

# CRESTA10 Final Delivery Presentation

## NTT DATA QAT Team

March 2017

# Agenda

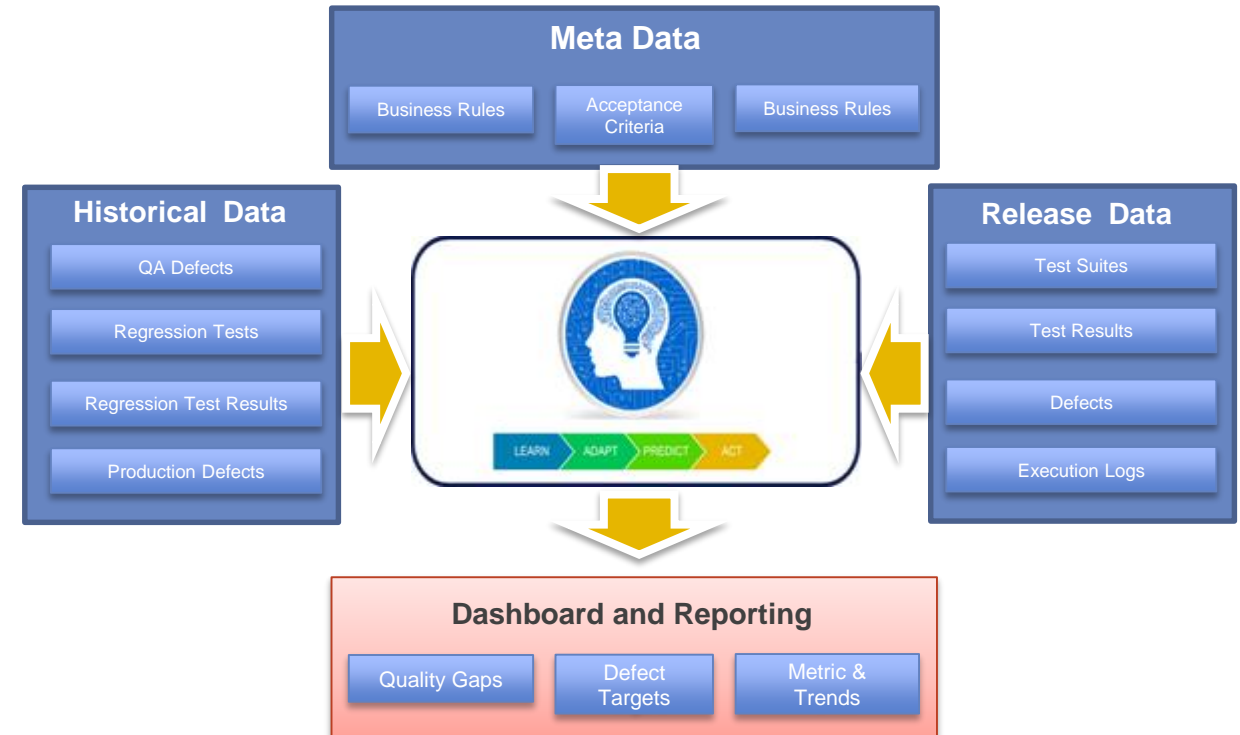
Topic	Presented By	Duration
Overview	Project team	5 minutes
<b>Project results and deliverables</b> <ul style="list-style-type: none"><li>▪ Scope &amp; Approach</li><li>▪ Final project status (updated monthly reporting template)</li><li>▪ Overview of deliverables in accordance with SOW</li><li>▪ Demonstration</li><li>▪ Accuracy of Pilot Results</li><li>▪ Customer Feedback</li></ul>	Project team	25 minutes
Next steps & Product Roadmap	Project team	20 minutes
Questions & Answers	All	10 minutes

# Overview

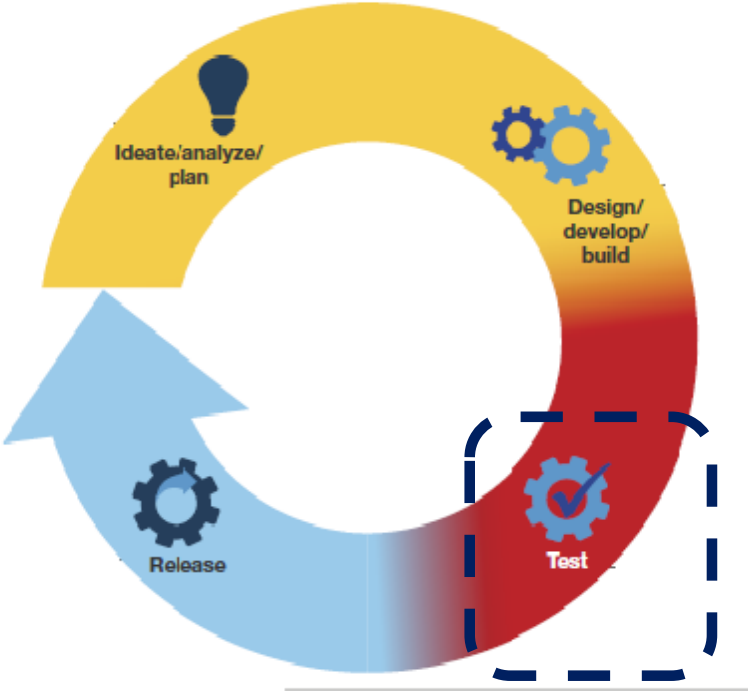
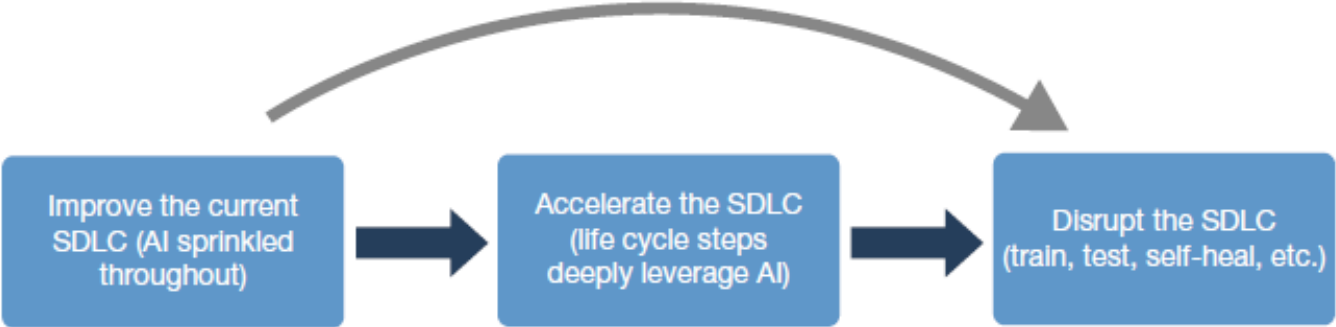
# CRESTA: Comprehensive Robotic Engine for Software Test Acceleration

- CRESTA is a web based solution for analyzing historical test artifacts such as test cases, defects and defect metrics of the project
- CRESTA is a platform that offers Data analytics, Visualization and it also had in built Testing domain knowledge and able to make QA centric decisions It makes data driven decisions which helps organizations to cut short the long road

CRESTA Flow Diagram



# Importance of Artificial Intelligence in Software Development Life Cycle



FORRESTER

## How AI Will Change Software Development And Applications



by [Diego Lo Giudice](#)  
with [Christopher Mines](#), [Amanda LeClair](#), [Rowan Curran](#), and [Amy Homan](#)  
October 13, 2016 | Updated: November 2, 2016

