# ESX

## ELECTRONIC SECURITY EXPO

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# Rise of the Machine – When and How to Leverage Artificial Intelligence

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**1** Answer 5 Questions About This Session

**2** Gain access to the PPT Slides

**3** Be Entered to Win a $100 Gift Card

3 GIFT CARDS ($100 EACH) AVAILABLE FOR SURVEY RESPONDENT RAFFLES.

**WINNERS WILL BE NOTIFIED THROUGH THE ESX APP**

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## COURSE OBJECTIVES

- **Define AI, machine learning and deep learning**

- **Identify real world applications for your customers today**

- **Discuss the challenges and opportunities these technologies bring**

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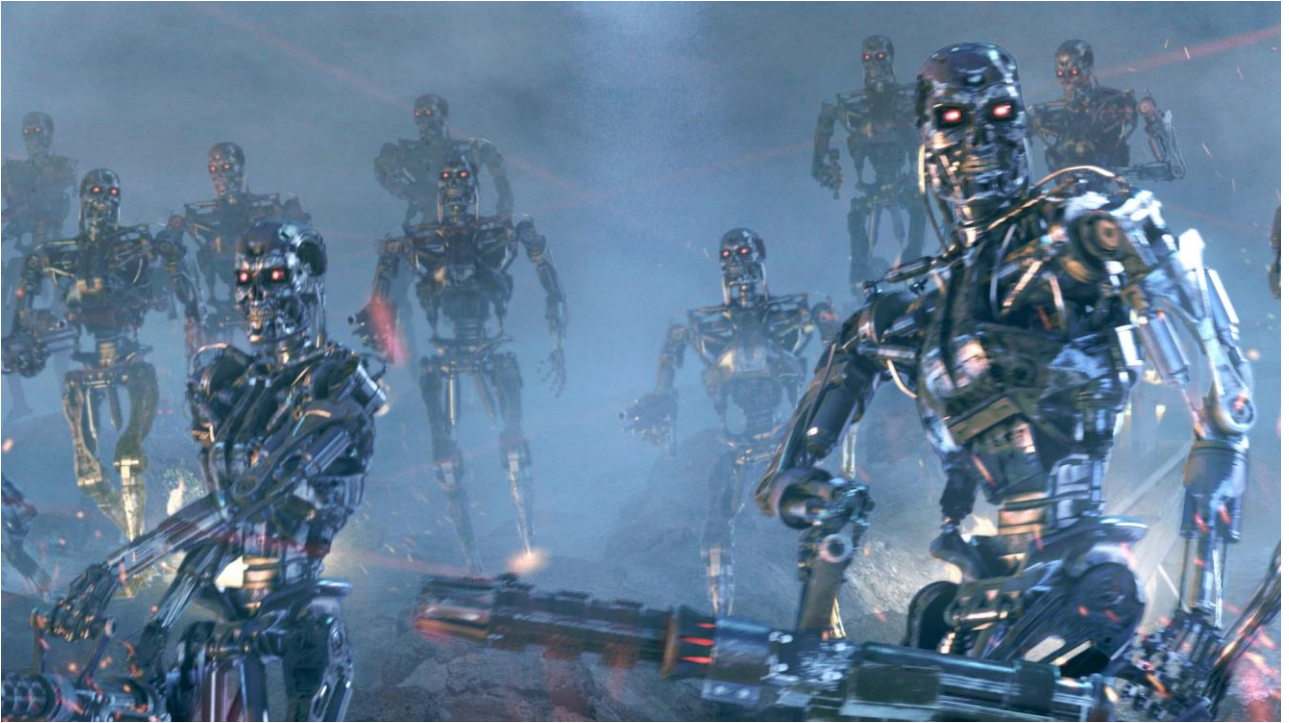5

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## MEET THE SPEAKERS

**Abe Kinney**
**Sr. Director, Product Management**
**Alarm.com**

**Charlie Erikson**
**CTO**
**Stanley Security**

**NetworkOptix**

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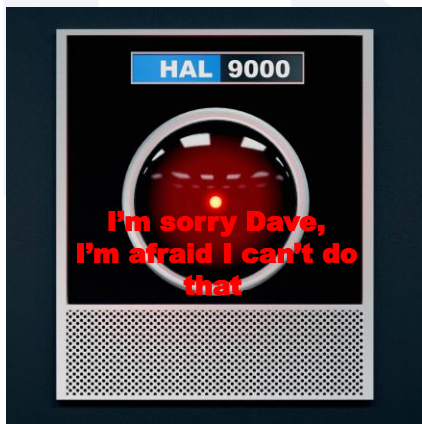


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HAL 9000, a computer in the 1968 movie "2001, A Space Odyssey"

**HAL** is an acronym standing for "Heuristically programmed ALgorithmic computer." "Heuristic" and "Algorithmic" are two primary processes of intelligence. **HAL** is capable of speech recognition, natural language understanding, lip reading, and thinking well enough to beat humans at chess.

