



**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**

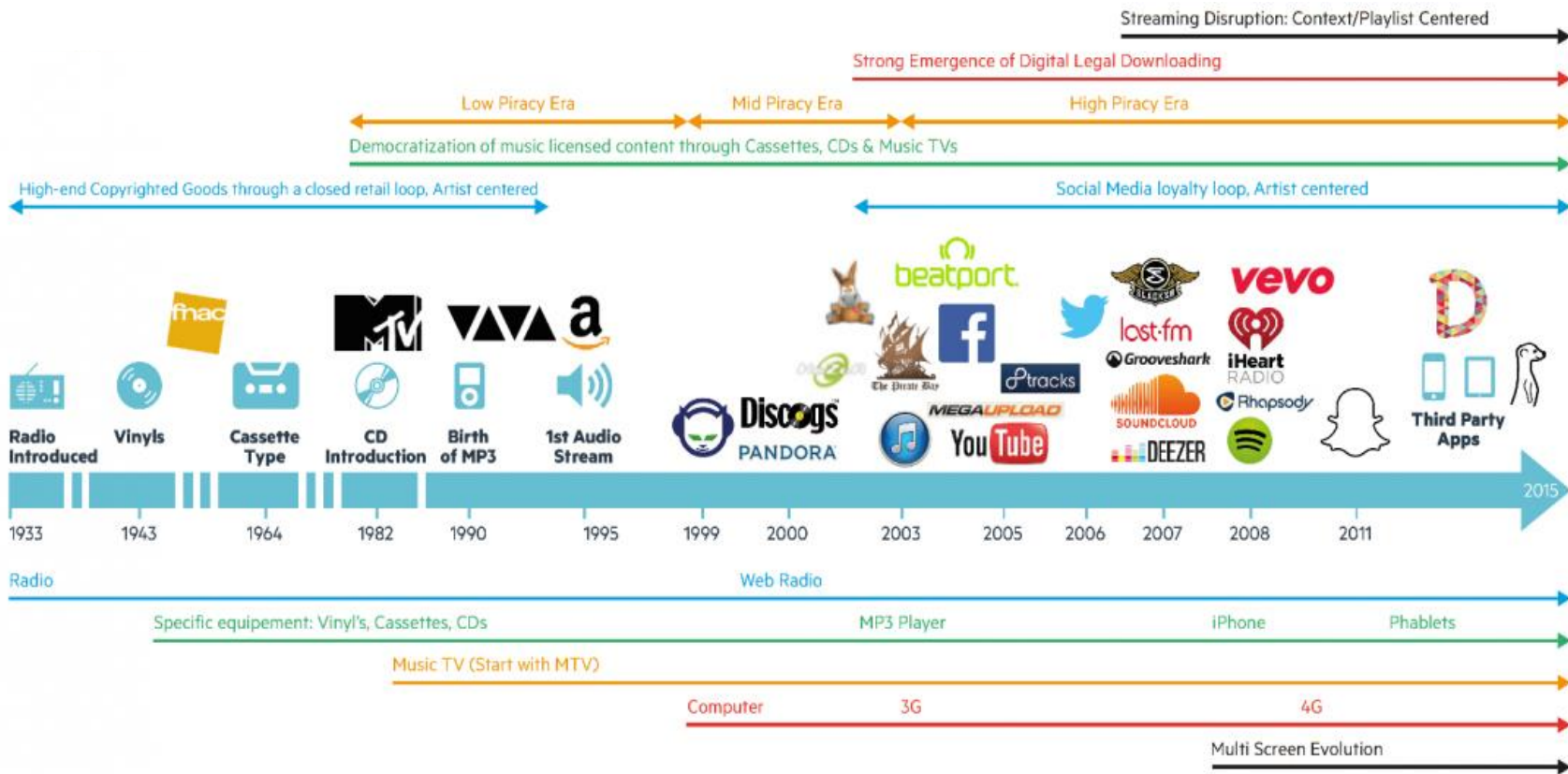
Dave Thomas.





# Global Trends in Technology

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# 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