- High Interest
- Medium Interest
- Low Interest

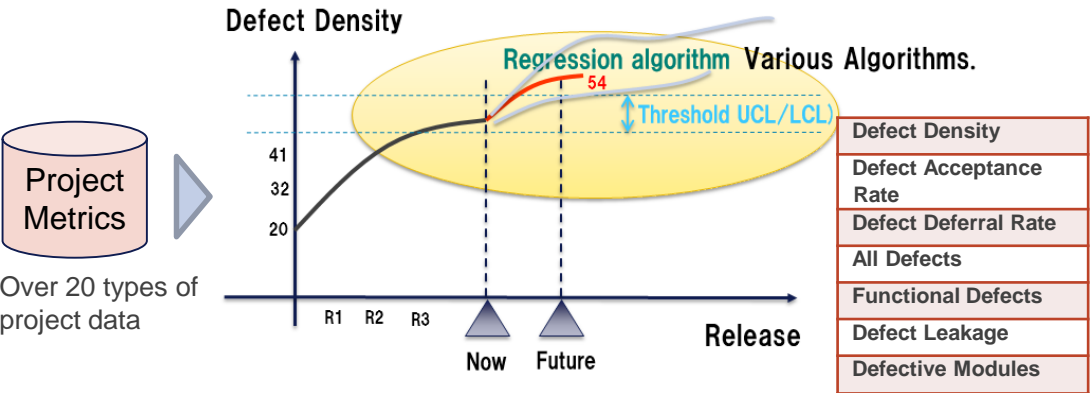


AI will be important for Testing, going ahead

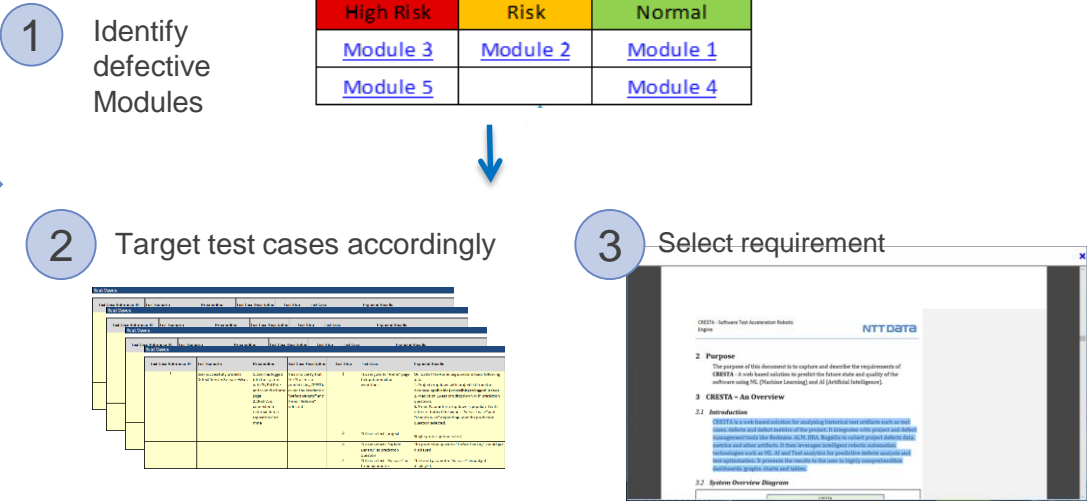
# Scope & Approach

# Base Use Cases for CRESTA 1.0

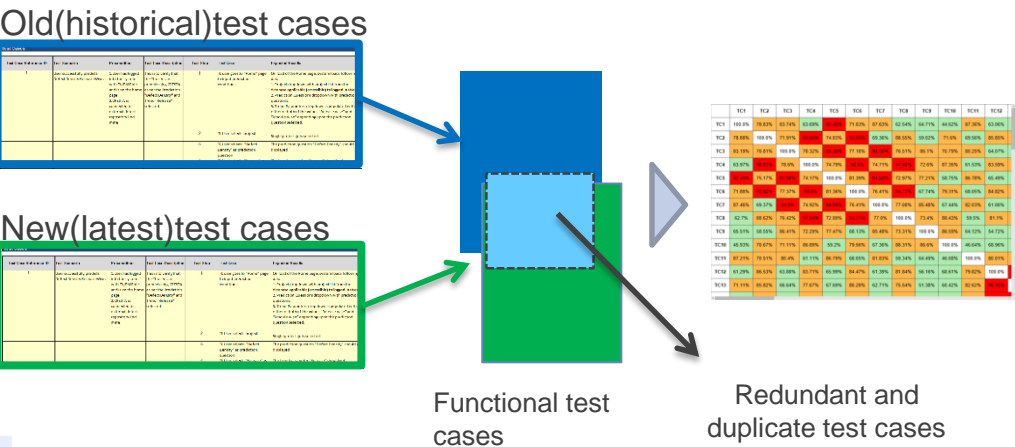
## Quality Prediction(故障予測) (Usecase 1)



## Test Coverage (テストケースの妥当性) (Usecase 3)



## Test Optimization (テストケース最適化) (Usecase 2)

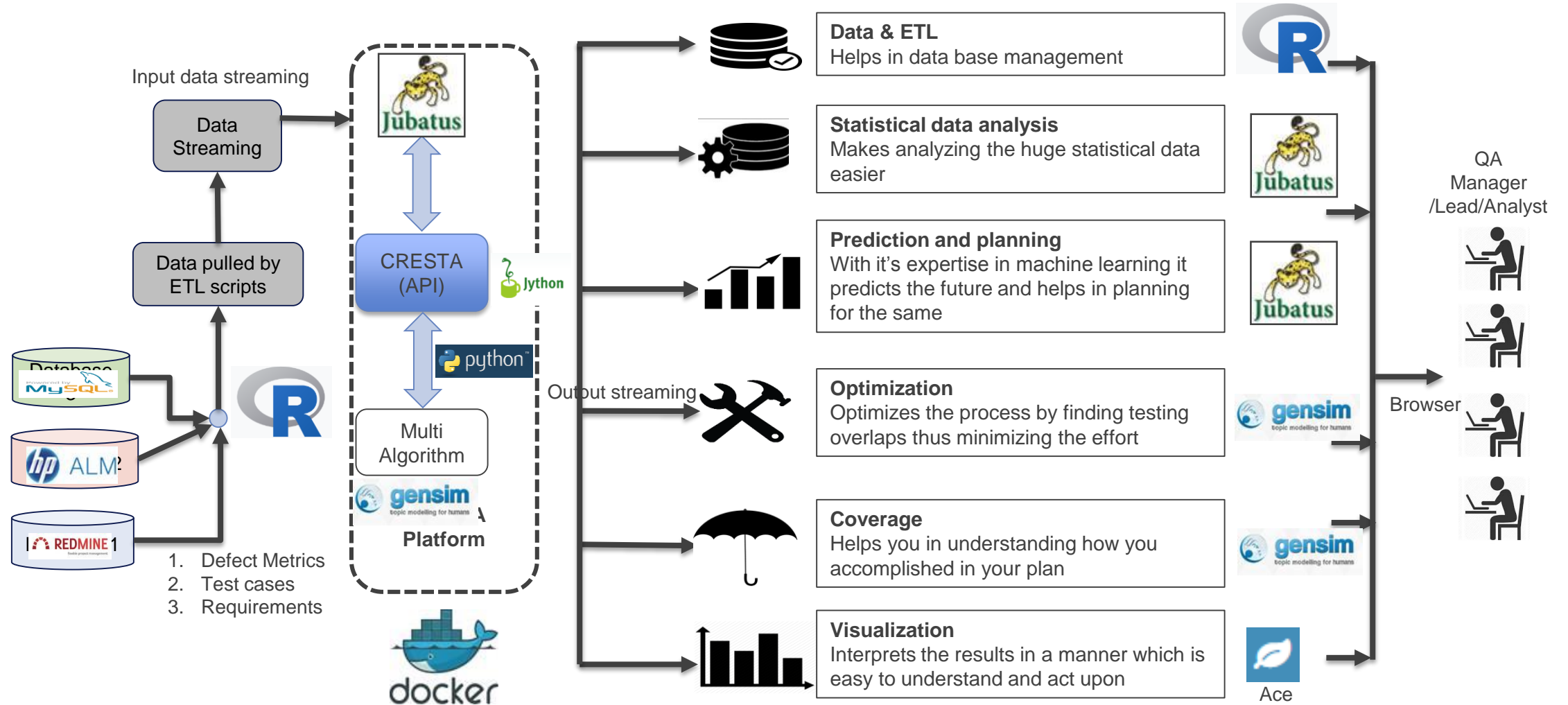


### Test Case Coverage for given Requirement is :

Test Case ID	Status	Percentage
TC1	X	73.15%
TC2	X	83.27%
TC3	X	66.13%
TC4	X	75.53%
TC5	X	71.65%
TC6	X	79.22%
TC7	O	98.11%
TC8	O	96.96%
TC9	X	70.48%
TC10	X	51.69%
TC11	X	68.42%
TC12	O	94.52%
TC13	O	94.61%



