FEBRUARY 5 - 6 • LOS ANGELES, CA

SMART PORTS
(INFORMATION TECHNOLOGY)

Machine Learning and Artificial Intelligence

Pavel Skournik.

Saab Technologies LTD

Machine Learning Neural Networks

No Rules Are **Universal**

(except this one)

All Rules Need **Context**

Dave Thomas.

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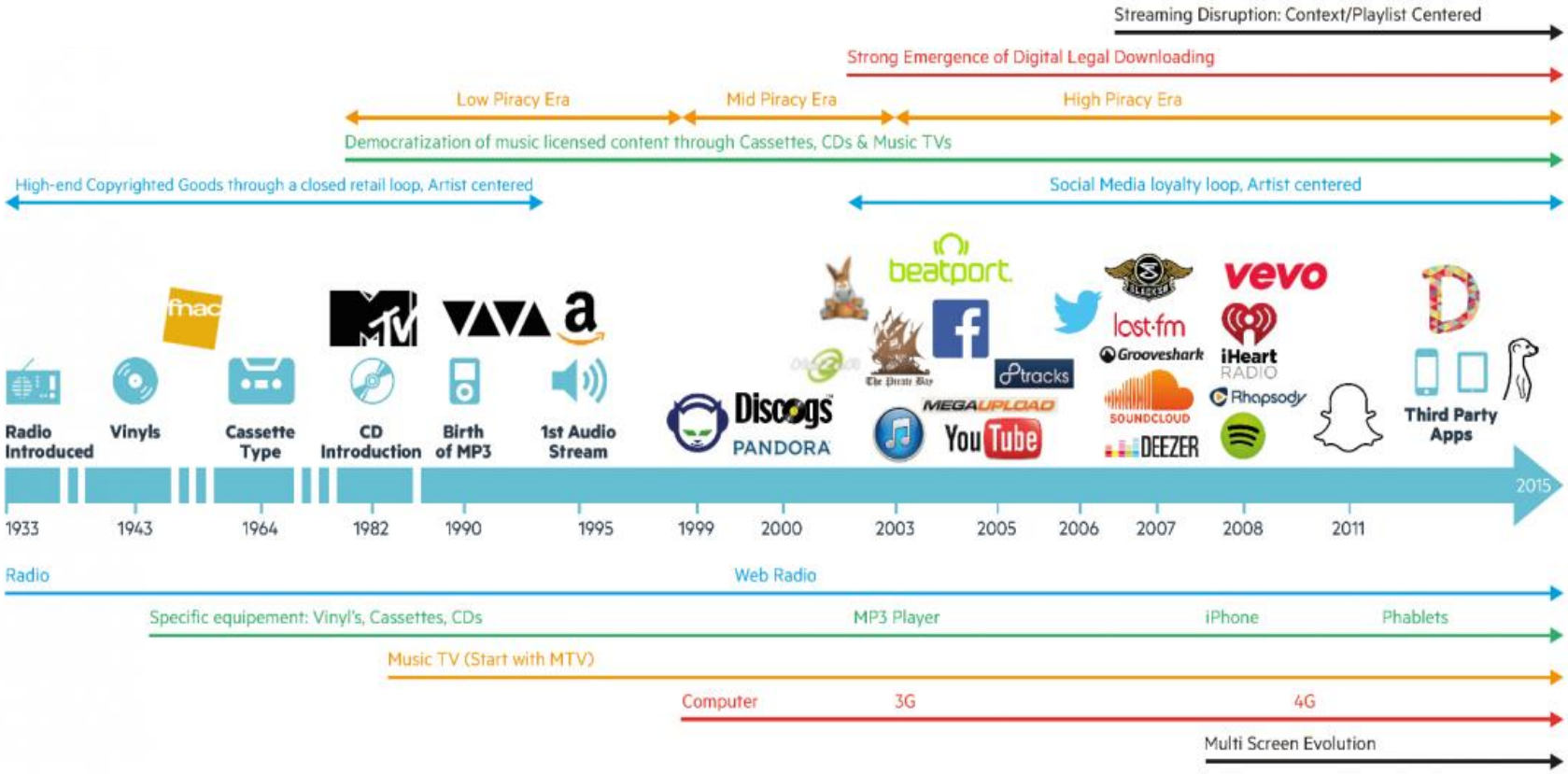
Global Trends in Technology



Trends in Maritime Domain

Communication

3G, 4G, 5G, Internet, VDES

Shift

Owned – Subscription (e.g. email, office 365)

On premises – Cloud

Dedicated – Open standards

Fat client – Web client

Other ways of working

Being more efficient / agile

More digitalization

Stakeholder integration/interface

Autonomous vessels

Focus towards planning

Vessel control centers instead of VTS

Level	Name	Definition (Proposed Maritime Autonomy Framework)	Who is in Control? Sustained operational task	Who takes over control? Fail Safe Operational Task	System Capability
0	No Autonomy	All aspects of operational tasks perform by human operator even when enhanced with warning or intervention system. Human operator safely operates the system at all time. (e.g. Select pumps)	 Manual		n/a
1	Partial Autonomy	The targeted operational tasks perform by human operator but can transfer control of specific sub-tasks to the system. The human operator has overall control of the system and safely operates the system at all time. (e.g. start engine sequence)	 Automation		Some Operational Tasks
2	Conditional Autonomy	The targeted operational tasks perform by automated system without human interaction and human operator perform remaining tasks. Human operator is responsible for its safe operation.	 Semi-Autonomous		Majority of Operational Tasks
3	High Autonomy	The targeted operational tasks perform by automated system without human interaction and human operator perform remaining tasks. System is responsible for its safe operation. (e.g. PMS, DP)	 Semi-Autonomous		Majority of Operational Tasks
4	Full Autonomy	All operational tasks perform by an automated system under all defined conditions.	 Full Autonomous		All Operational Tasks

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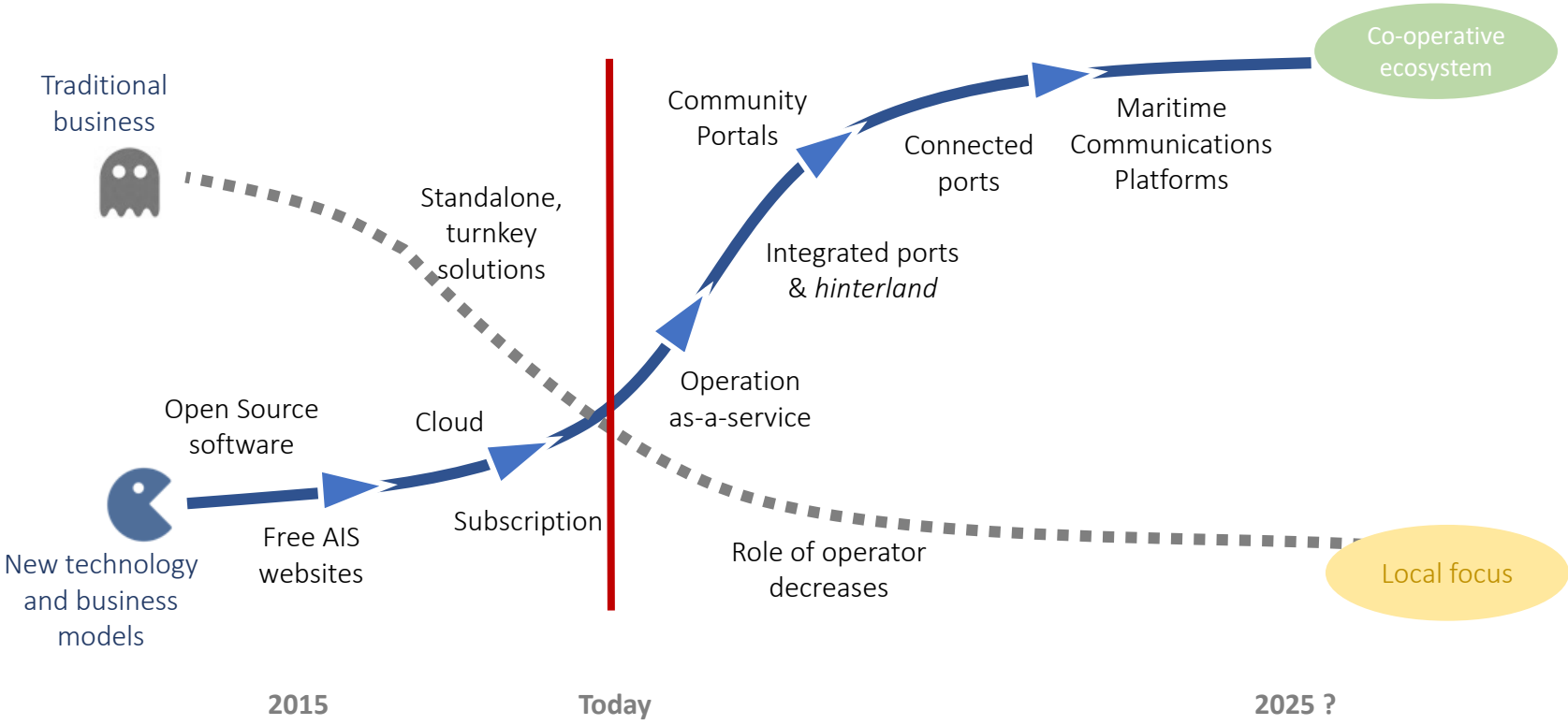
Evolution of Business



