IDUG

Using AI/ML to Enhance Db2 Subsystem and Application Performance

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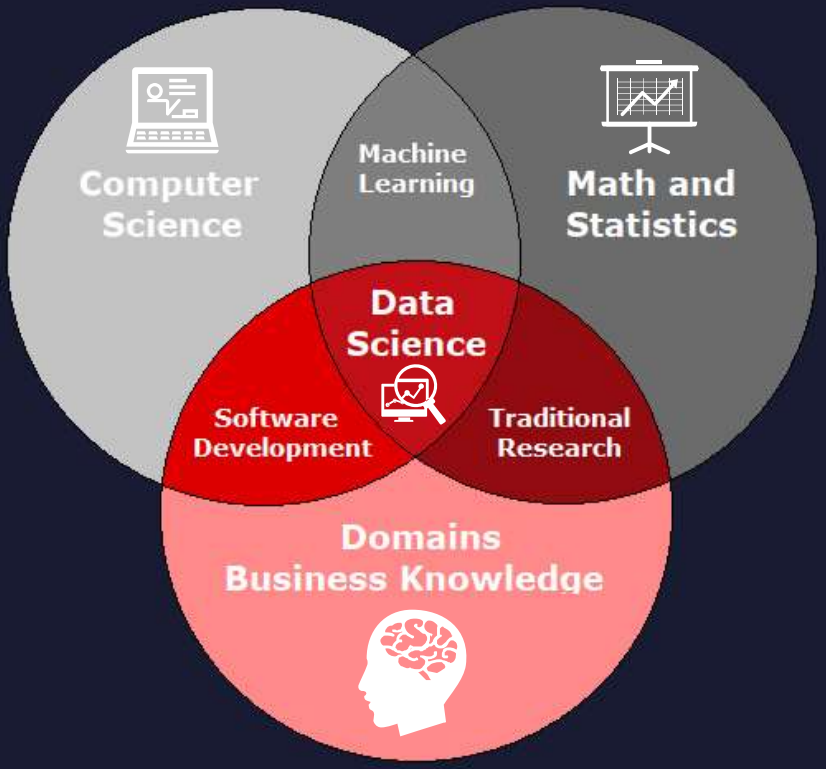
Broadcom

Session Code: DI3 SESS-157 | Platform: z/OS

Agenda

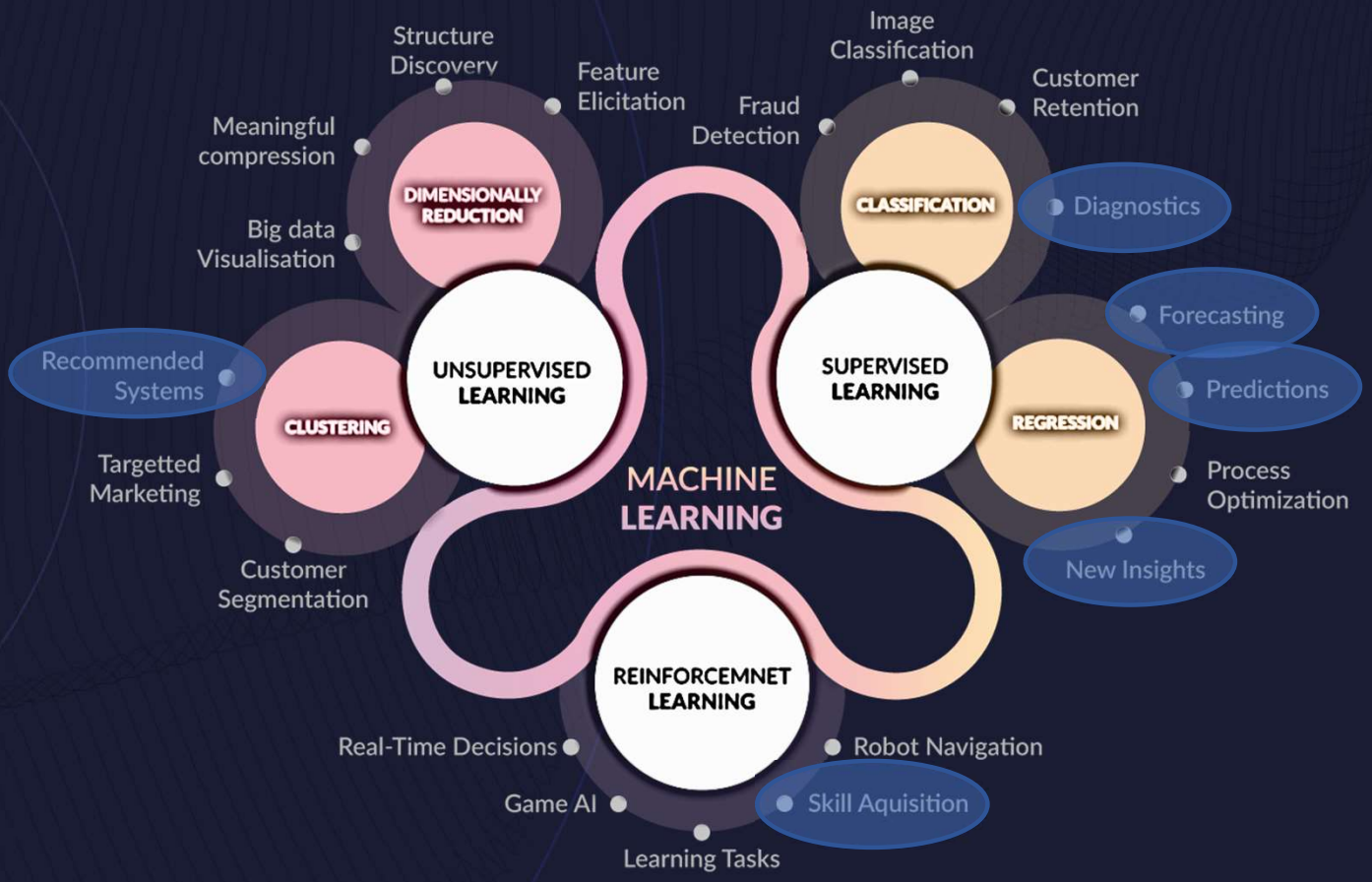
- **Machine Learning** Concepts
- Applied Machine Learning to **enhance Db2 Performance**
- Costumer **Use Cases**
  - What makes a Business Application?
  - High CPU usage on Db2 DIST
  - Db2 Package and Plan performance investigation
  - Use Case #3
  - Use Case #4
  - Use Case #5

