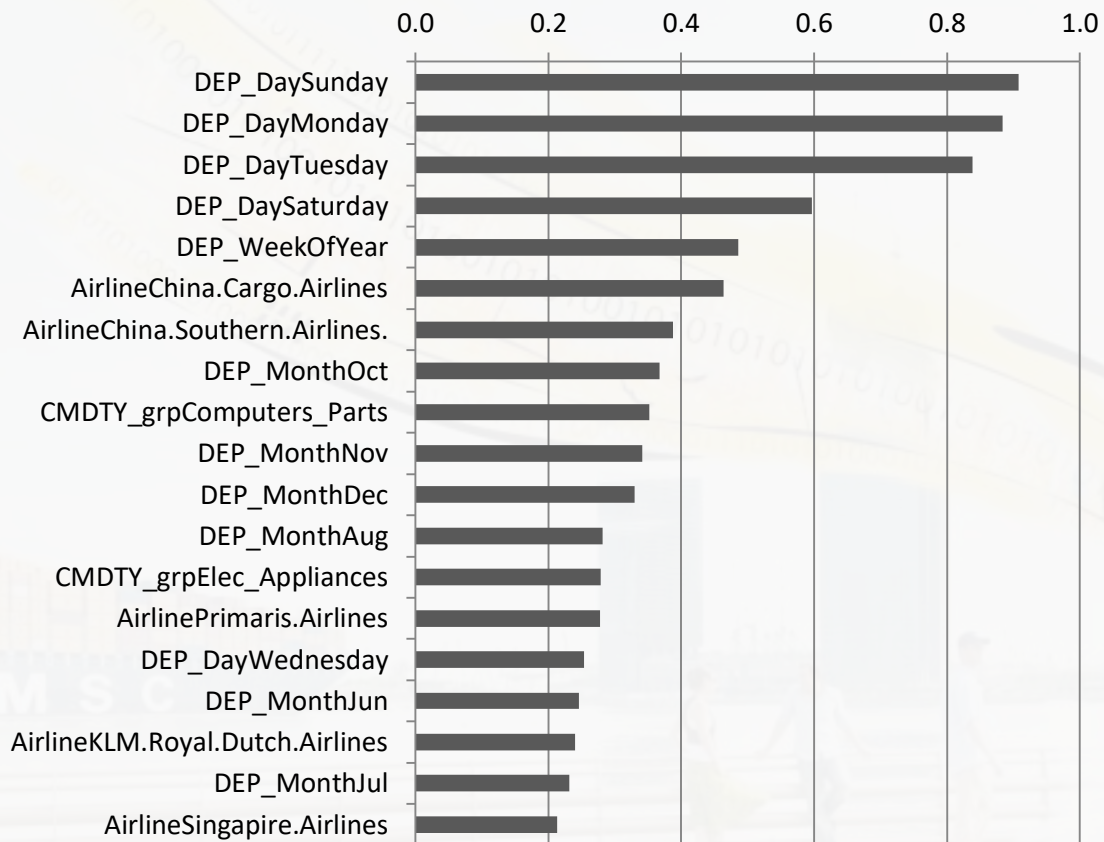
Yes
No

Prediction accuracy of an event in 10 days time



USE CASE 1: AIRFREIGHT DELAYS

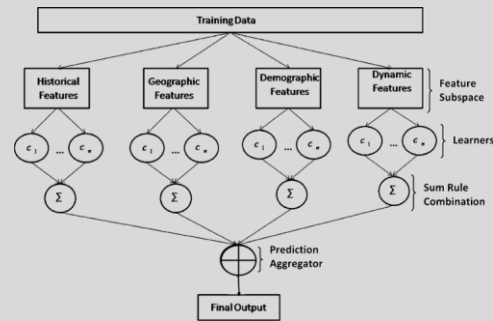
Top Influences in the Logistic Regression Model