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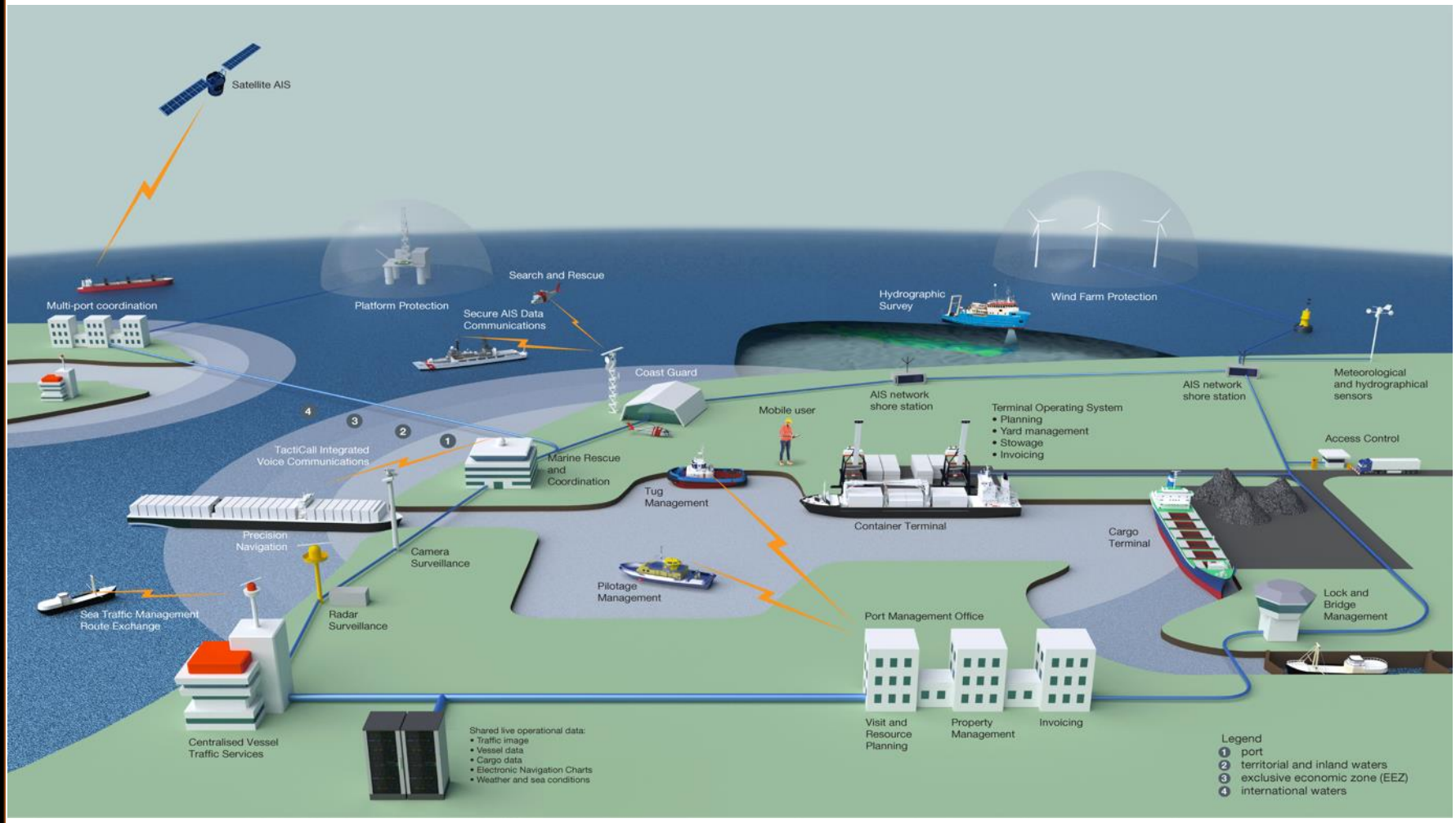
Eco-system: Fairway to Freeway



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Machine Learning and AI

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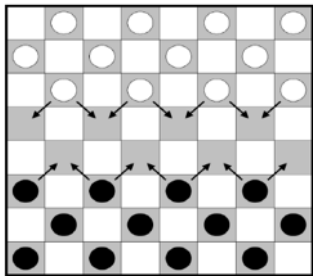
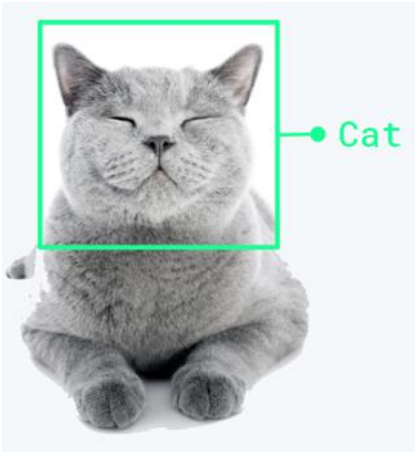
Machine Learning evolution

AI



Machine Learning

Deep Learning



1950

1980

2010

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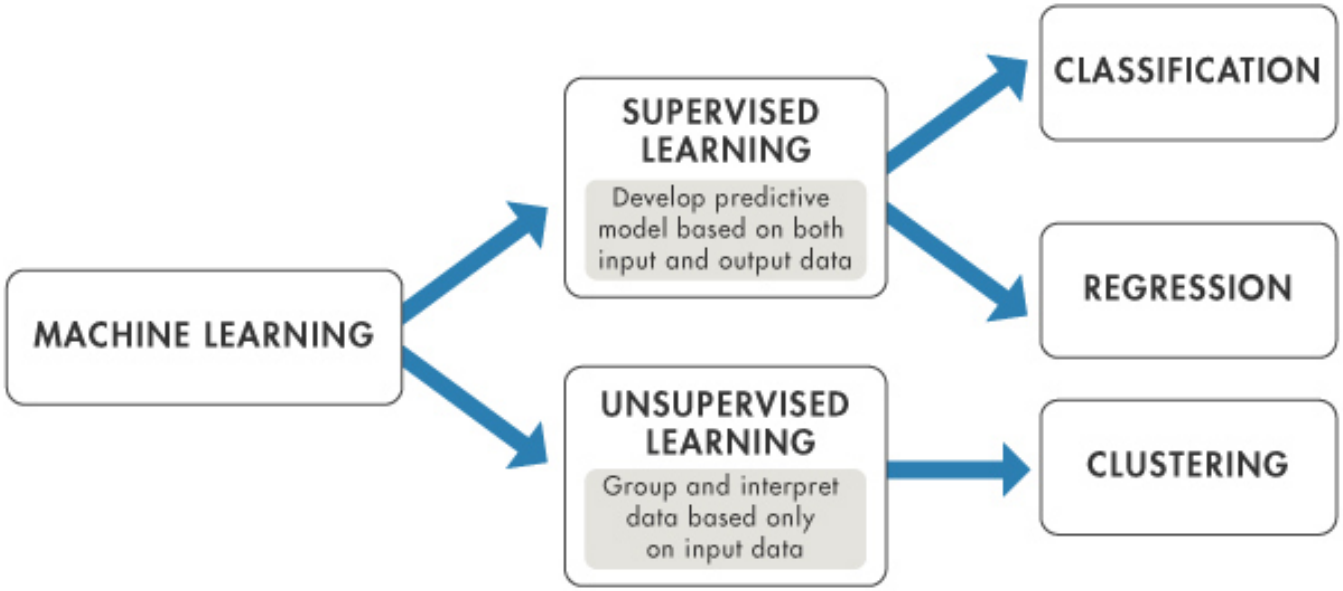
Machine Learning groups