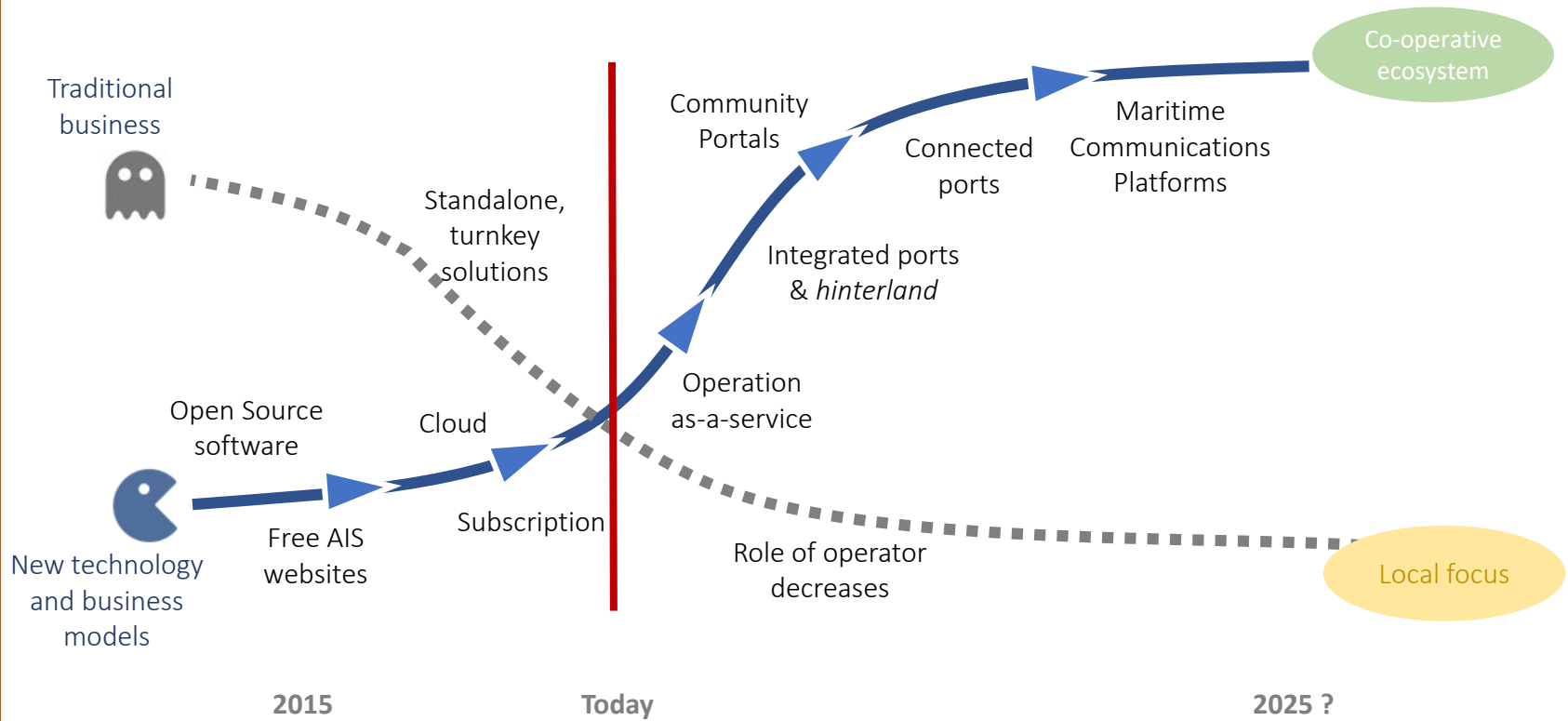
Vessel control centers instead of VTS

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	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	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	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	Semi-Autonomous	Majority of Operational Tasks
4	Full Autonomy	All operational tasks perform by an automated system under all defined conditions.	Full Autonomous	Full Autonomous	All Operational Tasks



# Evolution of Business

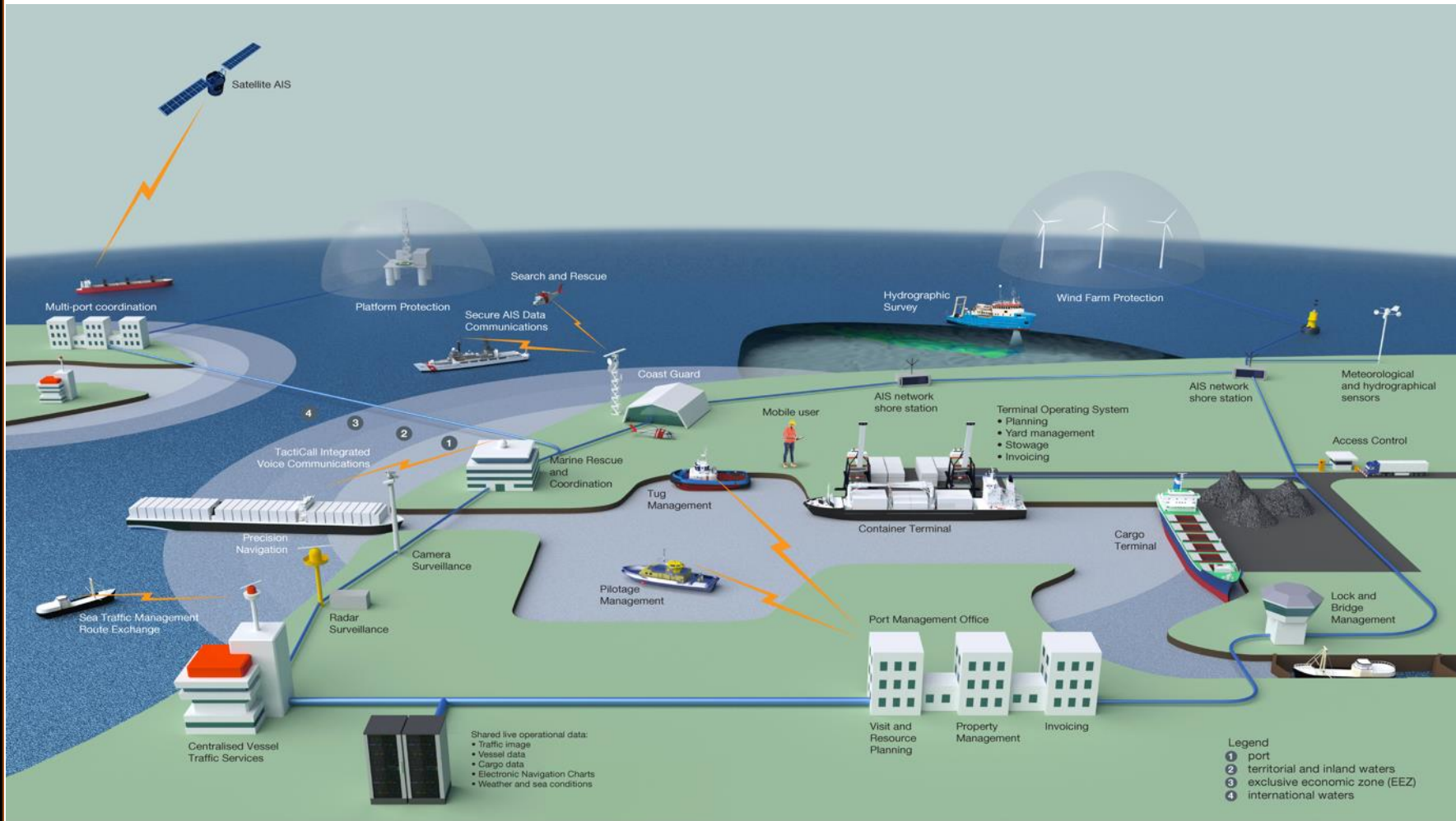
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# Eco-system: Fairway to Freeway

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# Machine Learning and AI

AI means that computers can process information on their own and advise on the situation or solution on their own

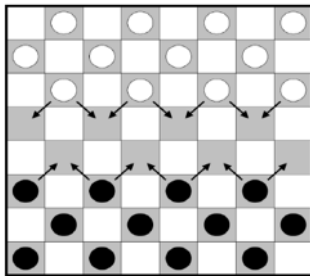
One of the biggest benefits of AI or Machine Learning is the ability to make accurate predictions based on historical patterns.