Attribute Name	Coefficient	Influence
DEP_DaySunday	0.908	(+)
DEP_DayMonday	0.884	(+)
DEP_DayTuesday	0.838	(+)
DEP_DaySaturday	0.597	(+)
DEP_WeekOfYear	0.485	(-)
AirlineChina.Cargo.Airlines	0.463	(+)
AirlineChina.Southern.Airlines.	0.387	(+)
DEP_MonthOct	0.367	(+)
CMDTY_grpComputers_Parts	0.352	(+)
DEP_MonthNov	0.341	(+)
DEP_MonthDec	0.330	(+)
DEP_MonthAug	0.281	(+)
CMDTY_grpElec_Appliances	0.279	(+)
AirlinePrimaris.Airlines	0.278	(-)
DEP_DayWednesday	0.254	(+)
DEP_MonthJun	0.246	(+)
AirlineKLM.Royal.Dutch.Airlines	0.240	(+)
DEP_MonthJul	0.232	(+)
AirlineSingapore.Airlines	0.213	(-)
PCS	0.194	(-)
AirlineAir.China...Air.China.Cargo.	0.181	(+)
AirlineYangtze.River.Express.	0.176	(+)
AirlineEAT.European.Air.Transport.	0.150	(+)
AirlineEVA.Air.	0.149	(-)
DEP_MonthMay	0.138	(+)
AirlineAirbridge.Cargo.Airlines	0.138	(+)
DEP_MonthSep	0.135	(+)
CMDTY_grpVehicle_Parts	0.130	(-)

USE CASE OPPORTUNITIES

Event Prediction



Demand Prediction

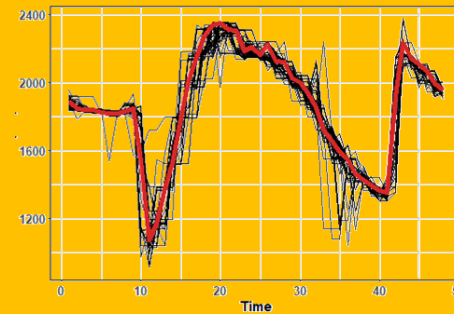


Image Recognition



USE CASE 2: KEY CUSTOMER DEMAND PREDICTION



Predicting demand at Client and SKU level

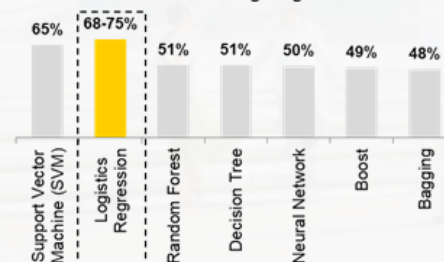
- Demand pattern identification (i.e. surges)
- Improving fill-rate
- Profiling customer order behavior
- Finding hidden relationships

Predicting aggregate demand
i.e. For SKU with top volume: 93% accuracy



Predicting if next order would be a surge

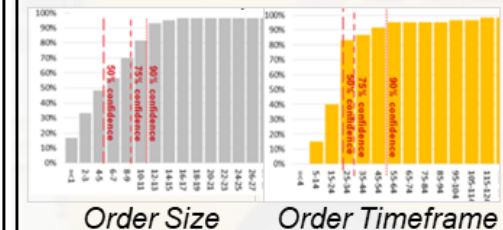
Evaluating the effectiveness of various machine learning algorithms



Identifying key dealer clusters based on demand recency, frequency & value



Simulation upcoming dealer order behavior



USE CASE 3: DEMAND & INVENTORY ANALYTICS



						
Name	Home Brew	20 Litre	Pony Keg	Slim 30	Import / Micro	Full Keg
Dimensions	23"h x 9"w	24"h x 10"w	14"h x 17"w	24"h x 12"w	21"h x 17"w	24"h x 17"w
Litres	18 Litres	20 Litres	30 Litres	30 Litres	50 Litres	58.7 Litres
Imp. Oz	634 oz	704 oz	1056 oz	1056 oz	1760 oz	2065 oz
Weight	49 lbs	58 lbs	87 lbs	82 lbs	139 lbs	161 lbs
Height with Coupler	29"	30"	20"	30"	26"	30"