- Machine learning is the general term for when computers learn from data
- There are lots of different ways that machines can learn
- They can be grouped into **supervised**, **unsupervised**, and **reinforcement** algorithms
- The data that you feed to a machine learning algorithm can be input-output pairs or just inputs



Supervised Learning

Supervised learning algorithms require input-output pairs (i.e. they require the output)

- you feed it an example input, then the associated output
- you repeat the above step many many times
- eventually, the algorithm picks up a pattern between the inputs and outputs

now, you can feed it a brand new input, and it will predict the output for you

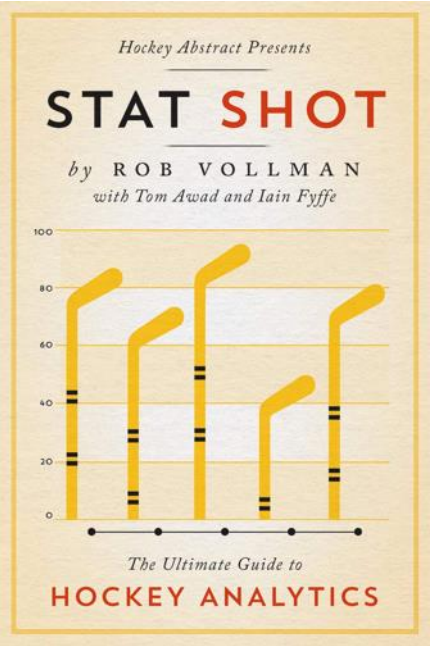
Feature -> Label

Unsupervised Learning

Unsupervised learning requires only the input data (not the outputs)

- you feed it an example input (without the associated output)
- you repeat the above step many times
- eventually, the algorithm clusters your inputs into groups

now, you can feed it a brand new input, and the algorithm will predict which cluster it belongs with



Quiz

Facebook Face Recognition

NETFLIX

Netflix Movie recommendation

Credit Card Fraud Detection

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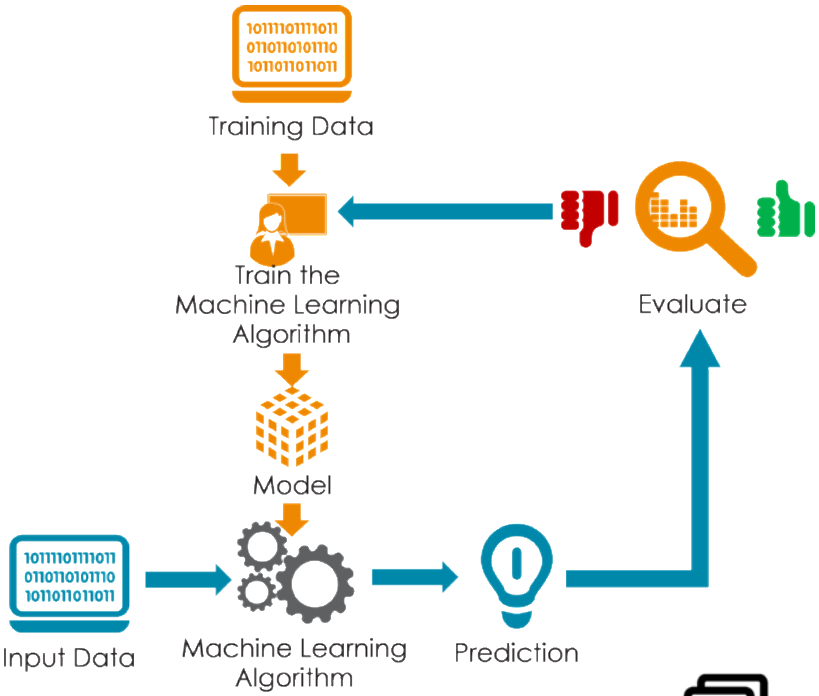
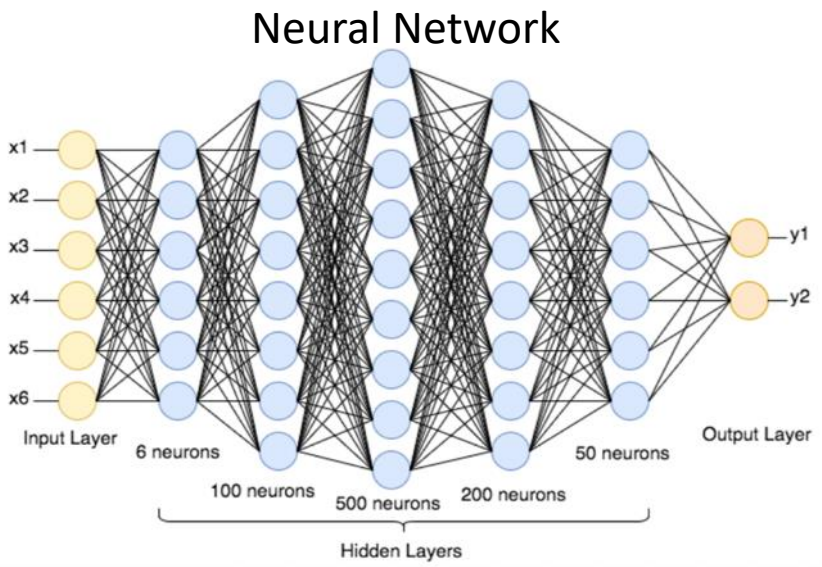
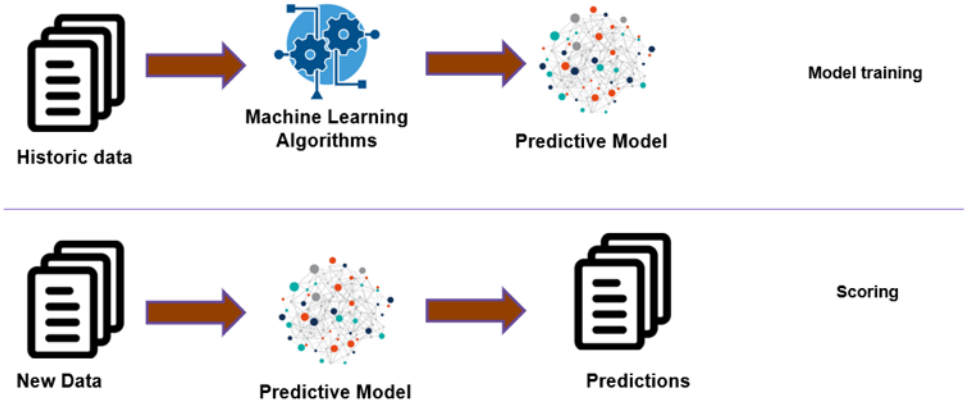
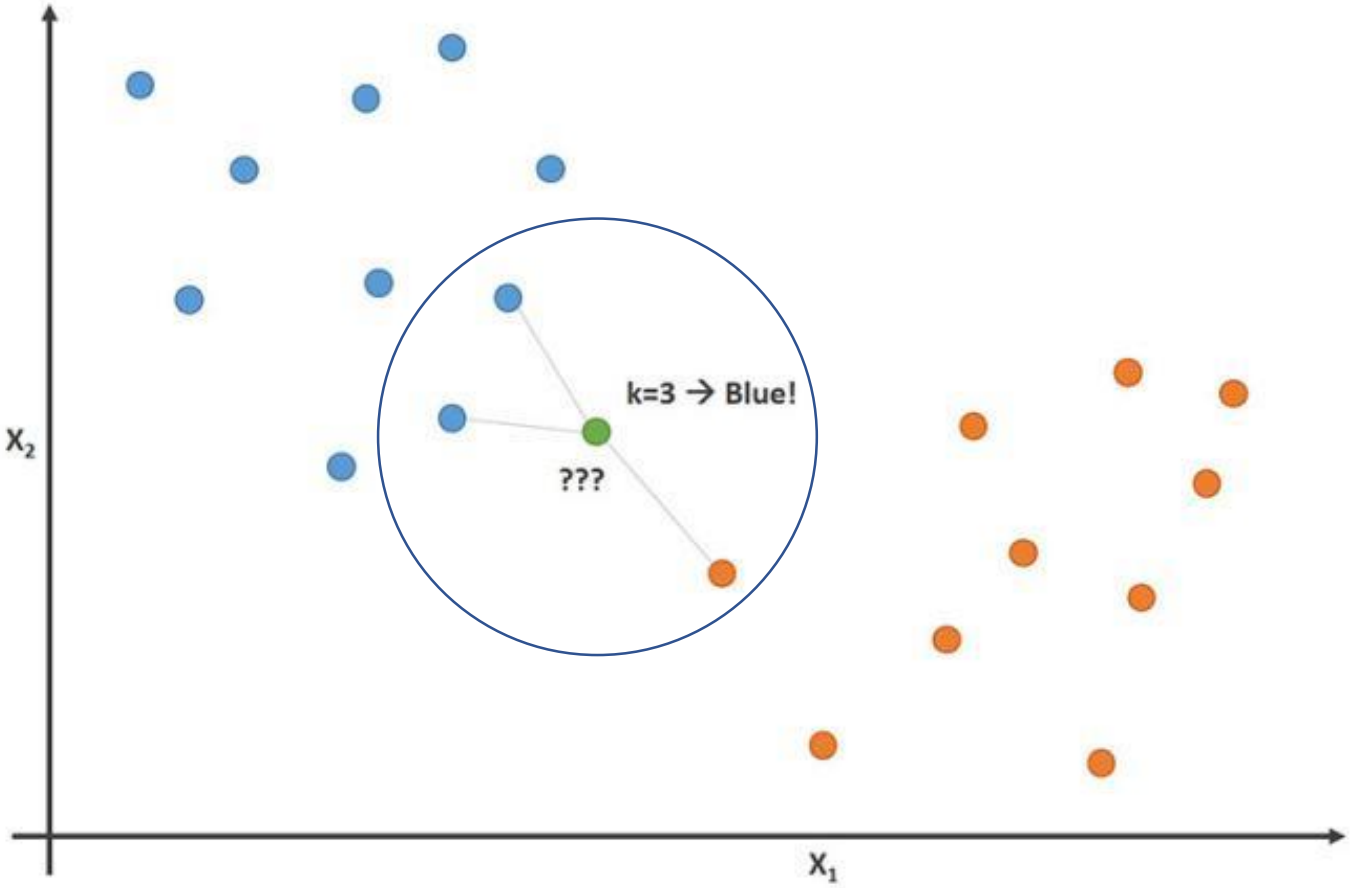
Machine Learning basics