Machine Learning



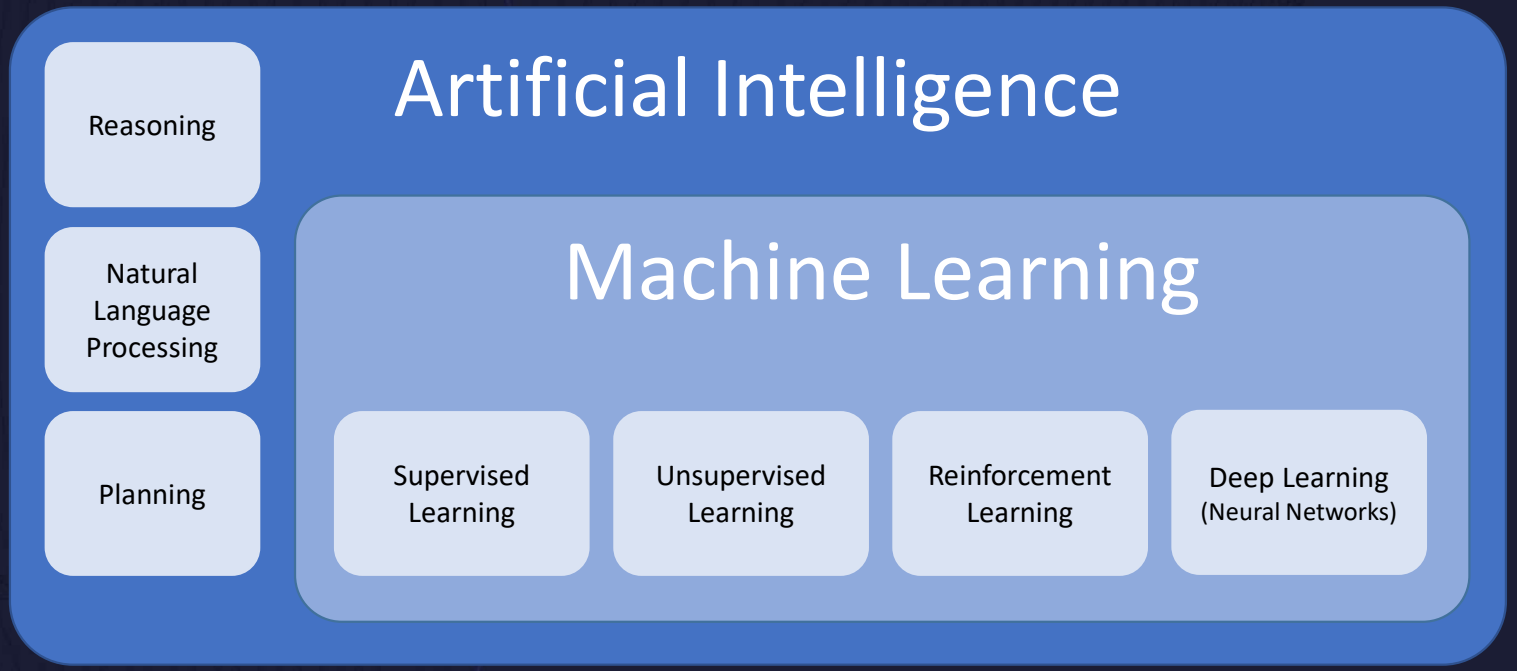
(1) https://towardsdatascience.com/introduction-to-statistics-e9d72d818745

Machine Learning



(1) https://towardsdatascience.com/coding-deep-learning-for-beginners-types-of-machine-learning-b9e651e1ed9d

