



A TECHWELL EVENT

W7

Test Analytics, AI/ ML

Wednesday, October 3rd, 2018 1:45 PM

Marrying Artificial Intelligence with Software Testing: Challenges & Opportunities

Presented by:

**Wendy Chin and Heng Kar Lau,
Intel Corp.**

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Wendy Chin

Wendy Siew Wen Chin received her PhD in Electrical & Electronic Engineering from The University of Nottingham with the specialization in computer vision and machine learning. She is currently a software engineer in Internet of Things group, Intel. Her focus is on machine learning, visual fog computing and predictive analytics based solutions. Her research interests include machine learning, computer vision, signal processing and data analytics. Wendy has filed 6 patent applications and more than 30 technical publications.

Keng Kar Lau

Heng Kar Lau has been developing application, system software and managing software development teams for 15 years. As a product owner of software testing department for Internet of Things Group at Intel, he is responsible to lead a team to develop software testing life cycle framework, incorporate agile practices into current development and establish KPI and metric to achieve efficiency for software testing department. Most recently, Heng Kar has been focusing on how to apply data science knowledge into software testing domain. Heng Kar has filed 2 patent applications.



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Wendy is a computer vision research engineer in Intel Corporation. She holds a PhD in Electrical & Electronic Engineering from The University of Nottingham with the specialization in computer vision and machine learning. Prior to Intel, Wendy played a lecturer role for 2 years with the main research area in Human Computer Interaction and Brainwave Analytics. Wendy joined Intel, Internet of Things group since 2014 focusing on machine learning, visual fog computing, software test analytics and predictive analytics based solutions. Her research interests include machine learning, computer vision, signal processing and data analytics. Wendy's research contribution includes 10+ issued/pending patent applications and 30+ technical publications.



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MARRYING SOFTWARE TESTING WITH AI -OPPORTUNITIES & CHALLENGES-

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Internet of Things Group, Intel Corporation

Acknowledgement: Deric Quek Zhen Han, Chin Lean Lee

October 2018 @ STARWEST Software Testing Conference

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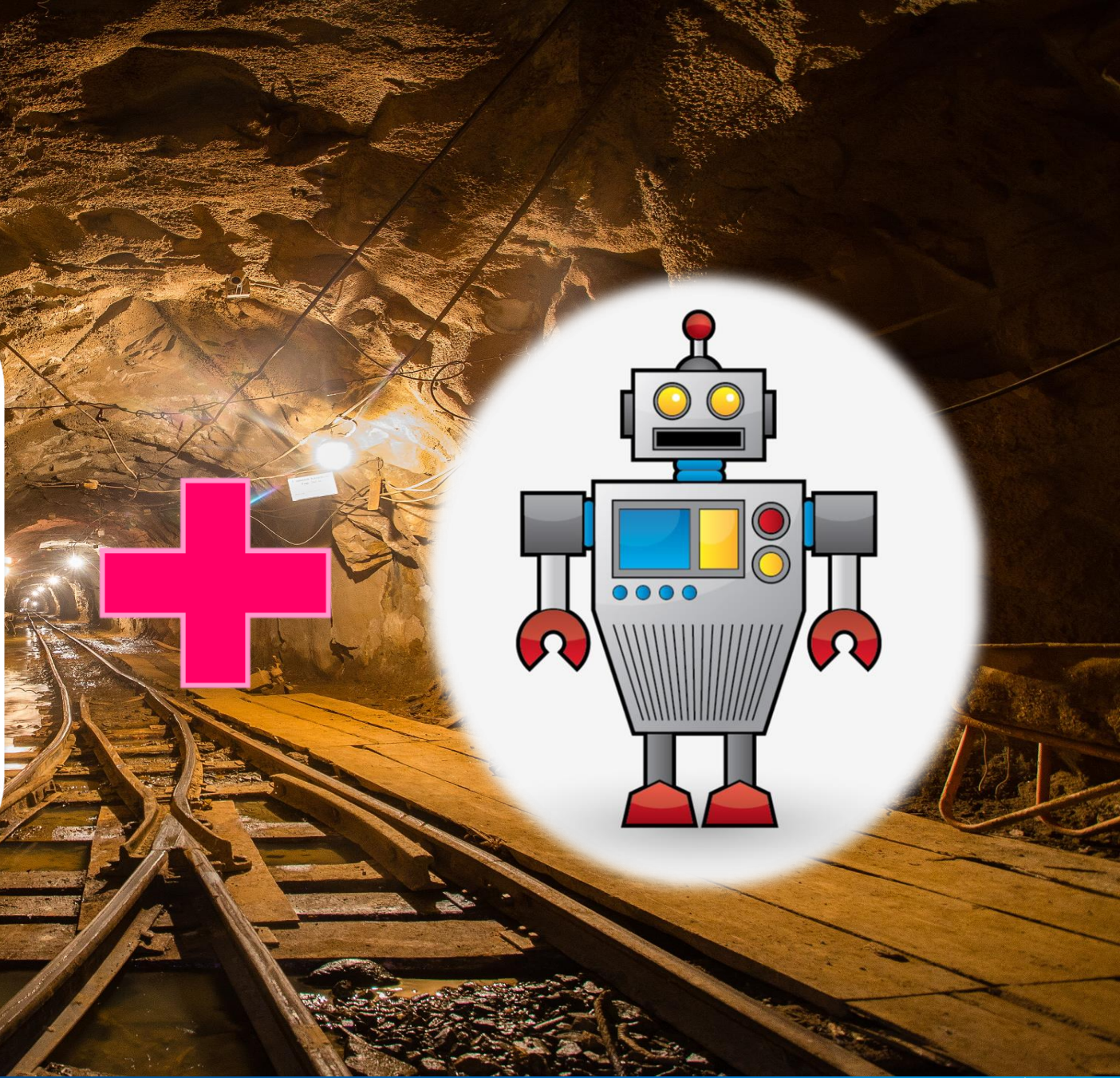
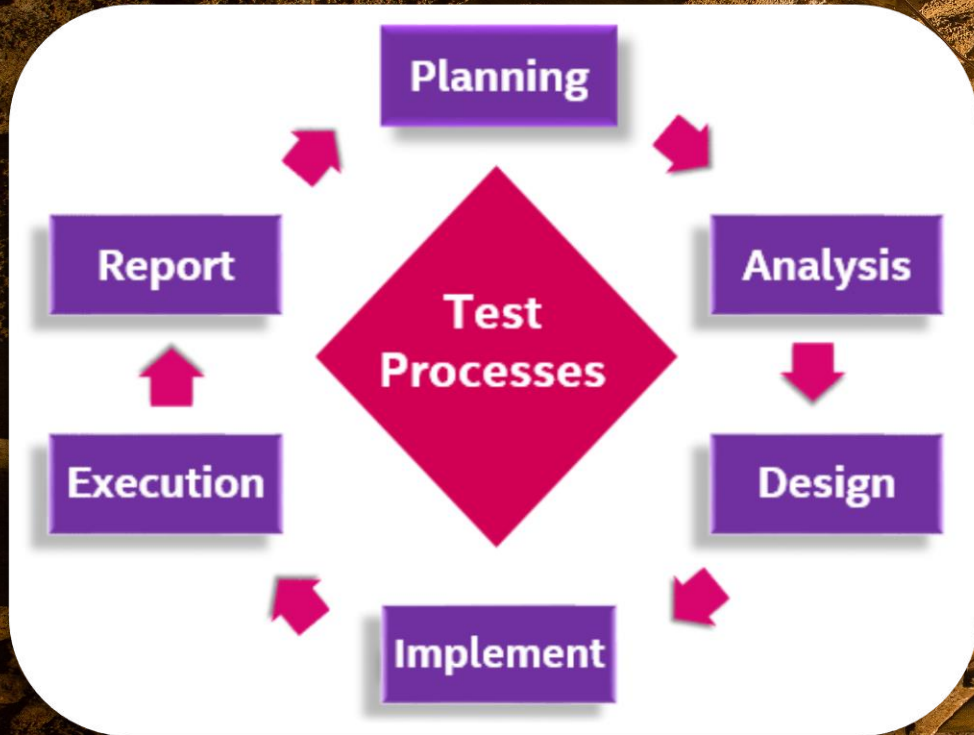
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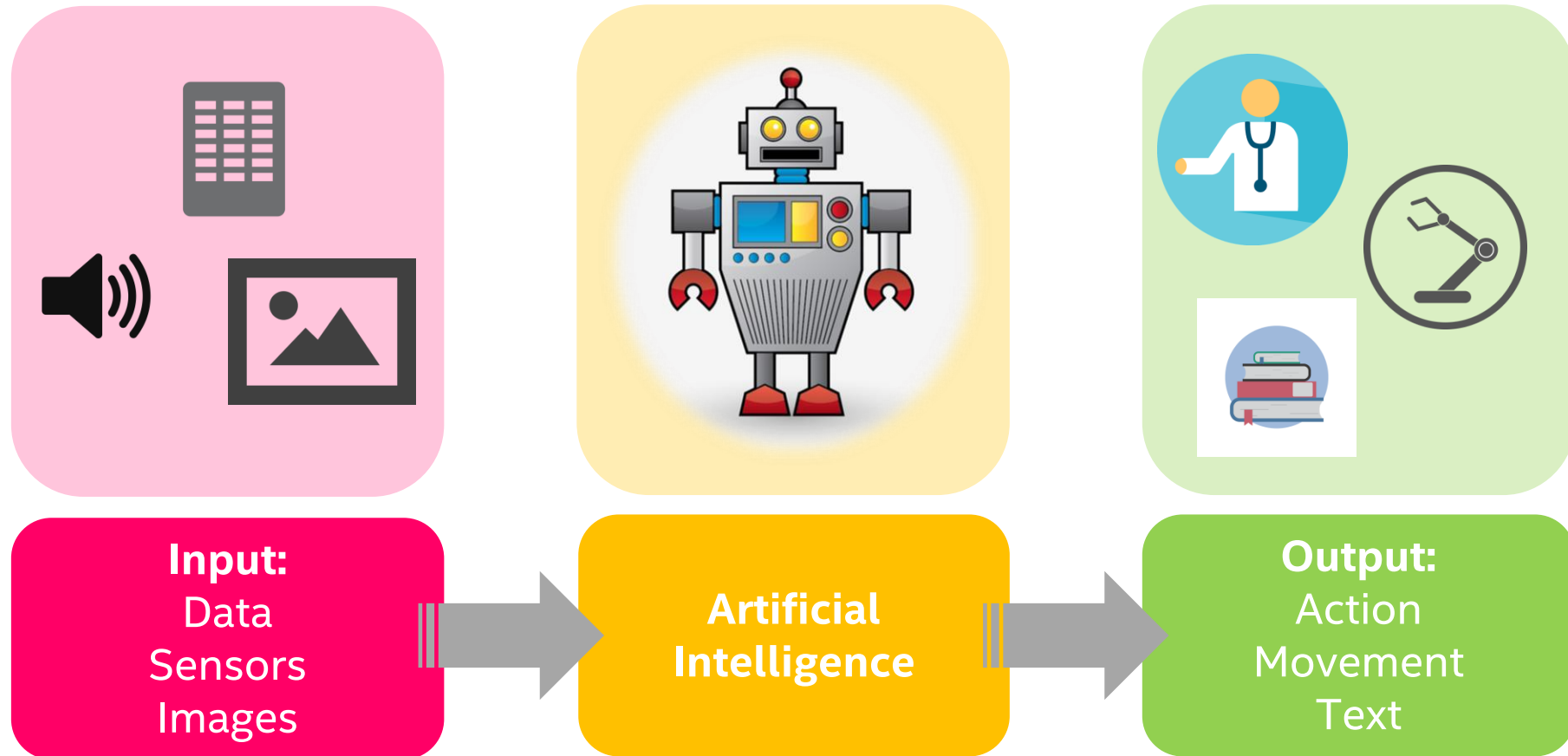