K-Nearest Neighbors



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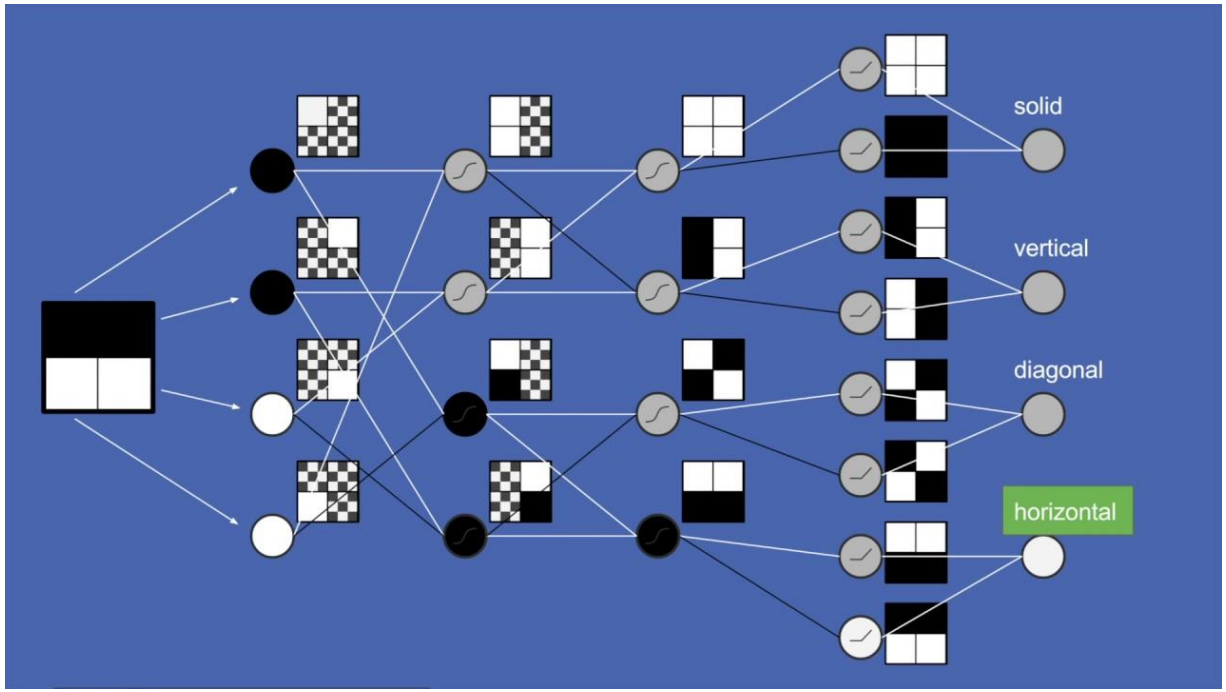
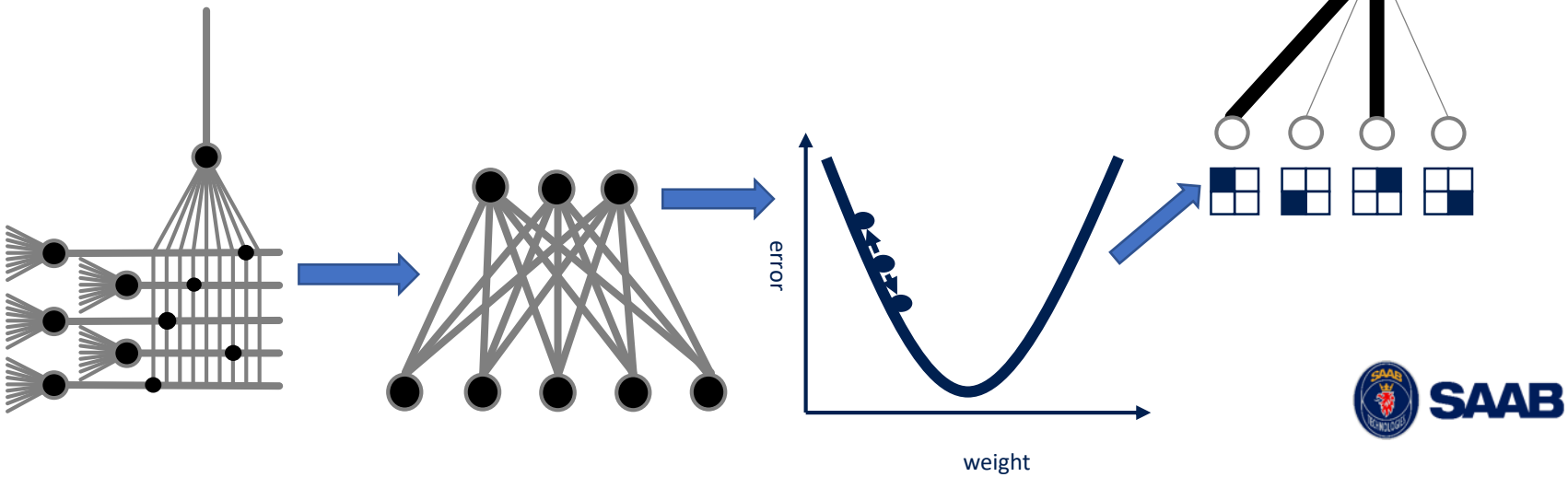
Convolutional Neural Network





