AI & ML for Business Value

greatlearning
Learning for Life

What is this talk about? (and what it is not!)

What is this talk about:

- Understand how business decisions are made and the relevance of AI / ML
- Understand the basics of Artificial Intelligence and its relevance in business context
- Discuss industry applications of AI / ML

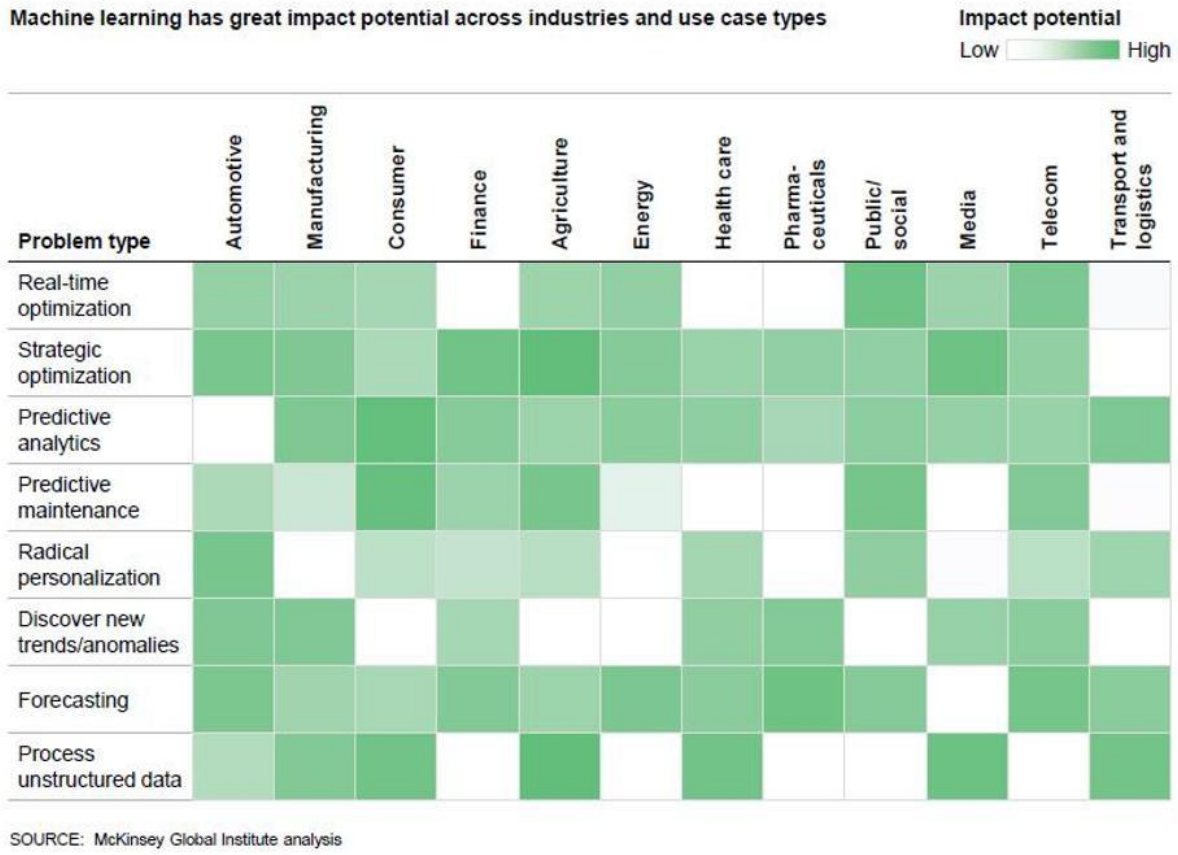
What this talk is not:

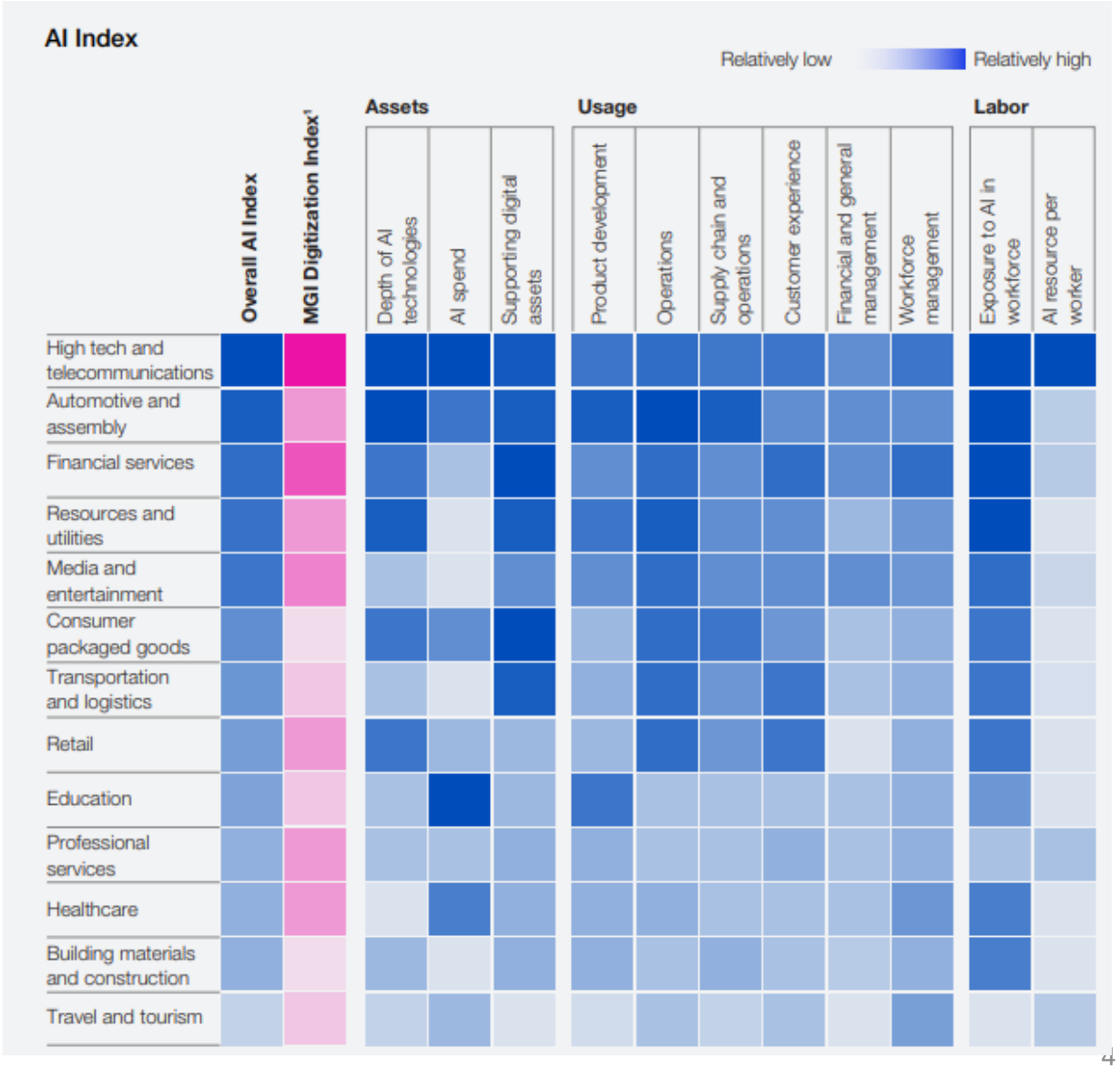
- Does not deal with cost-benefit analysis of use cases
- Does not cover moral, ethical dimensions of applications
- Does not cover any math behind the techniques

How delivered: I am going to put myself in your shoes, ask & answer key questions that you might have in your mind as you embark on this course!

Q1: What is the motivation for us to understand Data Science, AI & ML?

There is increasing use of AI/ML across industries…





https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/an-executives-guide-to-ai

But getting true business value needs (lot) more work…

Stacked Ensemble has an accuracy of 97% without overfitting

DL Network with 25 hidden layers beat the existing benchmarks

Business Value?? Not so sure

Do they understand the business complexity, the context?