# Varied Use Cases Demand Complex Platform Architecture



**CRESTA is an orchestration of 12 technologies !**

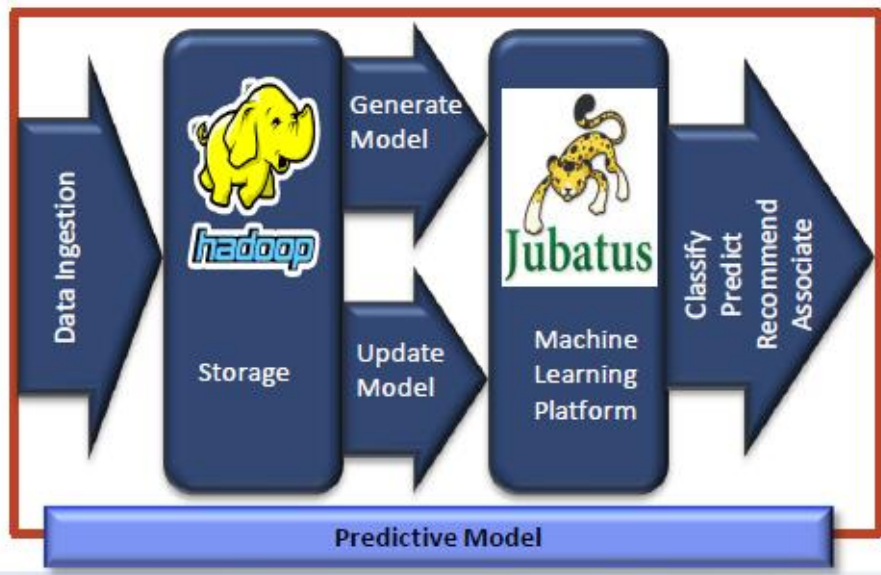


# Reusing and Extending Existing Functionality in a completely new application



© Copyright 2011-2017 PFN & NTT

- Developed in partnership with NTT, University of Tokyo, and Preferred Infrastructure Inc, Jubatus was released as Open Source in 2011

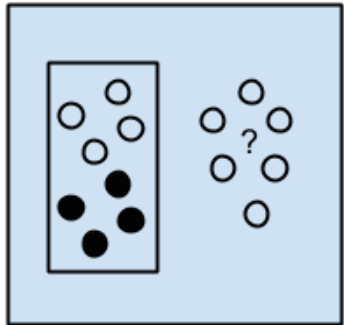


- Jubatus is a processing platform for real-time analysis of flow-type data capable of supporting large volumes within a distributed, scalable architecture
- Developed in partnership with NTT, University of Tokyo, and Preferred Infrastructure Inc, Jubatus was released as Open Source in 2011
- Updates a model instantaneously just after receiving data, and analyzes the data instantaneously as well a key differentiator
- Designed for large-scale, distributed computing rather than small-scale & stand-alone
- Focus on real-time/online processing vs batch mode processing (SAS, SPSS, etc)
- Jubatus uses a loose model sharing architecture for efficient training of models, employing Update, Analyze & Mix operations similar to the Map-Shuffle-Reduce operations in Hadoop

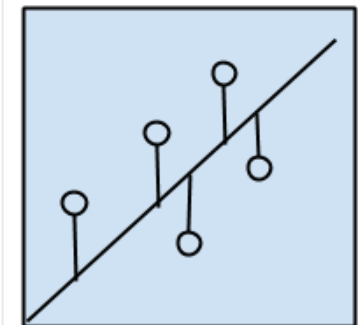
<http://jubatus/en/about/indexhtml>

# CRESTA uses a complex set of routines to demonstrate the use cases

## Regression



Supervised Learning Algorithms

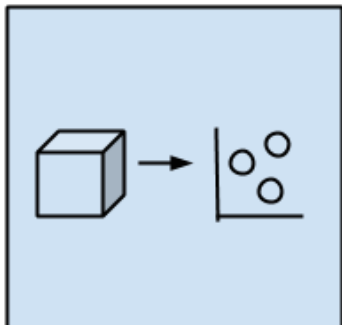


Regression Algorithms

Model Creation using Training

Model Creation using Standard Statistical curves

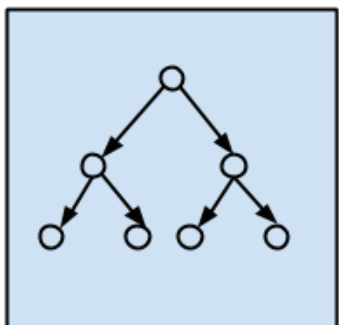
## Clustering



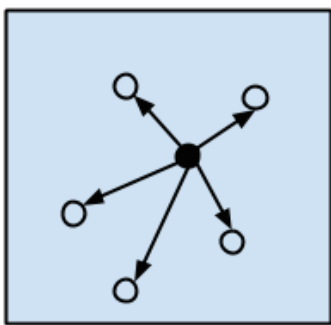
Dimensional Reduction Algorithms

Vector Driven Matrix model Vectorization done using neighborhood sets

## Classification

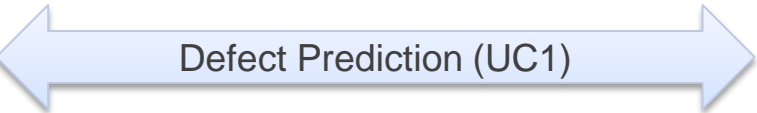


Decision Tree Algorithms



Instance-based Algorithms

Vector Driven Matrix model classification algorithms



NLP based use cases Coverage and Optimization (UC2,UC3)

Finding Defective Modules (UC1)

Vectorization Optimization Algorithms (UC2,3)

Multiple Linear, SVR Linear and SVR RBF

Gensym Word2Vec

Gensym Word2Vec, LSA Linear Symantec Analysis and Random Forest

# Deliverables & Output

# How is CRESTA useful for QA Manager role ?



## QA Managers face this situation frequently :

When the product release is close, QA Manager has the following questions :

- (1) Which Modules are defective and are more likely to result in customer dissatisfaction ?
- (2) Are our Test cases well written? Do they match up with the requirements ?
- (3) The release coverage is less by 20 % Of the test cases that are remaining, how many are duplicate ? How many Test cases can I skip without increasing my risk to the product quality



## What would help the QA Manager in this situation :

A tool that can consolidate all the QC data and predict the health of all the modules

A tool that will look at all the test cases and compare them to requirements intelligently

A tool that will compare test cases and tell the QA Manager about duplicate test cases that can be skipped without risking product quality



