Enhancing Quality Control & Transforming Industry 4.0 with AI & IoT

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anblicks
Your Digital Transformation Partner

wisdom 2020
boston

Agenda

1

Industry 4.0

Current Challenges in automotive manufacturing

2

AI in Quality Assurance

How Anblicks is helping automobile industry leverage the power of AI for better Quality Checks

3

Predicting leakage failure in Engine Block

Data, Model building and Results

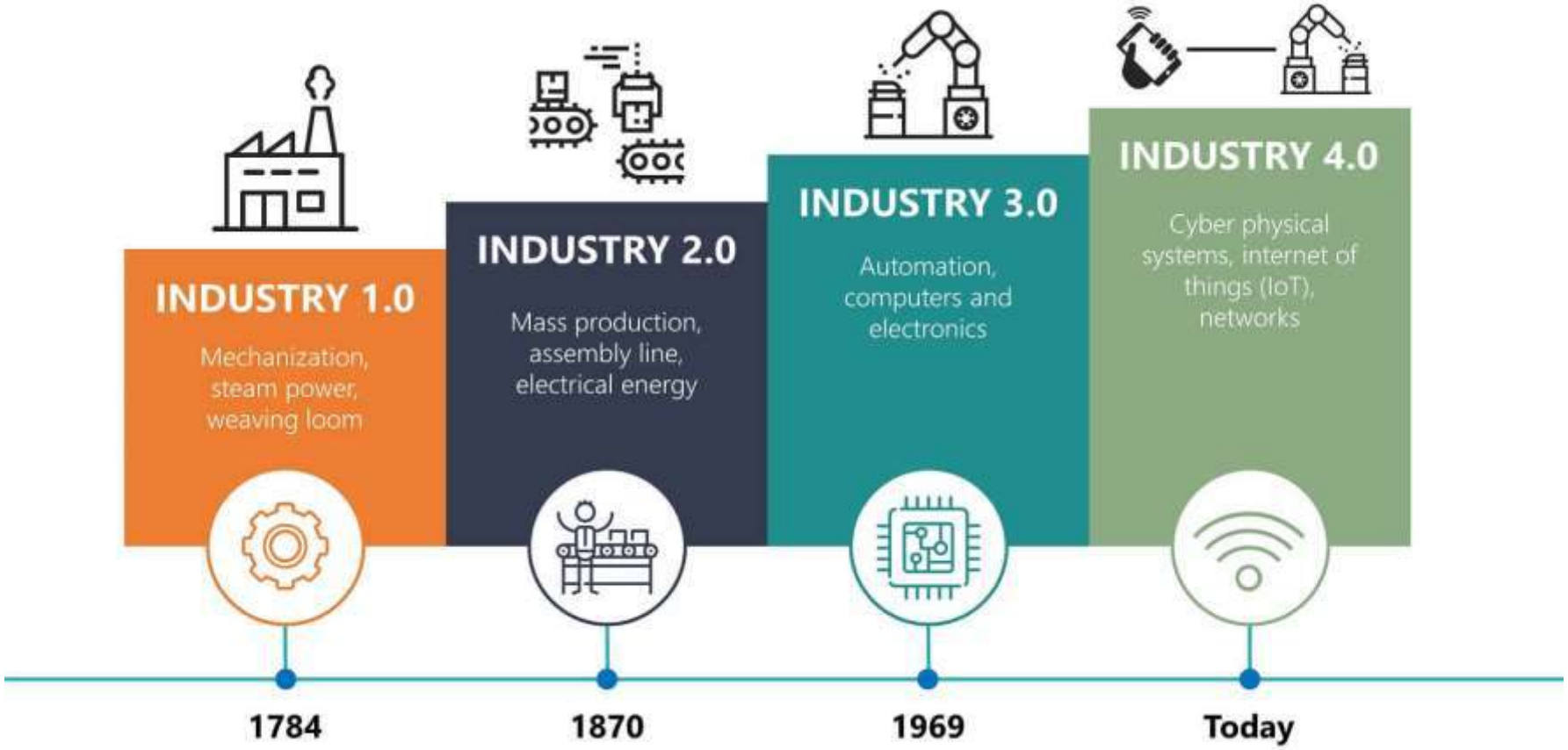
4

Anblicks

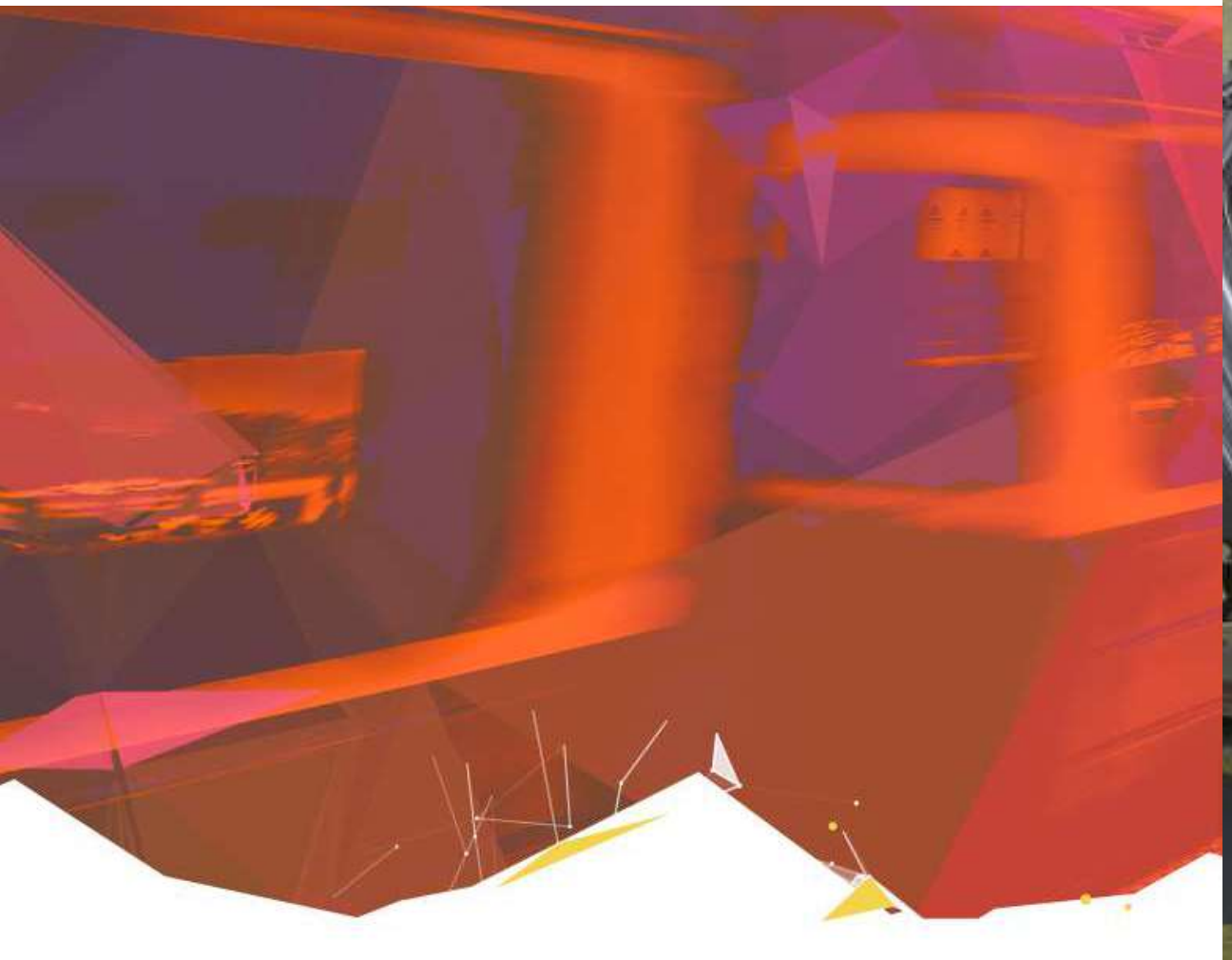
Who are we?