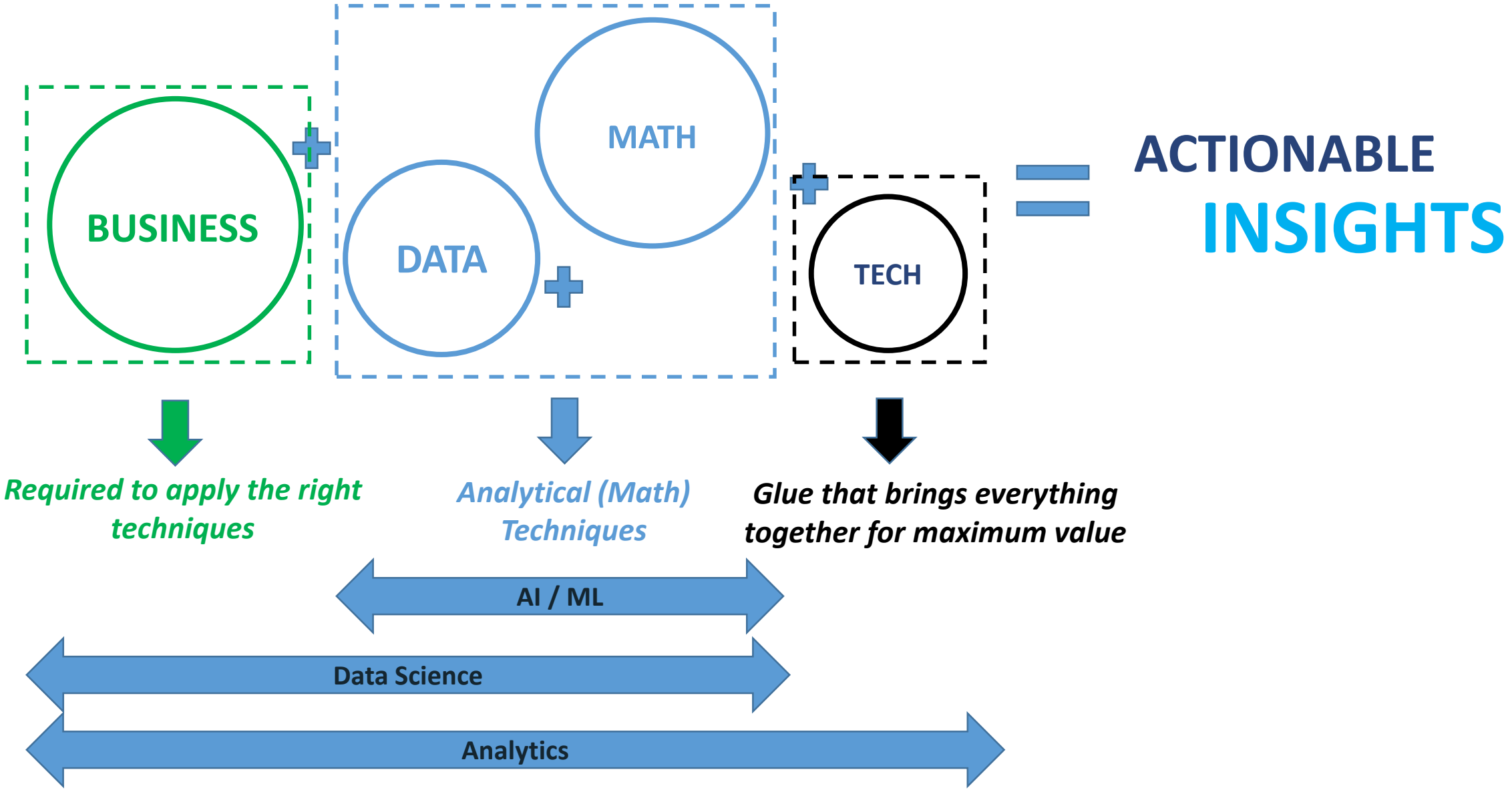
Data Science (AI/ML) is powerful but there exists a divide

Data Scientists

Business Decision Maker

Q2: Before getting into the details, can you show me the simplest possible picture to understand Analytics and its relationship to AI / ML?

Analytics is a tool to solve business problems…



Q3: What are the broad categories of decisions taken in organizations and how are these decisions made?

On a daily basis organizations take hundreds of decisions…

Should I acquire Company A?

What revenue guidance should I give my investors?

What price should I set for my product?

How do I increase checkouts on my ecommerce website?

What campaigns should I run? How much should I spend on those campaigns?

How do I increase manufacturing throughput?

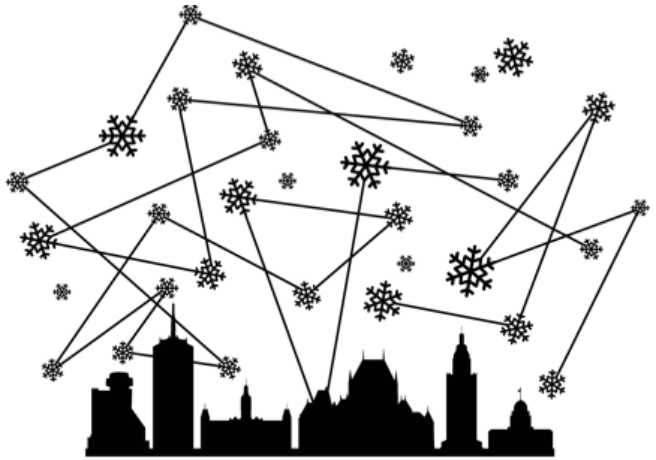
Should I hire this person or not?

What offers should I give my customers?

How do I comply with regulatory requirements?

Business Decisions – Type 1 - Strategic

Real World (Business)



Strategic

DECISIONS

EXPERTISE

What is the company's next blockbuster product?

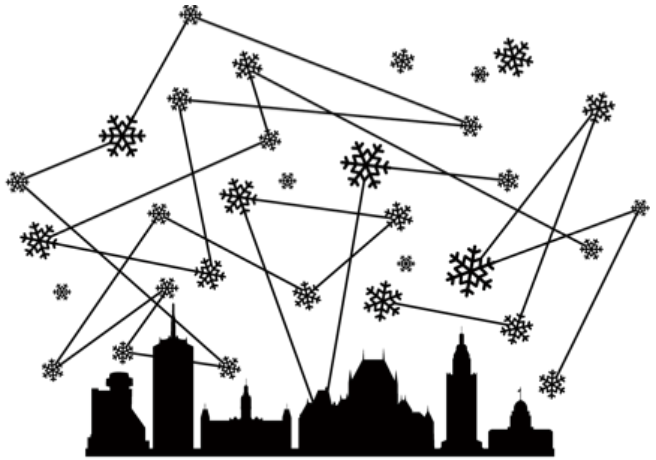
Should I acquire company X?

Should I expand into country A or B?

1. Experience
2. Education
3. Training

Business Decisions – Type 2 - Tactical

Real World (Business)



Tactical

DECISIONS

EXPERTISE

1. Education
2. Experience
3. Training

Head of Sales & Marketing

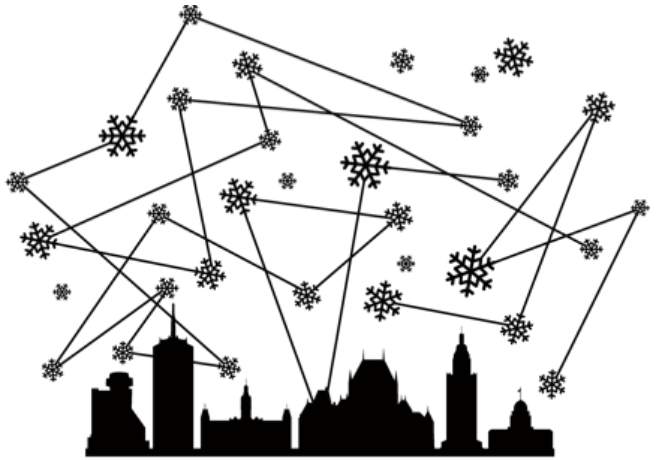
What price should I set for Product X, SKU Y?

What should the next week marketing campaign focus on?

How do I handle the negative brand perception on social media?

Business Decisions – Type 3 - Operational

Real World (Business)



Operational

DECISIONS

EXPERTISE

1. Training
2. Experience
3. Education

How many shifts should I run today?

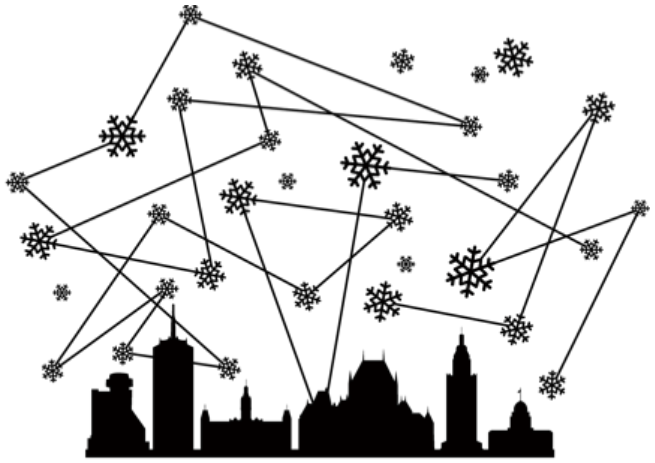
How do I improve safety on the shop floor?

What is the bottleneck in the process?

Shop floor Manager

So how are business decisions made?

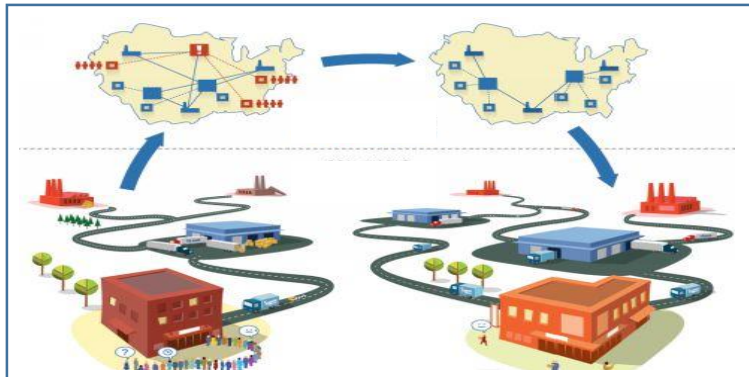
Real World (Business)



DECISIONS

EXPERTISE

1. Experience
2. Education
3. Training



MENTAL MODELS

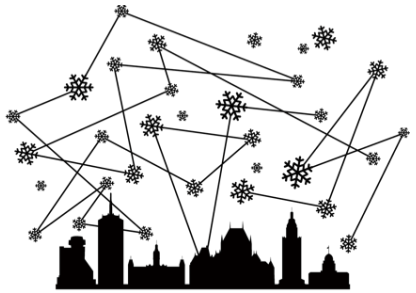
Approximation of the Real World

Business Decision Makers

Mental Models backed by Human Expertise (Gut Feel)