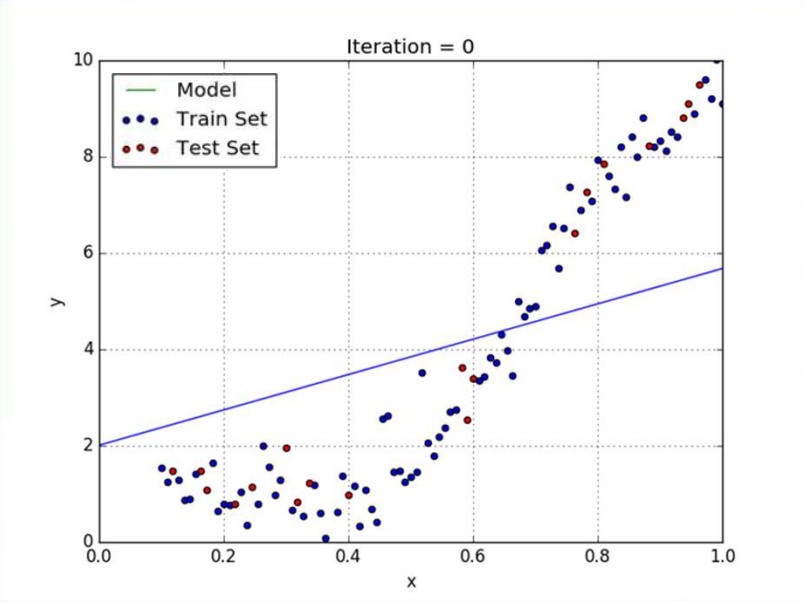
Machine Learning and Artificial Intelligence



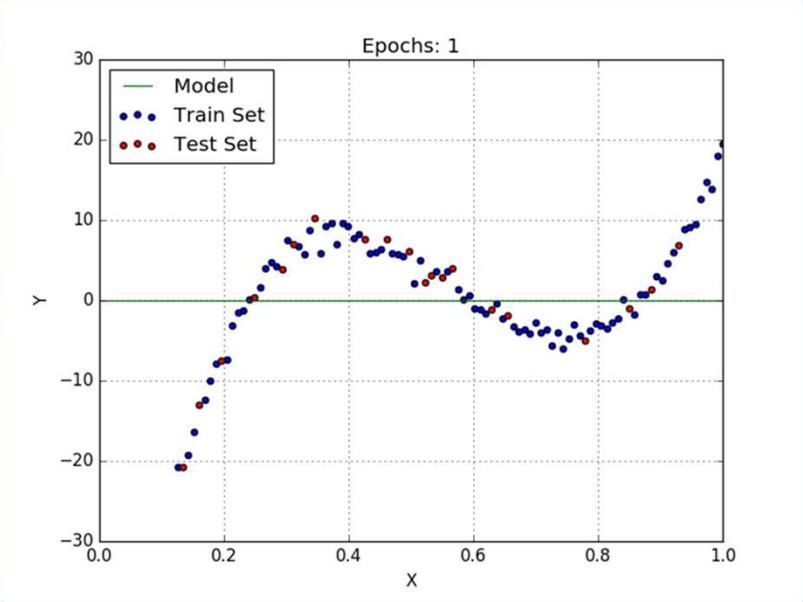
(1) https://www.ibm.com/downloads/cas/GB8ZMQZ3

Supervised Learning

Linear Regression



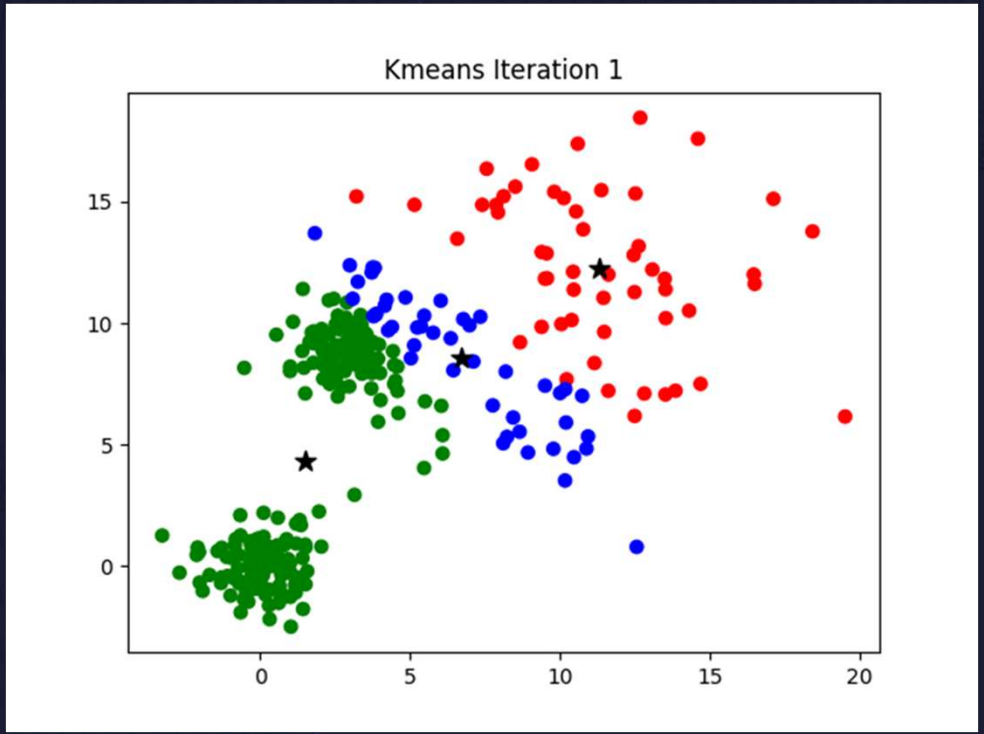
Logistic Regression



(1) https://medium.com/analytics-vidhya/simple-linear-regression-cost-function-gradient-descent-50c5ed085770
(2) https://medium.com/@vaibhavnohria36/coming-up-logistic-regression-for-you-23a3134a4d7e