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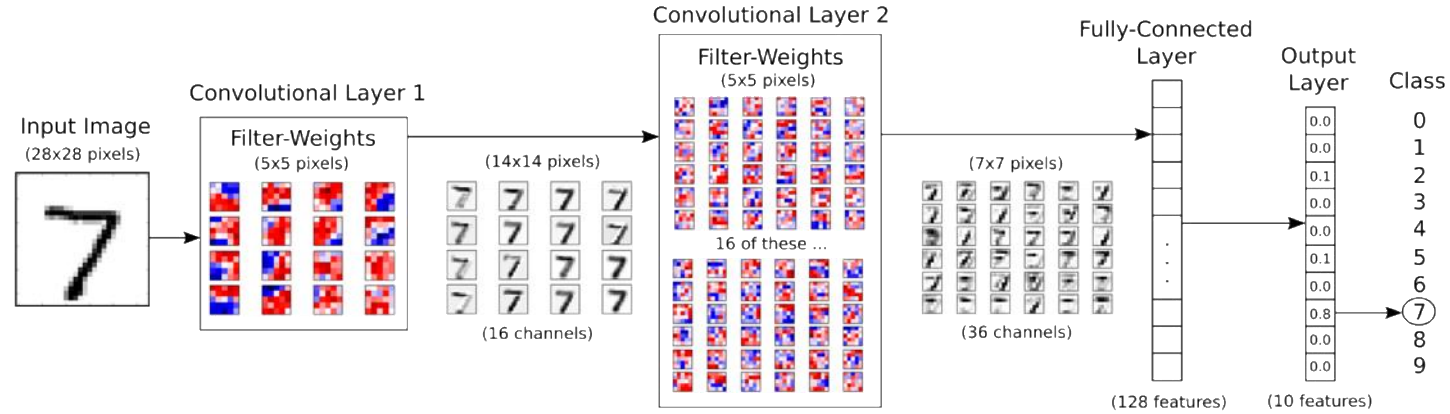
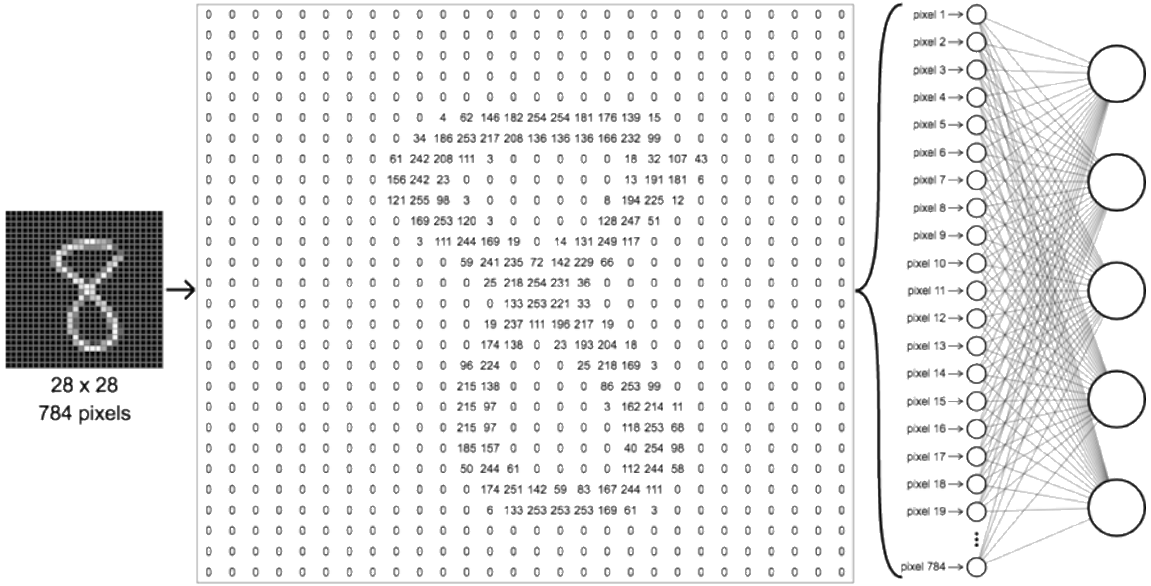
Machine Learning processing





Questions that can be answered

1. How Much / How Many?
   - What Temperature on Tuesday? How many users log in tomorrow?
2. Which Category?
   - Is it a Cat or a Dog?
3. Which Group?
   - Which viewers like the same movie?
4. Is it weird?
   - Is this internet message is typical? (spam, fraud)
5. Which action to take?
   - Turn left, go forward and so on (PID systems)

Not enough data

Teaching with Data

Barely enough data

Teaching with Data

Enough data

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Tools / Platforms

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Accurately Predicting Requirements

AI can use huge datasets to learn the history

- Transport time of cargo ships
- What are required services?
- How long they wait to unload cargo?
- How many cranes are available at port/terminal?
- How long inspections and other handling takes?
- Learn weather patterns consequences
- Learn the affects of certain shipping seasons
- Learn congestion in shipping lanes.

Computers can synthesize all that data, offering better estimation of ship times/service requirements than previously possible.

Computers can detect potential problems in advance, providing ability to make adjustments to plans when needed.

Improving Shipping Speed and Safety

- Regulate a vessel's environmental efficiency
- Reduce unnecessary fuel consumption, greenhouse gas emissions
- Optimize terminal operations
- Help better maintain the equipment used by flagging certain milestones or identifying malfunctioning equipment
- Ensure compliance with regulations

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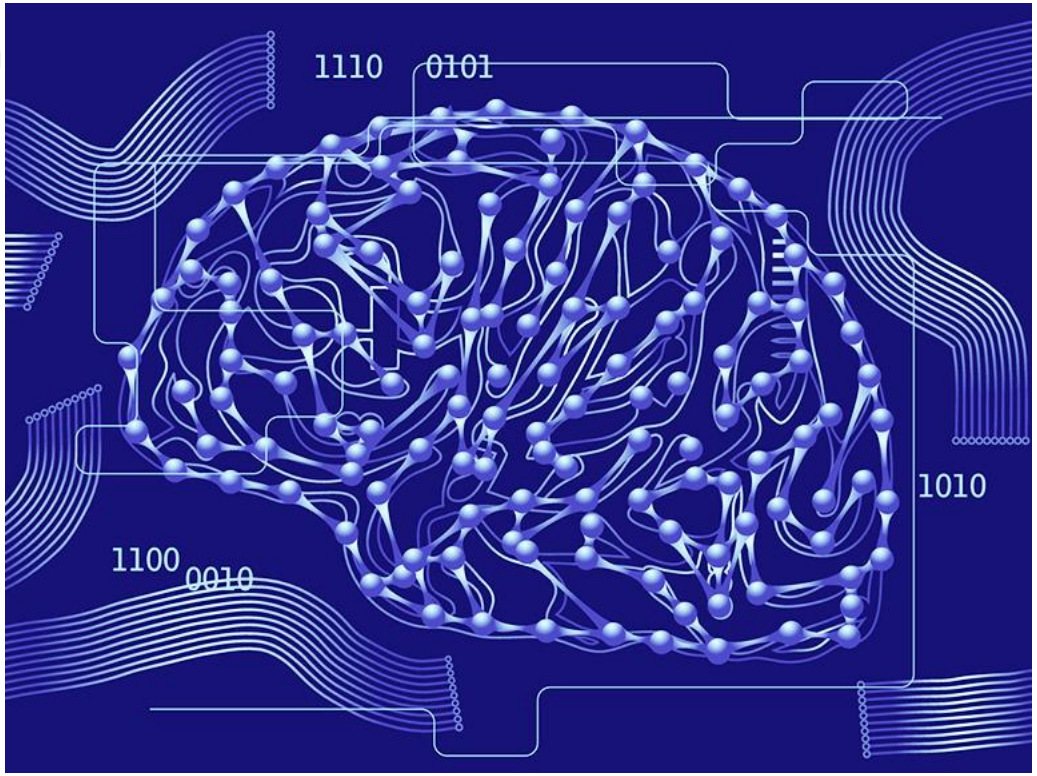
‘Mimicking’ Human - Making Decisions

- Imitate human senses
- Responding to visual cues and sound.
- Ability to read and interpret data from sensors
- Rules engines
- Predictive Modeling
- Learned selection
- Pattern Recognition
- ……..