## Does CRESTA help the QA Manager to address these questions :

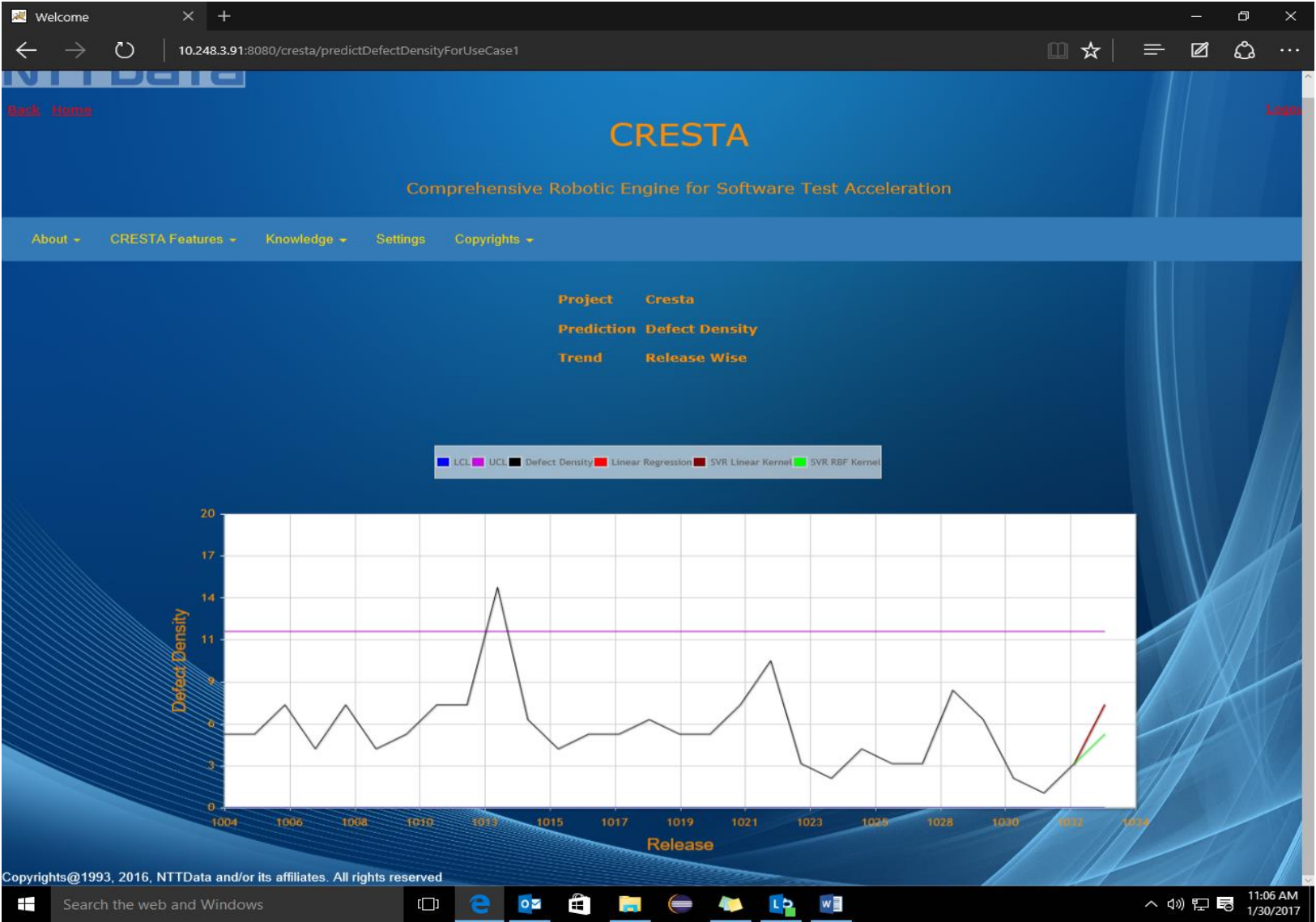
**Use Case 1: Prediction**

**Use Case 3: Coverage**

**Use Case 2: Optimization**

## CRESTA 1.0 Demo

# Use Case 1: Prediction – Sample Output



## Use Case 2: Test Optimization – Sample Output




The screenshot displays the CRESTA web application interface. At the top, there's a navigation bar with the NTT Data logo, a 'Logout' link, and a menu with options: 'About', 'CRESTA Features', 'Knowledge', 'Settings', and 'Copyrights'. The main heading is 'CRESTA' with the subtitle 'Comprehensive Robotic Engine for Software Test Acceleration'. Below this is a table showing test results for 13 test cases (TC1 to TC13) across 12 criteria (TC1 to TC12). The table cells are color-coded: green for high performance, yellow for medium, and red for low. An 'Export to excel' button is located at the bottom of the table. The browser's address bar shows the URL '10.248.3.91:8080/cresta/testoptimization'. The Windows taskbar at the bottom indicates the time is 11:33 AM on 1/30/2017.

	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9	TC10	TC11	TC12
TC1	100.0%	78.83%	83.74%	63.69%	92.45%	71.83%	87.63%	62.54%	64.71%	44.62%	87.36%	63.06%
TC2	78.88%	100.0%	71.91%	90.06%	74.83%	93.06%	69.36%	88.55%	59.02%	71.6%	69.56%	85.85%
TC3	83.19%	70.81%	100.0%	78.32%	91.95%	77.18%	94.86%	76.51%	86.1%	70.79%	80.25%	64.07%
TC4	63.97%	90.03%	78.6%	100.0%	74.79%	96.5%	74.71%	97.85%	72.6%	87.35%	61.53%	83.59%
TC5	92.45%	75.17%	91.98%	74.17%	100.0%	81.39%	94.89%	72.97%	77.21%	58.75%	86.78%	65.49%
TC6	71.88%	92.92%	77.37%	96.5%	81.36%	100.0%	76.41%	94.77%	67.74%	79.31%	68.05%	84.82%
TC7	87.46%	69.37%	94.8%	74.92%	94.89%	76.41%	100.0%	77.08%	85.48%	67.44%	82.03%	61.06%
TC8	62.7%	88.62%	76.42%	97.84%	72.89%	94.77%	77.0%	100.0%	73.4%	88.43%	59.5%	81.1%
TC9	65.51%	58.55%	86.41%	72.29%	77.47%	68.13%	85.48%	73.31%	100.0%	86.59%	64.12%	54.72%
TC10	45.93%	70.67%	71.11%	86.89%	59.2%	79.56%	67.36%	88.31%	86.6%	100.0%	46.64%	68.96%
TC11	87.21%	70.51%	80.4%	61.11%	86.79%	68.05%	81.83%	59.34%	64.49%	46.08%	100.0%	80.01%
TC12	61.29%	86.53%	63.88%	83.71%	65.99%	84.47%	61.39%	81.84%	56.16%	68.61%	79.82%	100.0%
TC13	71.11%	85.82%	66.64%	77.67%	67.69%	80.28%	62.71%	75.54%	51.38%	60.42%	82.62%	95.19%

Export to excel



# CRESTA 1.0 Project Status

Overall Status	Project Status		Project completion percentage	Planned	Achieved	Key Risks & Issues	Total	Closed	Report date			
	Green			100%	100%			0	0	13-March-2017		
<b>Overall Status:</b> <ul style="list-style-type: none"><li>• Usecase 1, usecase 2 and usecase 3 have been completed</li><li>• Accuracy measurements for usecase 1, usecase 2 &amp; usecase 3 have been completed</li><li>• UAT completed</li><li>• Documentation:<ul style="list-style-type: none"><li>Installation guide, User Manual, Tutorial, Use case coverage, Sample kit, Input (eg csv, doc etc)/Output (eg graph) has been completed</li></ul></li></ul>												
Achievements	<ul style="list-style-type: none"><li>• Accuracy improvement and finding trend for usecases 1, usecase 2 and usecase 3</li><li>• UAT documentation has been completed</li><li>• ACE Integration has been completed as per client request</li><li>• Adaptive Planning has been completed as per client request</li></ul>						Deliverables		ON	AV		
							Installation docker			X		
Next Steps	<ul style="list-style-type: none"><li>• Customer PoC is in progress at TiAA</li></ul>						Documentation			X		
Milestones & Progress	<ul style="list-style-type: none"><li>• Project was Kicked – Off on 14<sup>th</sup> July 2016</li><li>• Requirements were defined in the form of use cases, by 7<sup>th</sup> Dec 2016</li><li>• Use cases were prioritized and the scope was defined on 7<sup>th</sup> Dec 2016</li><li>• Use case 1 was delivered on 9<sup>th</sup> Dec 2016</li><li>• Use case 3 was delivered on 20<sup>th</sup> Jan 2017</li><li>• Use case 2 was delivered on 10<sup>th</sup> Feb 2017</li><li>• Re-work configuration for improving usecase 3 efficiency was completed by 10<sup>th</sup> Feb 2017</li><li>• Re-work configuration for improving usecase 2 efficiency was completed by 23<sup>rd</sup> Feb 2017</li><li>• Re-work configuration for improving usecase 1 efficiency was completed by 24<sup>th</sup> Feb 2017</li><li>• CRESTA 10 release meeting on 13<sup>th</sup> Mar 2017</li></ul>											