Fourth Industrial Revolution

Industry 4.0 factories have machines which are augmented with wireless connectivity and sensors, connected to a system that can visualize the entire production line and make decisions on its own



The Automotive Industry



Quality Checks Gone Wrong!

1.5M

Vehicles recalled by an American Brand between 97 – 2003 due to oil leakage issue

9M

Faulty floor mats in Japanese brand of cars necessitated a huge recall

1.4M

Cars were recalled by a Detroit based automaker because it failed collision tests

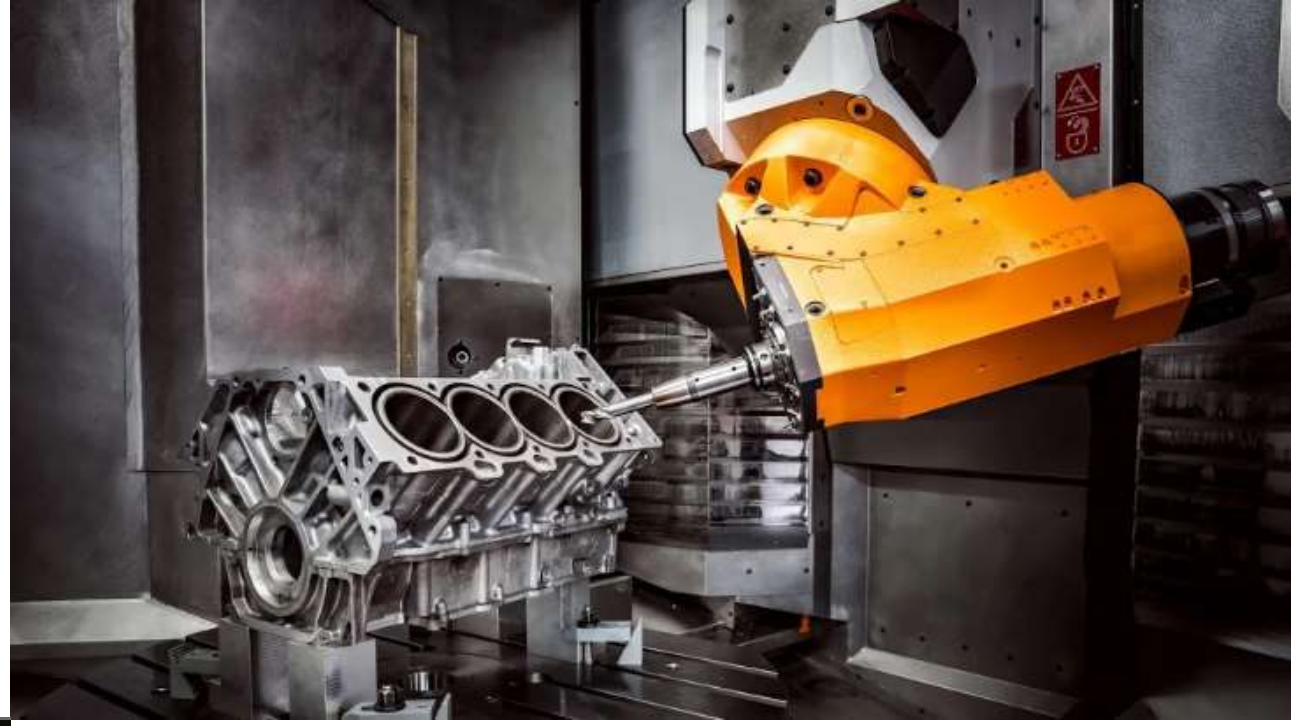
116

Workdays spent per site in Quality management

AI in Quality Assurance

Block Engine – The Heart of Vehicle

- 20% - 25% of Engine Weight is constituted in this block
- Cost of Production: $1500 - $5000
- Average Production: 300,000 units



- Functional Requirements: Water resistant, Pressure & Vibration tolerance, Withstand High temperatures and many more. . .
- Number of Quality Checks: ~30
- Vibration analysis, Combustion air control, Engine fluid tests, Multiple speed tests and many more. . .