# Machine Learning evolution

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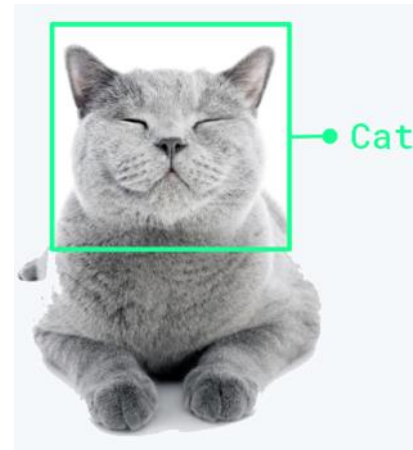
*AI*



*Machine Learning*



*Deep Learning*



1950

1980

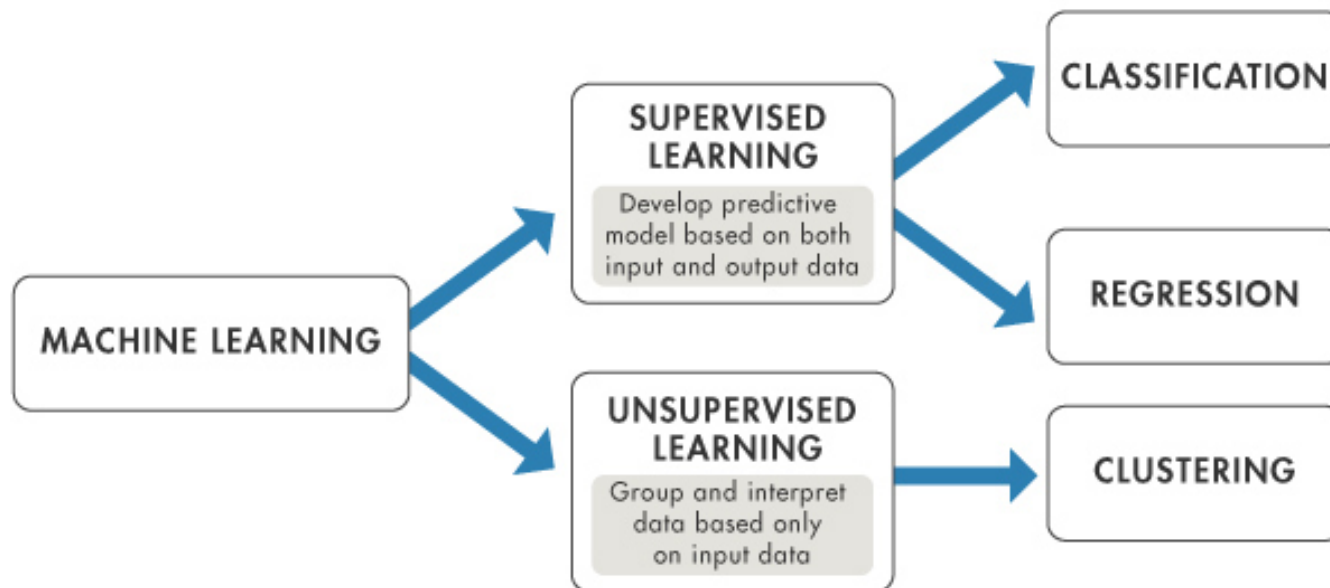
2010





# 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**

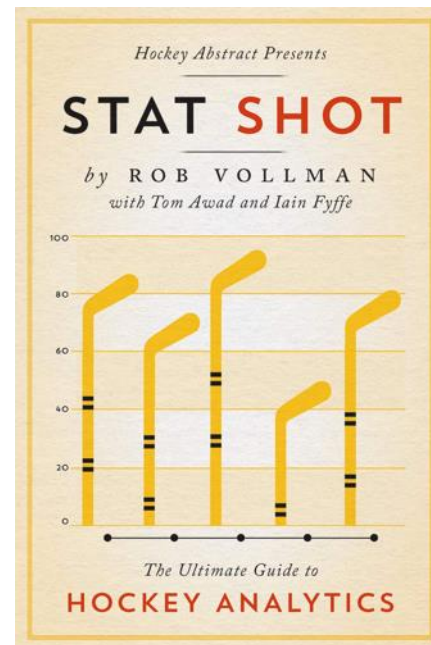


# Unsupervised Learning

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