ON= OnGoing; AV= Available

ON= OnGoing; AV= Available

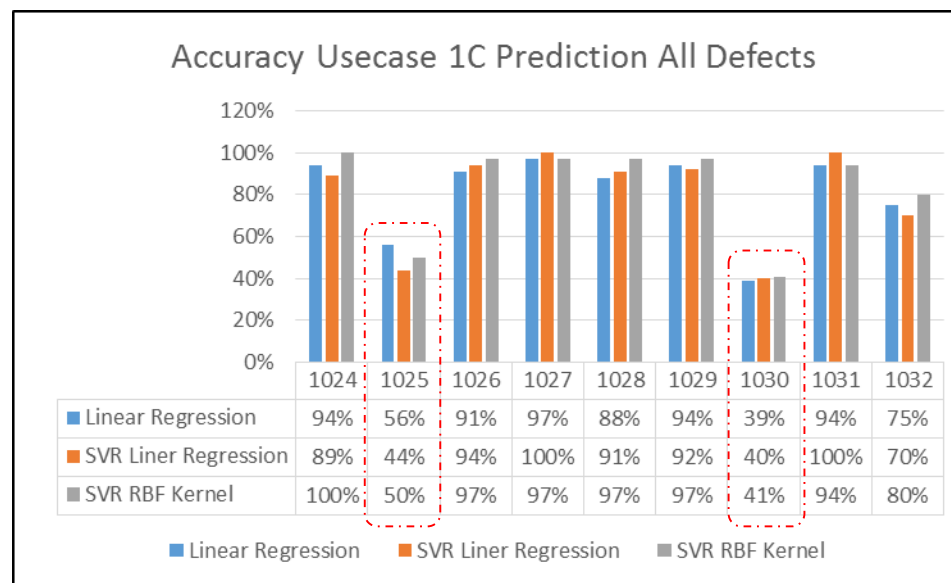
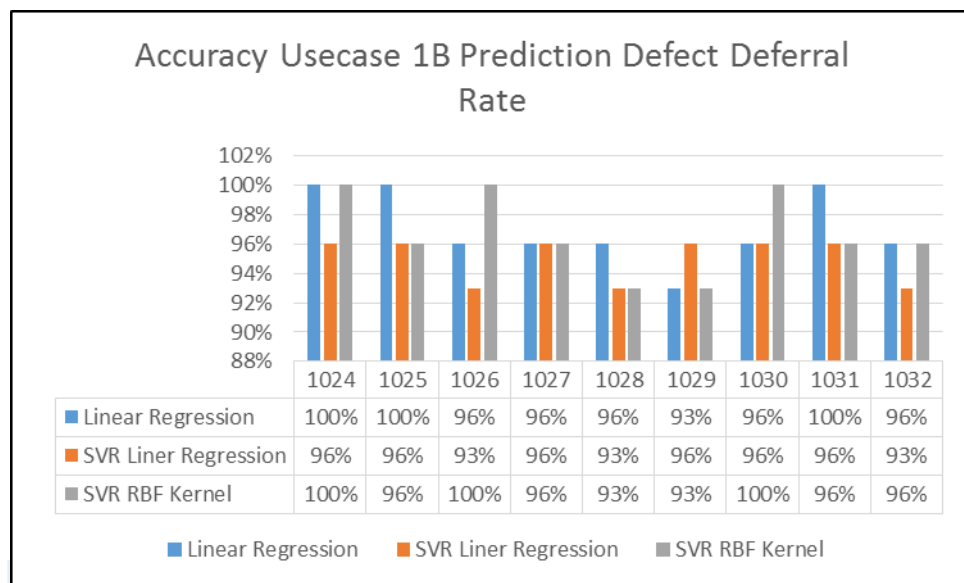
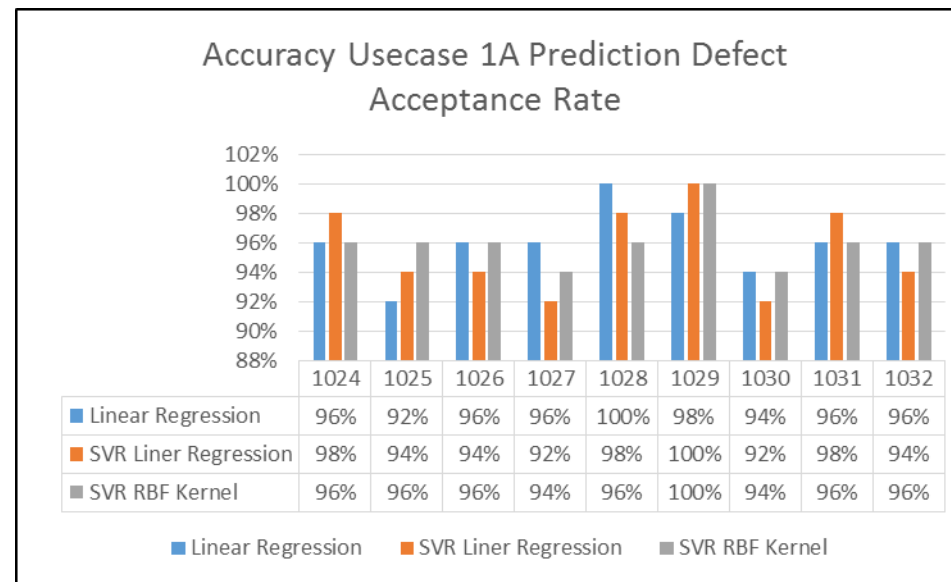
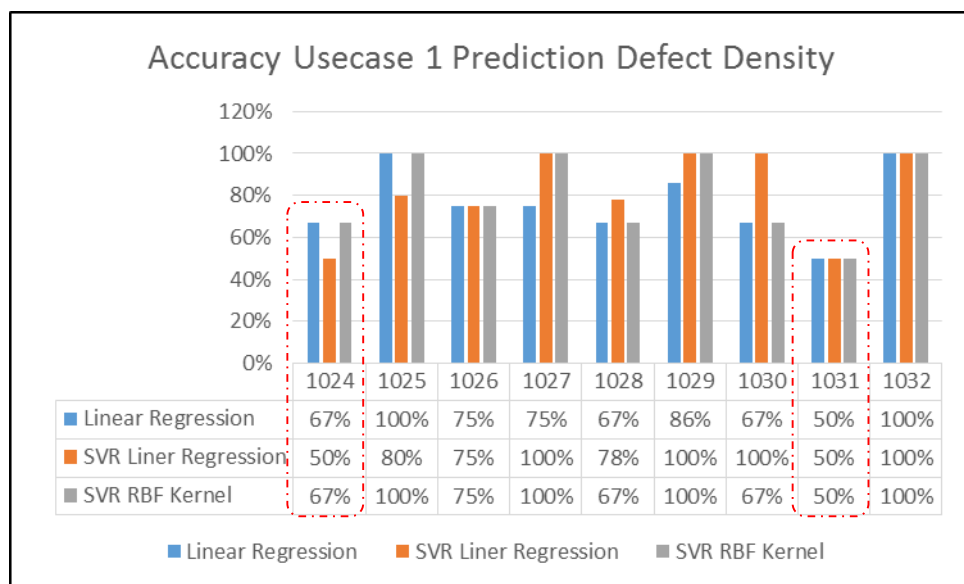
# CRESTA SoW Mapping



Plan of Work	Deliverables	Details	Status	Type of deliverables	Format
CRESTA Framework Build-out	1 Framework of predictive defect analysis	CRESTA solution package comprising of:	●	Zipped source code, text files and doc	txt, zip,
	2 Framework for Test Optimization	<ul style="list-style-type: none"> <li>Predictive Analytics on historical data to provide insights on Quality Gaps, Defect Targets/Trends</li> </ul>	●	Microsoft word document	doc
	3 Reporting Dashboard & Integration	<ul style="list-style-type: none"> <li>Dashboard &amp; reporting to provide visibility to stakeholders based on historical and release data</li> </ul>	●		
		<ul style="list-style-type: none"> <li>Visual Coverage Maps for uncover coverage issues prior to release intuitively</li> </ul>	●		
		<ul style="list-style-type: none"> <li>Analyze test case in real-time or offline and identify redundancy and reusability</li> </ul>	●		
		<ul style="list-style-type: none"> <li>Analyze execution logs and identify untested areas of software proactively</li> </ul>	●		
		<ul style="list-style-type: none"> <li>Data aggregation from commonly used industry standard tools</li> </ul>	●		
	Pilot results	Details of the pilot runs and its results	●	Document	Docx
	Solution Overview	Presentations, videos	●	Presentations, videos	pptx, mp4
	Training	Training classes	●	Document	pptx

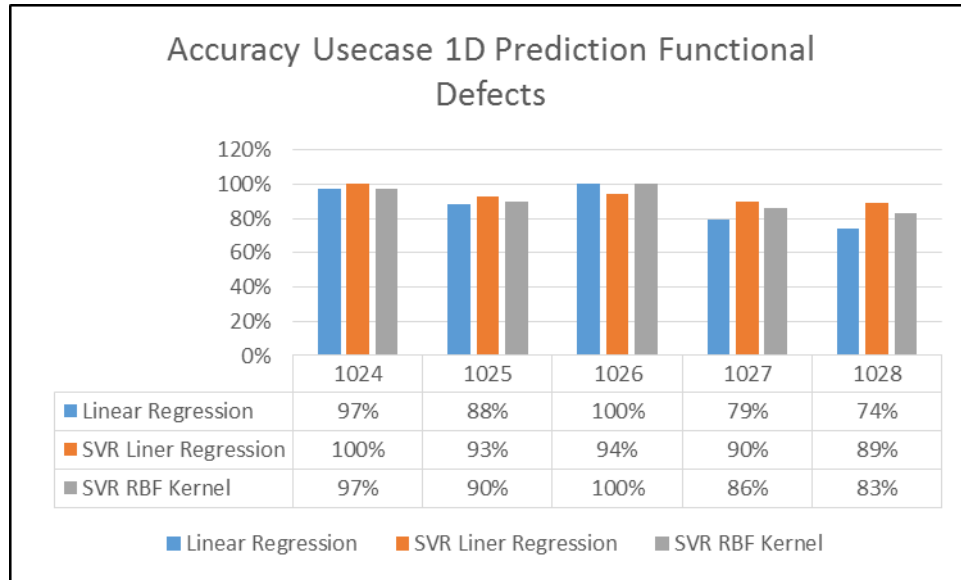
# Accuracy Analysis (Based on Client Pilot)