Problem Statement

Predict the Engine leakage failure for the QA team to:

- Better utilize the resources in prioritizing the cohort of engines that are at risk of failure
- And remove those failed engine blocks from the production line

Data Flow and Solution Architecture

Factory Assembly Line

Pattern Making

The pattern is the main tool required to form the mold, it is normally machined by wood or aluminum

Casting

Metal is Poured through the mold to take the shape of the pattern

Machining

The casting has to be machined to get correct dimensions and smooth surfaces of the engine block.

Assembly and Testing

Engine block is ready for further fittings of crank, cam, cylinders, connecting rods, and valves.

Predicting Leakage failure in engine block

Data Features

- 106 Attributes
- Data Range of 1.5 years
- Target Label is a Minority Class
- Dimensionality Reduction to 75 attributes

Model Building

Algorithm

- Naïve Bayes
- Ensemble – Random Forest + Naïve Bayes
- 1-class SVM

Validation Technique

- Bootstrap validation

Results

Model Evaluation: Performance matrix

Metric: F1 Score

Why?: Harmonic mean of Precision and Recall and gives a better measure of the incorrectly classified cases than the Accuracy Metric.

Objective: Reduce False positives and False Negatives

Data Preparation

Training Data

Months	Production Count	Failures
Jan-18	6838	0
Feb-18	4971	4
Mar-18	6598	7
Apr-18	8798	0
May-18	7928	12
Jun-18	5423	18
Jul-18	3548	0
Aug-18	9865	0
Sep-18	6555	7
Oct-18	9162	9
Nov-18	8369	7
Dec-18	7412	0
Jan-19	7648	11
Feb-19	3584	4
Mar-19	4587	0
Apr-19	3695	0
Total	**104981**	**79**

Test Data

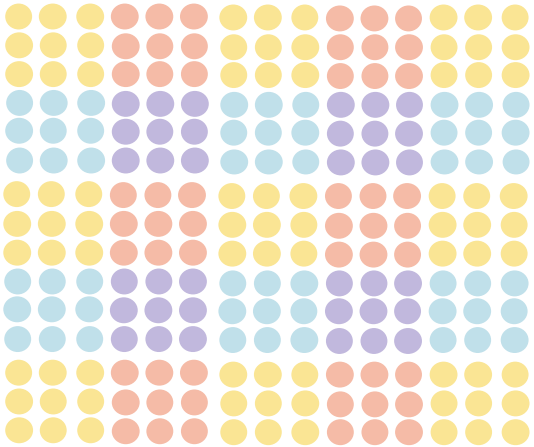
Months	Production Count	Failures
Jul-20	3007	6
Aug-20	3569	8
Sep-20	4375	8
Total	**10951**	**22**

Variable Names

Metal Pressure	Insert Time
Intensification Time	Molten metal position
Vacuum Time	Pouring Die Temp
Spray Time	Push Pressure
Return Core time	End Fluid Pressure

Data Preparation

- High Class Imbalance
- Less explain-ability
- Less correlation with the target label



Sensor data

- Outlier Detection
- Linearity
- Pair-Wise correlation
- Univariate Analysis
- Chi-Square
- Principal Component Analysis
- SMOTE Up sampling
- Window Frame mapping

Model Building

Start with ideation, align with problem we are trying to solve and then proto type the solution

- Naïve Bayes
  - Based on Bayes' Theorem of conditional Probabilities
  - High number of features
  - Less correlation with Target label
  - Best assumption
- Ensemble – *stacking & boosting*
  - Combination of two or more different models
  - Random Forest + Adaboost
  - Gradient Boosting Machines
- 1-class SVM
  - Learns only on one class which can be minority/majority class
  - Overfitting one class