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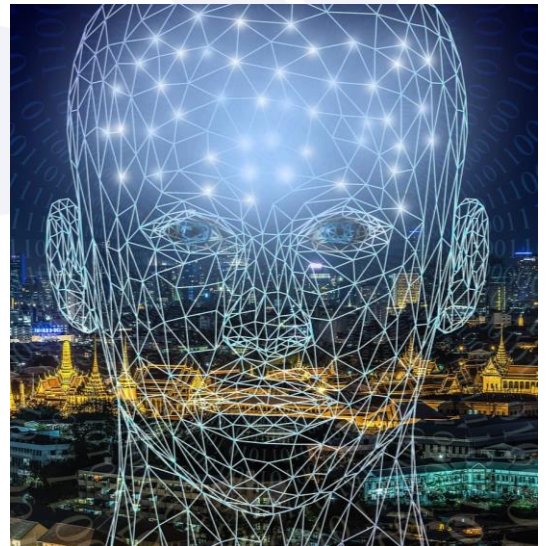
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# What is AI?

# Machine Learning and AI

*"Field of study that gives computers the ability to learn without being explicitly programmed".*
*- Arthur Samuel (1959)*

# A Short History

| Decade | Summary |
|--------|---------|
| <1950s | Statistical methods are discovered and refined. |
| 1950s | Pioneering **machine learning** research is conducted using simple algorithms. |
| 1960s | **Bayesian methods** are introduced for **probabilistic inference** in machine learning. |
| 1970s | 'AI Winter' caused by pessimism about machine learning effectiveness. |
| 1980s | Rediscovery of **backpropagation** causes a resurgence in machine learning research. |
| 1990s | Work on machine learning shifts from a **knowledge-driven approach to a data-driven** approach. Scientists begin creating programs for computers to analyse large amounts of data and draw conclusions – or "learn" – from the results. **Support Vector Machines** and **Recurrent Neural Networks** become popular. The fields of computational complexity via neural networks takes off. |
| 2000s | Support Vector Clustering and other **Kernel methods** and unsupervised machine learning methods become widespread. |
| 2010s | **Deep learning** becomes feasible, which leads to machine learning becoming integral to many widely used software services and applications. |

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# Machine Learning and AI



Deep learning
Example: MLPs
Example: Shallow autoencoders
Example: Logistic regression
Example: Knowledge bases
Representation learning
Machine learning
AI
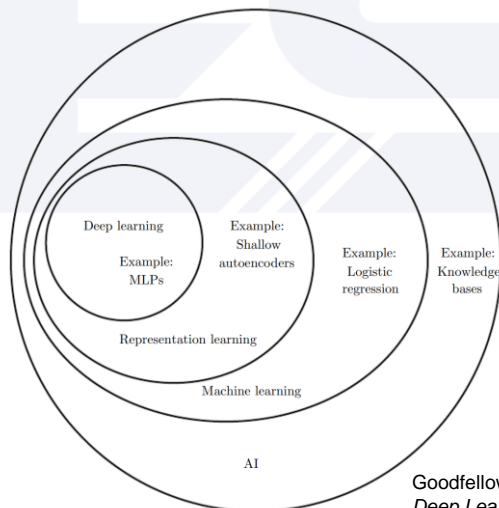
Goodfellow, Bengio and Courville, *Deep Learning*, 2016



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# Learning Types

### Supervised (~70%)
Trained using labelled examples when the desired output is known.

E.g. Fraud detection in credit cards

### zUnsupervised (~ 10-20%)
Trained on unlabelled data with the objective of finding hidden patterns.

E.g. Face matching in social media apps

### Semi-supervised
Trained on small amounts of labelled data and large amounts of unlabelled data. Use when labelling is unfeasible