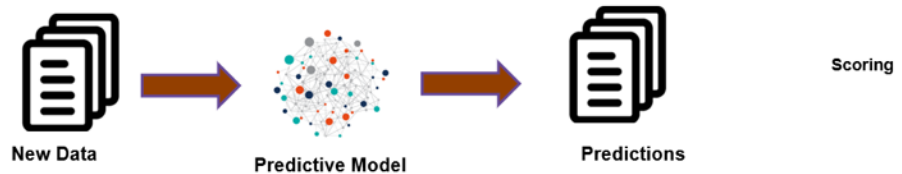
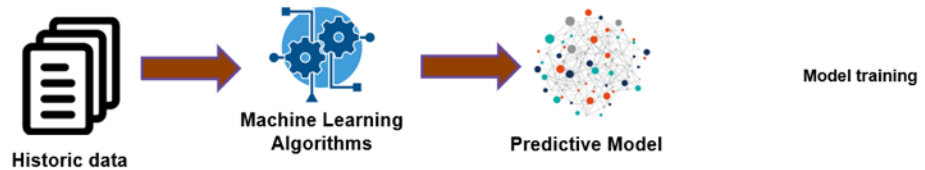
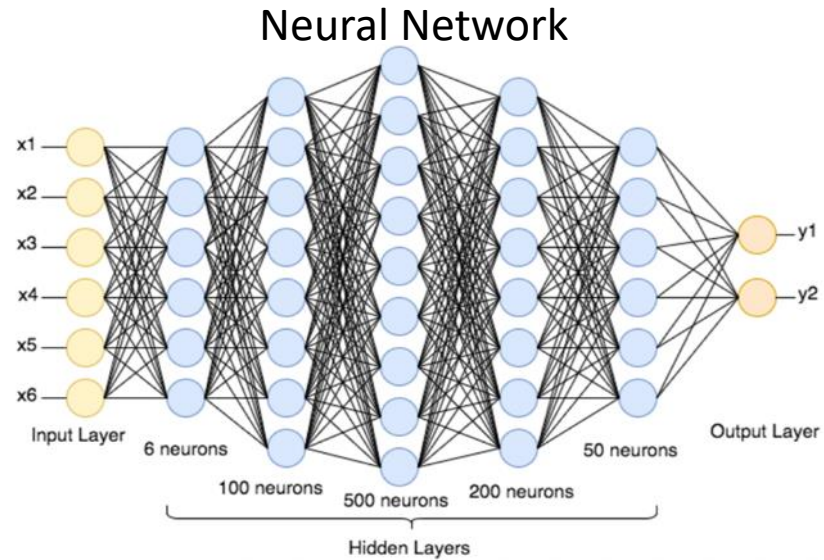
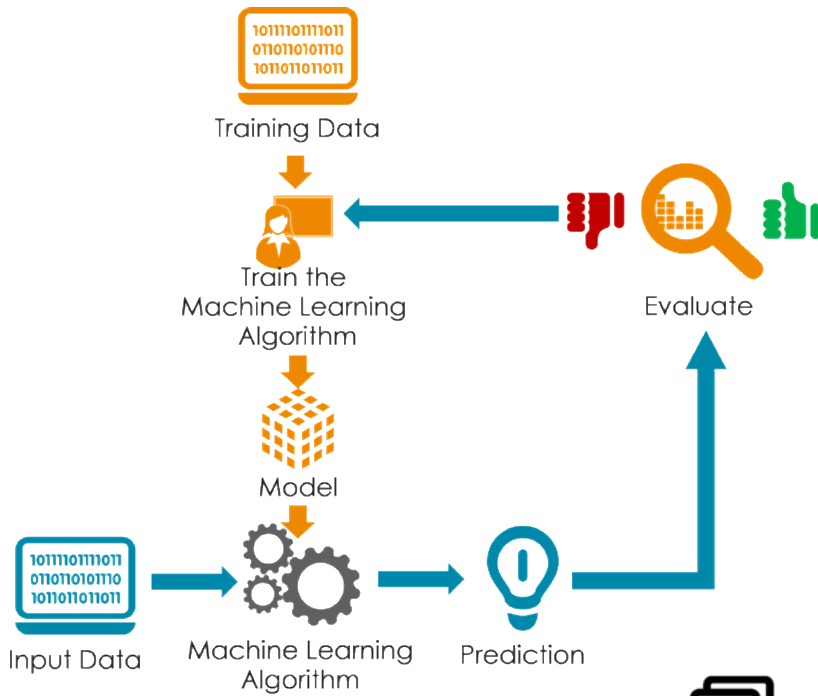


Credit Card Fraud Detection



# Machine Learning basics

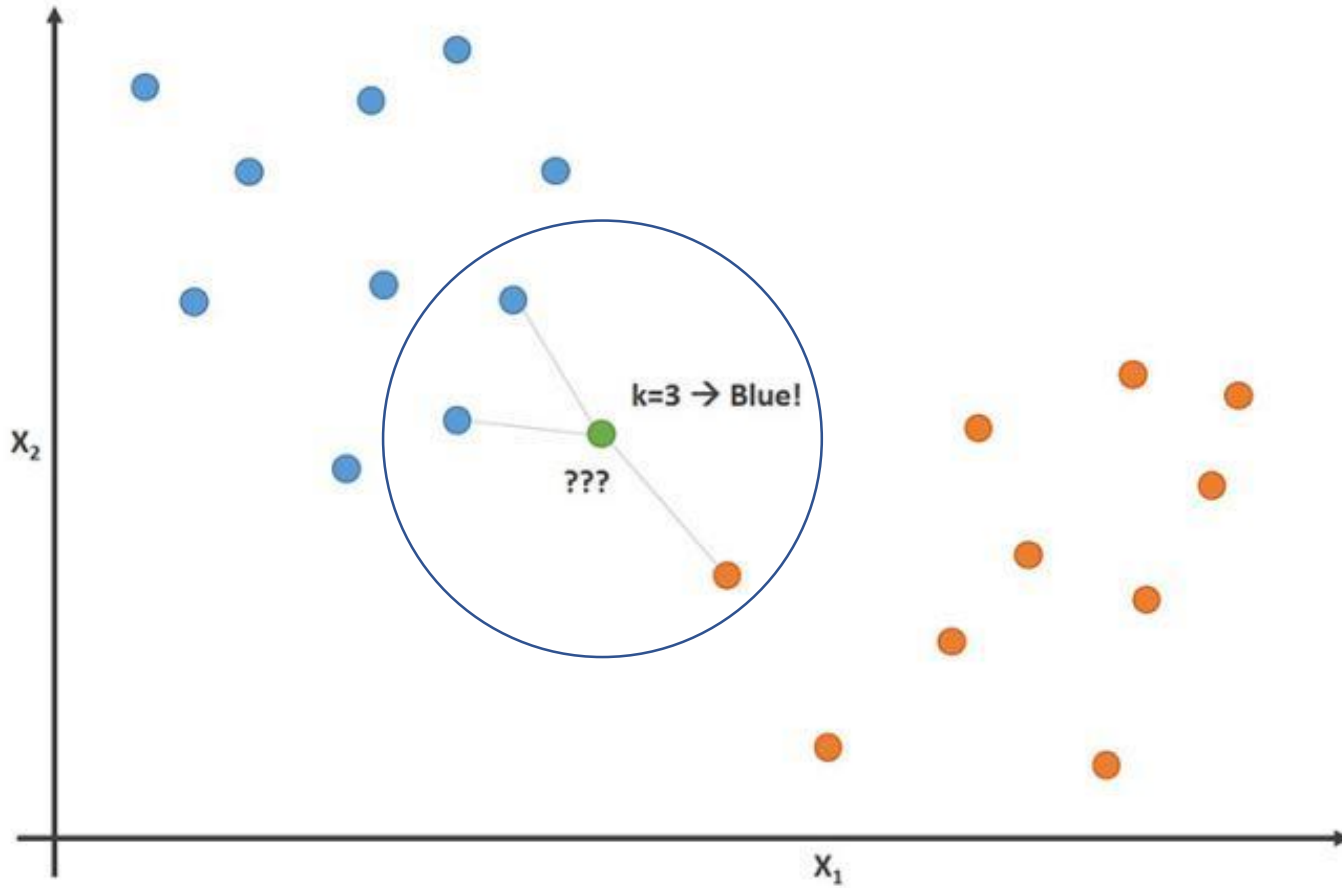
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# K-Nearest Neighbors