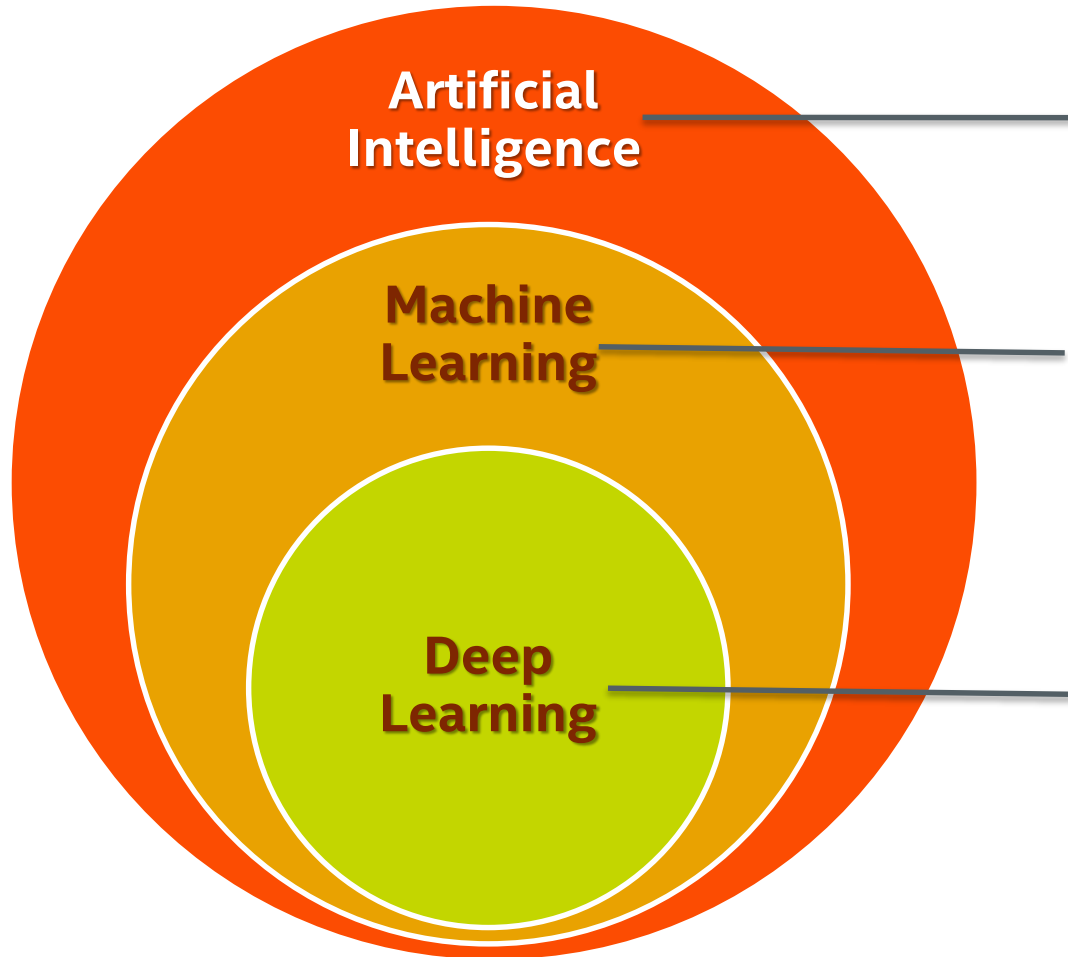
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What is Artificial Intelligence



Some Subsets of Artificial Intelligence



Any technique which enables computers to mimic human behavior

Subset of AI techniques which use statistical methods to enable machines to improve with experiences

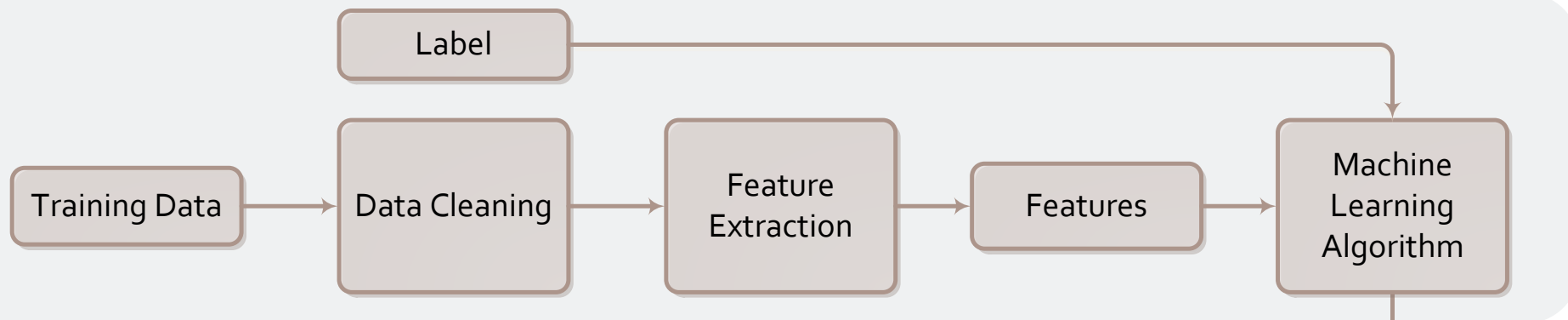
Subset of ML which make the computation of multi-layer neural networks feasible

What is Machine Learning

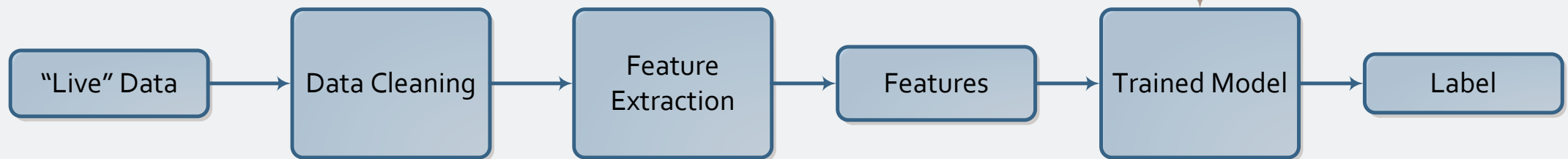
“A computer program is said to learn from experience E with respect to some task T and some performance measure P , if its performance on T , as measured by P , improves with experience E ”