Stock analysis to enable network & inventory optimization

- Predicting demand across all SKUs
- Optimizing inventory safety-stock levels
- Decomposing trends to identify seasonality & impact of external influences

Improving forecasts to lower safety stock levels

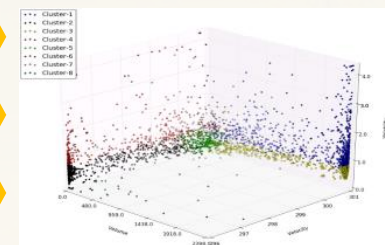


Multi-dimensional clustering to identify optimal distribution approach

Volume

Velocity

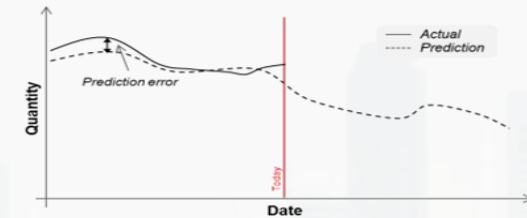
Volatility



USE CASE 3: DEMAND & INVENTORY PLANNING



+10%
Forecast Accuracy
Improvement



> € 4M (>30 %)

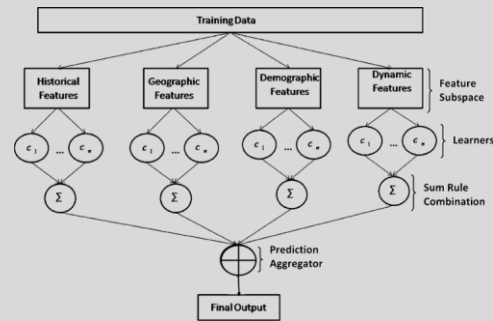
Working Capital
Savings

23%

Storage Space
Reduction

USE CASE OPPORTUNITIES

Event Prediction



Demand Prediction

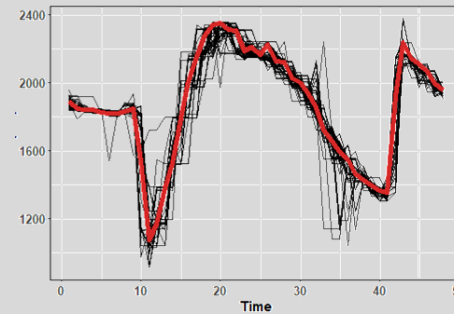


Image Recognition



WHAT IS IMAGE RECOGNITION?

94	90	92	90	90	91	91	86	85	90	87	91	98	93	95	93	87	90	88	87	85	81	79	78	77	78	76	80	79	86
116	114	111	110	107	111	109	106	104	106	106	111	112	107	107	108	104	109	108	108	105	105	107	108	103	107	111	112	114	109
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136	144	150	151	149	151	156	154	152	158	139	130	201	212	185	122	61	36	22	99	150	141	144	147	153	154	149	148	151	148
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60	72	72	85	99	92	92	98	97	79	59	55	49	116	174	144	152	141	69	50	45	38	68	76	78	107	130	112	98	104
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23	19	18	19	22	30	30	26	21	23	31	40	29	22	17	13	14	17	22	12	7	6	13	10	6	8	14	18	17	24



WHY IS IMAGE RECOGNITION SO CHALLENGING?



Round edges
Linear edges



2x Circle
2x Triangles
2x L-shapes



Bicycle!

C

E

DIFFICULT TO SCALE AND BRITTLE!