E.g. Textual analysis

### Reinforcement
Algorithm discovers which action yields the greatest rewards.

E.g. Control systems

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# Statistics and Machine Learning

|  | Statistics | Machine learning |
|---|---|---|
| **Heritage** | **Math** heritage | **Engineering/Computer** science heritage |
| **Objective** | **Finding patterns** in data | Making **predictions** from data |
| **Background** | Formal mathematics | Algorithms and systems |
| **Modelling approach** | **Models** appropriate to the problem | Large scale **generic** networks and systems |
| **Confidence interval** | Variability and uncertainty of parameters are propagated and computed | Not available explicitly |
| **Assumptions** | Explicit a-priori assumptions | No prior assumptions "we learn from data" |
| **Fit** | Fit to distribution | Best fit to learning networks (generalisation) |

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# Statistics ~~vs~~ Machine Learning
## AND

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There are two cultures in the use of statistical modeling to reach conclusions from data. One assumes that the data are generated by a given stochastic data model. The other uses algorithmic models and treats the data mechanism as unknown. The statistical community has been committed to the almost exclusive use of data models. This commitment has led to irrelevant theory, questionable conclusions, and has kept statisticians from working on a large range of interesting current problems. Algorithmic modeling, both in theory and practice, has developed rapidly in fields outside statistics. It can be used both on large complex data sets and as a more accurate and informative alternative to data modeling on smaller data sets. If our goal as a field is to use data to solve problems, then we need to move away from exclusive dependence on data models and adopt a more diverse set of tools.

*Breiman, Leo, Statistical Science 2001, Vol. 16, No. 3, 199-231, Statistical Modeling: The Two Cultures*

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# Why has Machine Learning Taken Off?

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- Data quantity: the amount of data has grown exponentially, and the collection of data continues to proliferate in all aspects of businesses and society

- Computing power: the advent of using GPUs for parallel computation and the right price point

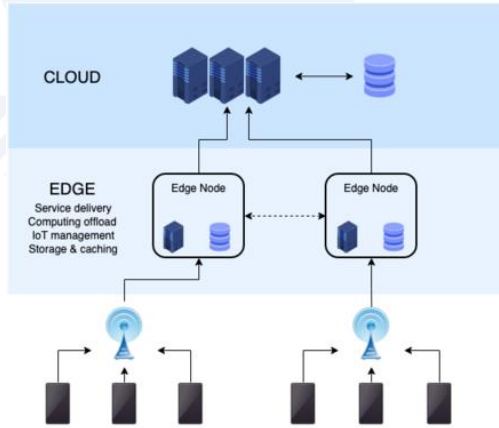- Platforms to deploy AI and machine learning to the edge are becoming increasingly available

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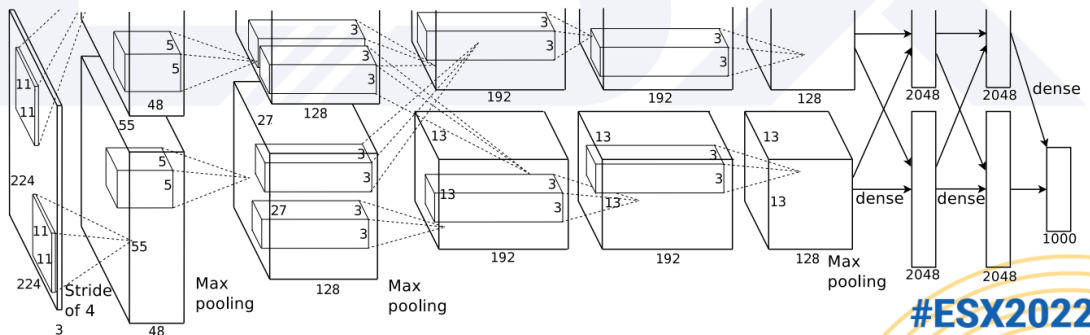
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# AI on the Edge

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# What Does a Deep Convolutional Neural Network Look Like?