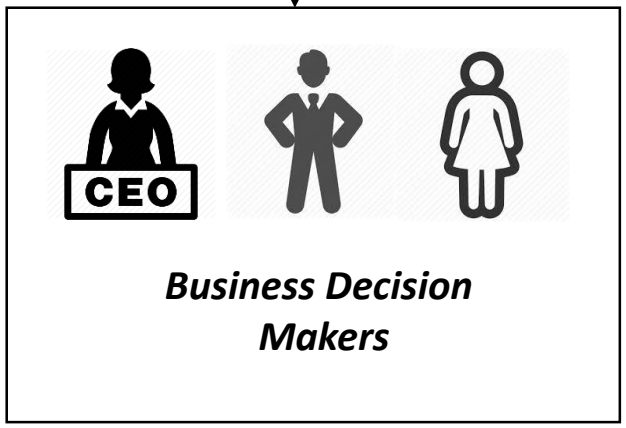
Mental Models

No Technology, Just Expertise



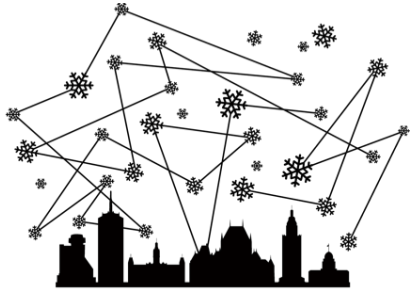
Real World (Business)

Develop an Approximation



Business Decision Makers

Use for decision making

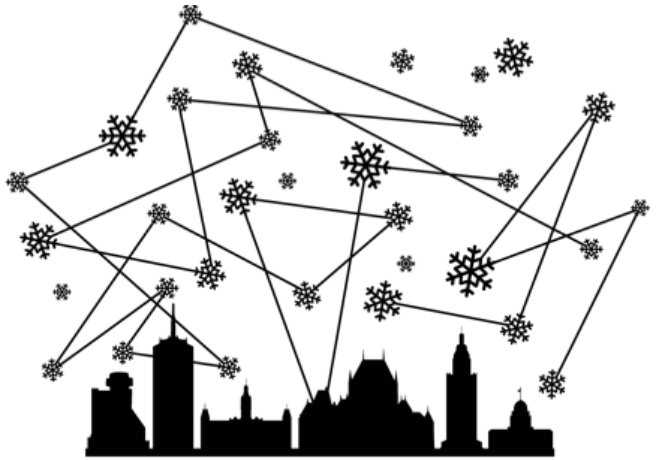


Real World (Business)

Q4: Decision making in a business context has been done for decades. Where does Analytics (AI/ML) play a role and why is there such a big interest now?

Business Decision Making is becoming increasingly ‘Complex’

Real World (Business)

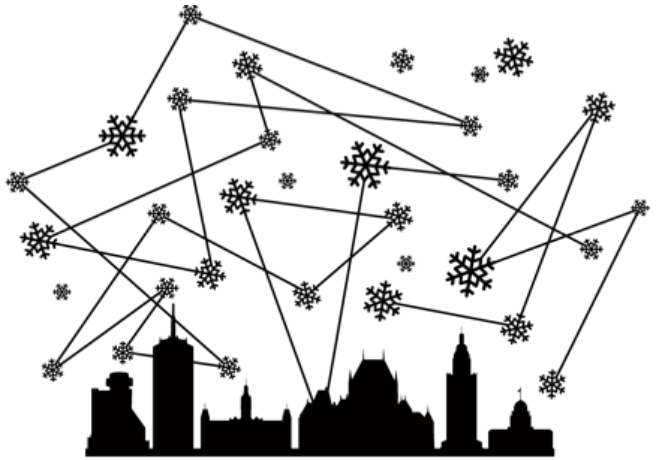


- Multiple Entities with their own goals
- Complex Non-Linear Relationships
- Delayed Feedback
- ‘Black Swan’ Events (Unpredictable events)
- Uncertainty & Long Term Consequences

Business decision makers are expected to take right decisions in this complex world

Goal & Purpose of Analytics (AI & ML is a core component of it)

Real World (Business)



Better **DECISIONS**

EXPERTISE

Better **MENTAL MODELS**

Better **Approximation of the Real World**

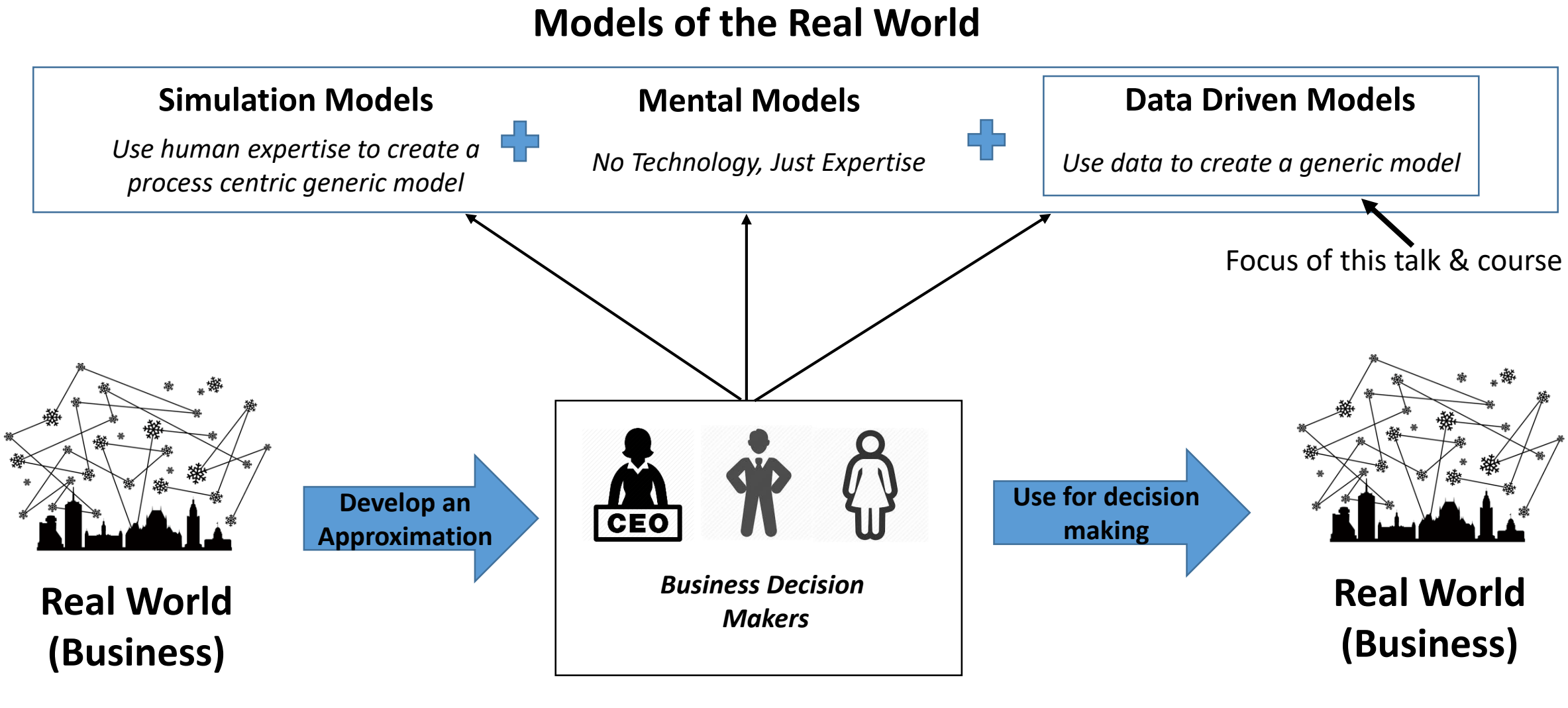
Business Decision Makers

Purpose / Goal of Analytics (AI & ML)