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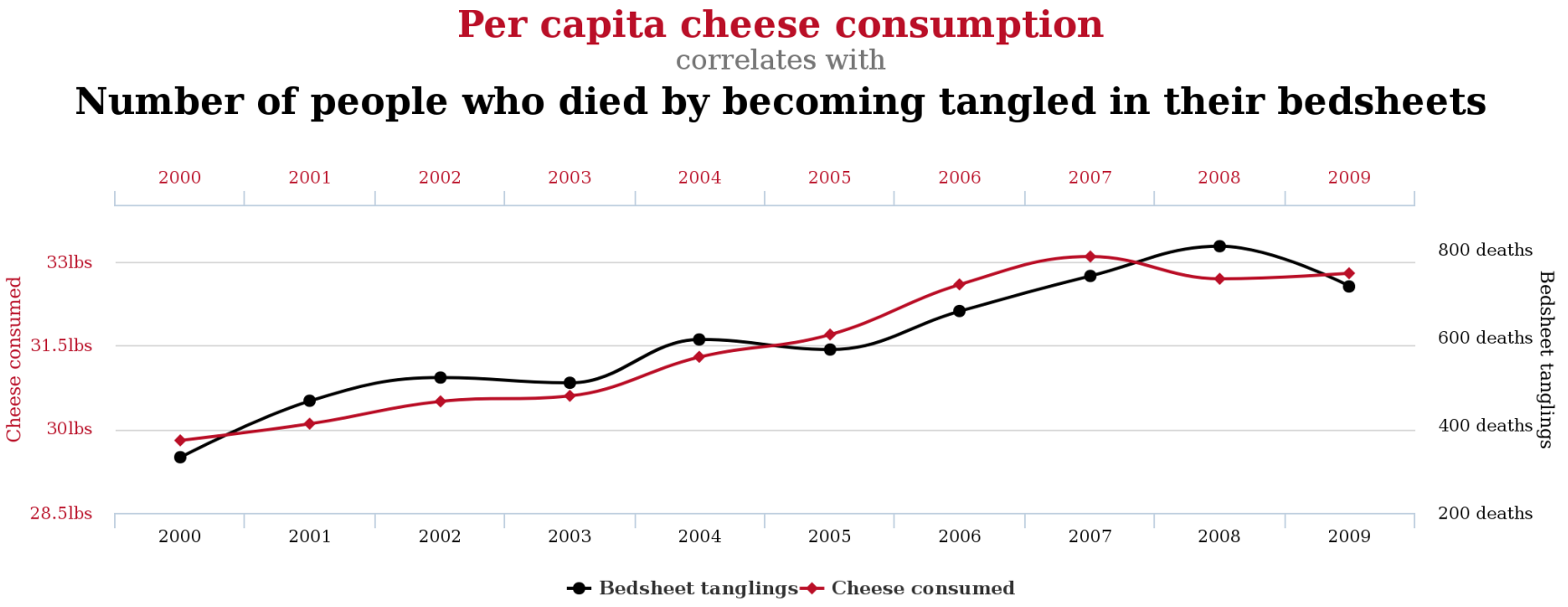
GAPS with AI

- Nearly all machine learning algorithms assume that the world does not change.
- Most machine learning algorithms take a lot of examples to learn
- Machine learning can't tell what caused what



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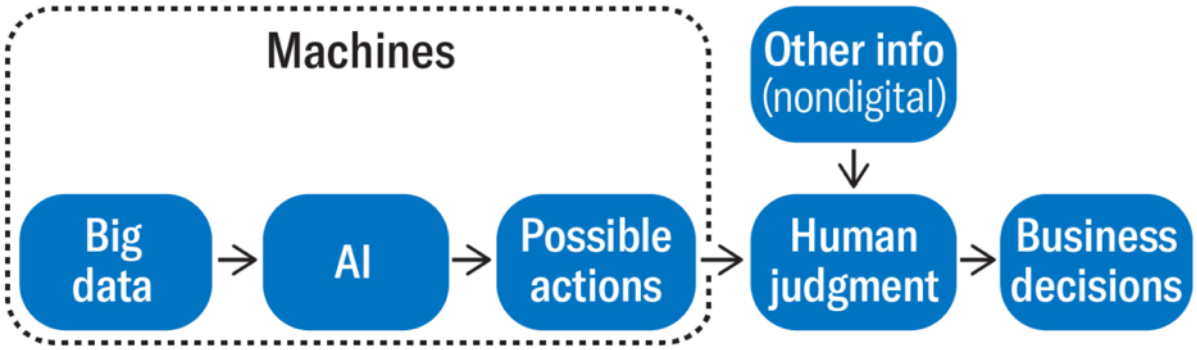
AI and Human in combined workflow

Human insight and judgment close the gap

There are many business decisions that depend on more than just big (structured) data.

Some information is only available in our minds and transmitted through culture and other forms of non-digital communication.

This information is inaccessible to AI and extremely relevant to business decisions



Source: Eric Colson

HBR

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Real-life Application Examples

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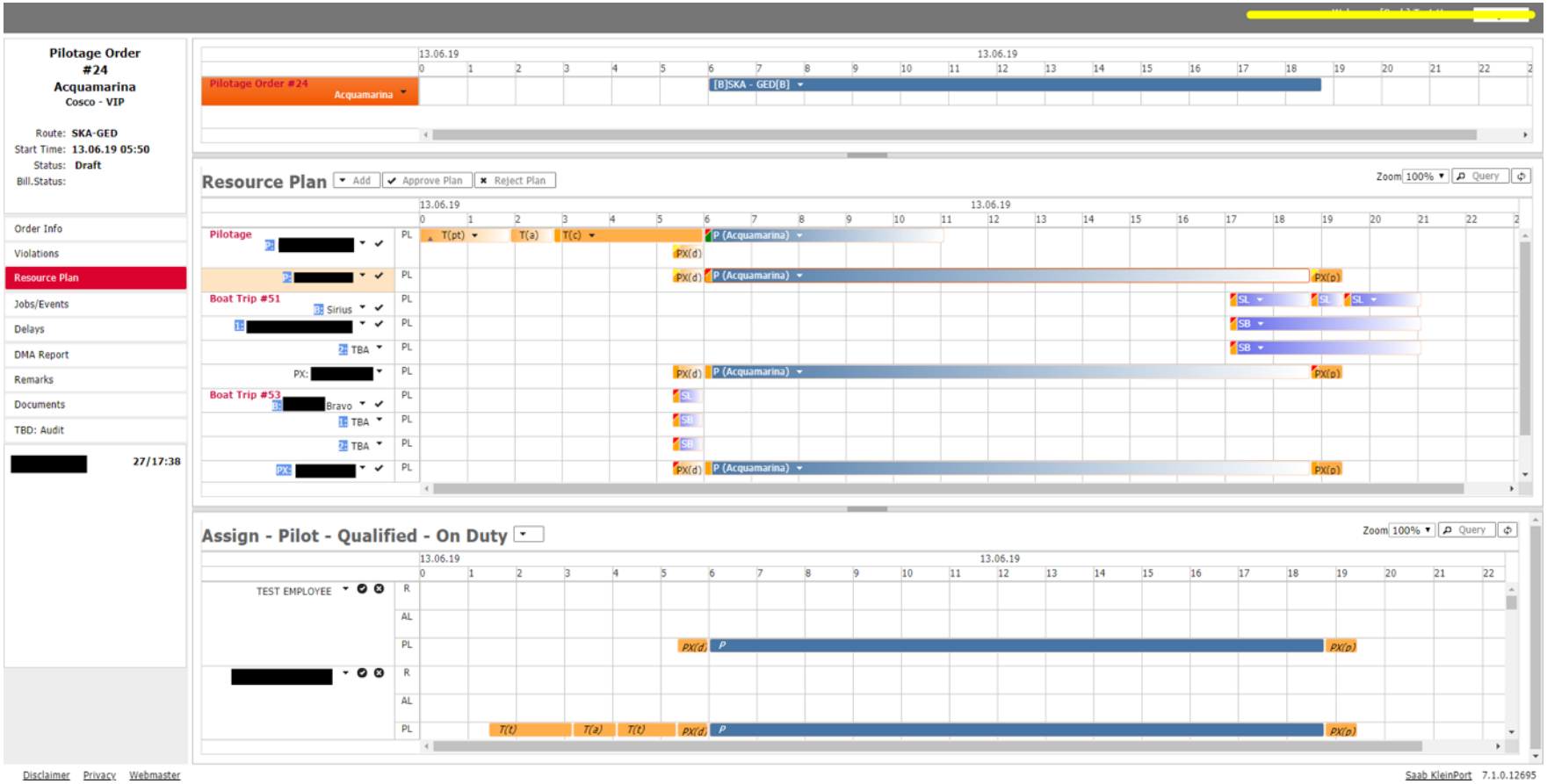
Collision Detection / Prediction