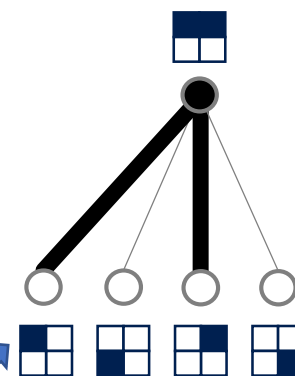
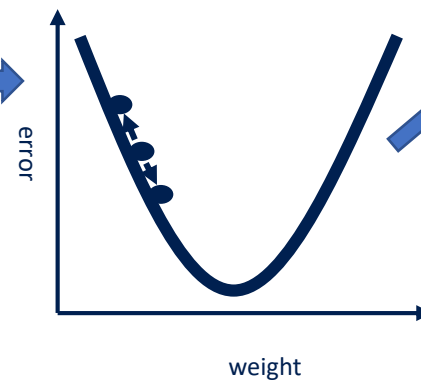
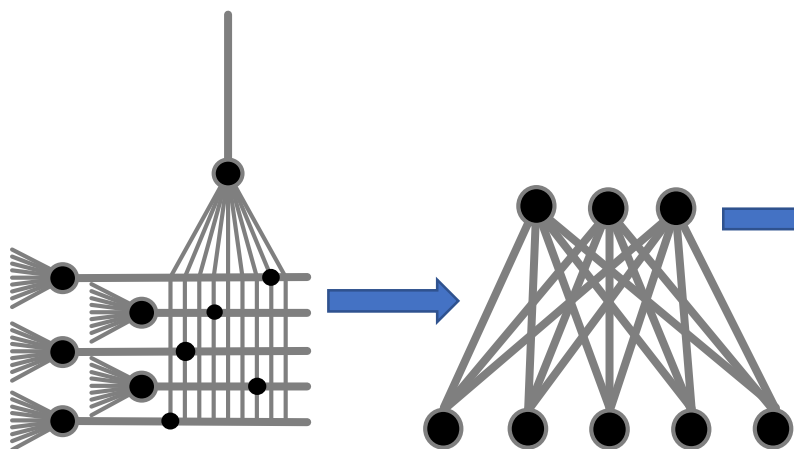
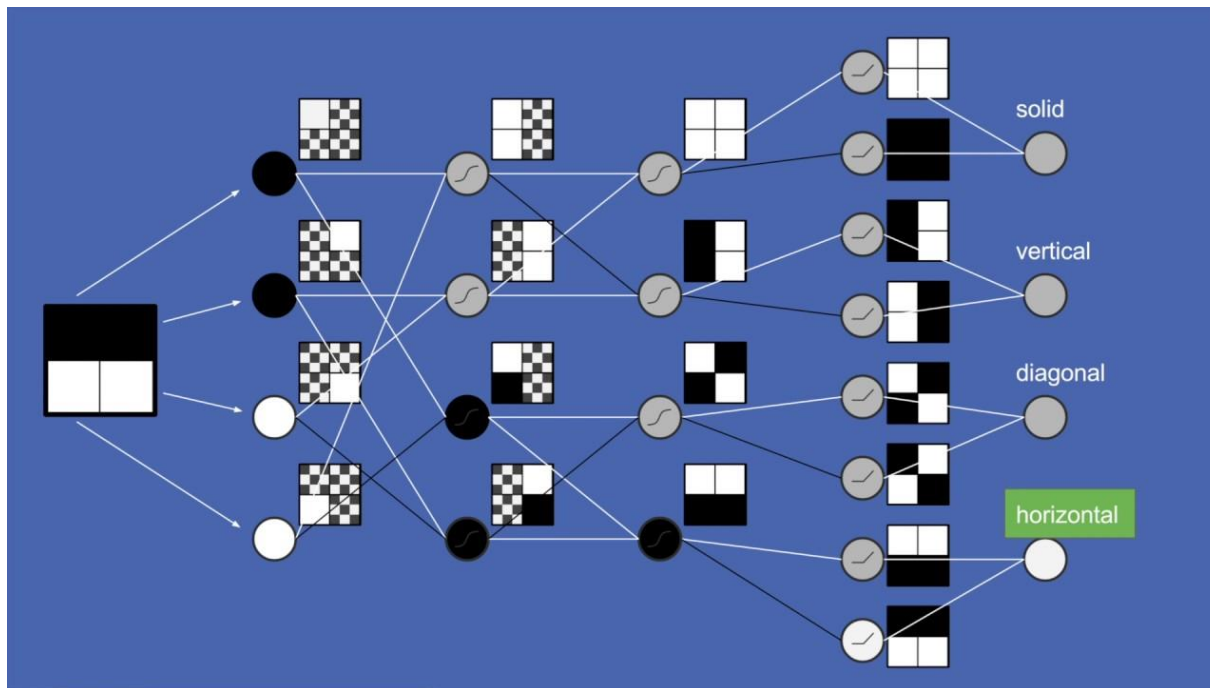
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# Convolutional Neural Network

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# 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)



# Teaching with Data

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Is that a good vacation spot?