A



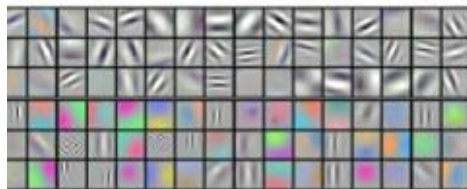
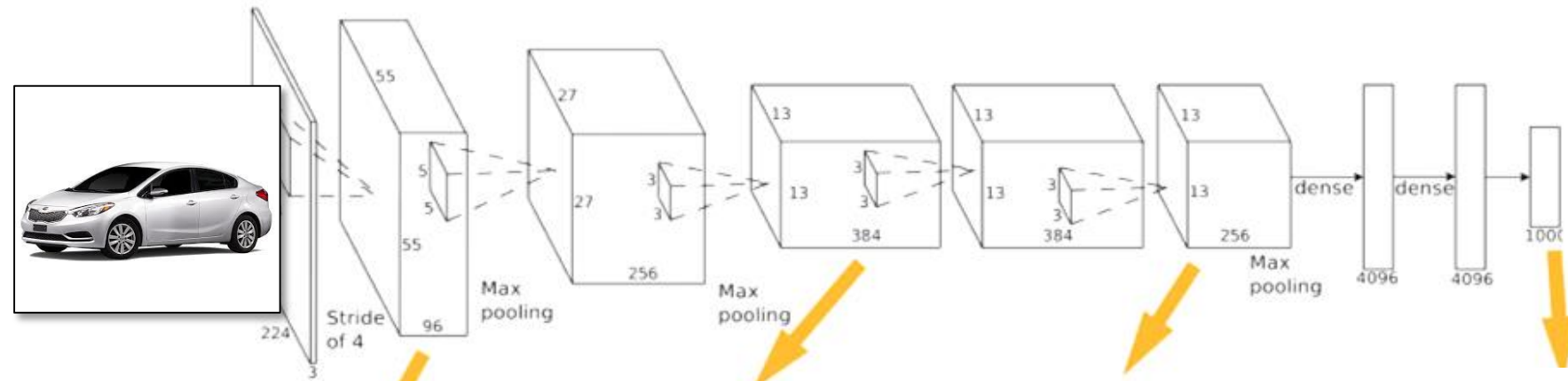
B



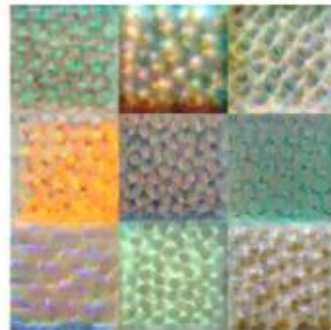
D



HOW DO COMPUTERS “SEE”