Krizhevsky, Sutskever and Hinton, **Deep Convolutional Neural Network**, 2012
150,528-dimensional, 60 million parameters, 650,000 neurons, 7 layers
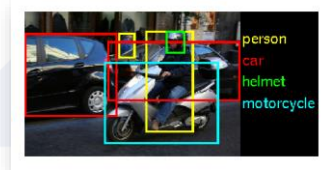Classifying 1.2 million images in the ImageNet LSVRC-2010 database into 1000 classes

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# Machine Learning vs Humans



## ImageNet (image classification challenge)
**5.10%** - Human performance, Russakovsky et al., 2014
**2015**: **4.94%** - Extremely Deep NNs. Microsoft Research Asia
2014: **6.66%** - Deep Convolutional NNs. Google
2013: **11.2%** - New York University/Clarifai

## MNIST (handwriting challenge)
**1.71%** - Human performance
2012: **0.23%** - Deep Convolutional NNs, IDSIA, Switzerland
2010: **0.35%** - Deep Simple Neural Nets, IDSIA Switzerland
**2003**: **1.60%** - Convolutional NNs. Microsoft Research

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# Chihuahua or Muffin?



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# AI Games



1997 DEEP BLUE



2017
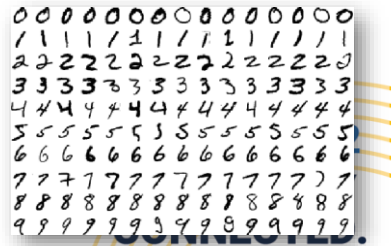
Beating humans in Chess was all about calculating possible moves. With the 2500-year-old Chinese game of Go, calculating wasn't an option, as the game has more possible positions than there are atoms in the universe. In order to win, AlphaGo had to get good at the game – and it did. By playing itself millions of times, AlphaGo bested Lee Sedol in a game often seen as the "Holy Grail" of AI

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# New Developments



**Amazing New Chinese A.I.-Powered Language Model Wu Dao 2.0 (Enlightenment) Unveiled June 1st 2021**

- 1.75 trillion parameters 10x Google GPT-3
- Multi modal (natural language, text generation, image recognition)
- Virtual Student – Wu Dao's "child" learns continuously, compose poetry, draw pictures, etc.

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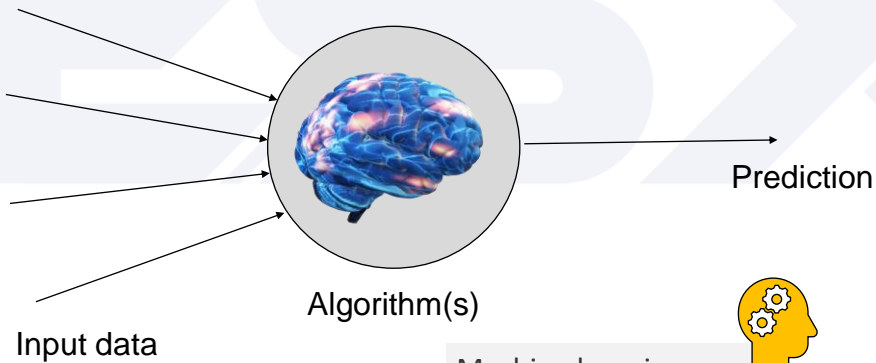
# AI Challenges
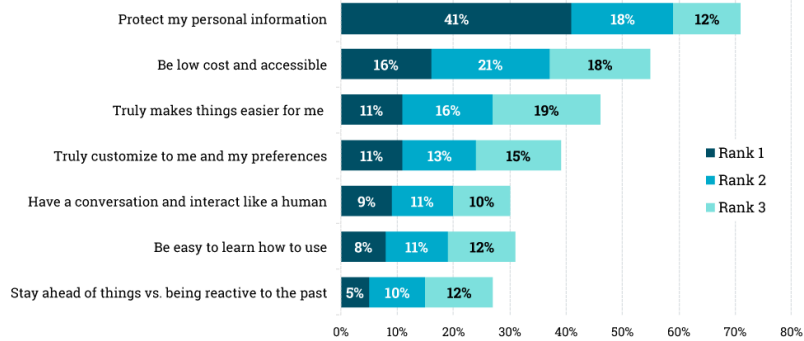
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# Machine Learning in Context

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Prediction

Algorithm(s)