AI / ML Pipeline

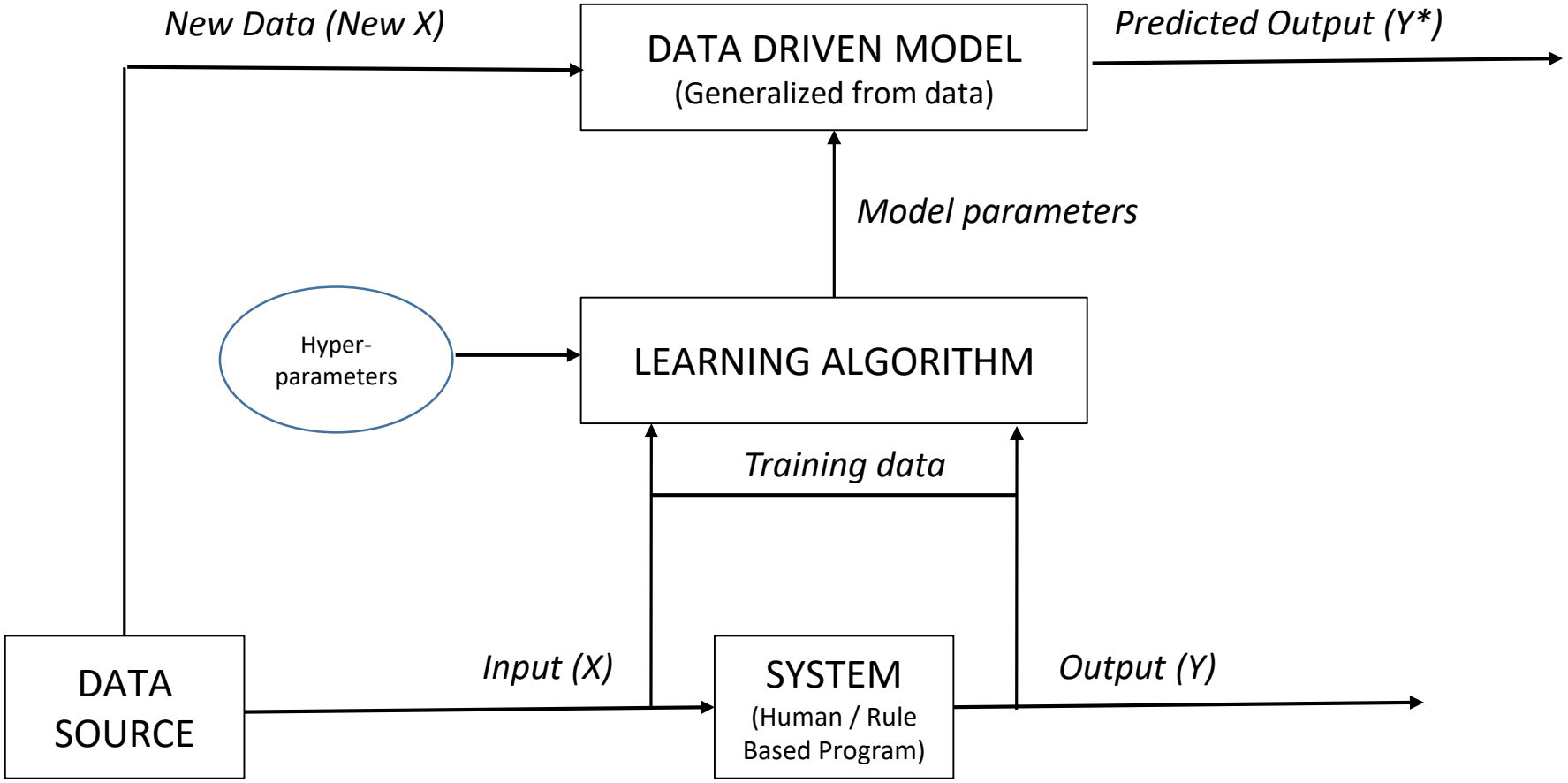
DATA → ML / DL Algorithms → Inferences / Predictions

‘Models of the Real World’ is at the centre of business decisions



Q5. What competencies are required to create data driven models and how do I formulate use cases?

How do we create Data Driven Models?



THERE ARE MANY USE CASES IN THE INDUSTRY …

Competencies to create Data Driven Models

Business	Use Case Formulation	Interpret Analytics Output	Domain Expertise
Data	Data Types – (Un / Semi) Structured	Data Visualization & Story Telling	Signals from data (subtract noise)
Math / Quant	Select the right techniques	Appropriate coding language / platform	Evaluating the output of algos
Tech / Software	Data Engineering / Pipelines	Front-end Applications	Software Engineering / SDLC

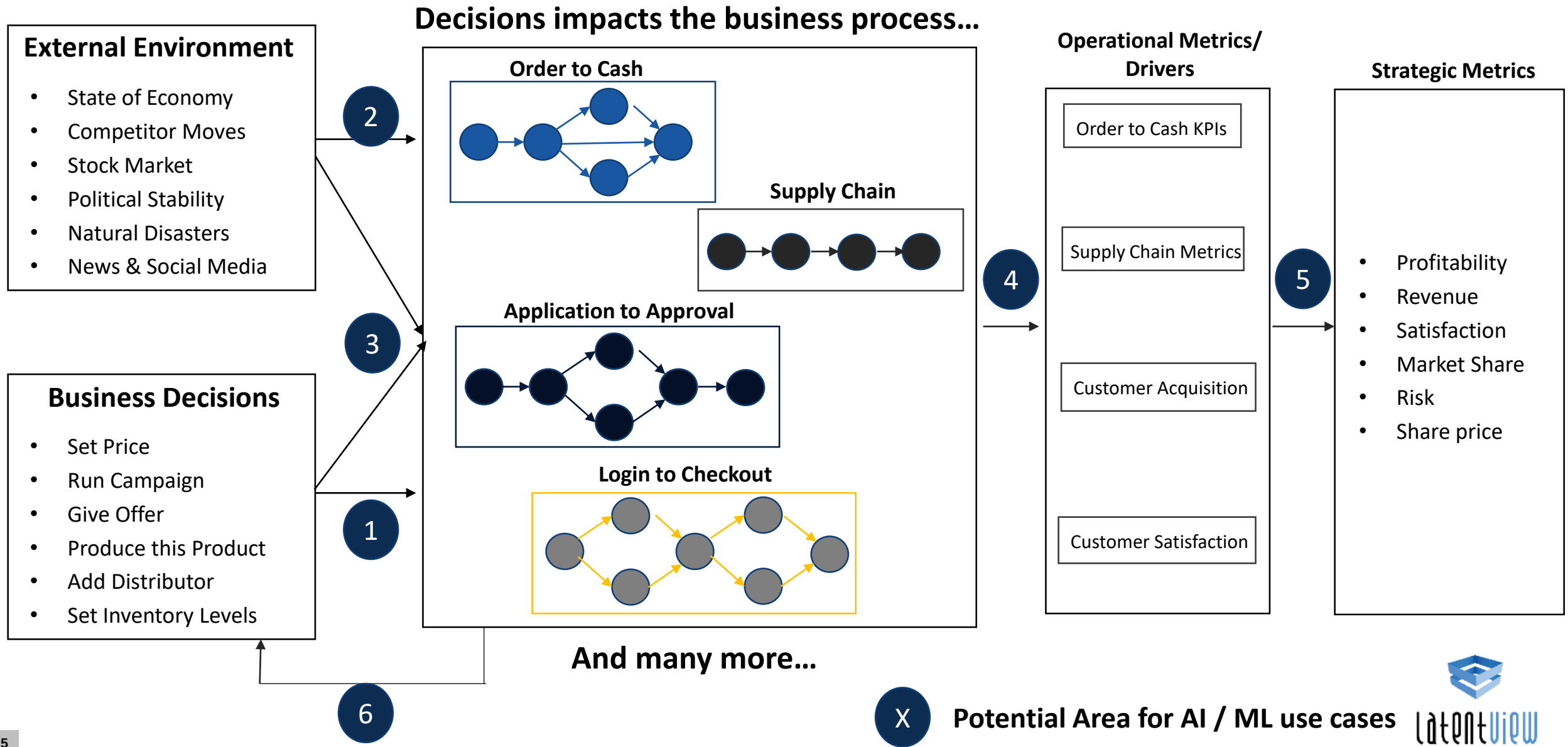
Horizontal View – AI & ML use cases in Marketing (my experience)

Predicting Lifetime Value (LTV)	Wallet share estimation	Churn	Customer segmentation
Product mix	Cross selling	Recommendation algorithms	Up-selling
Channel optimization	Discount targeting	Reactivation likelihood	Adwords optimization and ad buying

Vertical / Industry View – AI & ML use cases in Retail (my experience)

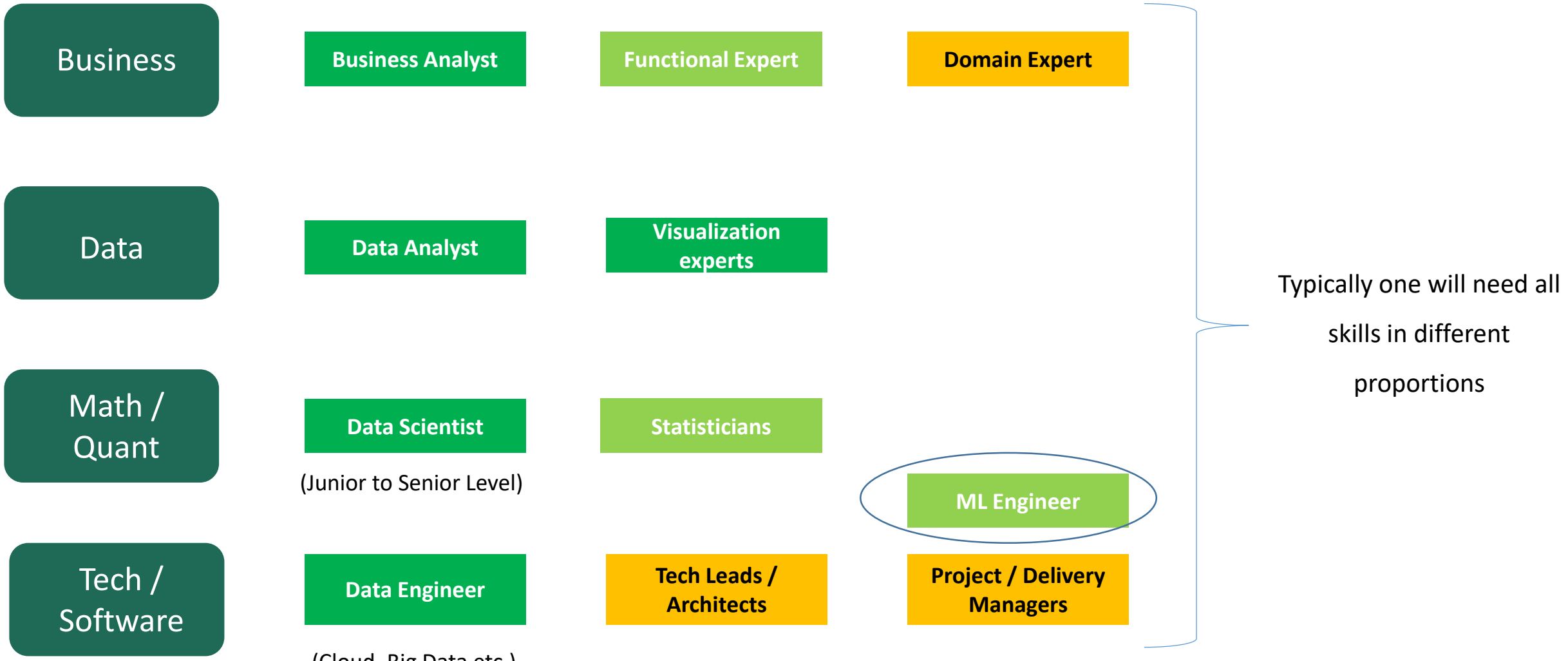
- Price optimization
- Location of new stores
- Product layout in stores
- Merchandizing
- Inventory Management (how many units)
- Shrinkage analytics
- Warranty Analytics
- Market Basket Analysis
- Cannibalization Analysis
- Next Best Offer Analysis
- In store traffic patterns

Potential Areas in an Enterprise for AI/ML use cases…



Q6: What are the typical roles in the analytics space and what specific skills are required to break into it?