Layer 1:
Identify Edges



Layer 3:
Identify Textures



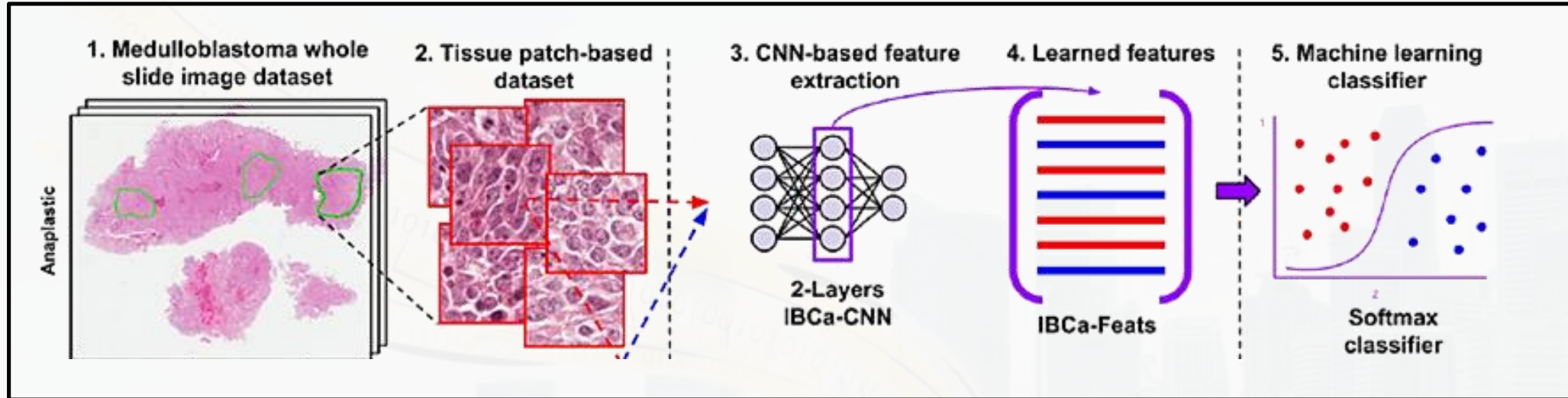
Layer 5:
Identify Object Parts



Conclusion:
Identify Item Probabilistically

CAR: 95%
CLOCK: 5%

EXAMPLE: CANCER DETECTION



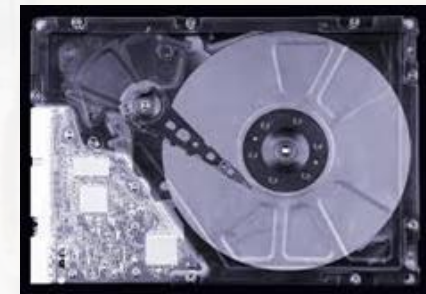
Faster, cheaper diagnosis on par or more **accurate** than humans
i.e. Detection sensitivity of very small tumors –
by clinicians: 38%