-- Tom Mitchell, Carnegie Mellon University 1997

Training



Prediction





From Buzz to the Battleground

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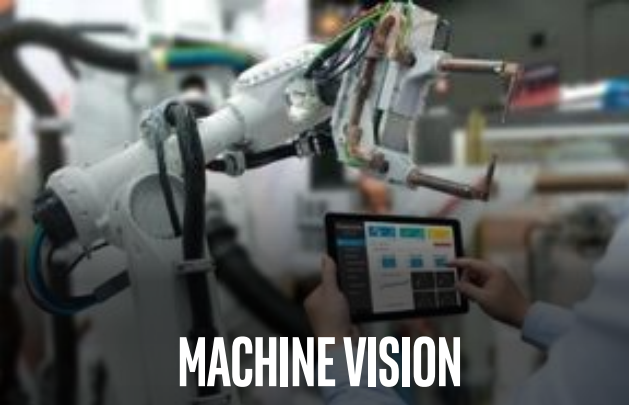




EMERGENCY RESPONSE



FINANCIAL SERVICES



MACHINE VISION



CITIES/TRANSPORTATION

20.4 BILLIONS CONNECTED DEVICES

By 2020



AUTONOMOUS VEHICLES



RESPONSIVE RETAIL



MANUFACTURING



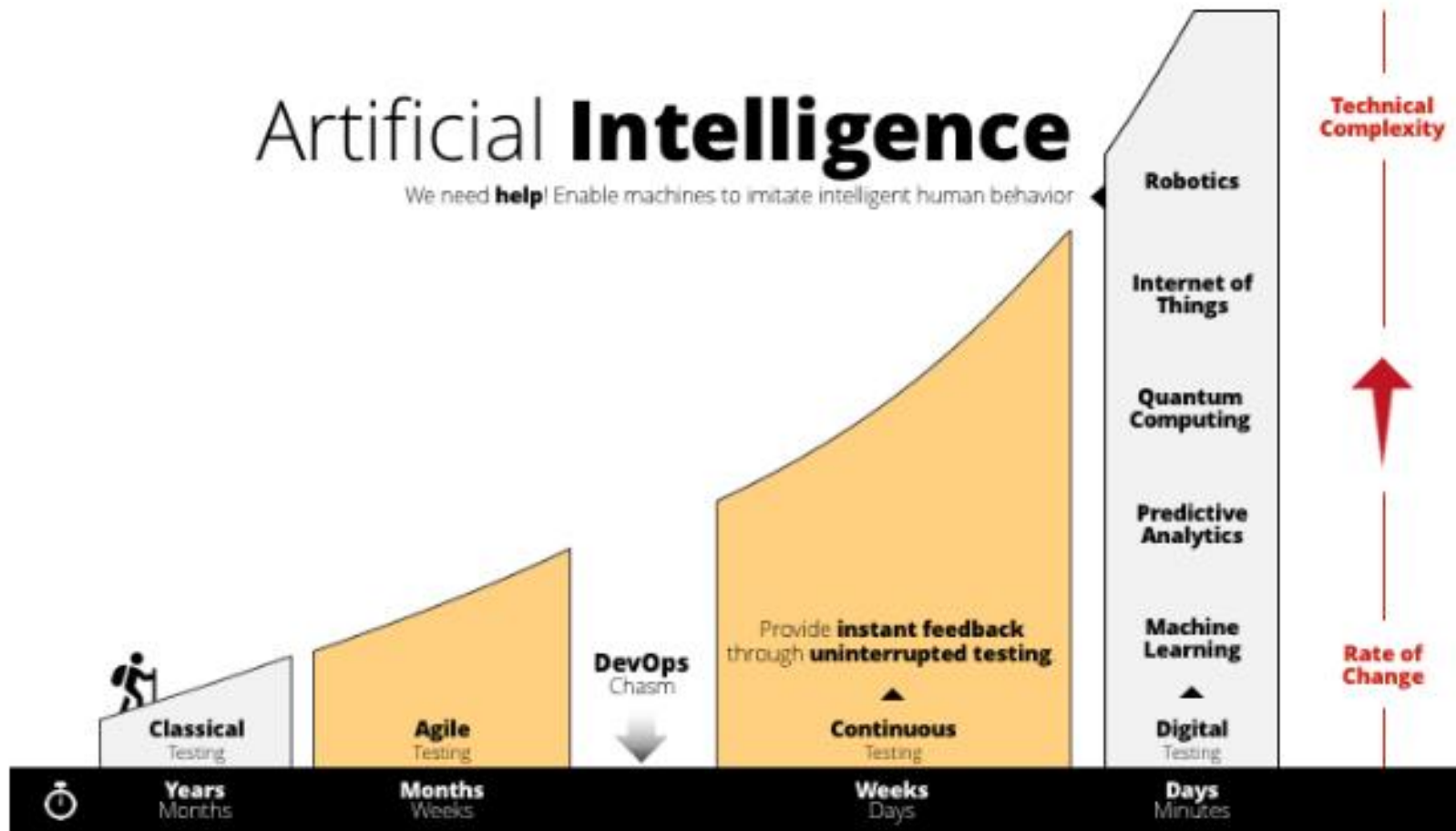
PUBLIC SECTOR

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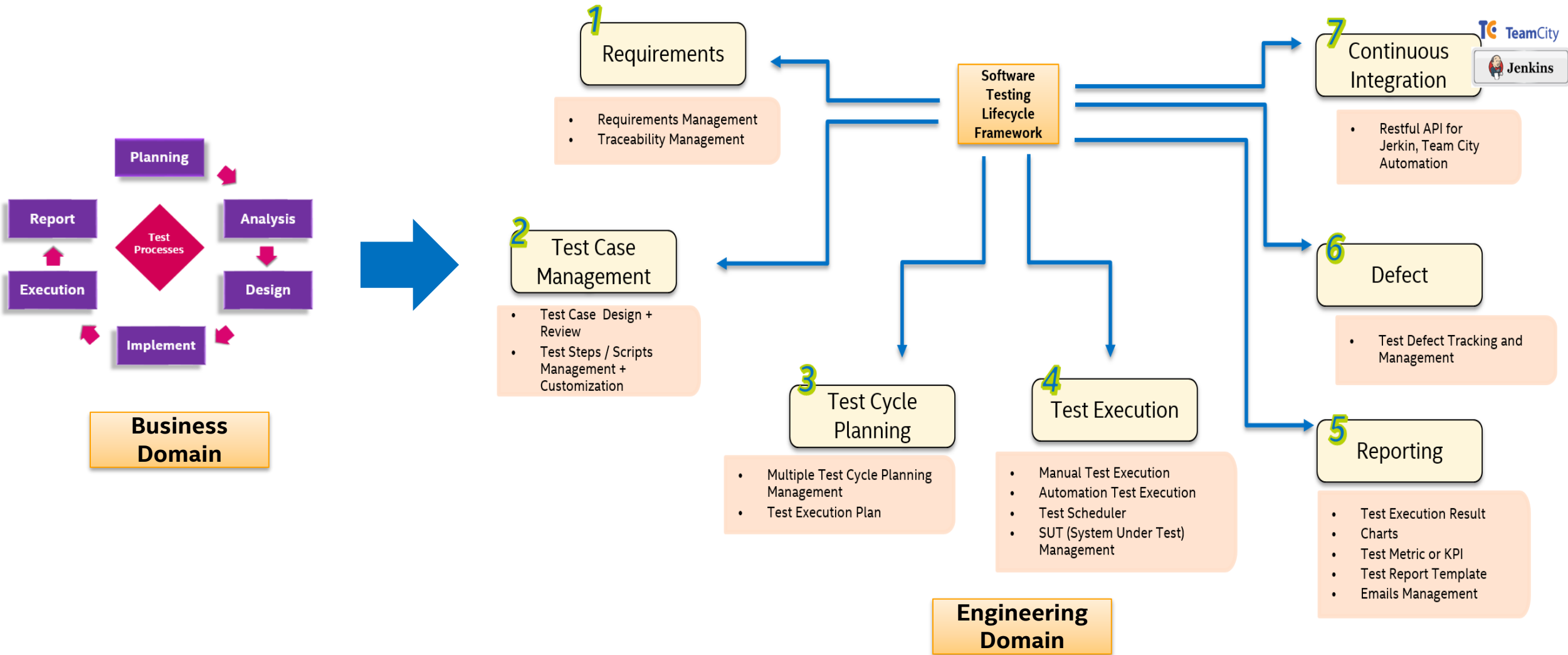


Software Testing + AI = Buzzword? Value Creation?