Input data

Machine learning applications are only as good as the data that underpins them

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# AI Concerns

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**Consumers' Biggest Concerns With Artificial Intelligence*** marketing charts

| | Rank 1 | Rank 2 | Rank 3 |
|---|---|---|---|
| Protect my personal information | 41% | 18% | 12% |
| Be low cost and accessible | 16% | 21% | 18% |
| Truly makes things easier for me | 11% | 16% | 19% |
| Truly customize to me and my preferences | 11% | 13% | 15% |
| Have a conversation and interact like a human | 9% | 11% | 10% |
| Be easy to learn how to use | 8% | 11% | 12% |
| Stay ahead of things vs. being reactive to the past | 5% | 10% | 12% |

■ Rank 1
■ Rank 2
■ Rank 3

0% 10% 20% 30% 40% 50% 60% 70% 80%

**Published on MarketingCharts.com in November 2017 | Data Source: The Integer Group**
*Based on "tech enthusiast" respondents (3,615) from a survey of 3,665 US consumers. Tech enthusiasts are those who described artificial intelligence in positive terms.
Q: "What are your biggest concerns when it comes to artificial intelligence in the future?"

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# AI Challenges

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**AI camera operator repeatedly confuses bald head for soccer ball during live stream**

*Like a distracted AI with a crush*

By James Vincent | Nov 3, 2020, 8:07am EST

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# AI Applications

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# AI Application Areas

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- Sound classification
- Image/video classification
- Component parameter prediction
- Natural language processing
- Predictive analytics
- Alarm reduction
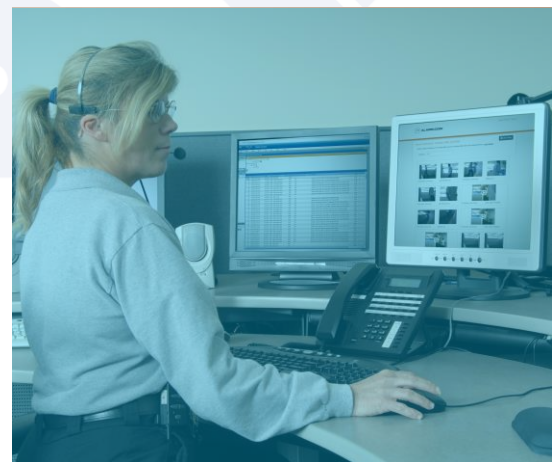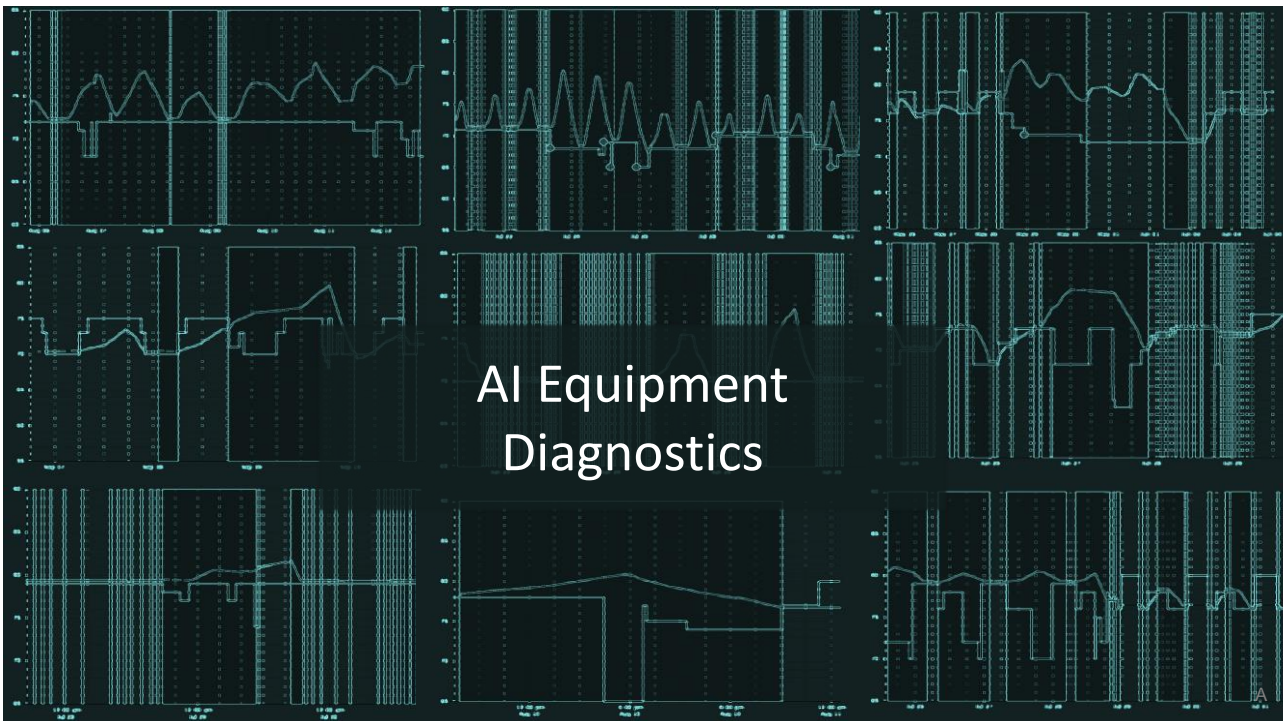- Voice authentication
- Autonomous navigation
- Operational analysis