by ConvNet (Machine Learning): 70%

USE CASE: DEFECT DETECTION / PREDICTIVE MAINTENANCE

Today: Manual inspection; AR/VR enabled service assistance

Future: AI driven diagnosis

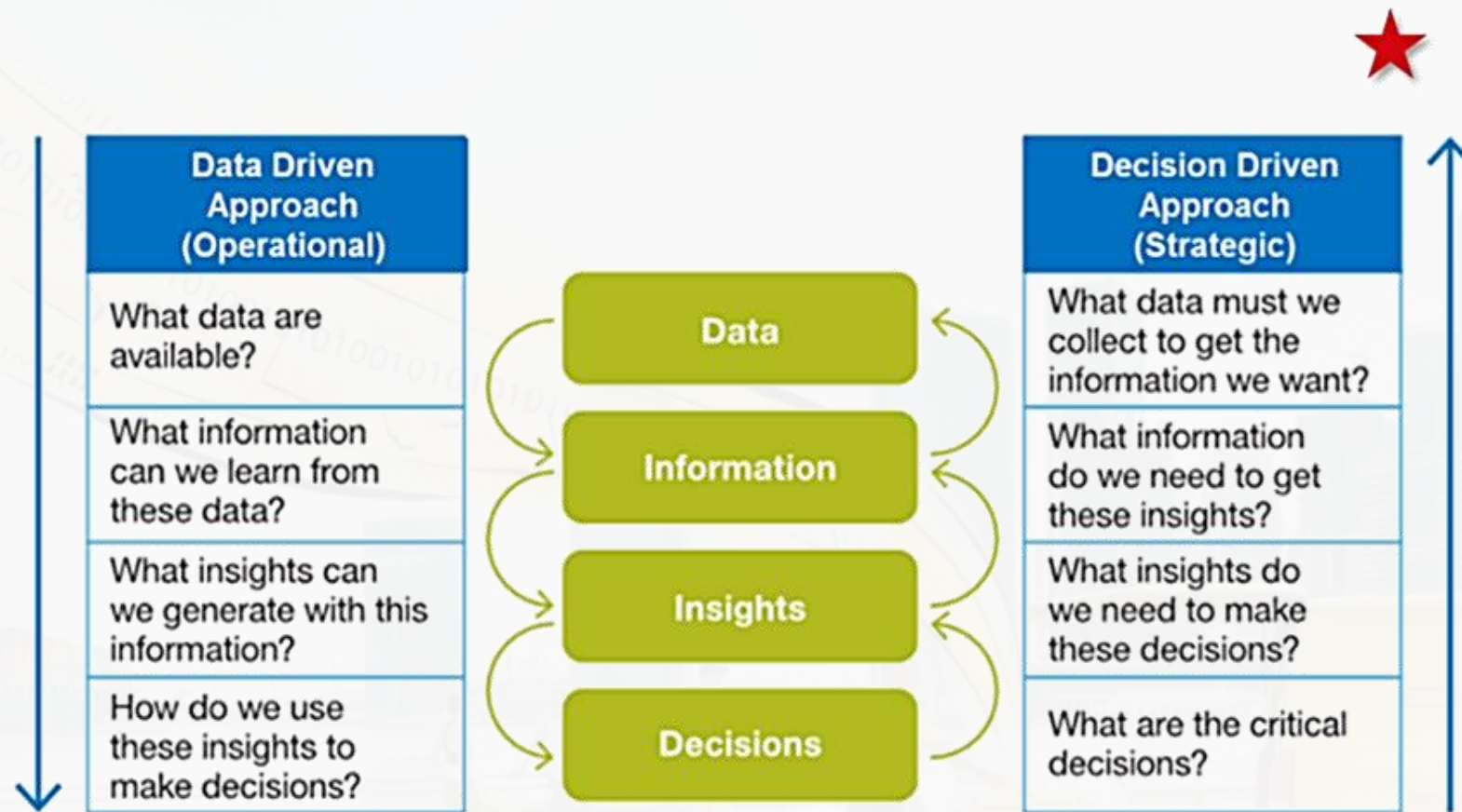
- Identification of defects using non-destructive tests: e.g. photos, X-ray or ultrasonic scans
- Able to identify unknown defects by learning data from good parts