Source taken from <https://sdtimes.com/ai/whats-beyond-continuous-testing-ai/>

Software Testing Lifecycle Management Framework

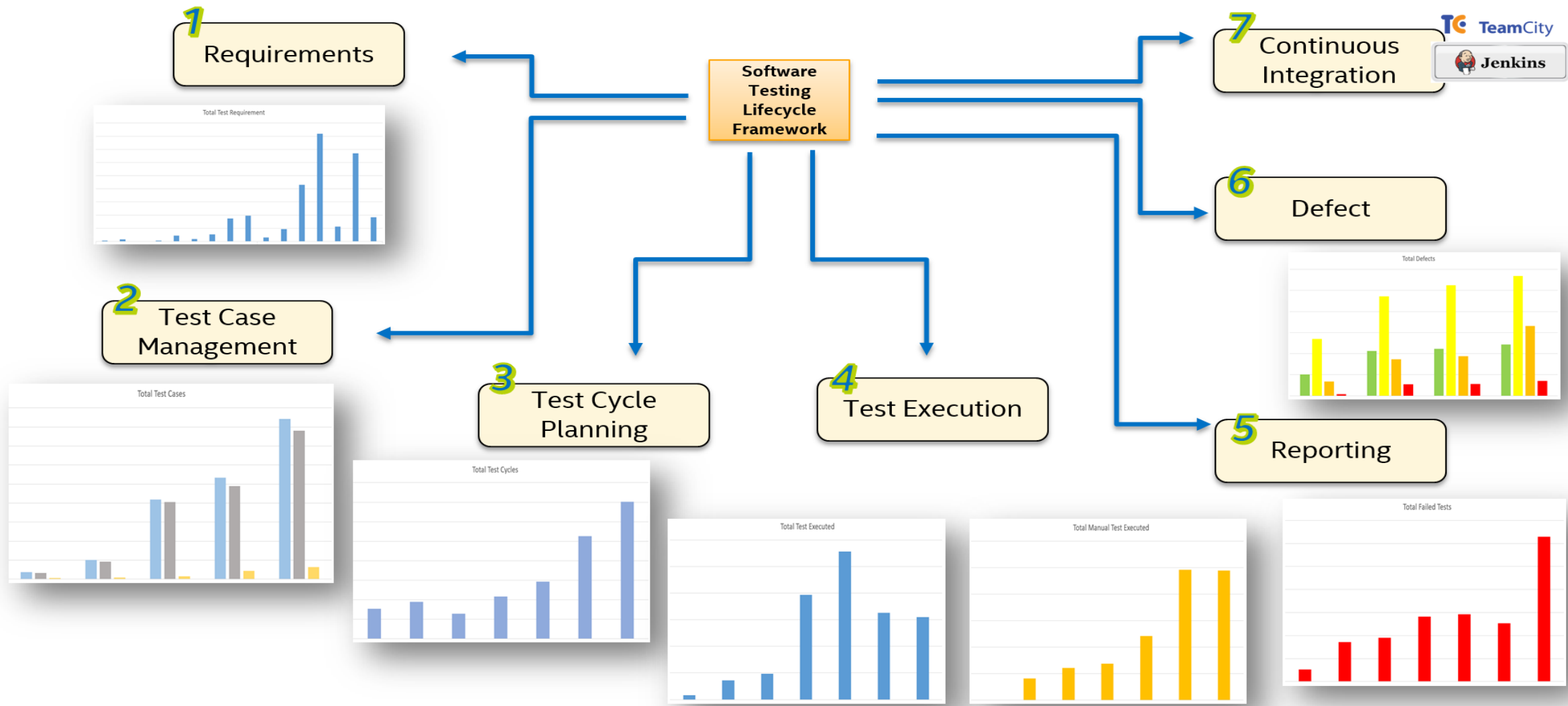


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Undiscovered Data is Everywhere..

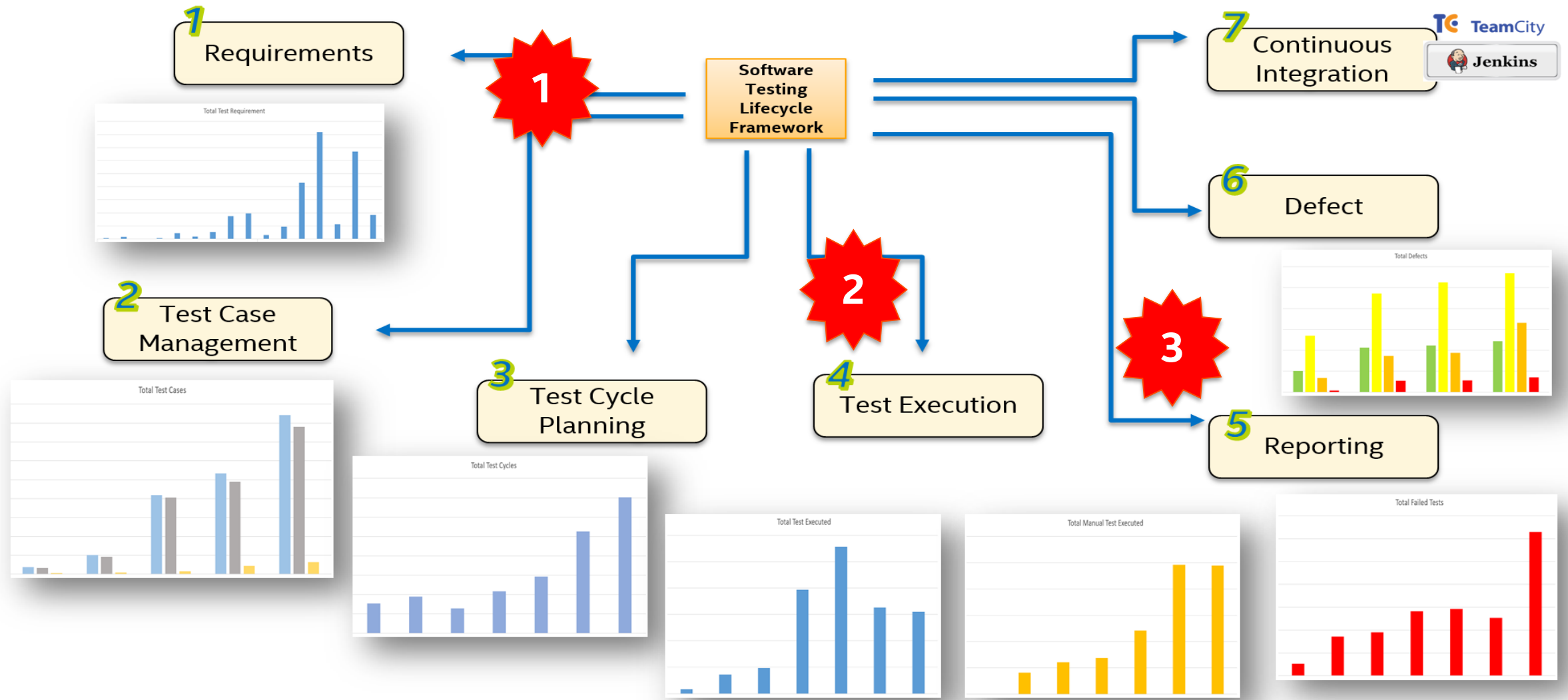


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Harnessing the Undiscovered Gold Mine



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AI based Applications for Software Testing

- Test Case Recommendation Engine
- Test Automation Recommendation Engine
- Test Failure Analytic Classification



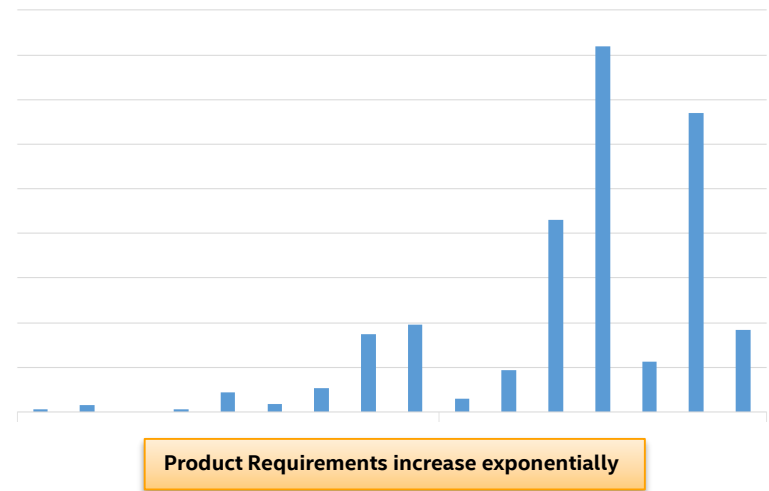
AI based Applications for Software Testing