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# Incident Verification & Analysis

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- Object Classification
- Activity Analysis
- Prioritization

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Business Activity Analytics
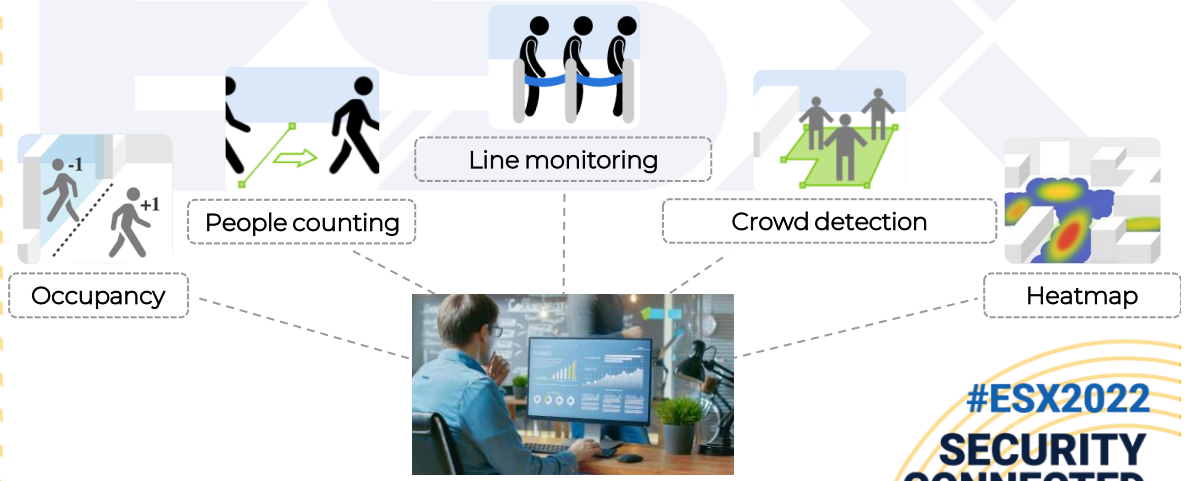
Occupancy

People counting

Line monitoring

Crowd detection

Heatmap

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AI Equipment Diagnostics

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# Healthy Equipment



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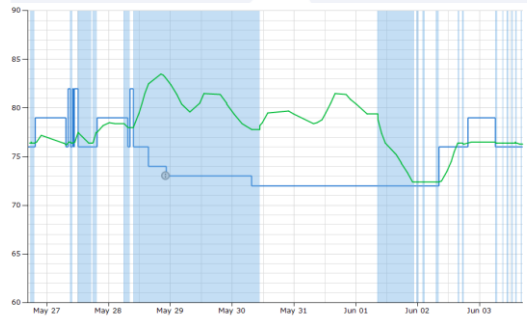VIDEO. POWERED.
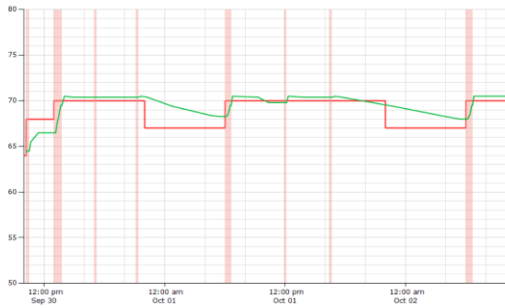
Temperature
Setpoint
Run Time
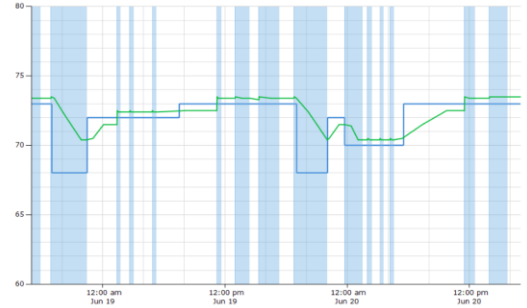
Temperature
Setpoint
Run Time