Typical Roles in Analytics / Data Science



Entry Points for different experience levels

Fresher / Junior Developer	Lead / Architect	Program Manager / Business Head
Business Analyst	**Functional / Domain Lead**	**Functional / Domain Expert**
Data Analyst	**Senior Data Analyst**	**Mid-Level Data Scientist**
Big Data / Cloud programmer	**Mid-Level Data Scientist**	**Analytics Delivery Manager**
	Data Engineer / Big Data / Cloud Specialist	**Consultant**

Skills to break into the Analytics space

1. **Business Orientation** – Basic understanding of business concepts

2. **Structured Thinking** – Ability to break down a problem into parts

3. **Analytical Techniques** – Articulate as to how data & analytics can help

1. Business Orientation - Basic understanding of business concepts

Value Creation – Reason for existence of a business

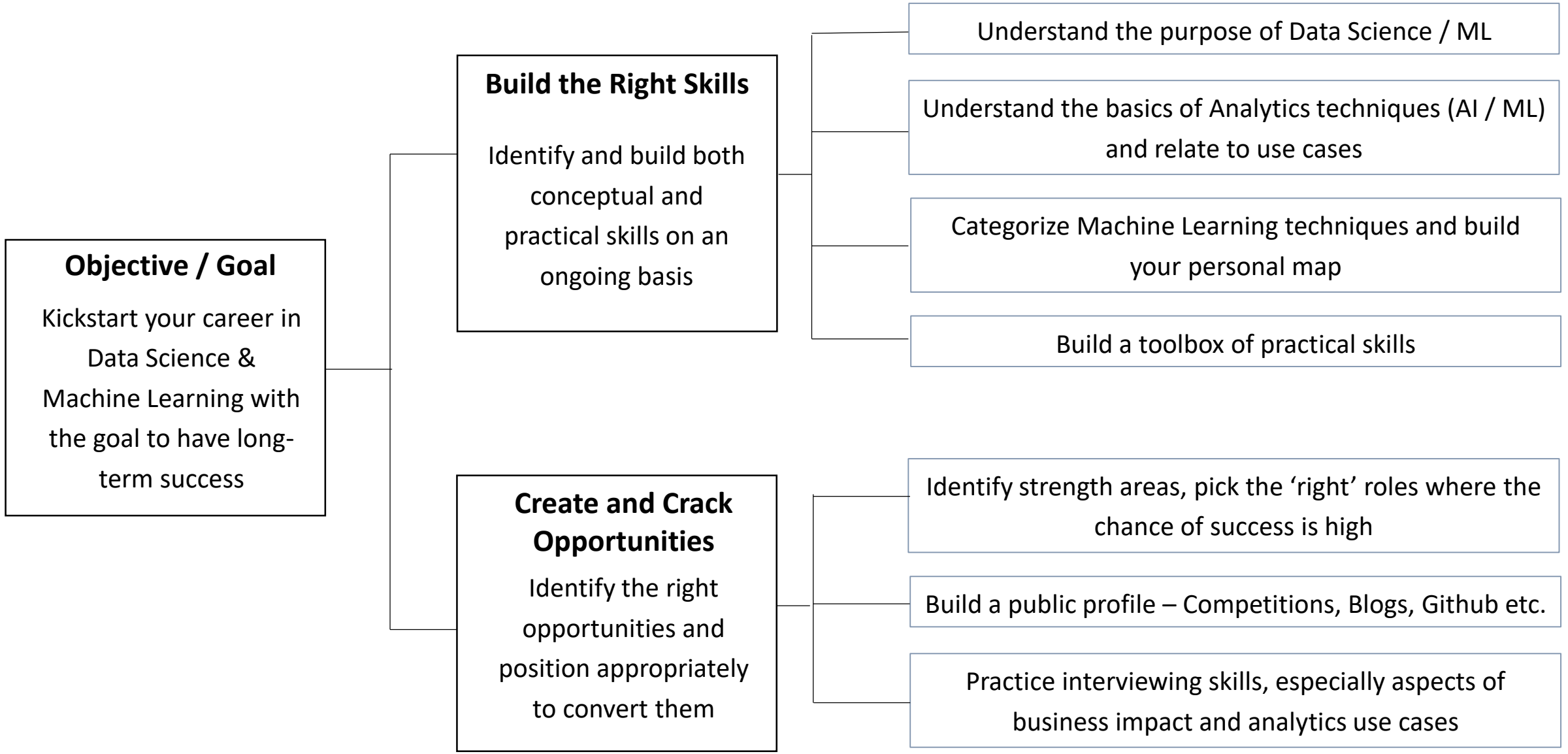
Business Model – Core actors & activities that generate value

Raw material / Ideas → Making a Product / Offering a Service | Marketing & Selling a Product / Service → Customers

Supporting Functions

- **Finance** – What numbers matter & why?
- **Strategy** – To deal with competition
- **R & D** – Innovation
- **HR** – Managing People

2. Structured Thinking – Ability to break down a problem



Structured Thinking - Many Resources are available…

Frameworks

- Cynefin (by Dave Snowden)
- Issue Tree & Hypothesis Formulation
- MECE Principle
- Porter's Five Forces
- 3C Framework (Company, Customer & Competitor)
- 4P Framework (Product, Price, Place, Promotion)
- SWOT
- 2x2 Matrices
- BCG Matrix
- McKinsey 7S Framework

Where Available

- Case Interview preparation websites like:
  - www.craftingcases.com
  - www.preplounge.com
  - Victor Cheng's CaseInterview prep
- Consulting company websites

(Ex: http://caseinterviewprep.deloitte.com/)

- YouTube (Case Interview Preparation videos)
- Forums like Quora

3. Analytics Techniques – Components of the toolbox

- Basic knowledge of Math concepts – Distributions, Probability, Matrices
- Good knowledge of Statistical Techniques & Machine Learning algorithms
- Atleast 1 programming language for ML – Python (Jupyter notebooks), R
- Data Visualization skills – Python or Tools like Tableau, Qlikview

→ *Structured course will help you get this knowledge faster*

- Atleast 1 GUI based ML platform – H2o, Azure ML, BigML
- 1 Cloud based platform (Nice to have) – AWS, Databricks, Paperspace
- Github
- Kaggle (Competition & Kernels), AnalyticsVidhya
- Database / SQL knowledge (preferable)

Q7. Where does Artificial Intelligence come into all of this? How are AI & ML related?

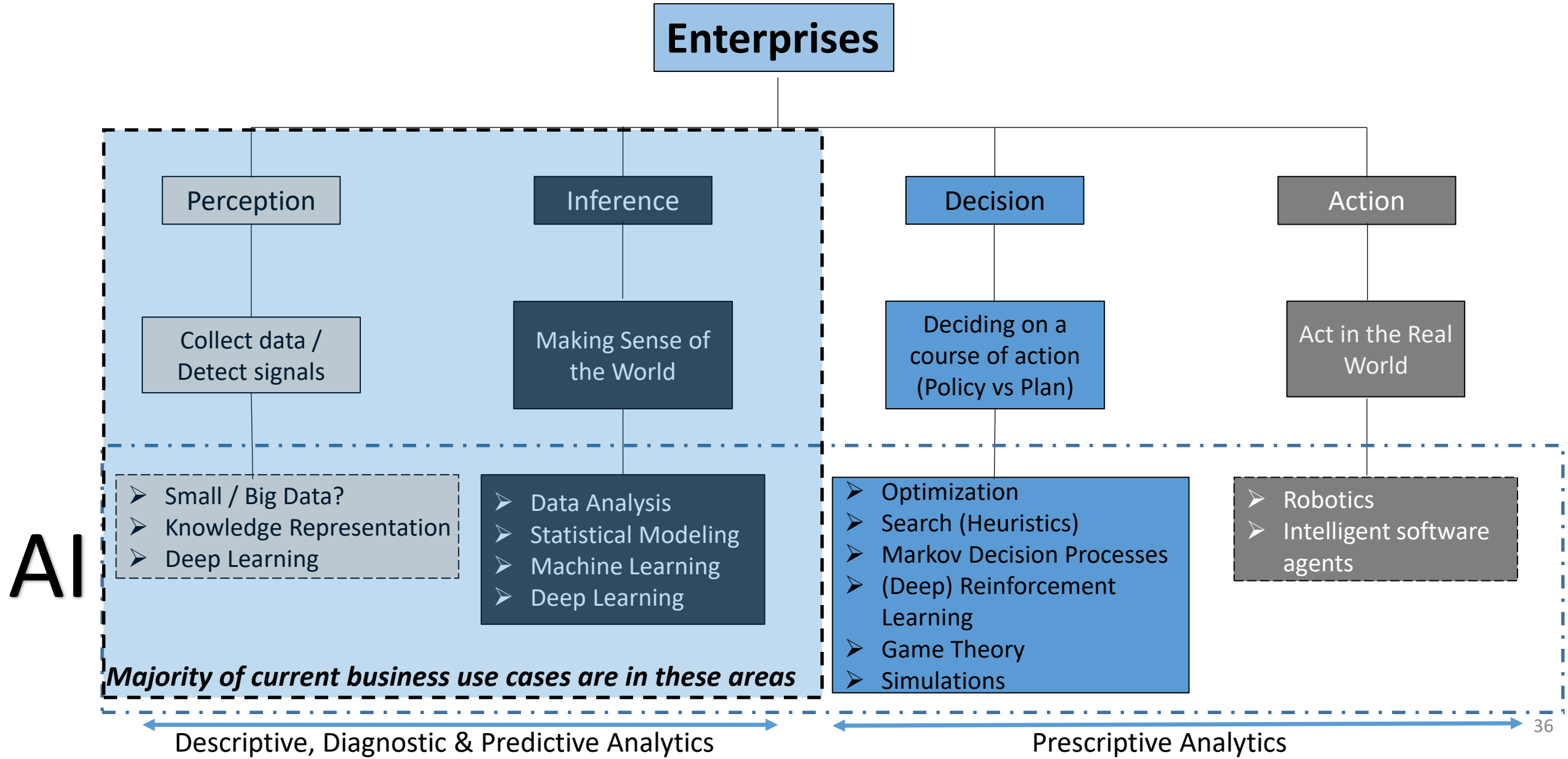
Artificial Intelligence – The Superset of Analytical Techniques