F1 Scores

0.32

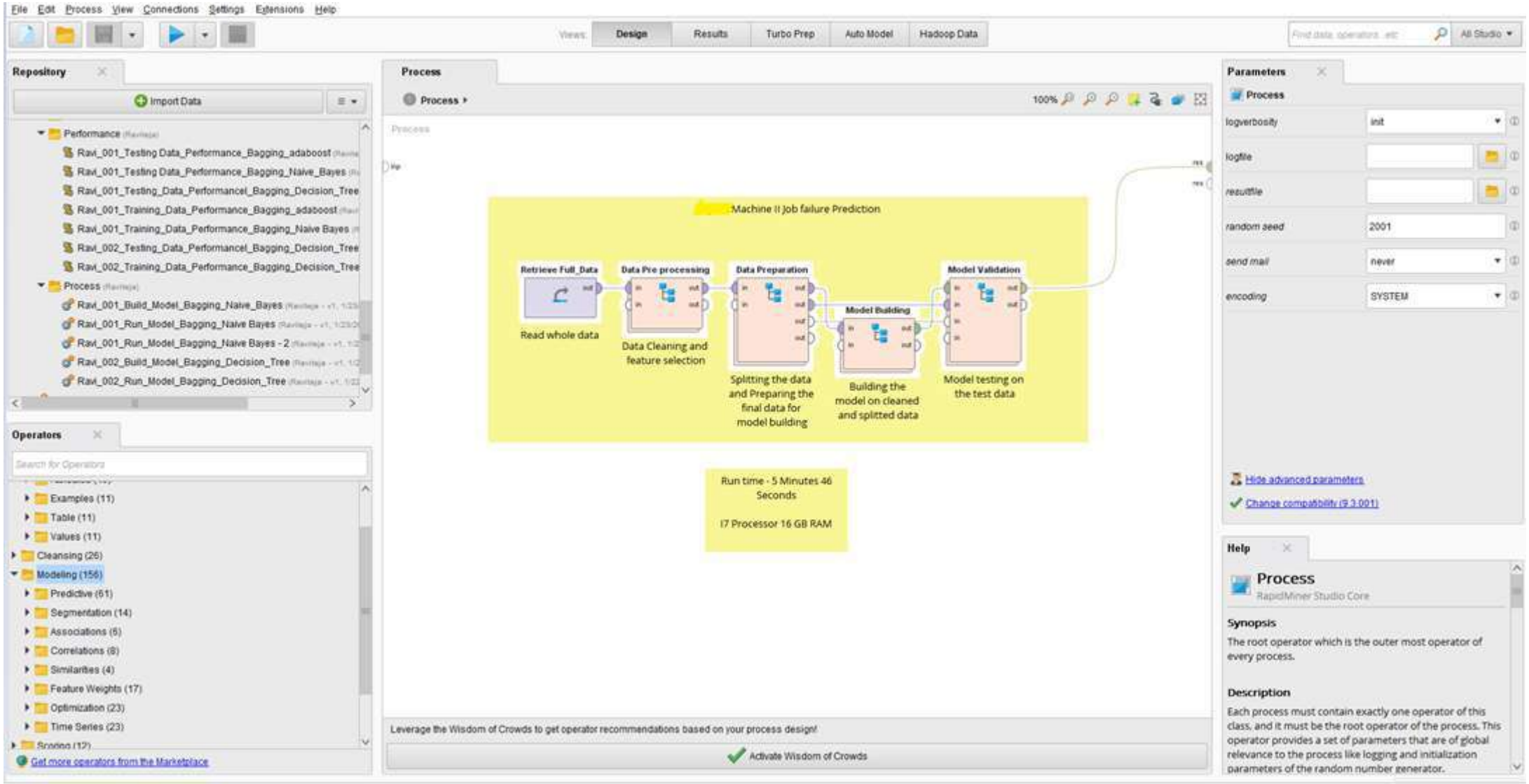
0.53

0.73

F1 Score is the weighted average of Precision and Recall.

Used for uneven class distribution where False positives and False Negatives are crucial

RapidMiner to the Rescue!