Not enough data





# Teaching with Data

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Barely enough data





# Teaching with Data

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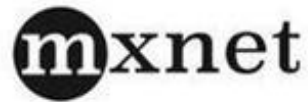


Enough data





# Tools / Platforms





# 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

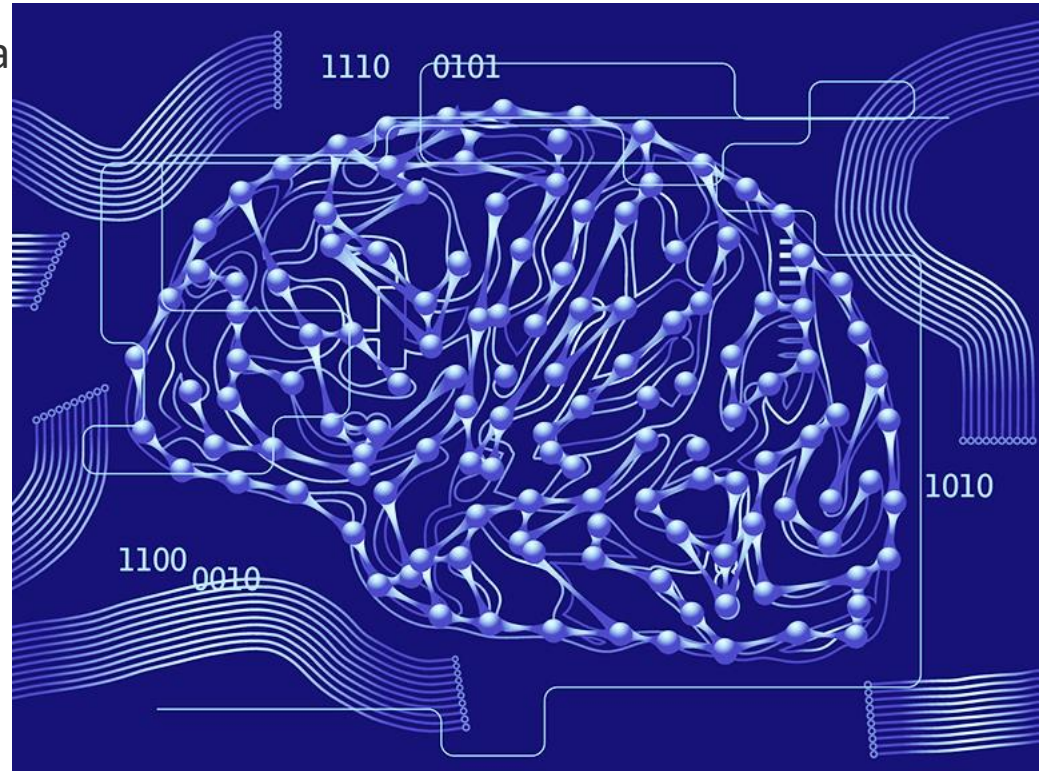
- Regulate a vessel's environmental efficiency
- Reduce unnecessary fuel consumption, greenhouse gas emissions
- Optimize terminal operations
- Help better maintain the equipment used by flagging certain milestones or identifying malfunctioning equipment
- Ensure compliance with regulations