MYTH

“Here’s all my data, find useful insights”

STARTING WITH THE END IN MIND



Source: Mckinsey & Company

BREAKING DOWN THE PROCESS



(a) Use Case

i.e. challenge, opportunity

(b) Objective

i.e. reduce safety stock

(c) Target Impact

i.e. Lower logistics costs, reduced working capital, improved service lead time

(d) Current State

i.e. forecast accuracy, processes, technology, root causes

(e) Target Future State

i.e. what is the future process flow

(f) Information / Insights needed to succeed

i.e. network, pull/push model, KPIs, SLAs

(g) Data

i.e. internal, external, time-range

(h) Stakeholders

i.e. ops, planning, sales

(i) Data Science Approach

i.e. clustering, machine learning predictions

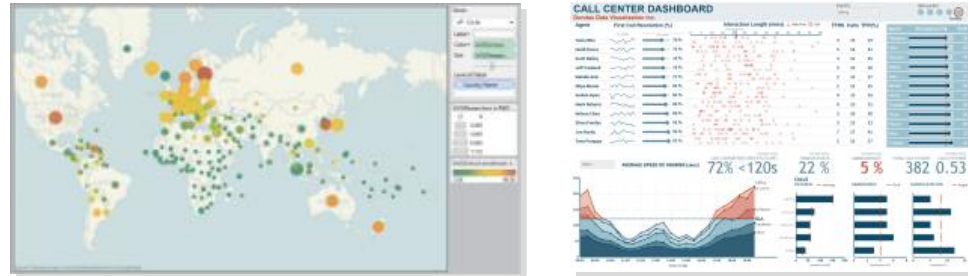
(j) Data Visualization Approach

i.e. Power BI, Tableau, Web-App

STORY TELLING

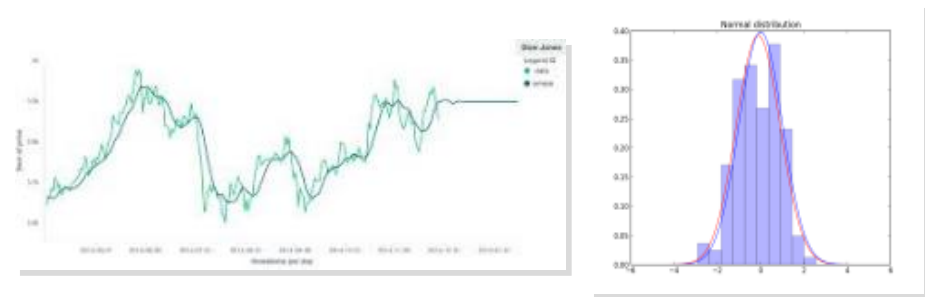
Interactive Visualization Dashboard

Enabling the slicing & dicing of data; For mining of insights



Volatility and Trend Analysis

Quantitative analysis for operational foresights and benchmarking



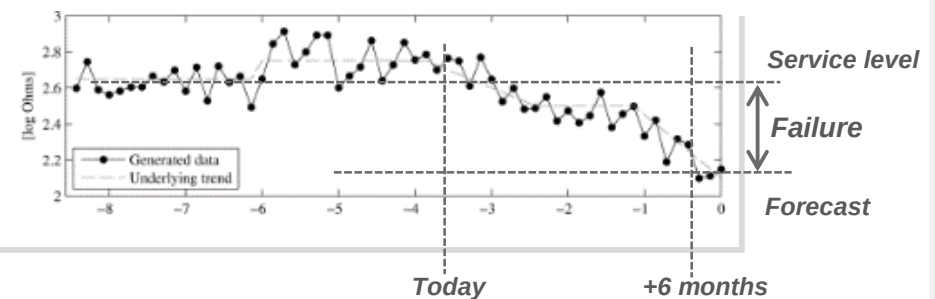
Risk Scoring & Ranking

One-stop operational view for end-to-end view of risk levels



Failure/Deviation Prediction

Predicting service levels to enable quicker risk /service mitigations



TIMELINES

Data Preparation

- Data Extraction
- Data cleaning
- Data integration

Analysis and Transformation of Variables

- Evaluation distributions of variables and relationships
- Imputing missing values
- Deriving new features

Develop Predictive Models

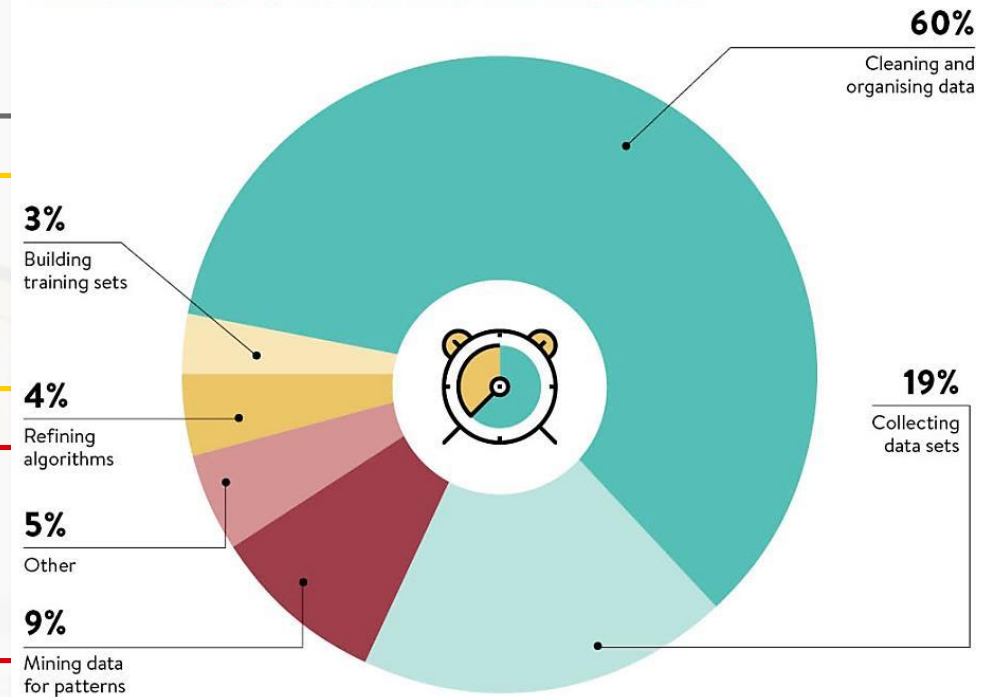


- Exploring different algorithms and methods
- Check model fit
- Refine predictors

Validate Models

- Evaluate model performance of models
- Accuracy vs Interpretability

WHAT DATA SCIENTISTS SPEND THE MOST TIME DOING



Source: CrowdFlower 2016

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THANK YOU