Service Planning



Rostering

	max	FE	FR		V			V 1		V 2		V 3		off wkds			part wkds			October																														
	days	req	req	skd	lb	skd	ub	skd	ub	skd	ub	skd	ub	lb	skd	ub	lb	skd	ub	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
	5	0	9	49	20	34	40	14	19	11	19	9	19	0	6	7	0	0	1	FR	FR	V	V	V	V	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	V	V	V	V	V	FR	FR	V	V	V	V	V	
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number of duty days in a row	3	4	5		
wanted percentage	10.0	20.0	70.0		
scheduled percentage	14.81	18.52	66.67		
number of duty days in a row	3	4	5	6	
wanted percentage	10.0	20.0	30.0	40.0	
scheduled percentage	0.00	0.00	0.00	0.00	
number of duty days in a row	3	4	5	6	7
wanted percentage	10.0	10.0	20.0	30.0	30.0
scheduled percentage	18.18	9.09	18.18	27.27	27.27

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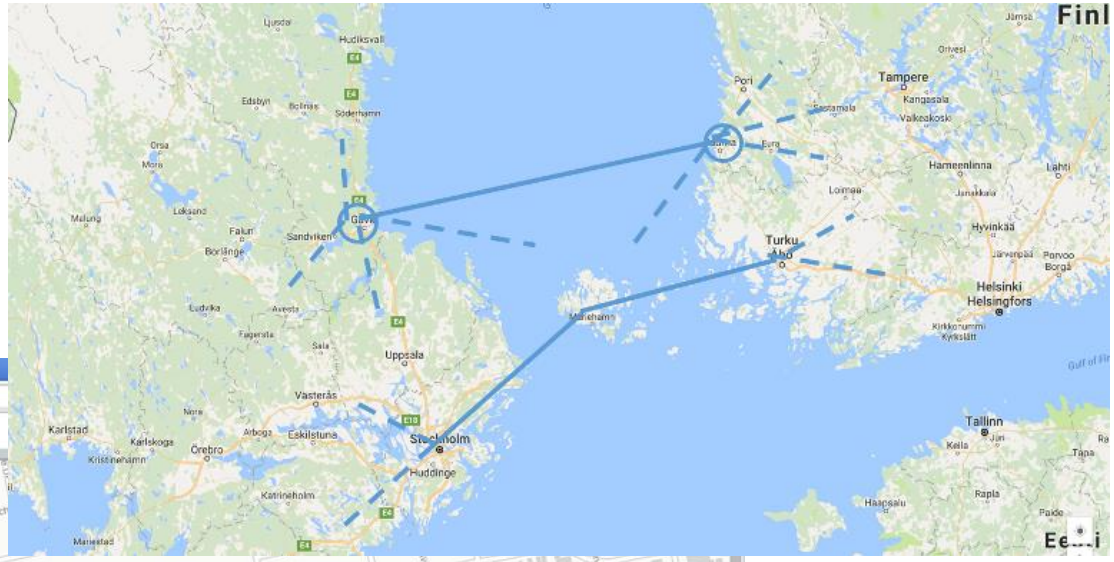
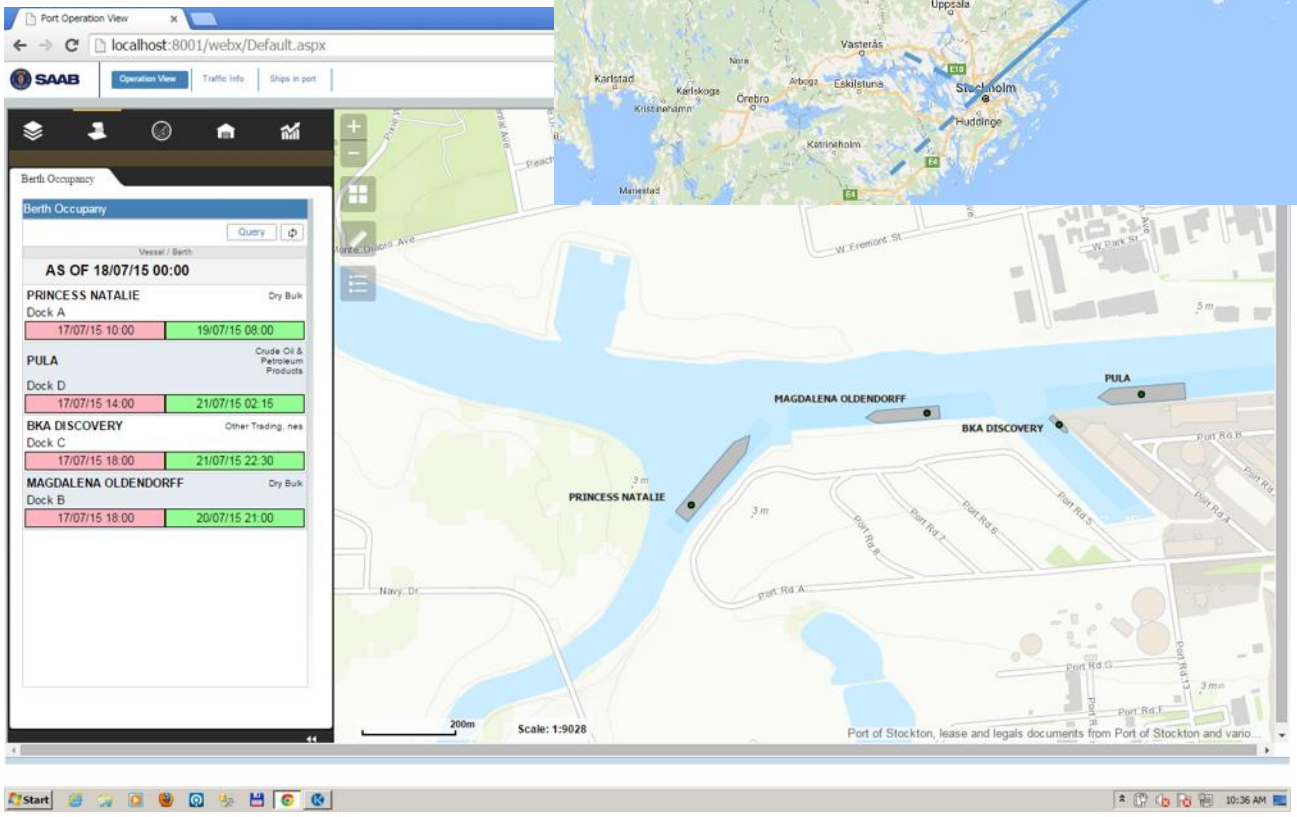
Route/ETA Prediction