# Use Case 1: Quality Prediction – Accuracy

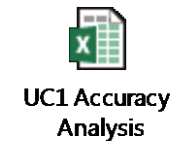


Known input Data Issues

# Use Case 1: Quality Prediction – Accuracy (Details)



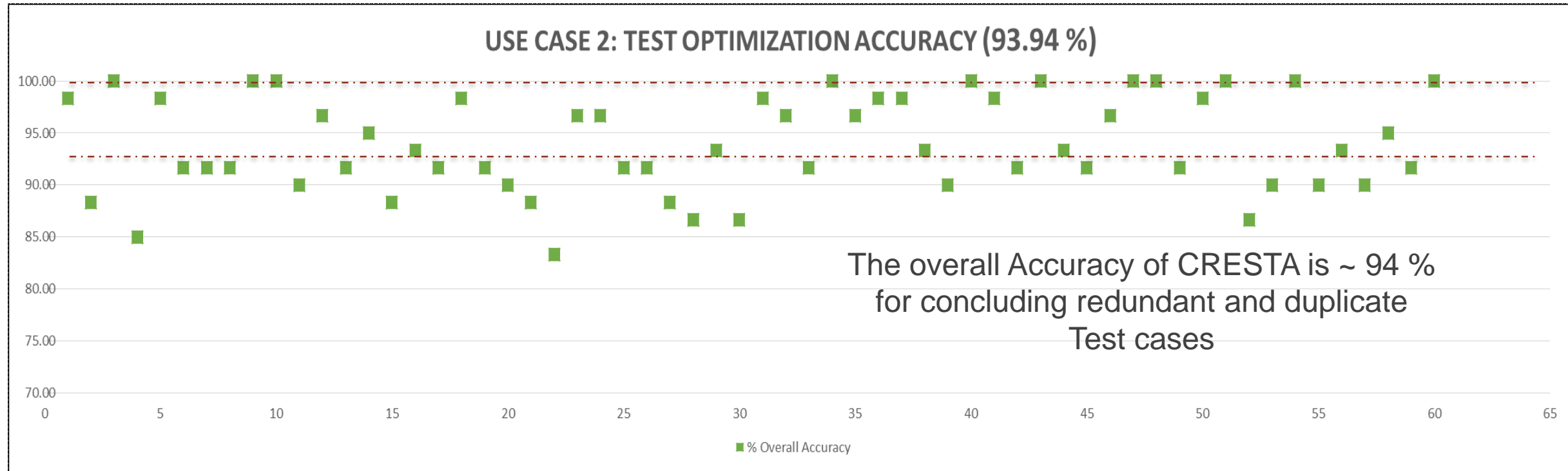
- Defects data taken from large European telecom company
- Defects data of nearly 20 releases used as training data
- CRESTA predicted defect metrics for future 8~10 releases based on training data
- Accuracy is measured statistically



$$\% \text{ Accuracy} = \frac{(\text{Actual defect density} - \text{Predicted defect density})}{\text{Predicted defect density}} \times 100$$

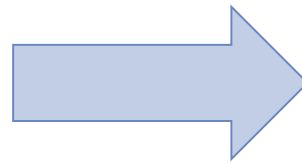
- If the project data is stable ie defect metrics & other project parameters don't change more than 5-10%, for the releases, user can use any of the Linear Regression algorithms (LR, SVR-Linear)
- If the project has large releases data, with defect metrics & other project parameters varying more than 5-10%, then user should use SVR-RBF algorithm as it will give more accurate prediction compared to any of the Linear Regression algorithms

## Use Case 2: Test Case Optimization – Accuracy



  
Input Test cases

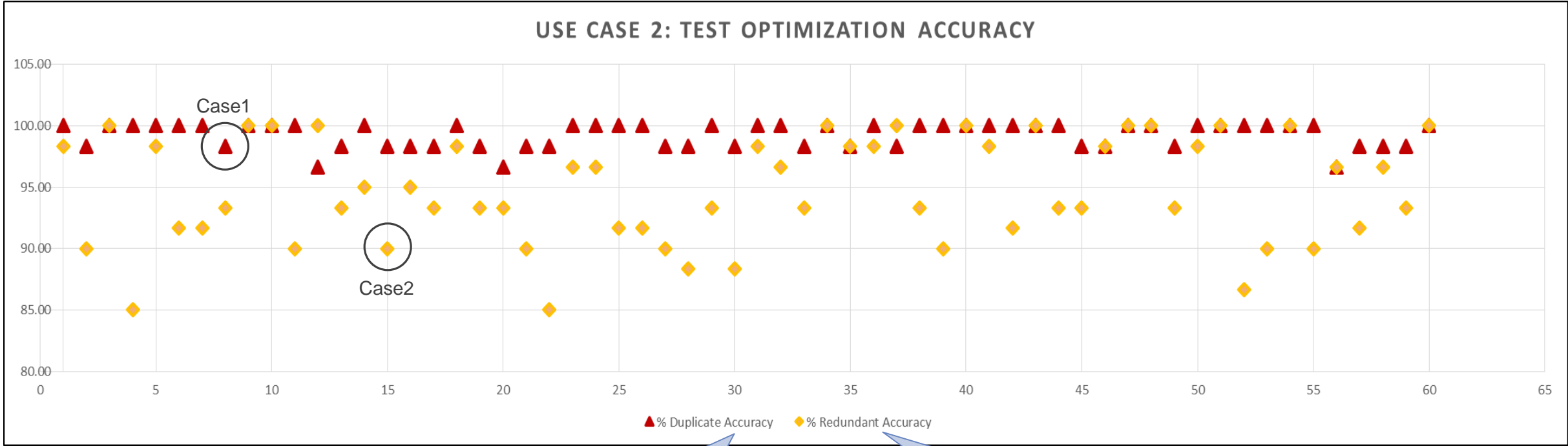
  
UC2\_Accuracy\_An  
alysis



**Accuracy of (Usecase 2),  
Test Case Optimization ~ 94%**

- Test cases taken from large European electricity company
- 60 Functional integration test cases of one module are considered
- CRESTA analyzed the duplicity and redundancy among the test cases of same module
- Accuracy of duplicity & redundancy measured with the help of functional expert
- Gensim Word2Vec algorithms is used