Unsupervised Learning

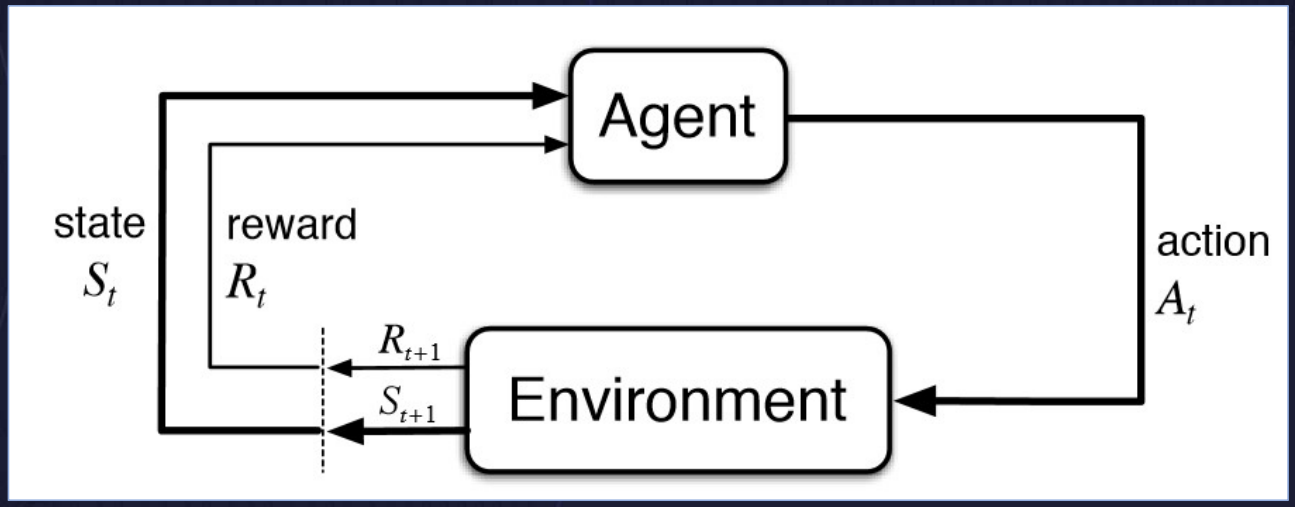
K-means Clustering



(1) https://medium.com/@imparth/k-means-clustering-algorithm-34807a7cec71

Reinforcement Learning

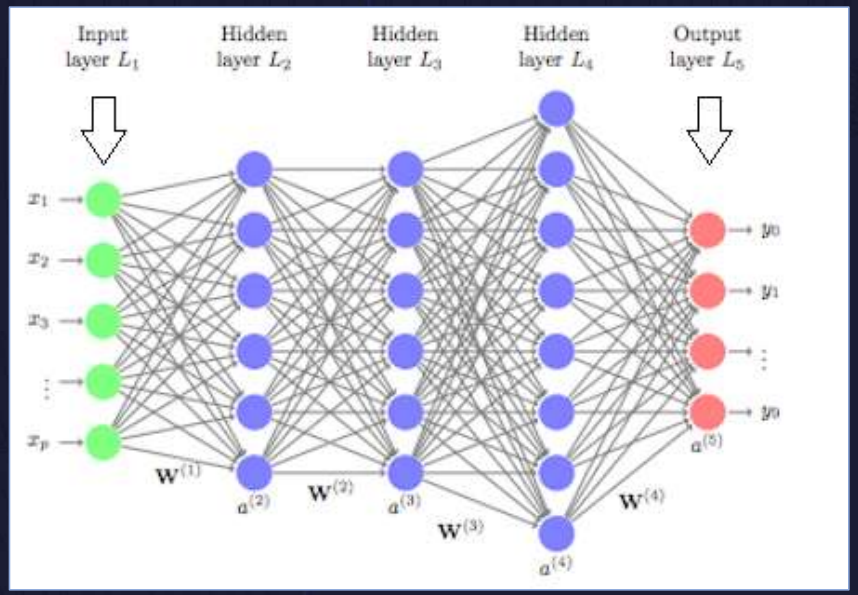
Generic Reinforcement Learning Model



(1) https://towardsdatascience.com/reinforcement-learning-101-e24b50e1d292

Deep Learning

Artificial Neural Network



(1) https://vishalyadav831874.medium.com/industry-use-cases-of-neural-network-cccc4b333621

Time Series Analysis

Time Series Data

For example: Db2 performance metrics, such as QBSTGET - Total number of GETPAGE requests at every 5 seconds, for a particular application, throughout the week.