Artificial Intelligence refers to the theory and development of computer systems & machines with the ability to perform tasks normally requiring human intelligence

What constitutes Human Intelligence?

1. Perceive the world, detect signals and collect data
2. Make sense of the world using data (Insights, Inference, Predictions etc.)
3. Decide on the next course of action
4. Act in the Real World

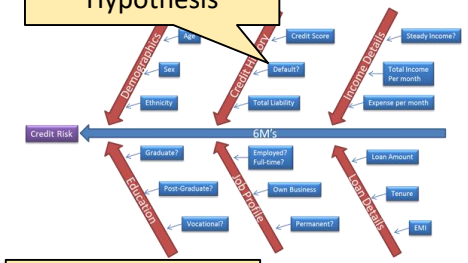
AI Techniques in Enterprises – Parallels to Human Intelligence



Machine Learning Pipeline – Subset of AI

1 Hypothesis Generation

Formulate Hypothesis

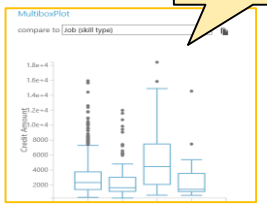


2 Gather Data

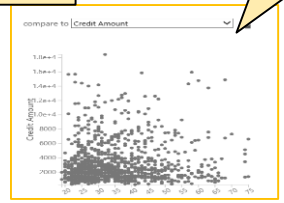
Input Data

3 Exploratory Analysis

Uni-variate Analysis

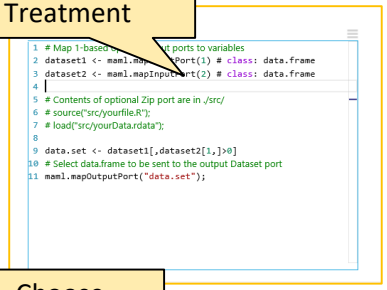


Bi-variate Analysis

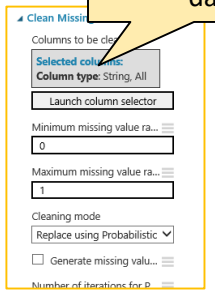


4 Pre-Processing

Outlier Analysis & Treatment

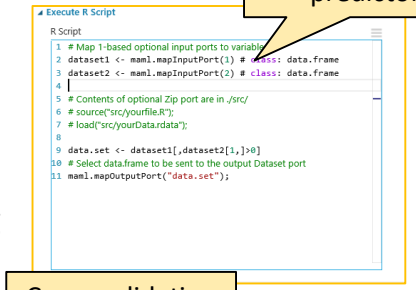


Clean Missing data



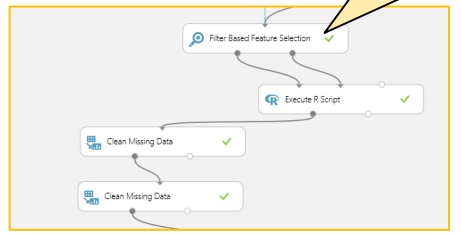
5 Feature Engineering

Generate new predictors



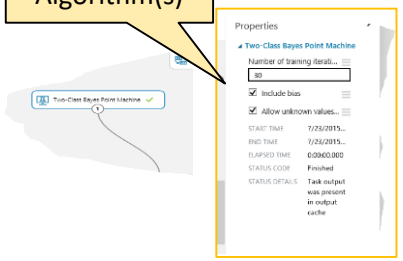
6 Feature Selection

Select final set of predictors



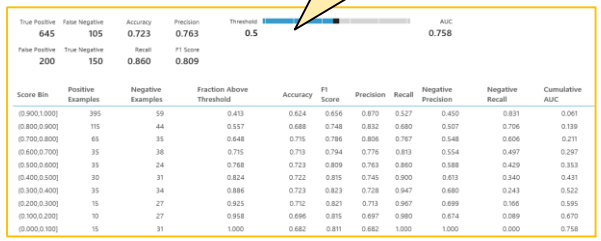
7 Algorithm & Ensembles

Choose Algorithm(s)



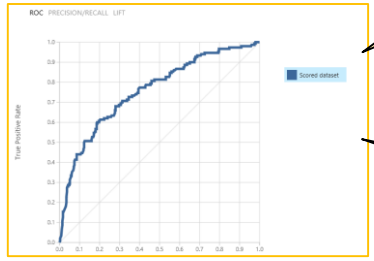
8 Tune Hyper-model Parameters

Cross-validation



9 Output Evaluation

AUC: 0.758



Reduce Bias & Variance

MANY USE CASES IN THE INDUSTRY ARE BASED ON THIS PIPELINE…

Q8: Can you bring these concepts to life with some examples from your personal experience?

Example 1: Automobiles – Utilizing Sensor data to predict defects

BUSINESS

For this automobile company, the warranty costs were rising year on year at an alarming rate

DATA

Semi-structured data from sensors from cars across 100+ countries (Ex: Pedal position, Oil temperature, Engine temperature…60+ parameters)

MATH

Clustering done on data to identify driving styles which is then correlated with warranty claims to predict defect probability

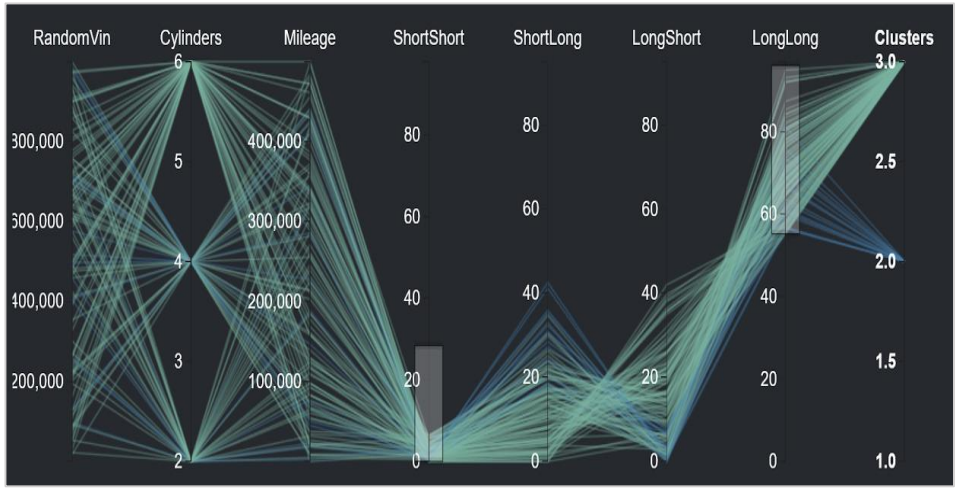
TECH

- Spark on the Cloud platform called Databricks for Machine Learning
- User Interface using React for self-service