# Use Case 2: Test Case Optimization – Accuracy (Details)



## Special Cases



Case 1: Only one change in one step



Case 2: Difference in pre requisites

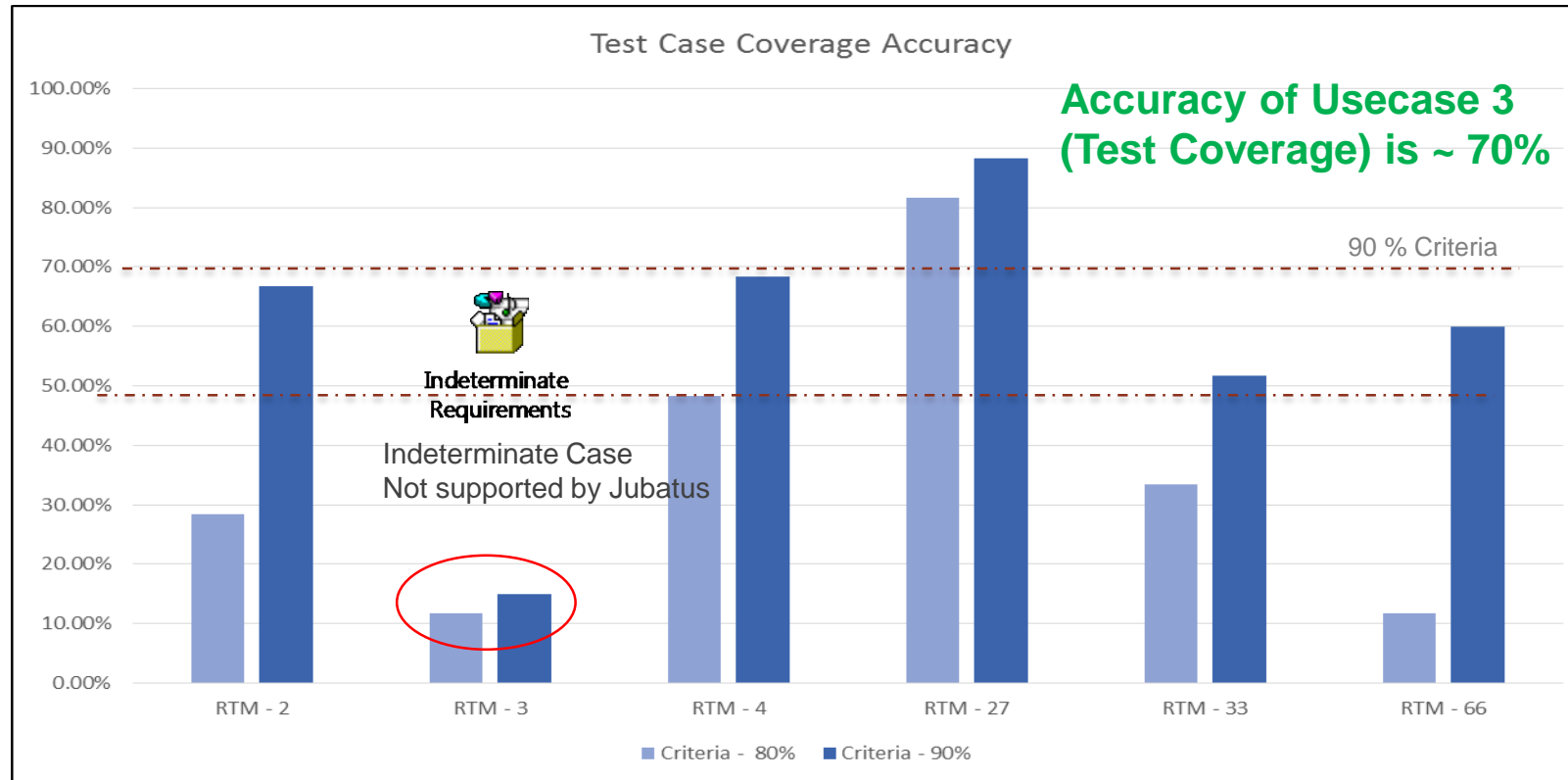
Duplicate test cases >90% match Test cases can be removed from test suite

Redundant test cases 71% - 90% match Some rework required on test cases

$$\% \text{ Accuracy} = \frac{(\text{Correct detection of Duplicate test cases} + \text{Correct detection of Redundant test cases})}{\text{Total no of test cases}} \times 100$$



## Use Case 3: Test Coverage – Accuracy



Input Test cases



Requirements Specification



UC3 Accuracy Analysis



UC3 Accuracy Improvement

- Requirements and Test cases taken from large European electricity company
- 60 Functional integration test cases of one module and 6 sample requirements are considered
- CRESTA analyzed the relativity between test cases and the requirements
- Latent Semantic Analysis algorithms is used

## Use Case 3: Test Coverage – Accuracy (Details)

$$\% \text{ Accuracy} = \frac{(\text{Correct detection of relevant test cases} + \text{Correct detection of non relevant test cases})}{\text{Total no of test cases}} \times 100$$





CRESTA Mapping	Actual Mapping	Count
Relevant Test Cases		
O	X	20
O	O	1
Total		21
Non Relevant Test Cases		
X	O	0
X	X	39
Total		39

- What we did to improve the accuracy:
  - 1) If the test case contains digits like 11, 12 that will be removed as part of pre-processing
  - 2) If any word is occurring more than or equal to 2 in test case or requirement then it will be considered for vector mapping (Previously it was 1)
- PROPOSAL for CRESTA 20:
  - 1) If number of vectors is increased accuracy will improve (UC2) -> Requires more processing power and/or time
  - 2) Separate the words joined by - or \_ this may improve accuracy -> Currently \_ or - are removed as part of pre-processing and treated as single word
  - 3) Create dictionary to map abbreviations and synonyms will improve accuracy  
eg PM is for (Project Manager), this will going to give context for the word

These pilot results can be generalized as live customer data is used to run the pilots











# Key Customer & Stakeholder Analysis

# Customer Feedback : “Very Innovative and Much Needed Capability”








Questions to Customer		 UK Telecom Major	 Bank of America	 US Annuity & Retirement Major	 US Insurance Major
1	Do they like CRESTA ?	✓✓	✓✓✓	✓✓	✓✓
2	Are they ready to do a POC ?	Yes	Yes	Yes	Yes
3	Initial Feedback	1. No Statistical Integration 2. Data dump ETL transfer issues	1. Prediction should be related to feature complexity 2. Usecase 2 will be executed via TOSCA	1. ETL component to use R 2. Integration with existing Dashboard	

## Pipeline

✓ Interest   ✓✓ POC Underway   ✓✓✓ POC Completed

Europe	 ✓✓	 ✓	 ✓	 ✓	
Americas	 ✓	 ✓	 ✓	 ✓	 ✓
Asia / Pacific	 ✓				

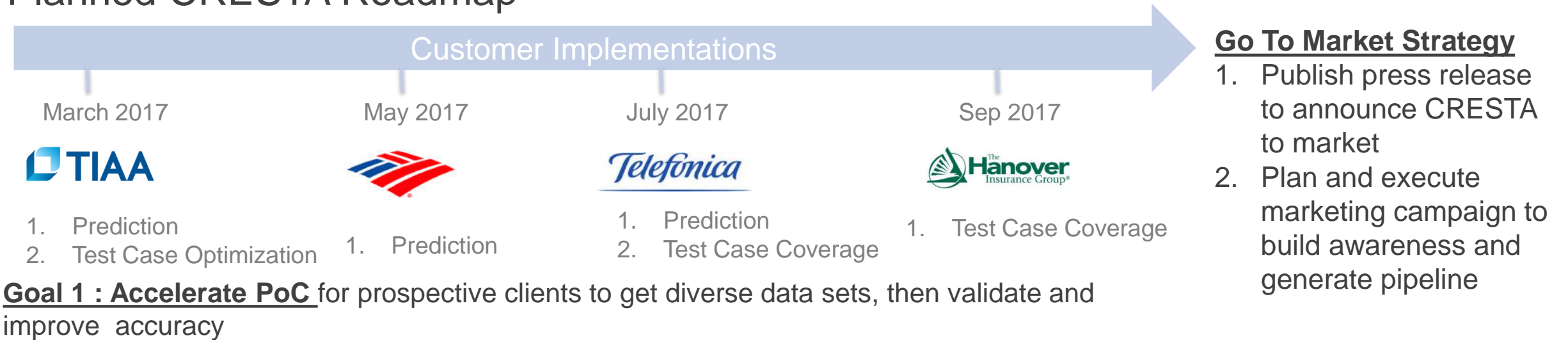
# Sales Team Feedback – “CRESTA is way ahead of its competition”

	 	 	 The best AI Kernel in the market	 
Feature	NTT DATA	INFOSYS	SAFFRON	CAPGEMINI
Kernel or Implementation	Both Kernel and Implementation	Both Kernel and Implementation	Only Kernel	Both Kernel and Implementation
Prediction	Supported	Supported	Supported but needs to be Implemented	Supported
Test Case Coverage	Supported	Not Supported	Supported but needs to be Implemented	Not Supported at present
Testcase Optimization	Supported	Not Supported	Supported but needs to be Implemented	Not Supported at present
Decision Making Identifying defective modules	Supported	Not Supported	Supported but needs to be Implemented	Not Supported at present

NOTE: Competitors information was surveyed as of Aug 2016

# Next Steps and Future Roadmap for CRESTA

# Planned CRESTA Roadmap



## Goal 1 A : Accuracy Improvement:

1. Define Specific Test Design methodology to improve accuracy
2. Machine learn input parameters for various algorithm
3. Establish usecase specific data dictionary