(1) https://towardsdatascience.com/the-complete-guide-to-time-series-analysis-and-forecasting-70d476bfe775

Anomaly Detection

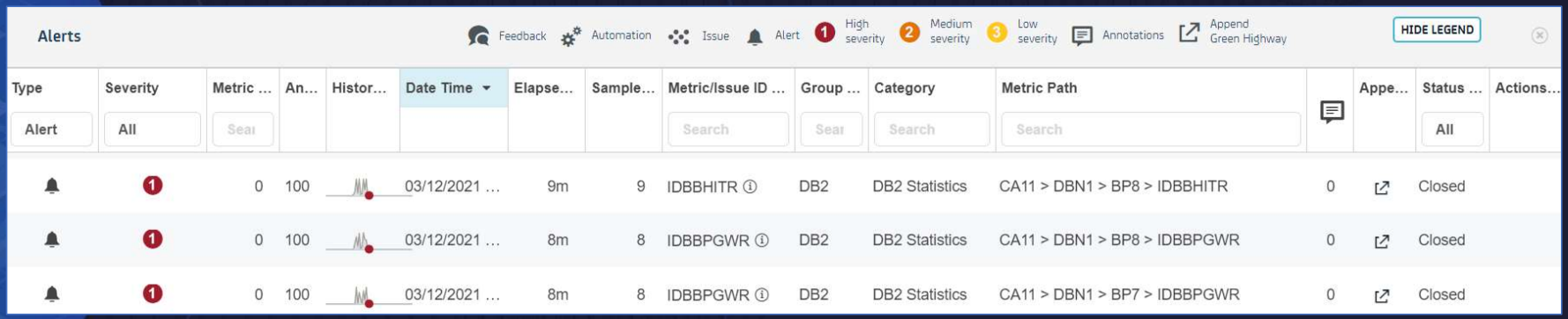
Detecting an Anomaly

For example: Db2 performance metrics, such as QBSTGET - Total number of GETPAGE requests at every 5 seconds, for a particular application, throughout the week.

(1) https://towardsdatascience.com/real-time-time-series-anomaly-detection-981cf1e1ca13

Pattern Discovery

Discovering Patterns



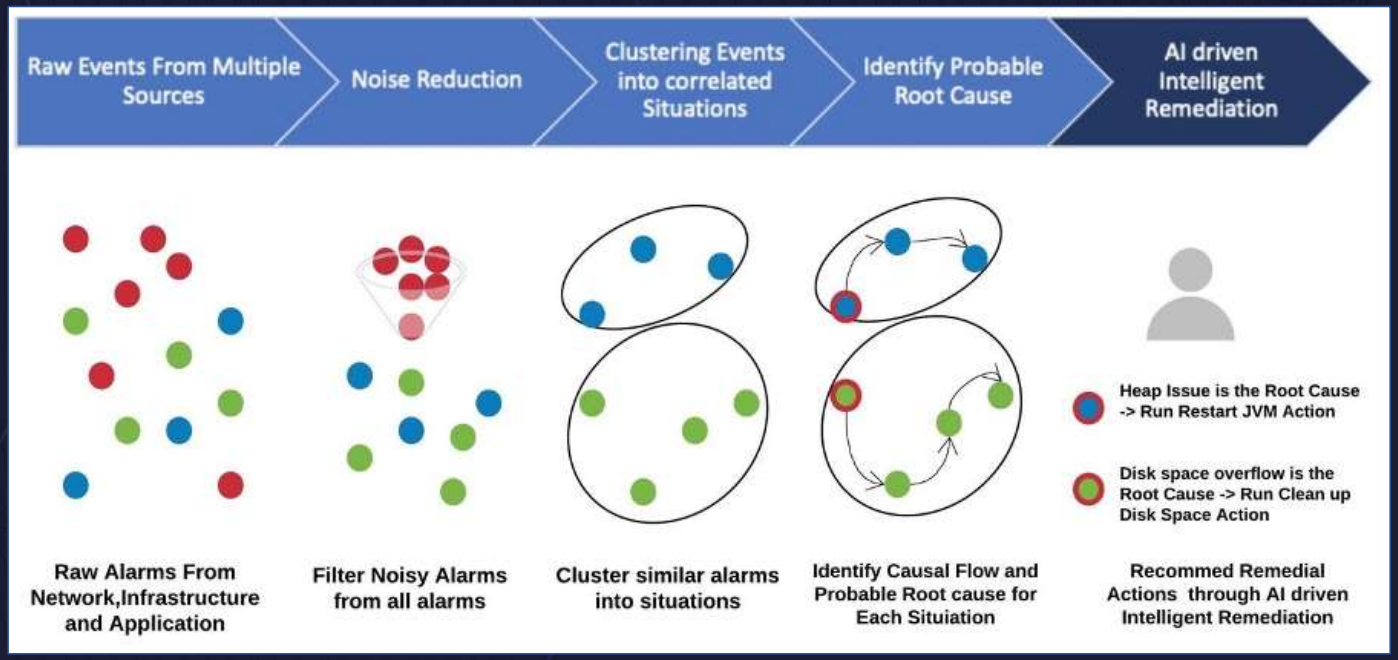
Type	Severity	Metric ...	An...	Histor...	Date Time	Elapse...	Sample...	Metric/Issue ID ...	Group ...	Category	Metric Path		Appe...	Status ...	Actions...
Alert	All	Sear						Search	Sear	Search	Search			All	
	1	0	100		03/12/2021 ...	9m	9	IDBBHITR	DB2	DB2 Statistics	CA11 > DBN1 > BP8 > IDBBHITR	0		Closed	
	1	0	100		03/12/2021 ...	8m	8	IDBBPGWR	DB2	DB2 Statistics	CA11 > DBN1 > BP8 > IDBBPGWR	0		Closed	
	1	0	100		03/12/2021 ...	8m	8	IDBBPGWR	DB2	DB2 Statistics	CA11 > DBN1 > BP7 > IDBBPGWR	0		Closed	

Pattern recognition is the process which can detect different categories and get information about particular data, predicting a label of an observation, such as: high, medium and low.