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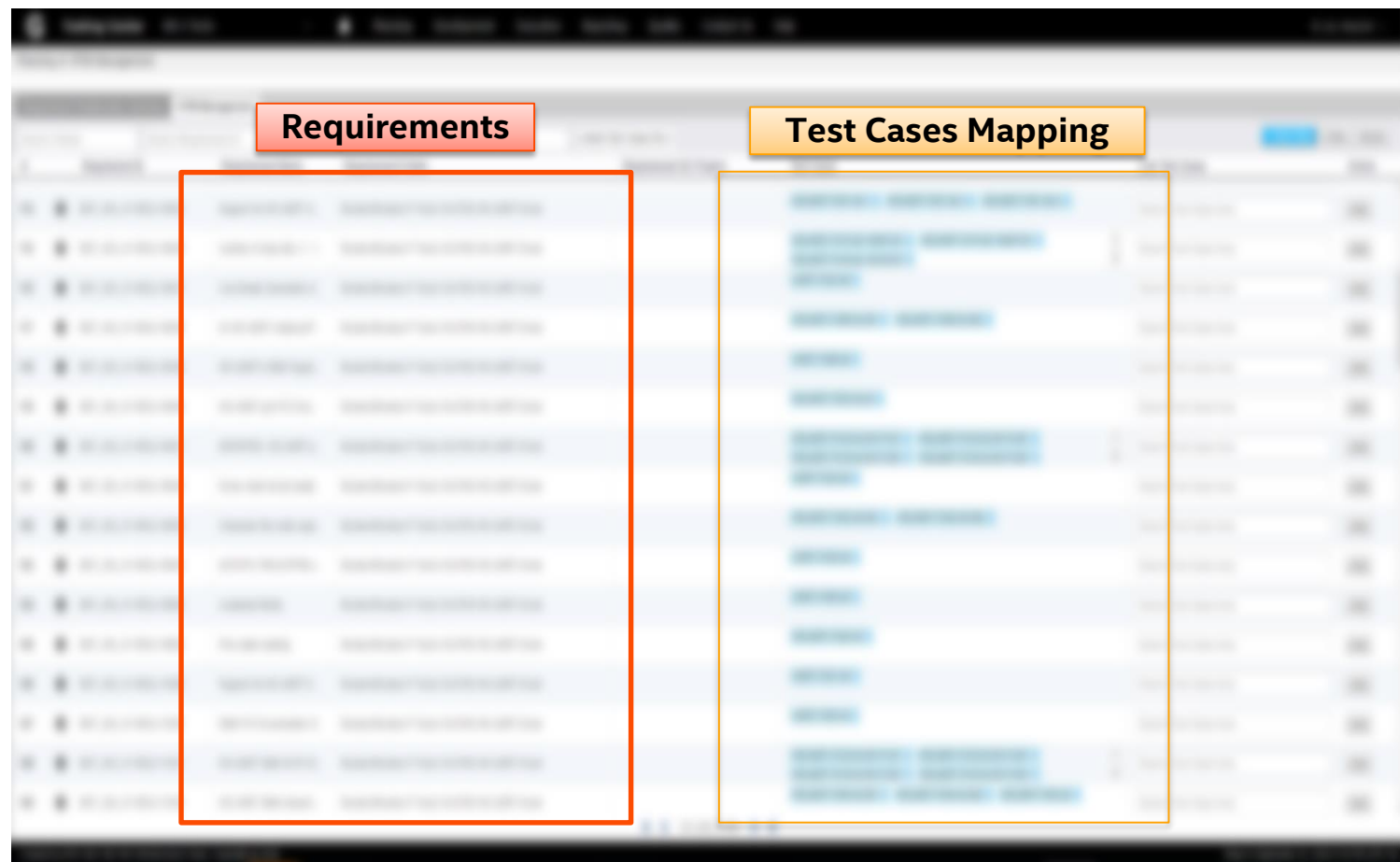
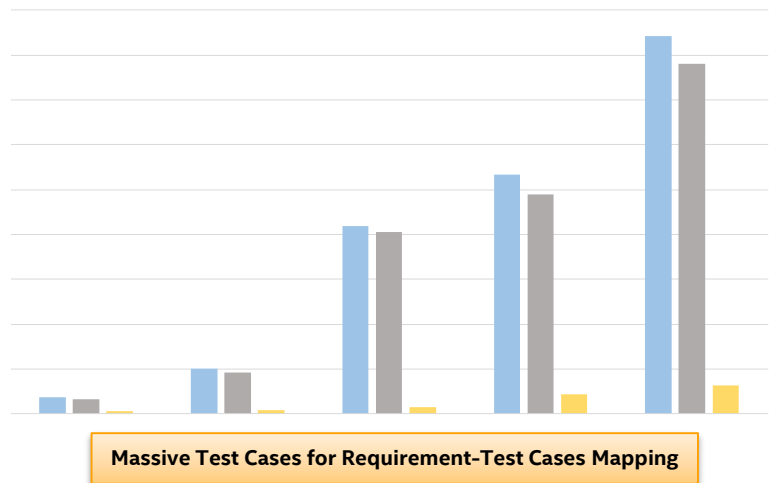


Conventional Requirement – Test Case Mapping

Total Test Requirement



Total Test Cases



Time and labor consuming for manual requirement analysis to test case mapping

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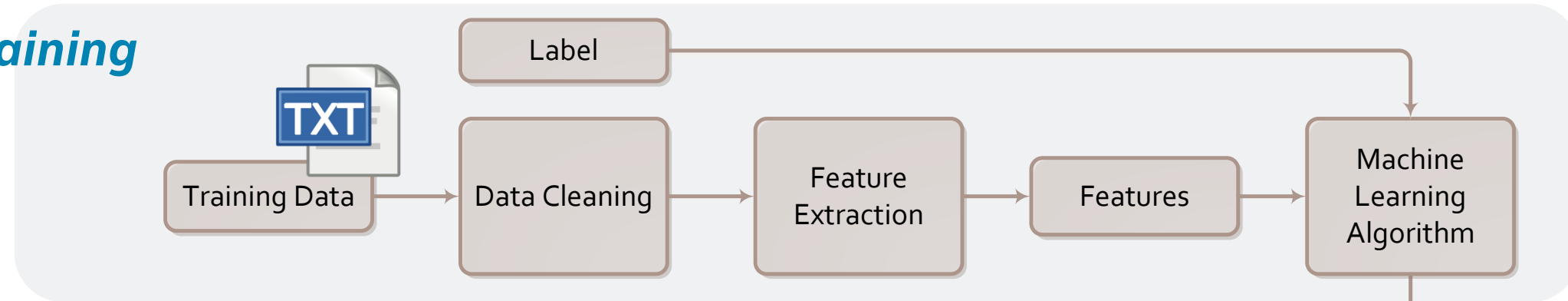
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A satellite with four solar panel arrays is shown in orbit above the Earth's surface. The Earth's curvature is visible at the top, and the satellite is positioned in the lower right quadrant. The solar panels are illuminated with a yellow glow.

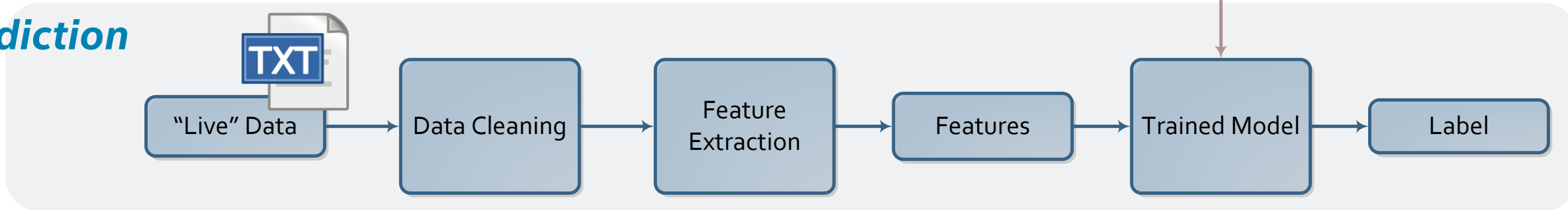
*What if there is a system that can
recommend relevant test cases
to the requirements...*

Text Analytics Pipeline

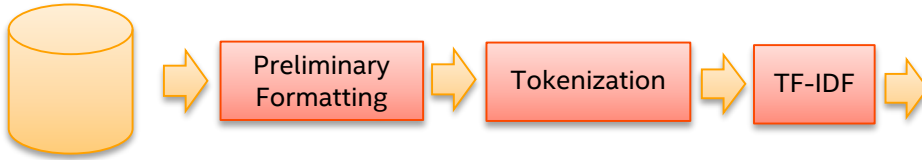
Training



Prediction



Test Case Recommendation System



Trained Model

Hash Table

Doc \ Hash Value	0	1	2	3	
0	0	0	0	0	● ● ● No. of docs
...	0	0	0	0	
"I2C Port"	23456	0.12312	0.12334	0	
34567	0	0.34353	0.23423	0	
"Port Speed"	45364	0.45645	0	0.34576	
56746	0	0.57456	0.9685	0	● ● ● Total: 0.896 0.678 0.556 0.435
"Speed Mode"	57746	0.23525	1.352	0.5564	
...					