## Goal 2 : Improve Solution Delivery :

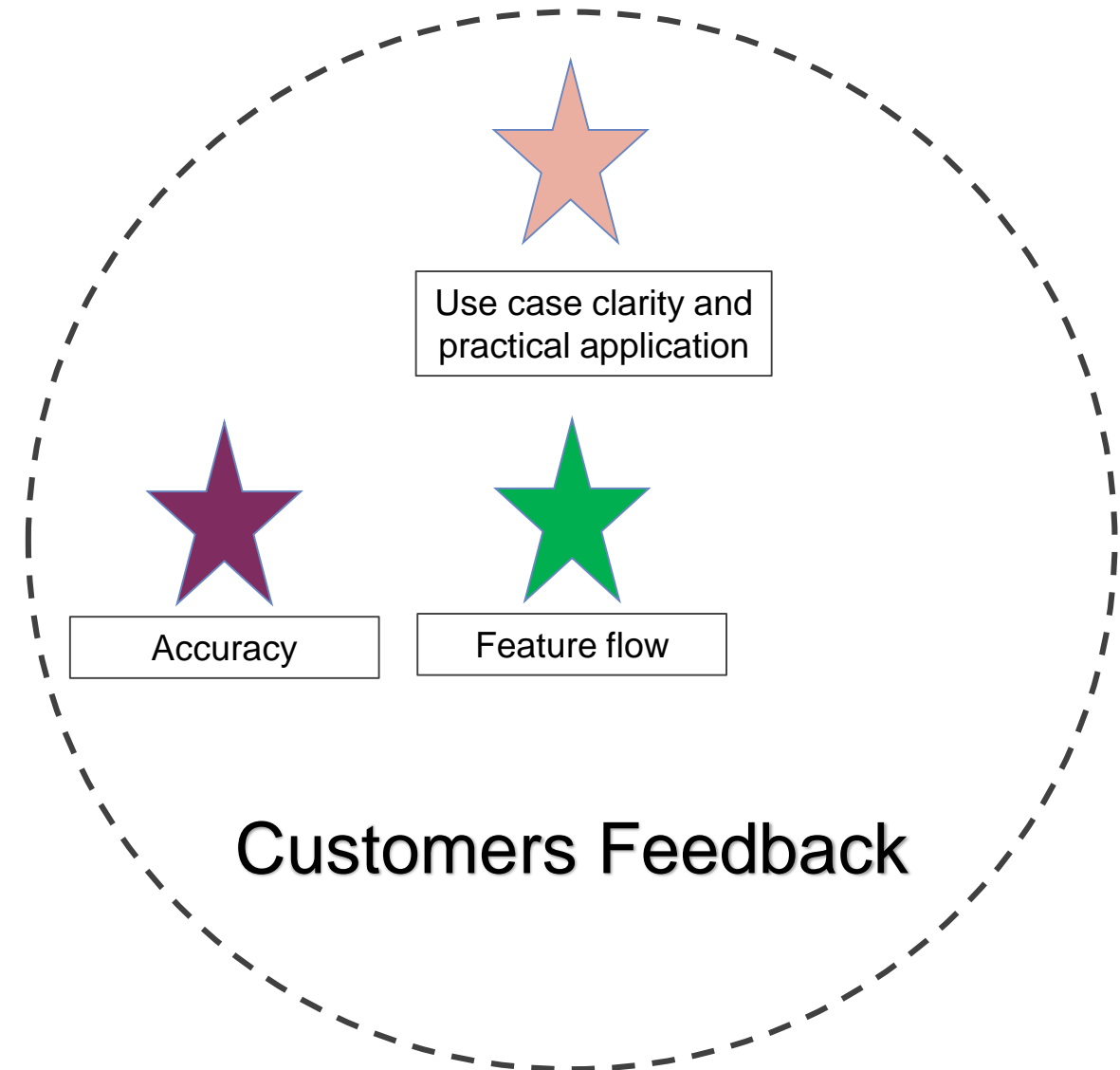
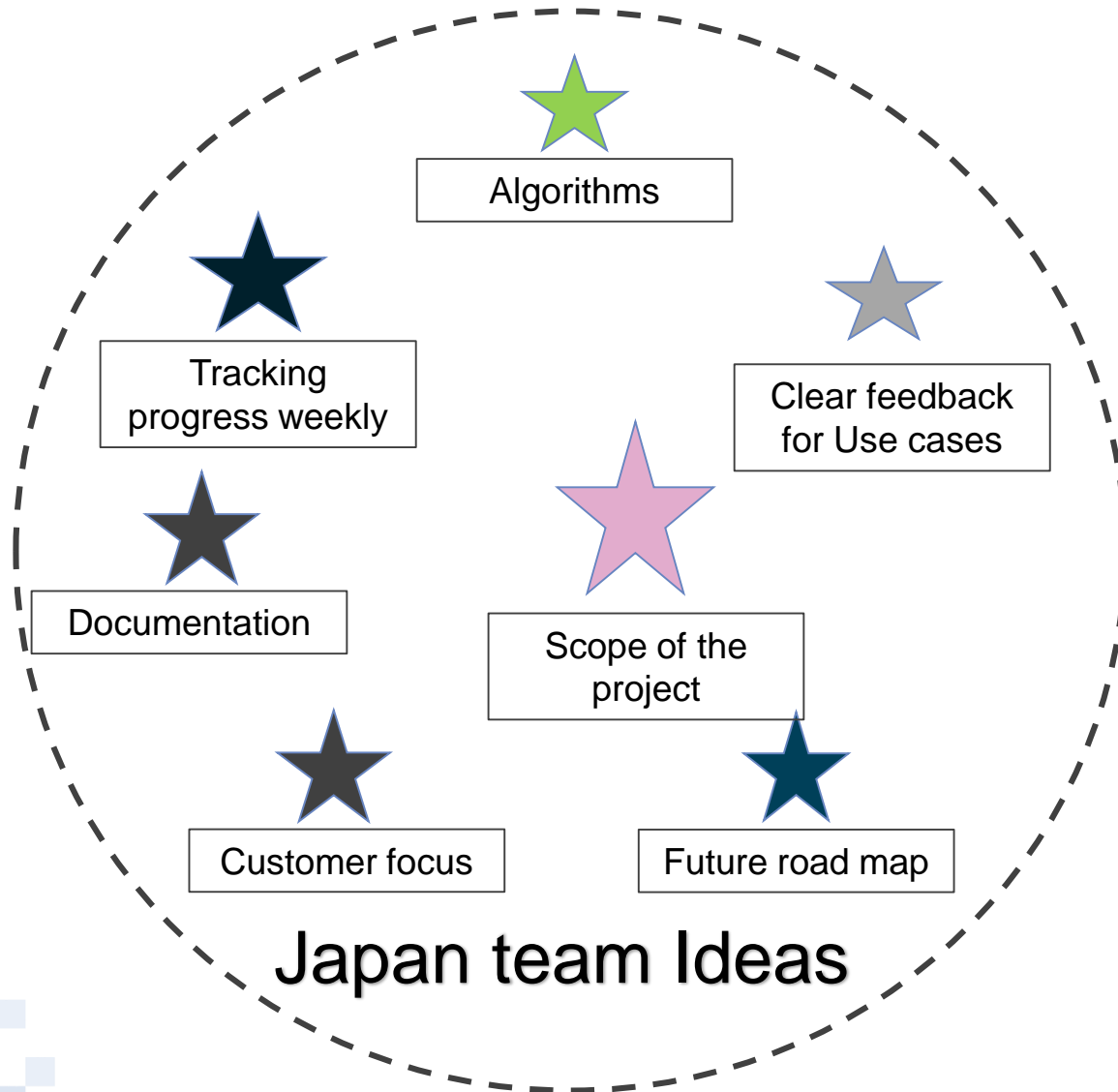
1. With rising demand, CRESTA installation needs to be robust
2. We already have many prospective clients, hence we should avoid trouble shooting effort in installation
3. An elementary mistake in typing command would cause lot of time consuming task in supporting, since we are about to deliver CRESTA on global basis

## Goal 3 : Implement Adaptive Planning

1. One of the well-known weakest point in typical machine learning solution is that user is not able to understand what to do next
2. Therefore, this Usecase should be regarded as most important and challenging mission



# Enabled by Tremendous Collaboration Between Global R&D, QAT Practice & Clients





Arigatou gozaimasu.

ありがとうございます

[thank you very much]