(1) https://medium.com/edureka/pattern-recognition-5e2d30ab68b9

Root Cause Analysis

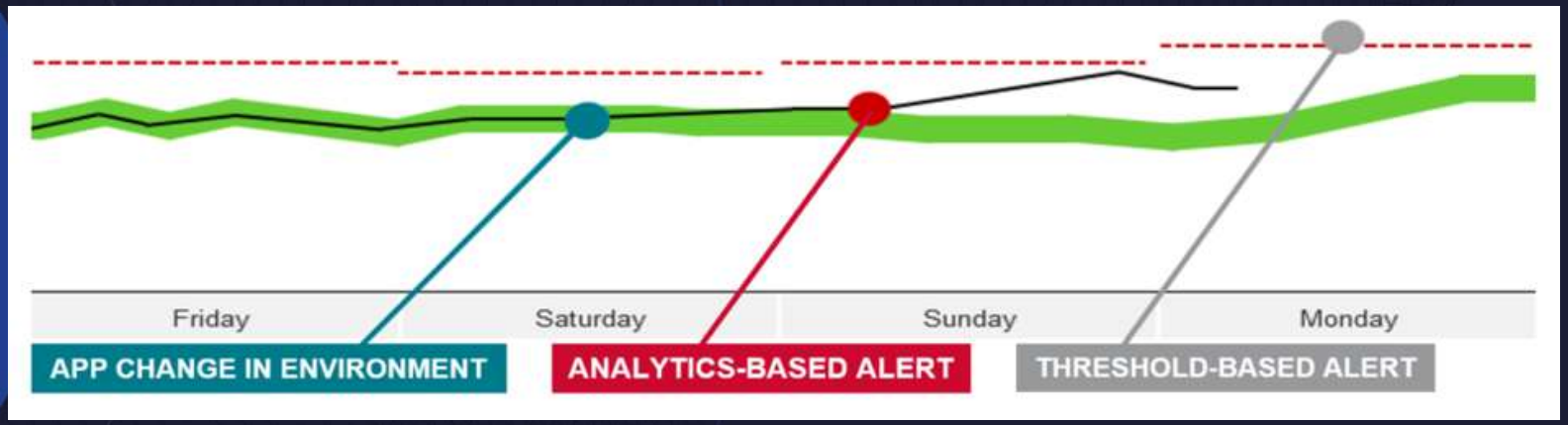
Steps to Root Cause Analysis



(1) https://towardsdatascience.com/how-to-conduct-a-proper-root-cause-analysis-789b9847f84b
(2) https://www.broadcom.cn/aiops-blog/reduce-toil-with-AI-driven-intelligent-remediation

Dynamic and Adaptive Alerting (1|2)

***ssid*DIST DB2 CPU Utilization**



Analytics-Based Alerts detect signal from noise

- Subtler than "**human-observed**"
- Subtler than **static thresholds** which may be the "**last defense**"

Dynamic and Adaptive Alerting (2|2)

Green Highway

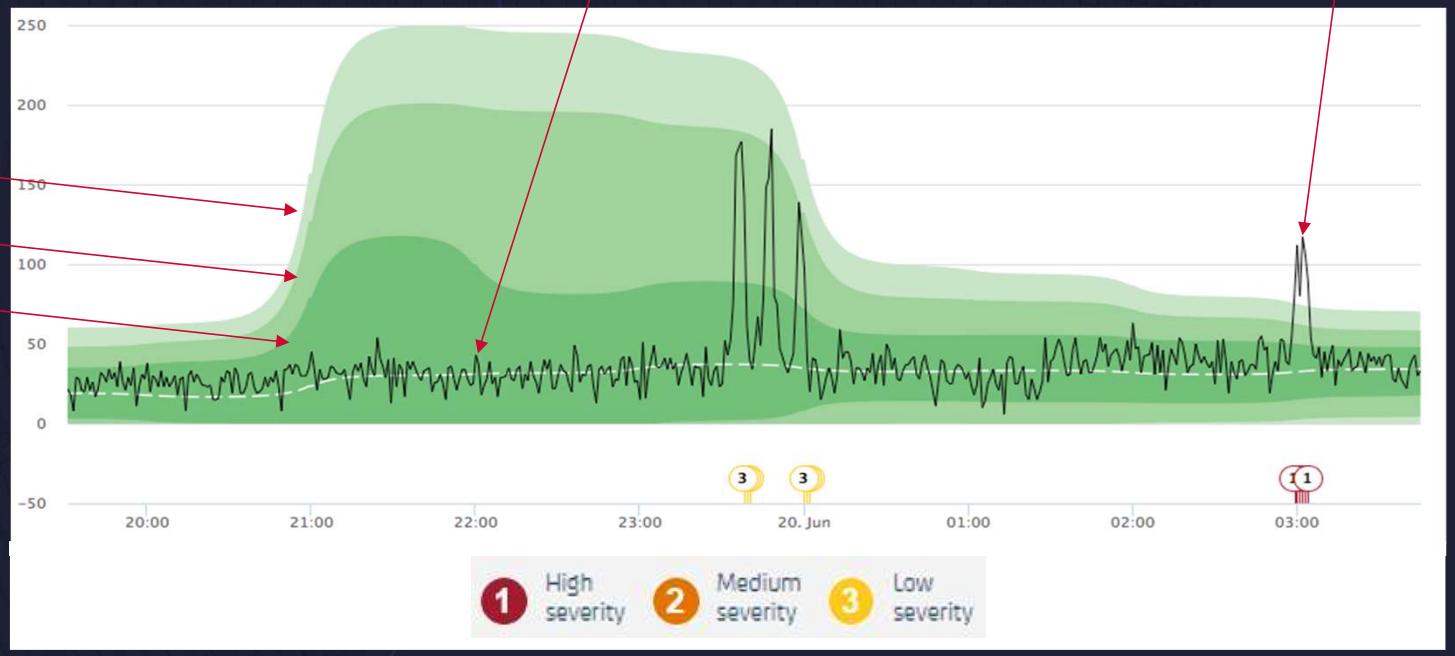
Outside the Bands =
Anomaly / Possible Alert