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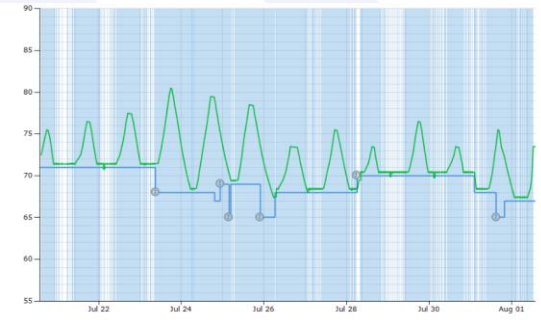RISE OF THE MACHINE – WHEN AND HOW TO LEVERAGE ARTIFICIAL INTELLIGENCE | ESX 2022

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# Equipment Issues



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Temperature
Setpoint
Run Time

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# Audio Analytics – Alarm Signal

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- Event generation: glass break, gunshot detection, person under duress, impact, etc.
- Classification of sounds that occur in locations that are expected to be empty to assist in alarm assessment : people talking, dog barking, banging noise, etc.
- False alarm reduction

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# Audio Analytics – SOC

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- Natural language processing for chat bots
- Conversational Analytics - Measurement of sentiment and tones
- Using voice instead of PIN can augmented with phone signature and the way you use your phone for additional security

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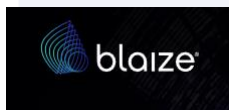**RISE OF THE MACHINE − WHEN AND HOW TO LEVERAGE ARTIFICIAL INTELLIGENCE | ESX 2022**

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# Video Analytics
# Large players entering the space
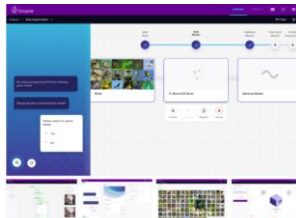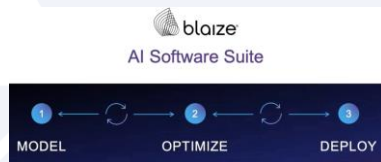
- AWS recently announced the general availability of Streaming Video Events, a new feature of Amazon Rekognition to provide real-time alerts on live video streams.

- The managed service for image and video analysis can help camera manufacturers and service providers detect objects such as people, animals, and packages in live video streams from connected cameras. Streaming Video Events triggers a notification to the device as soon as the expected object is detected.

- To better manage the machine learning inferencing costs, customers can specify the length of the video clips to be processed (between 10 and 120 seconds) and can choose one or more objects such as people, pets, and packages, minimizing false alerts from camera motion events.

- Costs are as low as 40 cents per hour of video processed

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# Video Analytics
# Many new players entering space



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Machine Learning
Large players creating powerful tools
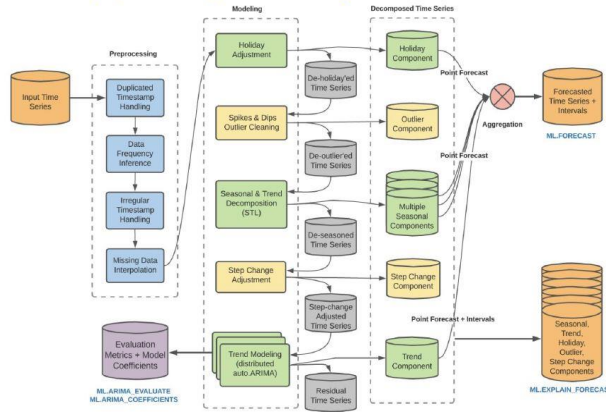


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WEINSTOCK CELEBRATION

**TONIGHT | 5:30-7:00PM**
LIVE MUSIC | CIGAR ROLLING
ACRE DISTILLING

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