Example 1: Utilizing sensor data to predict defects

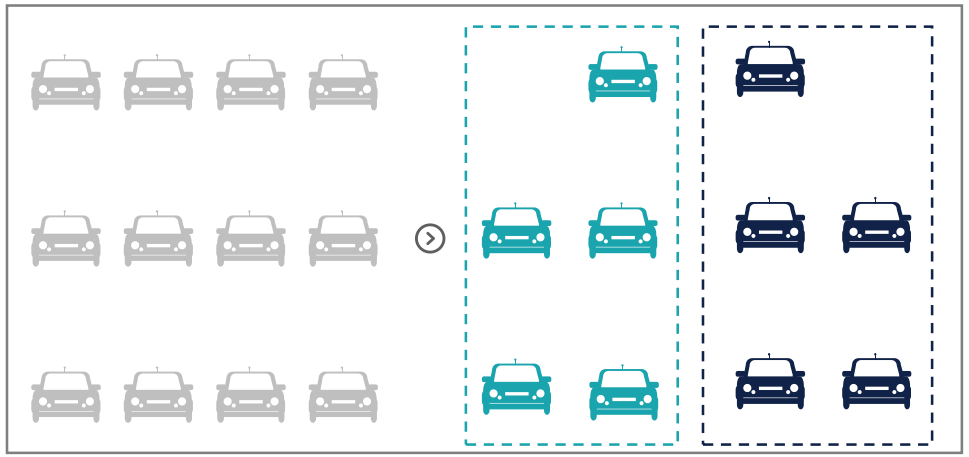
PERCEPTION

Sensor data from different countries

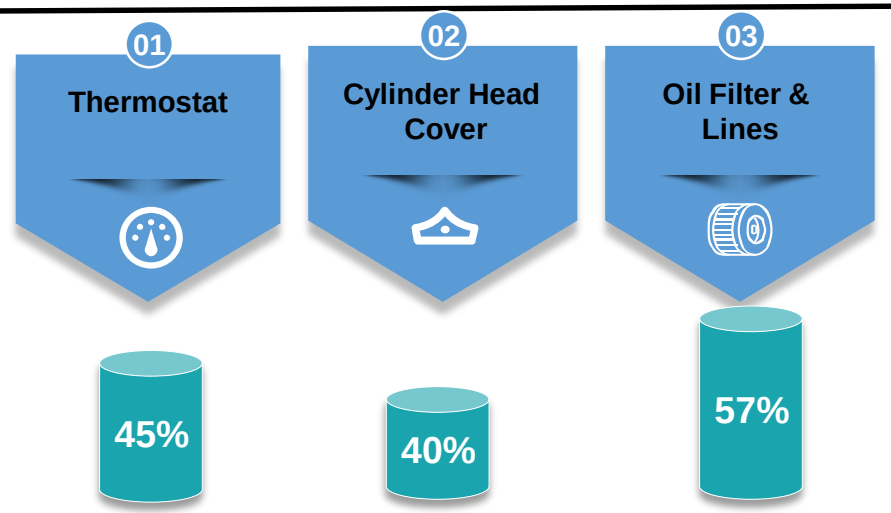


Visualization to understand the data

INFERENCE



Clustering to identify driving styles



Defects were correlated with driving styles

Example 2: Leveraging external data to drive innovation

BUSINESS

Consumer durables company wants to obtain product feedback as soon as its products are released in the market and not wait for 6-8 months which was the current state scenario?

DATA

Unstructured data from reviews in marketplaces, brand websites, Industry forums, blogs

MATH

Natural Language Processing Techniques to detect spam, emotion, entities, sentiments, contextual meaning etc.

TECH

Self-service visualization built using Tableau that provides the summary view and different levels of drill-down into specific consumer characteristics

Example 2: Leveraging external data to drive innovation

PERCEPTION

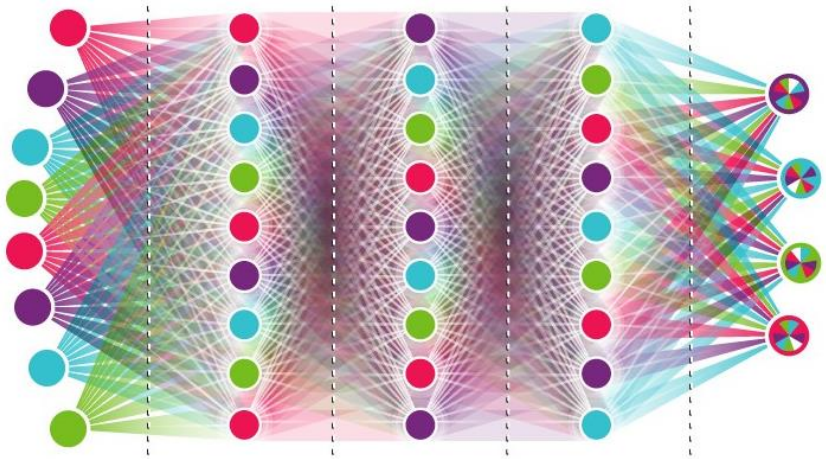
Industry Forums — Consumer Reports

+

Market Places — The Home Depot, a

+

Brand Websites — LG, Whirlpool



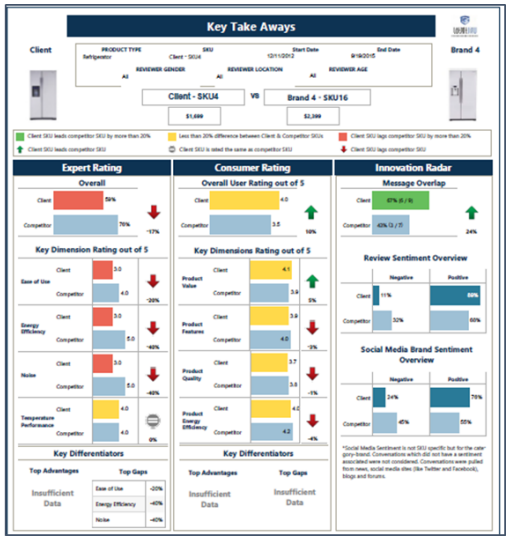
External data from ecommerce sites, brand websites etc.

Deep Learning for Natural Language Processing

INFERENCE

- Sentiment Analysis
- Drivers of Purchase
- Triggers of Purchase
- Expert Opinion
- ★★★☆ Consumer Rating
- Popular Features

Text Analytics

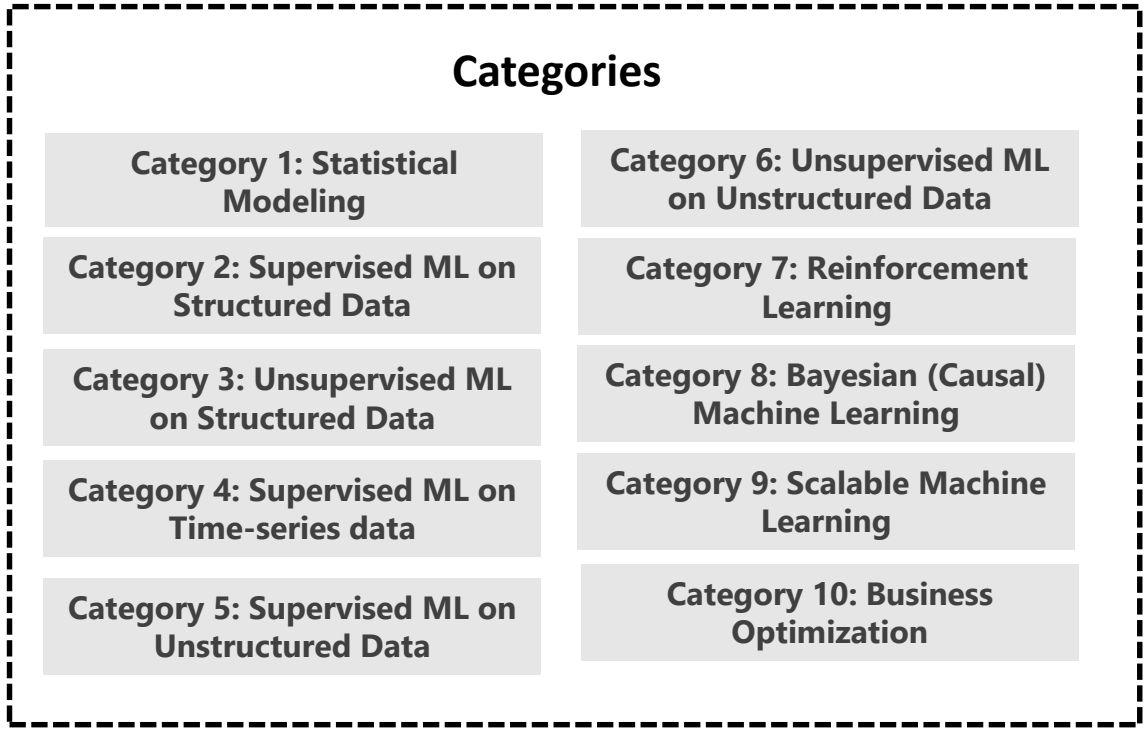


Understand key factors that influence customer perception & behavior

Q9: With so many algorithms & techniques available, how does one keep track and apply it?

AI / ML Techniques – There are a lot of them!

Categorization of Machine Learning Topics – My personal map



Problem 1:

Problem Statement: Apparel retailer runs marketing campaigns in stores and would like to measure whether the campaigns are effective in increasing sales

Data Driven Solution

- **Data:** POS data (sales), marketing campaigns info, test & control stores, brands
- **Math:** Statistical t-test to test whether there is significant difference in test & control stores
- **Technology:** Delivered through a web interface with the statistical computation done using R

Techniques

Statistical Modeling

- Inferential Statistics – Probability Distribution, Sample Statistic, Population parameters
- Hypothesis Testing – Null & Alternate Hypothesis, p-values, z-test, t-test, ANOVA
- Two schools of thought – Frequentist and Bayesian statistics

Problem 2:

Problem Statement: Snack Manufacturer has sensors in their assembly lines and they collect data on shop floor operations. They would like to predict whether the line will stop / slowdown in the next 2 hours

Data Driven Solution

- **Data:** Historical data on line stoppages / slowdowns, Products, Lines, Buffer levels
- **Math:** Logistic Regression to predict whether the line will stop or slowdown or keep running
- **Technology:** Predictions are delivered through a visualization done in Tableau

Techniques

Supervised Machine Learning on Structured Data

- Regression – DV being continuous, Classification – DV is discrete
- Exploratory Data Analysis (EDA)
- Feature Engineering / Transformations - Outliers, Missing data, Variable Transformations, Statistical features, Target Mean Encoding, Distance Features, Interaction features, Clustering based features etc.
- Feature Selection & Dimensionality Reduction
- Algorithms – Standalone vs Ensembles
- Machine Learning Interpretability - MLI
- Cross validation
- Hyper-parameter Tuning
- Predict on Test set

Problem 3:

Problem Statement: Jewellery manufacturer needs to understand the demand for existing designs and newly launched designs (SKUs) so that they can plan better

Data Driven Solution

- **Data:** Timeseries data on sales of SKUs, SKU attributes
- **Math:** a) Existing SKUs – ARIMA based forecasting, b) New SKUs – Look-alike modeling
- **Technology:** Forecasts are plotted and displayed in a visualization tool delivered on web & tablets

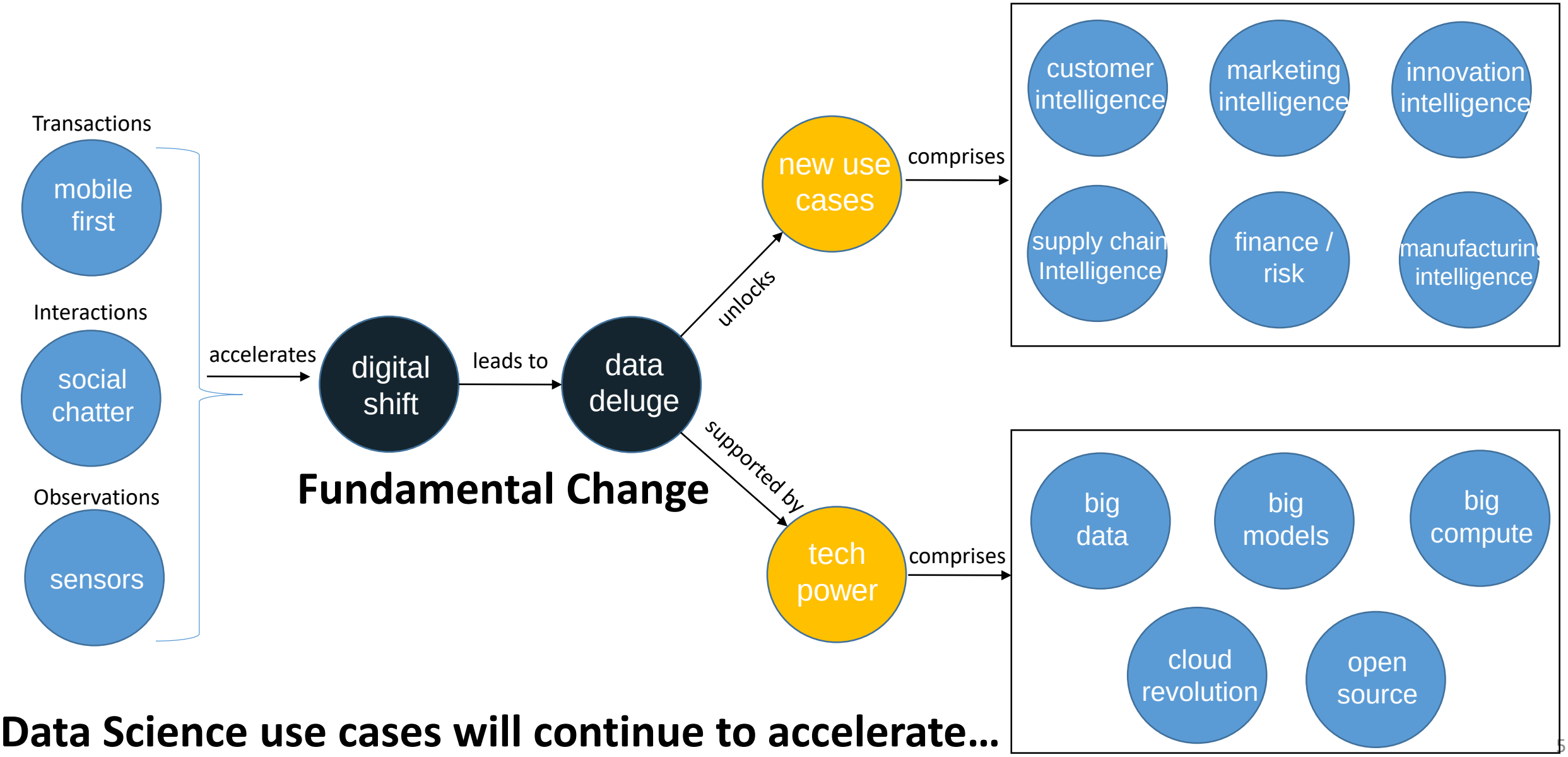
Concepts

Supervised ML on Timeseries data

- Visualizing and Decomposing Time series – Level, Trend, Seasonality, Error
- Stationary & Non-stationary Time series
- Plot Auto-correlation plots to find optimal differencing parameters
- Build Timeseries forecasting models like ARIMA, ETS, Holt-Winters etc.
- Feature engineering – Creating features like lag, moving average etc.
- Framing time series problem as regression problem
- Deep Learning Techniques like Recurrent Neural Networks (RNN)
- Automated generation of timeseries features using Python package like tsfresh
- Pyflux is another interesting package for time series forecasting

Q10: How are you sure that this field (Analytics, AI & ML) has long-term growth prospects and is not just a short-term fad?

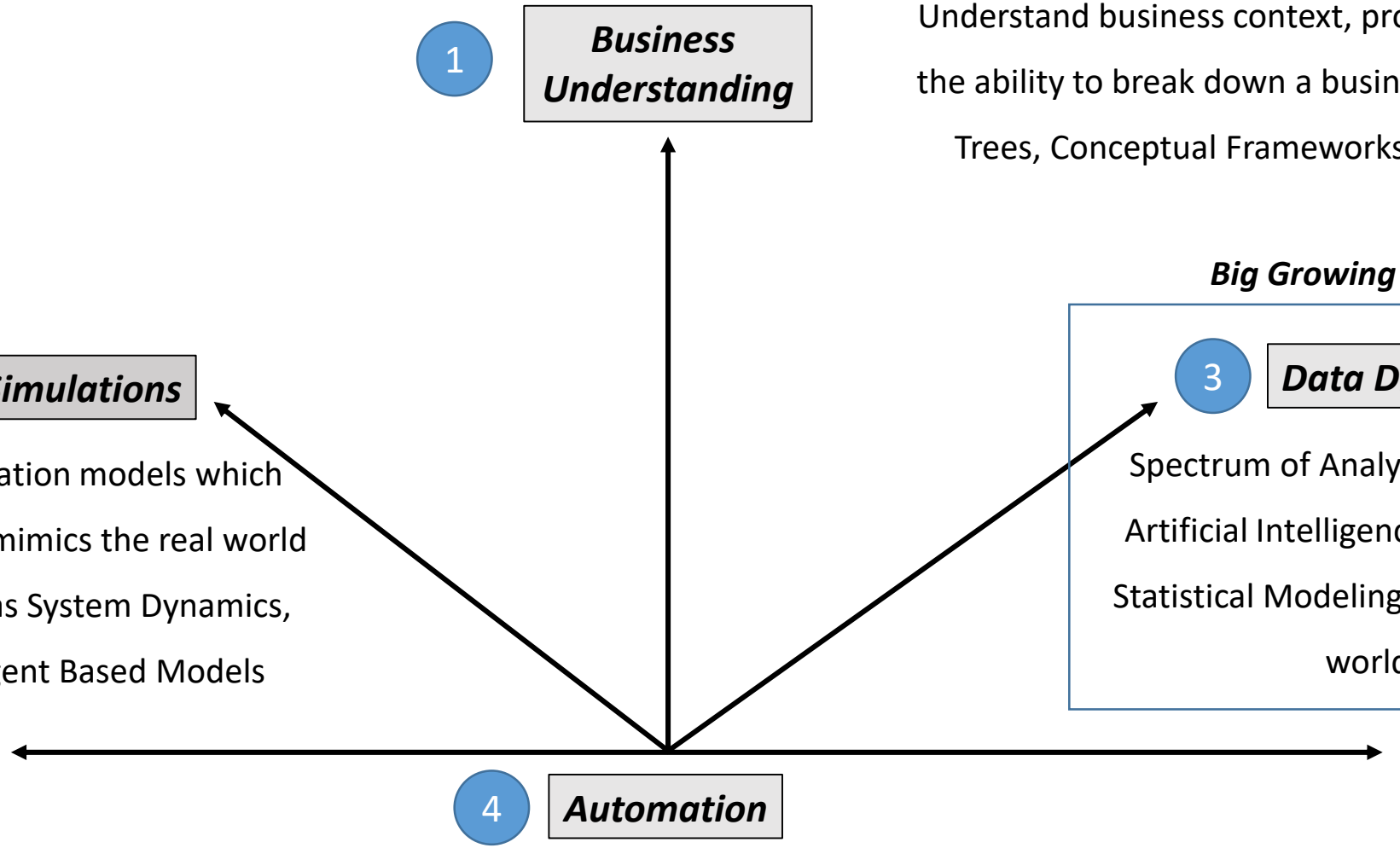
Digital Shift is a Fundamental, Irreversible Change



Data Science use cases will continue to accelerate…

Bonus Question: Going beyond AI/ML, Analytics etc. can you summarize the skills required for the digital age for business problem solving?

Business Problem Solving – The 4 Key Vectors



Understand business context, profit models and develop the ability to break down a business problem using Issue Trees, Conceptual Frameworks and MECE approach

Big Growing Interest in this area

Spectrum of Analytical techniques covering Artificial Intelligence, Machine Learning and Statistical Modeling to make sense of the real world using data

Computer based simulation models which are process centric and mimics the real world using techniques such as System Dynamics, Discrete Event and Agent Based Models

Technology used to automate known well-understood business process to drive efficiencies. This includes new age solutions like Blockchain, Robotic Process Automation etc. and also legacy systems like ERP, CRM etc.

Thank You!

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