16 million (hash size)



Query

E.G. I2C Port Speed Mode
 "I2C", "I2C Port", "Port", "Port Speed",
 "Speed", "Speed Mode", "Mode"



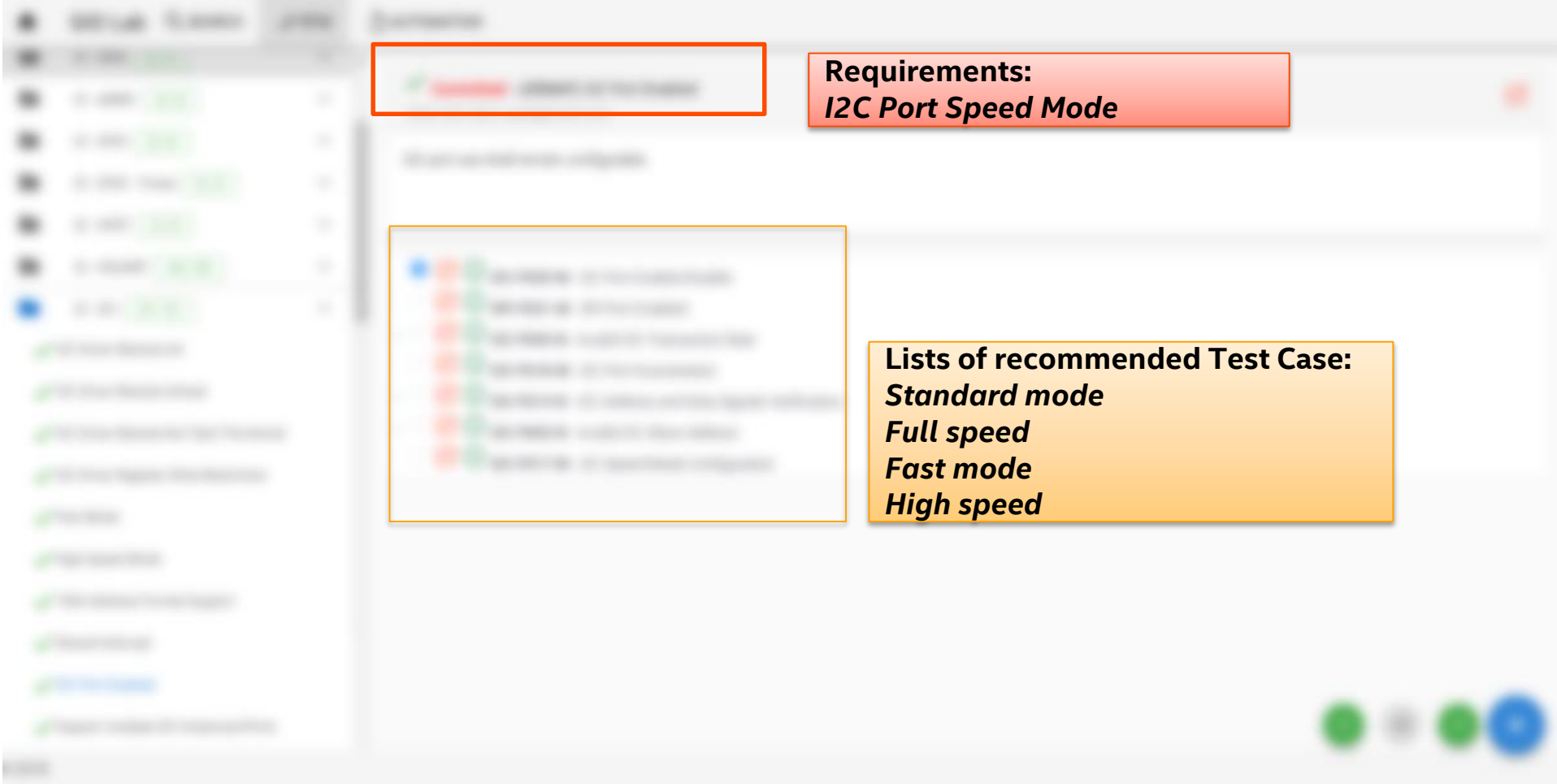
Hash Table

Hash Value	0 ...	23456	45364	57746	● ● ● 16 million (hash size)
-	0	0.34254	0.12345	0.67584	

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Test Case Recommendation System



AI based Applications for Software Testing

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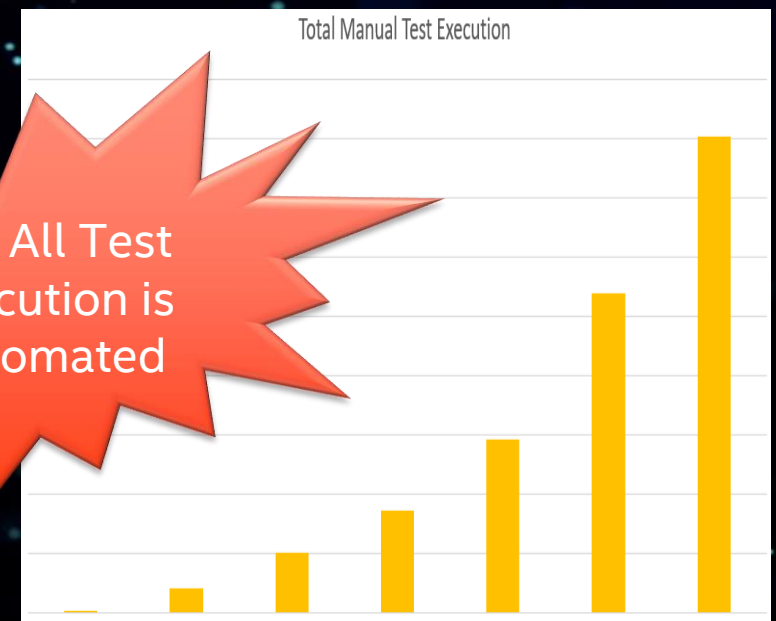