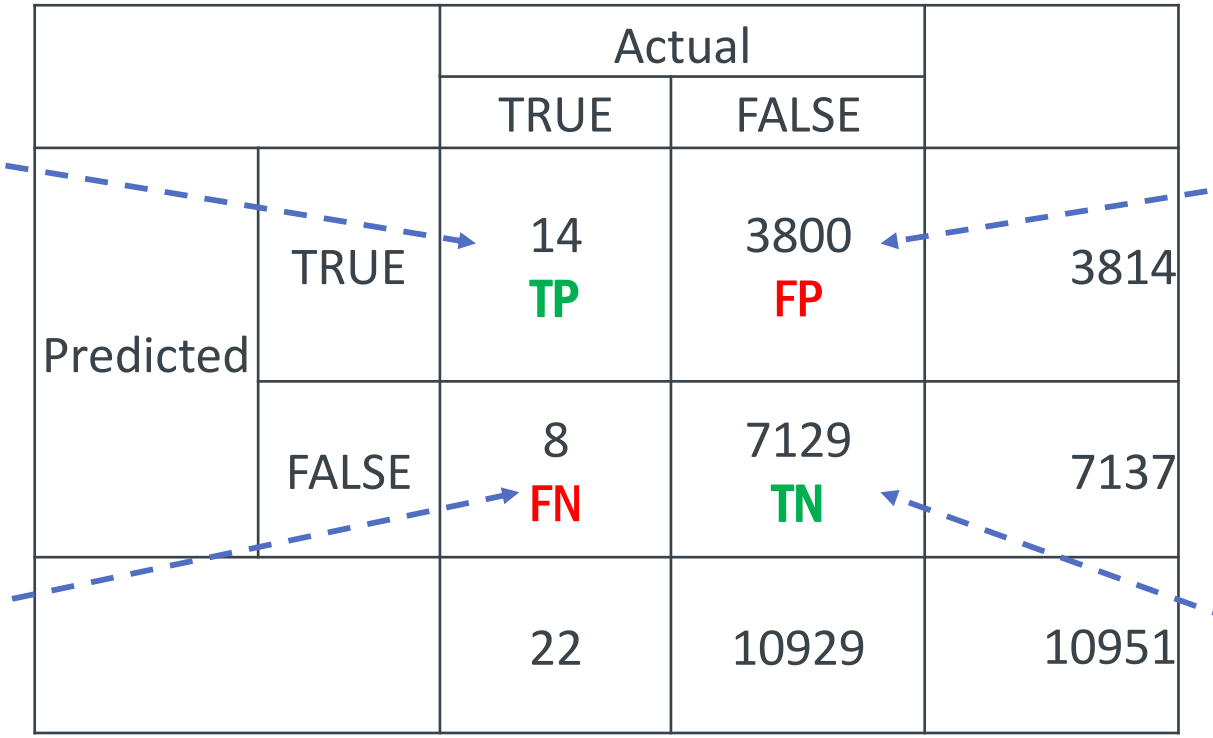


Results

Performance metrics and the impact of all the numbers.

Rightly predicted 14 failures out of 22.

~$60k worth savings for a timeline of 3 months



QA team will have to check 3800 Engines to get their hands on 14 failures

Throwing ~4000 hrs to find those 14 Engine blocks

Missed 8 failures.

QA team saves time by de-prioritizing 7129 Engines

Saving ~8000 Hrs of manpower

An Ounce of Prevention Is Worth a Pound of Cure


Anblicks

Anblicks Story: Practice Areas, Industries & Custom Products

2004
Established in Texas, USA

100+
Customers Served

400+
Strong Delivery Team

3
Countries Operating

Logistics | **Real Estate** | **Auto** | **Healthcare**

Experience
- Microservices, APIs
- Dashboards, Visualization
- Mobile and Intelligent Applications

Intelligence
- Data Analytics
- Artificial Intelligence
- IoT Analytics, Industry 4.0

Digital Core
- Cloud Infrastructure for Big Data
- Cloud Migration: Hybrid, AWS, Azure
- DevOps Automation, Data Security

Products

DataBlaze by Rowcubes

The Healthcare360 Risk Adjustment Made Easy

capptixAI Customer Interaction Analytics

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Thank you!

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