# '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
- .....







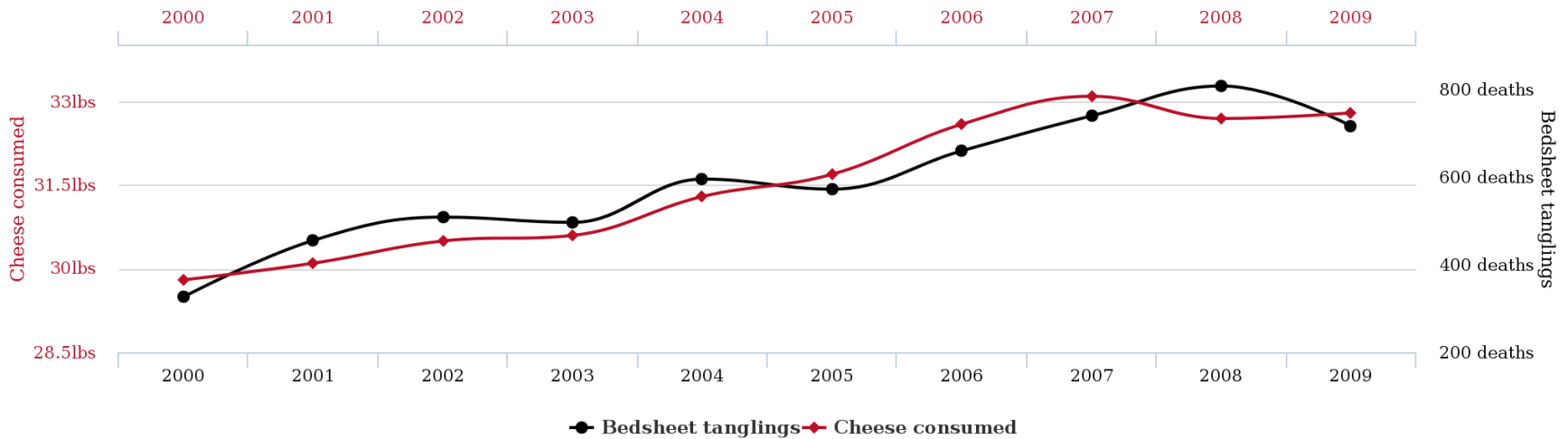
# GAPS with AI

- 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

## Per capita cheese consumption

correlates with

## Number of people who died by becoming tangled in their bedsheets



tylervigen.com



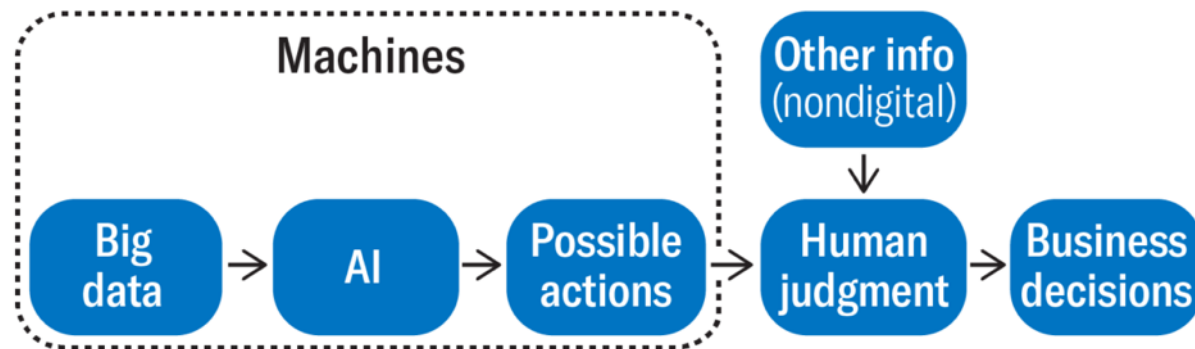
# AI and Human in combined workflow

## 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





# Real-life Application Examples

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# Collision Detection / Prediction

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# Service Planning

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**Pilotage Order #24**  
**Acquamarina**  
 Cosco - VIP

Route: **SKA-GED**  
 Start Time: **13.06.19 05:50**  
 Status: **Draft**  
 Bill Status:

---

Order Info

Violations

**Resource Plan**

Jobs/Events

Delays

DMA Report

Remarks

Documents

TBD: Audit

27/17:38

13.06.19

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Pilotage Order #24						[B]SKA - GED[B]																	

**Resource Plan** Add Approve Plan Reject Plan

13.06.19	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
<b>Pilotage</b>	PL	T(pt)	T(a)	T(c)		PX(d)	P (Acquamarina)																	
<b>Boat Trip #51</b>	PL					PX(d)	P (Acquamarina)												SL	SL	SL			
<b>Boat Trip #53</b>	PL					PX(d)	P (Acquamarina)												SB	SB				

**Assign - Pilot - Qualified - On Duty**

13.06.19	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
TEST EMPLOYEE	R																							
	AL																							
	PL						PX(d)	P																PX(d)
	R																							
	AL																							
	PL		T(t)	T(a)	T(t)		PX(d)	P																PX(d)

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Saab KleinPort 7.1.0.12695





# Route/ETA Prediction

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The screenshot displays a port operation system interface. At the top, a browser window shows the URL `localhost:8001/webx/Default.aspx` and the SAAB logo. The main interface is divided into two parts: a map and a table.

The map shows a geographical view of Sweden with a blue line indicating a predicted shipping route. The route starts at the port of Gäddede, passes through Gäddede, Åre, and Stockholm, and ends at Turku. The map includes labels for various cities and regions in Sweden, such as Gäddede, Åre, Stockholm, and Turku.

The table, titled "Berth Occupancy", provides a detailed view of the port's capacity. It lists the vessel name, berth, and the scheduled arrival and departure times for each vessel.

Vessel / Berth	Arrival	Departure
<b>AS OF 18/07/15 00:00</b>		
<b>PRINCESS NATALIE</b> (Dry Bulk) / Dock A	17/07/15 10:00	19/07/15 08:00
<b>PULA</b> (Crude Oil & Petroleum Products) / Dock D	17/07/15 14:00	21/07/15 02:15
<b>BKA DISCOVERY</b> (Other Trading, nes) / Dock C	17/07/15 18:00	21/07/15 22:30
<b>MAGDALENA OLDENDORFF</b> (Dry Bulk) / Dock B	17/07/15 18:00	20/07/15 21:00





# Port CDM

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Service Company	Status	Decline Reason	Service Remarks
<b>Confirmation Log Info</b>			
Running Log Time	Type	Description	Updated By
2015/09/29 15:43	Schedule	[Test] VTSO changes: Invoicing Body, Schedule Time	[Test] VTSO
2015/09/30 11:04	Schedule	[Test] VTSO changes: Schedule Time	[Test] VTSO
2015/09/30 11:20	Schedule	[Test] VTSO changes: Schedule Time	[Test] VTSO
0/2015 21:45	Schedule	[Test] VTSO changes: Sch Time: 2015-09-30 03:00	[Test] VTSO
2015/09/30 12:03	Schedule	[Test] VTSO changes: Sch Time: 2015-09-30 03:00	[Test] VTSO
2015/09/30 12:04	Schedule	[Test] VTSO changes: Sch Time: 2015-09-30 16:15	[Test] VTSO
2015/09/30 12:12	Pilotage	Service Confirmed	[Test] Pilot Company
2015/09/30 13:53	Schedule	[Test] VTSO changes: Sch Time: 2015-09-30 19:15	[Test] VTSO
2015/09/30 14:31	Pilotage	Service Confirmed	[Test] Pilot Company
2015/09/30 14:36	Schedule	[Test] VTSO changes: Sch Time: 2015-09-30 19:30	[Test] VTSO
1/2015 07:00	Pilotage	Service Rejected, Reason: No pilot available until 20:15	[Test] Pilot Company
2015/09/30 14:49	Stevedore	Service Rejected, Reason: Loader is broken. Back to work at 19:45	[Test] Stevedore SCRUTT