Test Automation – Ideal vs Realistic

Massive Test Execution

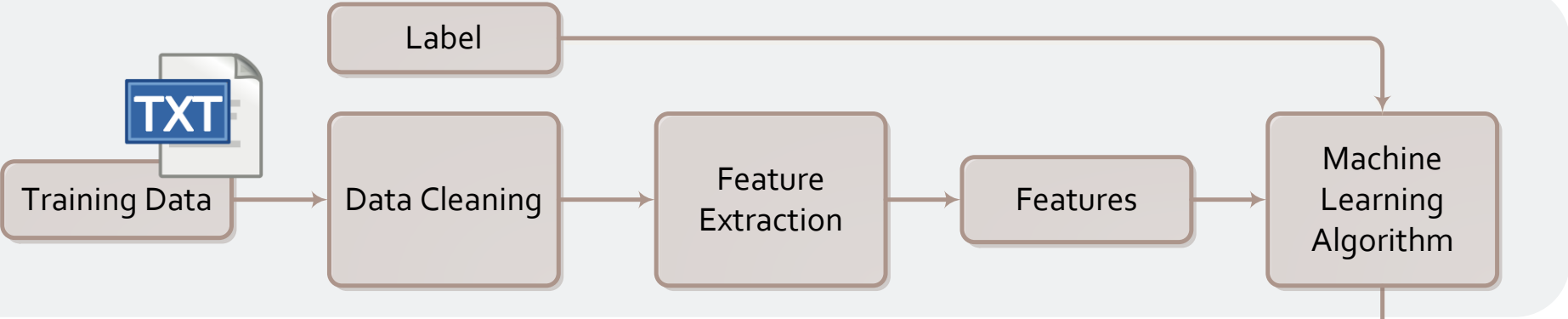


Not All Test Execution is Automated

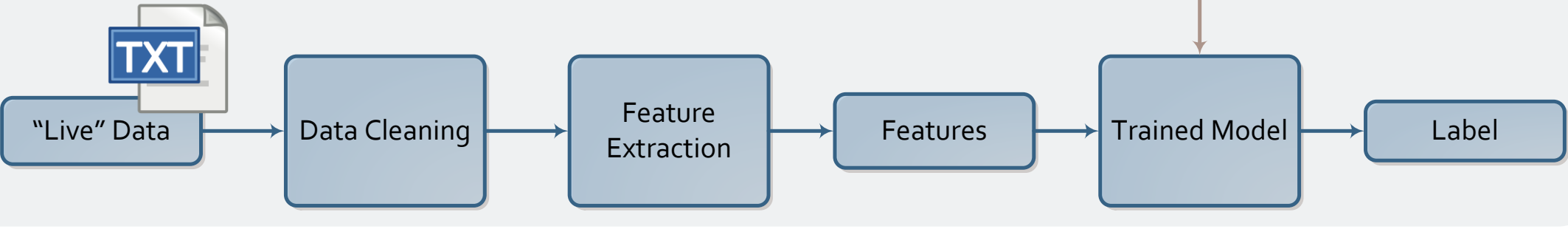


Text Analytics Pipeline

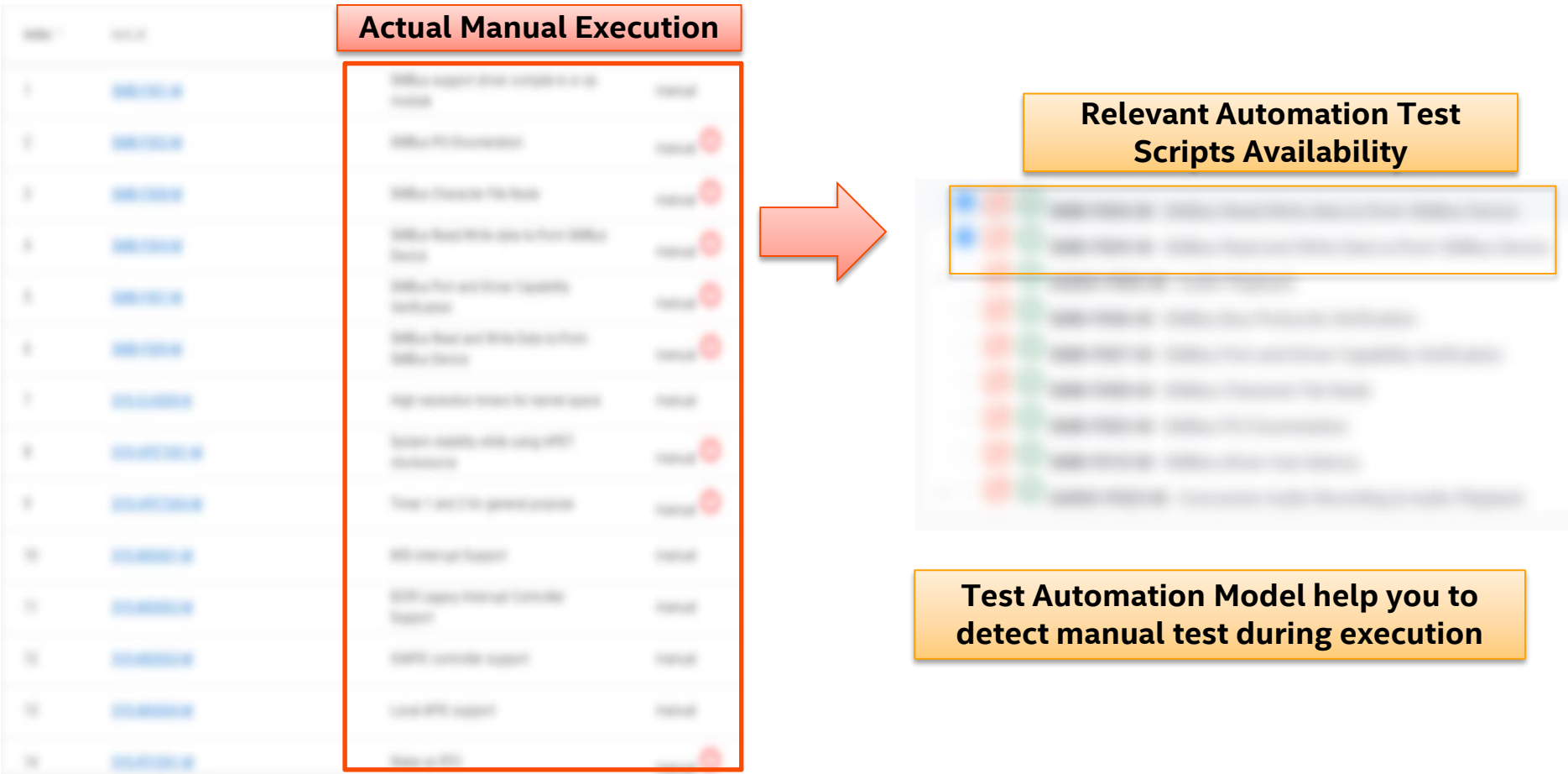
Training



Prediction



Test Automation Recommendation System



Test Code Recommendation System

How to reset USB port?

Rank	Answer
1	<pre>section::Reset USB port printf("Resetting USB device %s\n", filename); rc = ioctl(fd, USBDEVFS_RESET, 0); if (rc < 0) { perror("Error in ioctl"); return 1; } printf("Reset successful\n");</pre>

How to get input from command line?

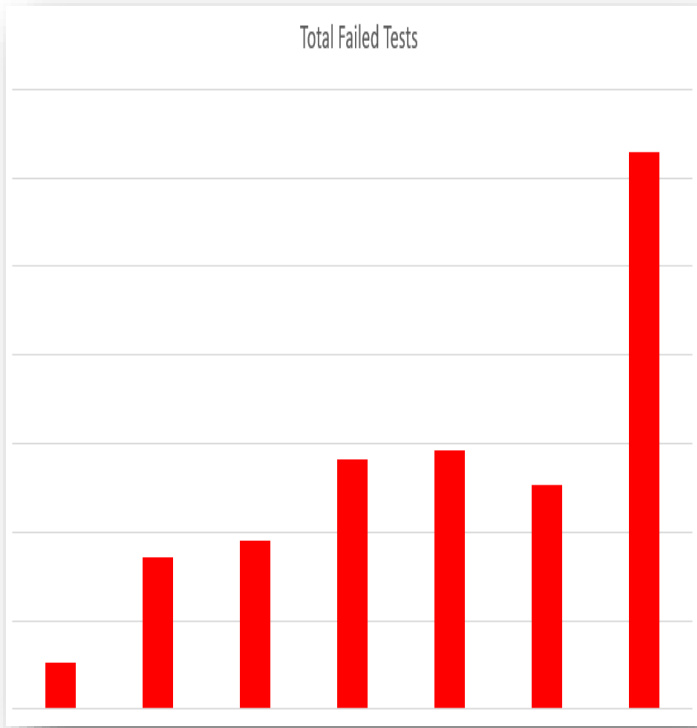
Rank	Answer
1	<pre>section::Get input from command line if (argc != 2) { fprintf(stderr, "Usage: usbreset device-filename\n"); return 1; } filename = argv[1];</pre>

AI based Applications for Software Testing

- Test Case Recommendation Engine
- Test Automation Recommendation Engine
- Test Failure Analytic Classification



Test Failure Analytic



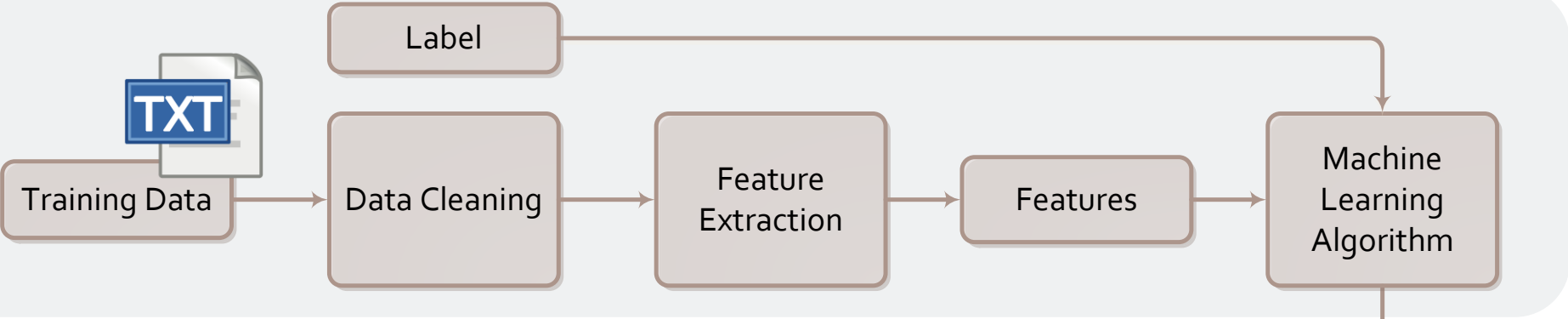
x% of number of total test execution

```
...
\nIntel Conformance failed.\nTotal Passed : 0\nTotal Failed : 1
...
```

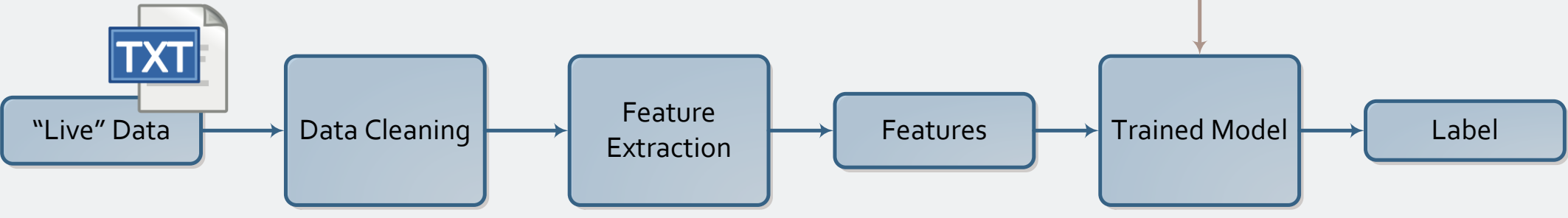
```
...
\n\nCaught connection error while connecting to 172.30.249.86\n\n
...
```