Metric Values

Rare Band

Probable Band

Common Band



APPLIED MACHINE LEARNING TO ENHANCE DB2 PERFORMANCE

CUSTOMER USE CASES

What makes a Business Application?

Web and Mobile apps

- Distributed App
- Middleware
  - MQ
  - WAS
- Package DISTSERV
- Dynamic SQL Statements
- Tables/Indexes
  - Other DB2 objects

CICS Transaction

- Transaction ID
- Program
- Plan
- Package
- SQL Statements
- Tables/Indexes
  - Other DB2 objects

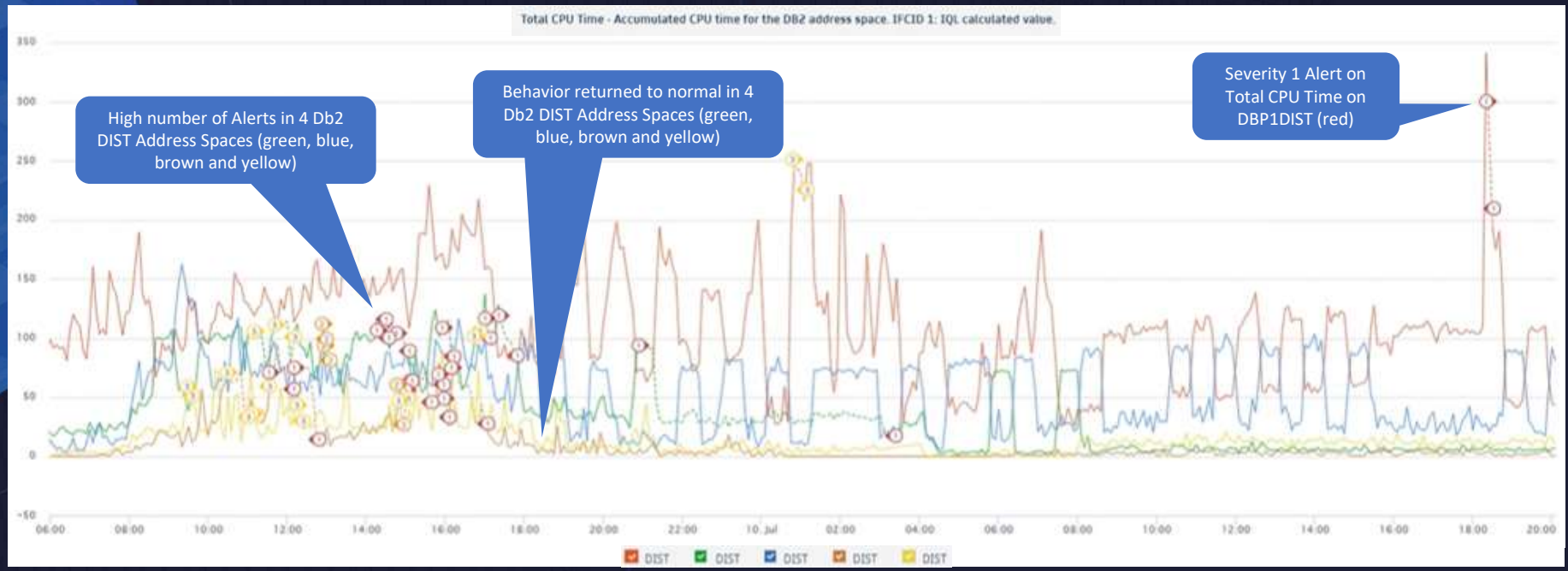
Batch Job

- Program
- Plan
- Package
- SQL Statements
- Tables/Indexes
  - Other DB2 objects

HIGH CPU USAGE ON DB2 DIST

High CPU usage on Db2 ssidDIST tasks (1|5)

- 5 Production LPARs and 5 Production Db2 Subsystems
- Accumulated CPU time for the Db2 **DIST**ributed Address Space