Service Type	Service Desc	Service Company	Status	Decline Reason	Service Remarks
<b>JOLANTA (DRY BULK)</b>					
<b>DEPART FROM STORMONT 5</b>		<b>10/01/2015 05:30</b>	<b>AGENT: JOHN BURKE &amp; CO. LTD.</b>		<b>CHANGE LOG</b>
PILOTAGE	DEP FROM STORMONT 5 TO SEA	BELFAST LOUGH PILOTAGE SERVICES LTD	Declined	Pilot only available from 07:00	
BOATMEN	DEP FROM STORMONT 5	D. FERRAN & SONS	Confirmed		
STEVEDORE	DEP FROM STORMONT 5	(Own Use Stevedore)	Requested		
<b>BLACK WATCH (CRUISE)</b>					
<b>ARRIVE TO STORMONT 2</b>		<b>09/30/2015 21:45</b>	<b>AGENT: JOHN BURKE &amp; CO. LTD.</b>		<b>CHANGE LOG</b>
PILOTAGE	ARR FROM SEA TO STORMONT 2	BELFAST LOUGH PILOTAGE SERVICES LTD	Confirmed		
BOATMEN	ARR TO STORMONT 2	JOHN MCLOUGHLIN & SON	Confirmed		
STEVEDORE	ARR TO STORMONT 2	SCRUTTONS NORTHERN IRELAND LTD	Confirmed		
<b>NORWEGIAN STAR (CRUISE)</b>					
<b>ARRIVE TO STORMONT 4</b>		<b>10/01/2015 07:00</b>	<b>AGENT: JOHN BURKE &amp; CO. LTD.</b>		<b>CHANGE LOG</b>
PILOTAGE	ARR FROM SEA TO STORMONT 4	BELFAST LOUGH PILOTAGE SERVICES LTD	Requested		
BOATMEN	ARR TO STORMONT 4	JOHN MCLOUGHLIN & SON	Requested		
STEVEDORE	ARR TO STORMONT 4	(Own Use Stevedore)	Requested		

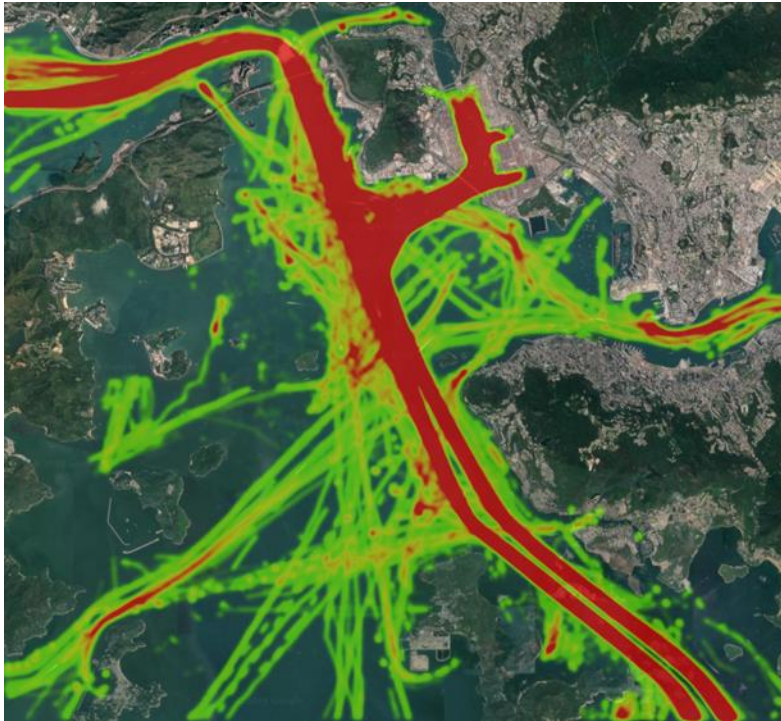







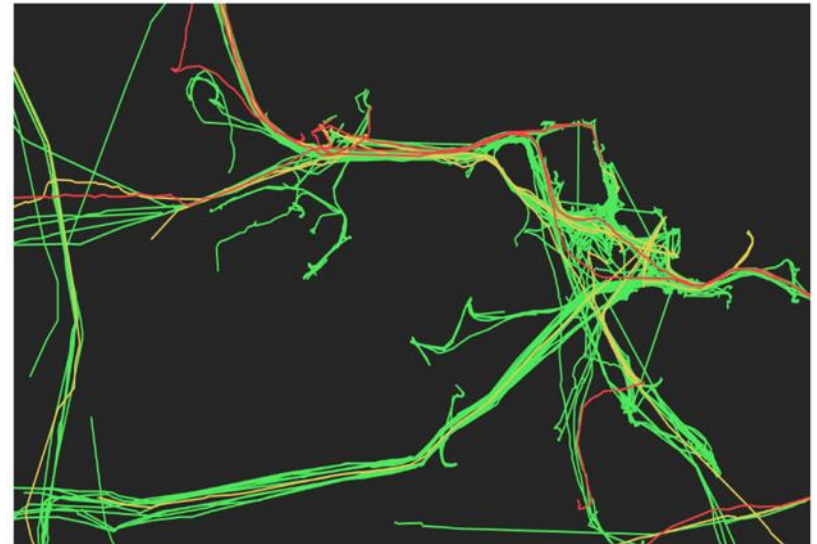


# Anomaly Detection / Density Prediction

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-  = Anomalous behaviour
-  = Peculiar behaviour
-  = Normal behaviour





Thanks for listening!

Questions ?

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Contact:

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