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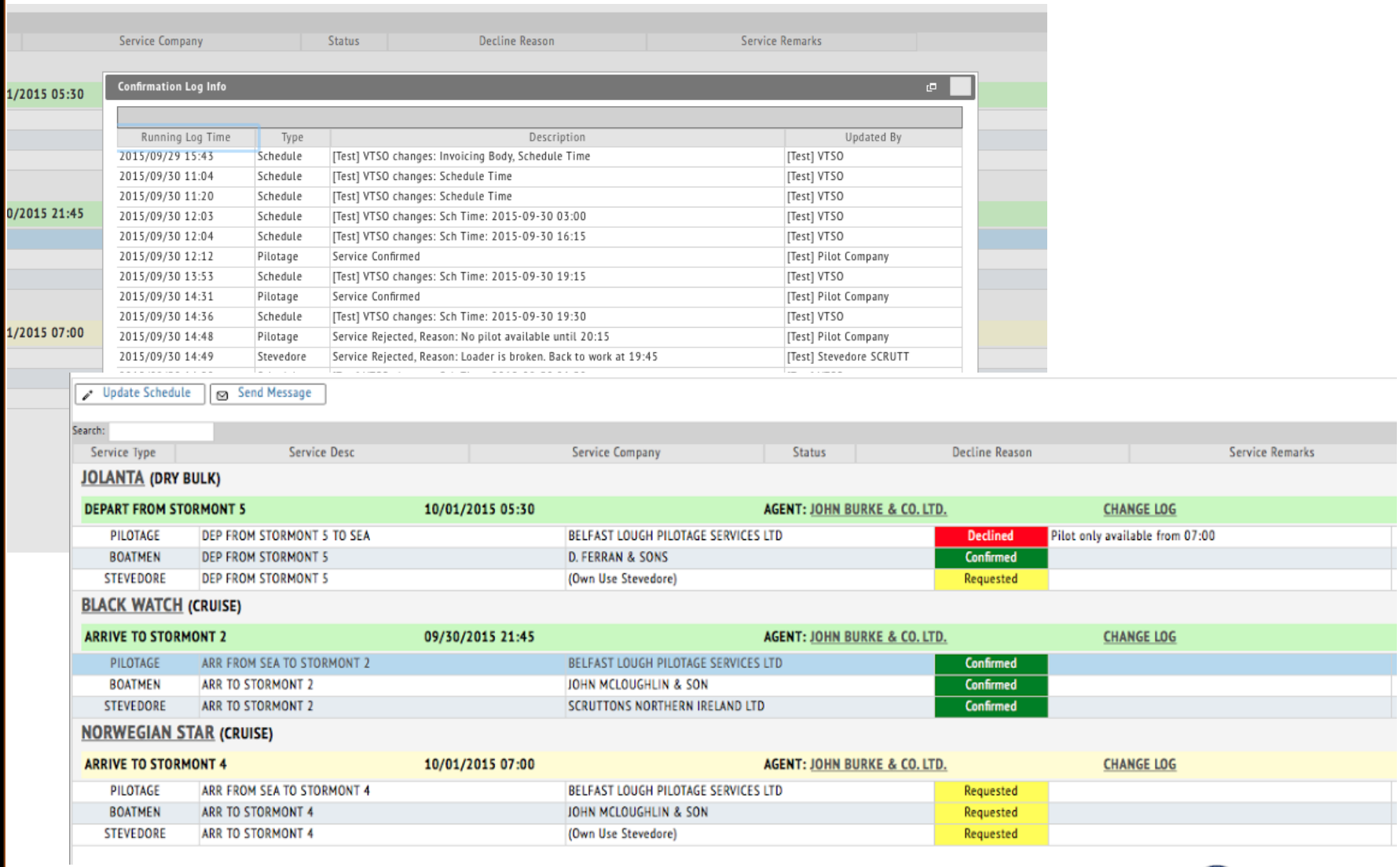
Port CDM



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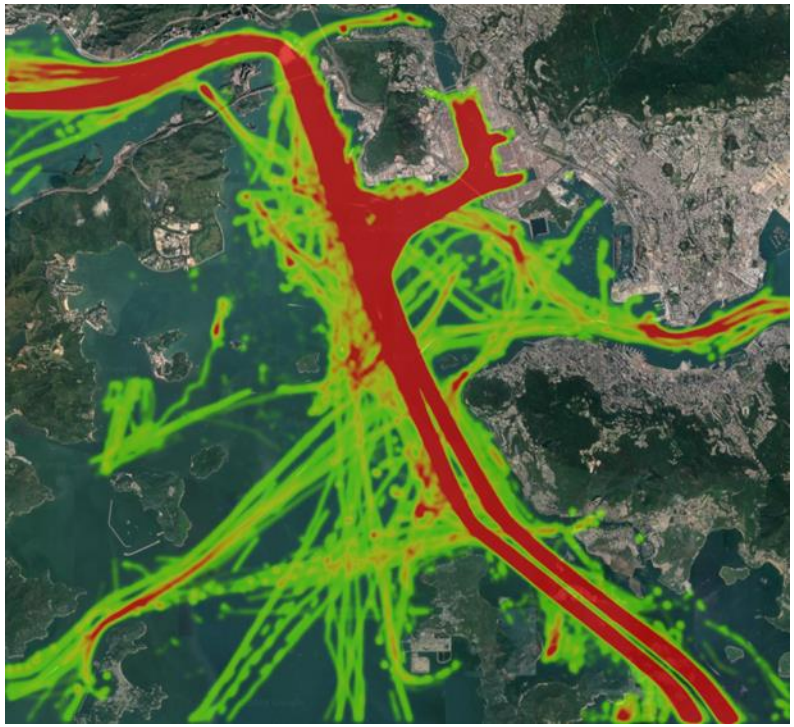
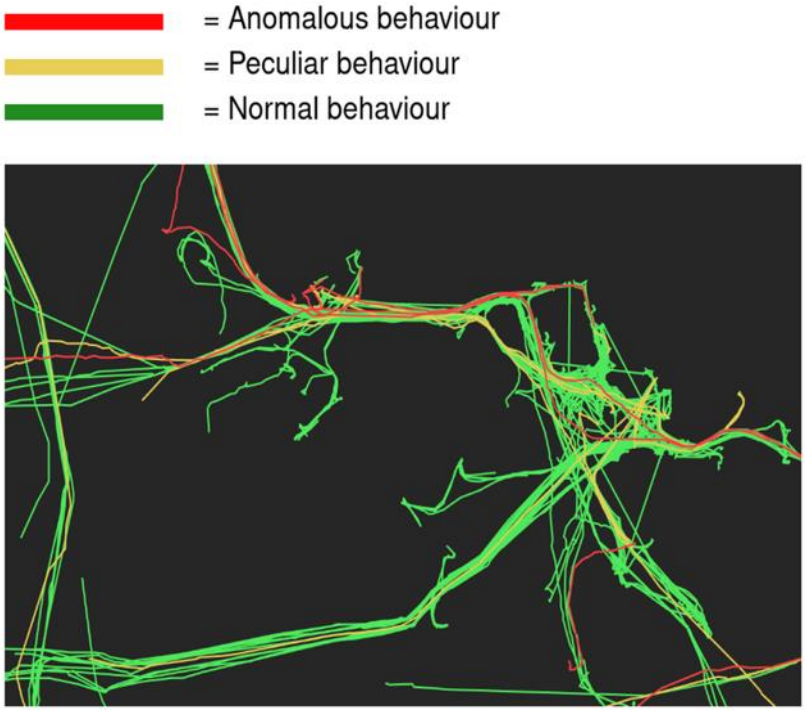
Anomaly Detection / Density Prediction





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Thanks for listening!

Questions ?

Contact:
info@saabmaritime.com