Text Analytics Pipeline

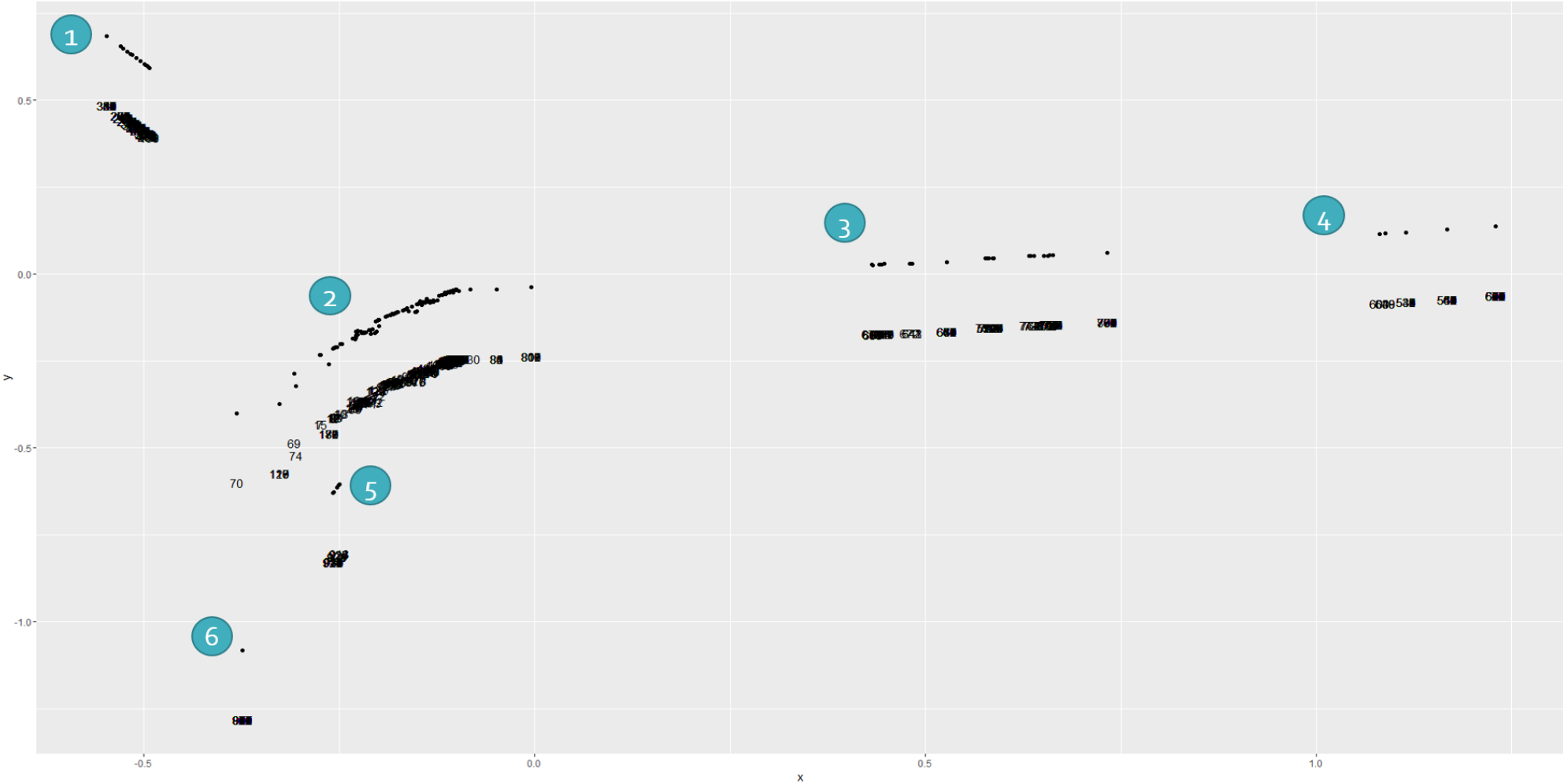
Training



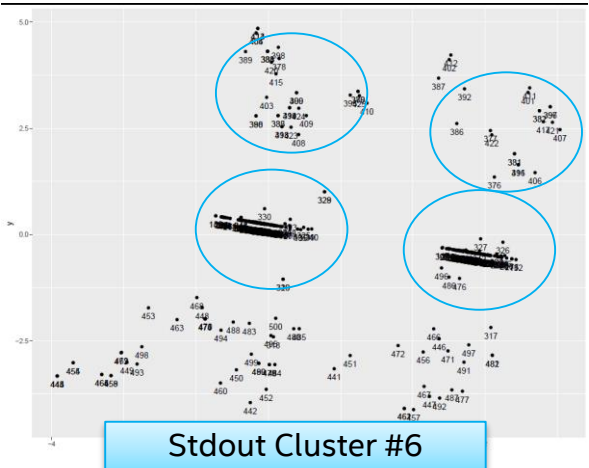
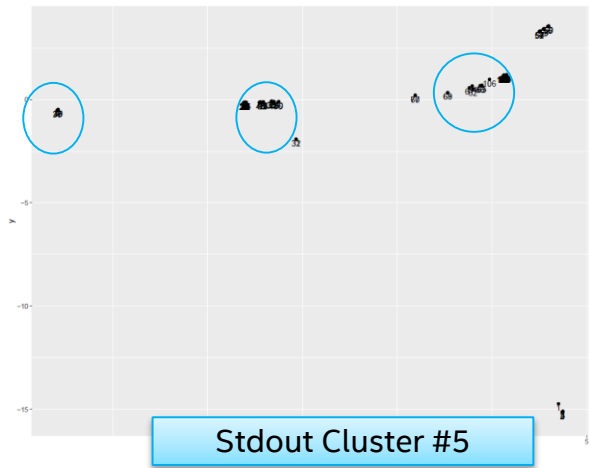
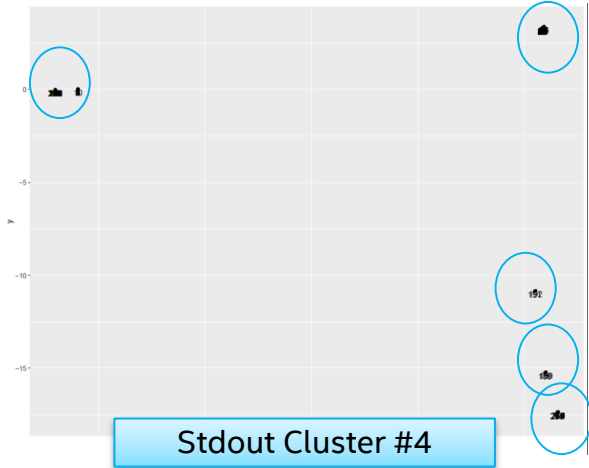
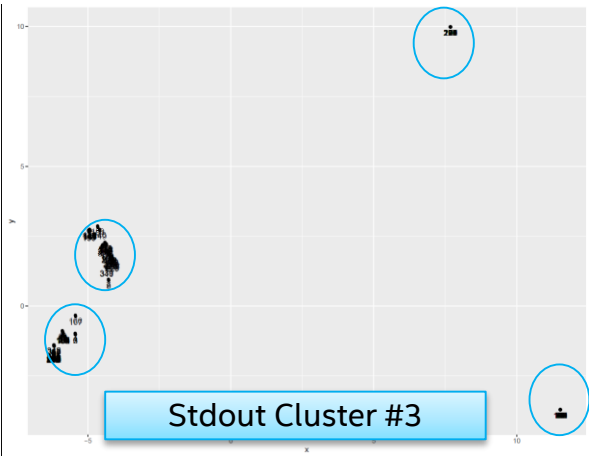
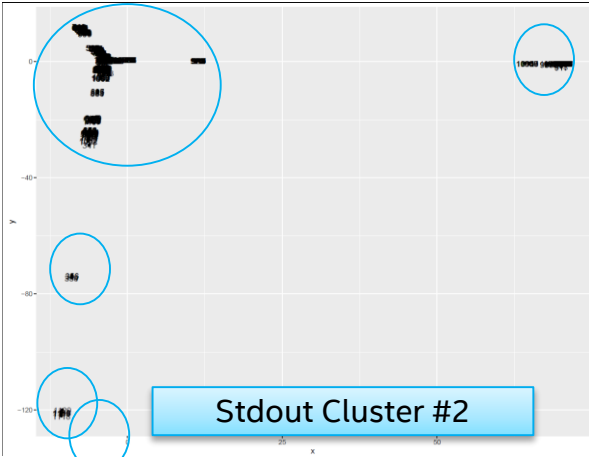
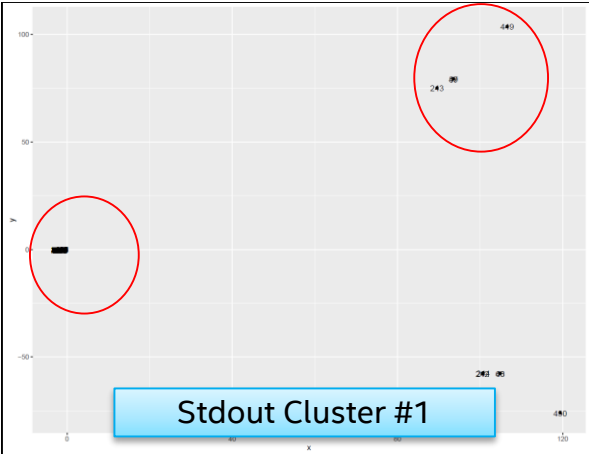
Prediction



Visualization (Test Component Failure)



Visualization (Test Failure Reason)



Recap

Opportunities:

- Harness the valuable insights from the testing life cycle and convert into actionable engineering decision

Challenges:

- Data Engineering is the key to perform qualitative data analysis