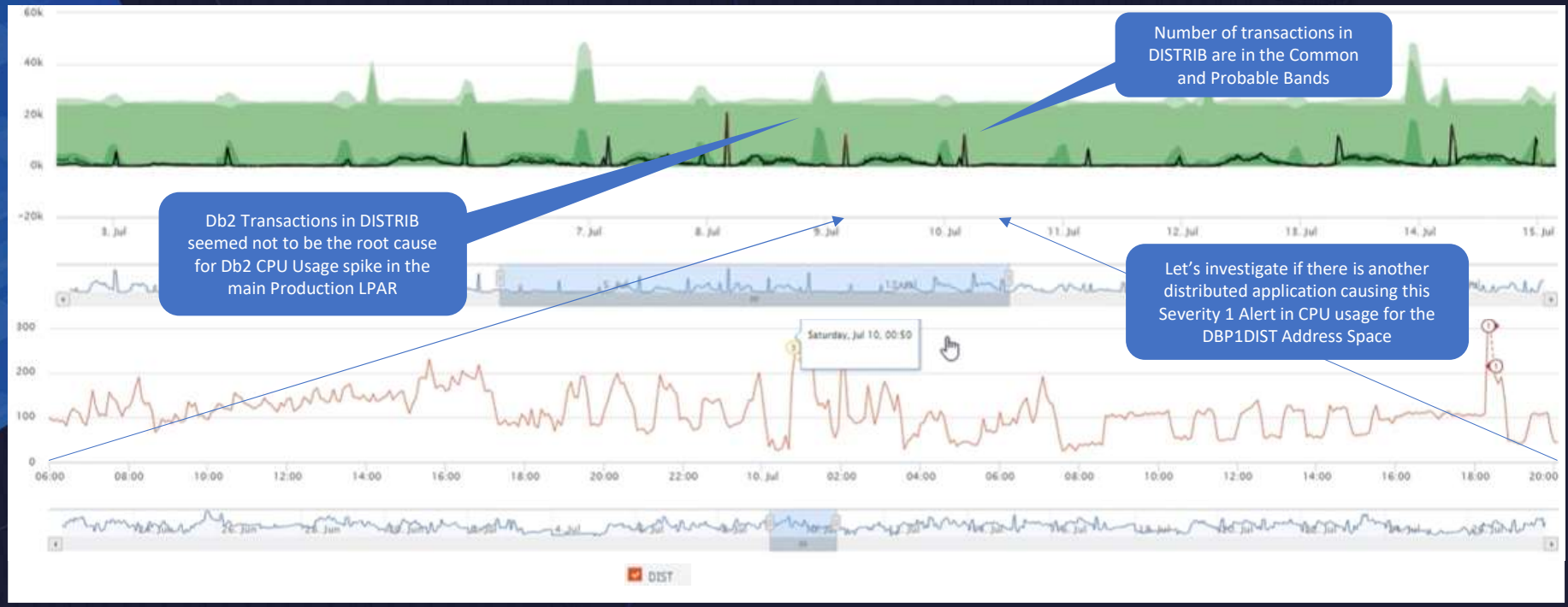
High CPU usage on Db2 ssidDIST tasks (2|5)

- Zooming in a particular LPAR and Db2 Subsystem
- Accumulated CPU time for the Db2 **DIST**ributed Address Space

Severity	Metric Value	Date	Time	Elapsed Time	Samples	Metric	Metric Path	Status
1	3.078766	07/10/21	18:29	6m	6	IDBDCPUT	S1P1 > **DBP1**> DIST > IDBDCPUT	Closed
3	1.513442	07/10/21	1:06	16m	16	IDBDCPUT	S1P1 > **DBP1**> DIST > IDBDCPUT	Closed

High CPU usage on Db2 ssidDIST tasks (3|5)

- Investigate if there was an increase in Number of Transaction for this connection type



High CPU usage on Db2 ssidDIST tasks (4|5)

- Investigate if there was another distributed application causing this Severity 1 Alert

Severity	Metric Value	Date	Time	Elapsed Time	Samples	Metric	Metric Path	Status
1	13915648	07/23/21	11:02	14d 23h 0m	21541	JOBRSTG	S1P1 > W8S161AA > JOBRSTG	Open

High CPU usage on Db2 ssidDIST tasks (5|5)

- Investigate if there was another distributed application causing this Severity 1 Alert

Severity	Metric Value	Date	Time	Elapsed Time	Samples	Metric	Metric Path	Status
1	13915648	07/23/21	11:02	14d 23h 0m	21541	JOBRSTG	S1P1 > **W8S161AA** > JOBRSTG	Open

DB2 PACKAGE AND PLAN PERFORMANCE INVESTIGATION

Db2 Package and Plan CPU usage issue

- Analyze the Total CPU Time spent executing a particular PLAN and PACKAGE

Severity	Metric Value	Date	Time	Elapsed Time	Samples	Metric	Metric Path	Status
1	0.721046	08/25/21	17:00	2h 0m	2	DB2_CPU_PKGE	MSTRSVW > D121 > MARBLES > DB2_CPU_PKGE	Closed
1	0.000362	08/25/21	15:00	2h 0m	2	DB2_CPU_AVG_PKGE	MSTRSVW > D121 > MARBLES > DB2_CPU_AVG_PKGE	Closed

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Session Code: **DI3 SESS-157**

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  - Main bullets have 26pt size
  - This bullet text has 22pt size
- Use no more than five to six main bullet points on a slide
- If needed, split your topics up to two or more slides
- Try to stay in the 40-50 slides limit to have time for questions

Usage of this slide deck template (2|3)

- Use Shift Enter to manually break a line
  and to keep text to the same bullet point over multiple lines
- If multiple slides have the same title, use (x|y) to number them
- For Consultants and User Speakers:
  - You may fill in your company's logo in the upper right corner of the first slide, as long as it is not bigger than the IDUG logo.

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- Optional: Put your speaker biography in the notes of the final slide

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Sample content slide

- First Topic
- Second Topic
  - Sub-Topic A
    - Secondary Sub-Topic 1
    - Secondary Sub-Topic 2
  - Sub-Topic B
  - Sub-Topic C
- Third Topic
- Fourth Topic