# Deep Learning algorithm forecasts of shellfish toxicity at site scales in coastal Maine

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# PSP and HABs


Figure 2: *Alexandrium Fundyense*, a common dinoflagellate that creates harmful blooms (NOAA)

# The Problem

Figure 1: Blue Mussels. *The Genome Compiler*

# Scientific Question

Can we create a shellfish toxicity forecast that is reliable at the site scale?

# Methods

- DMR PSP toxicity data processed by Dr. Steve Archer
- Use of site ID's
- Neural Network, a deep learning tool

# What is deep learning?

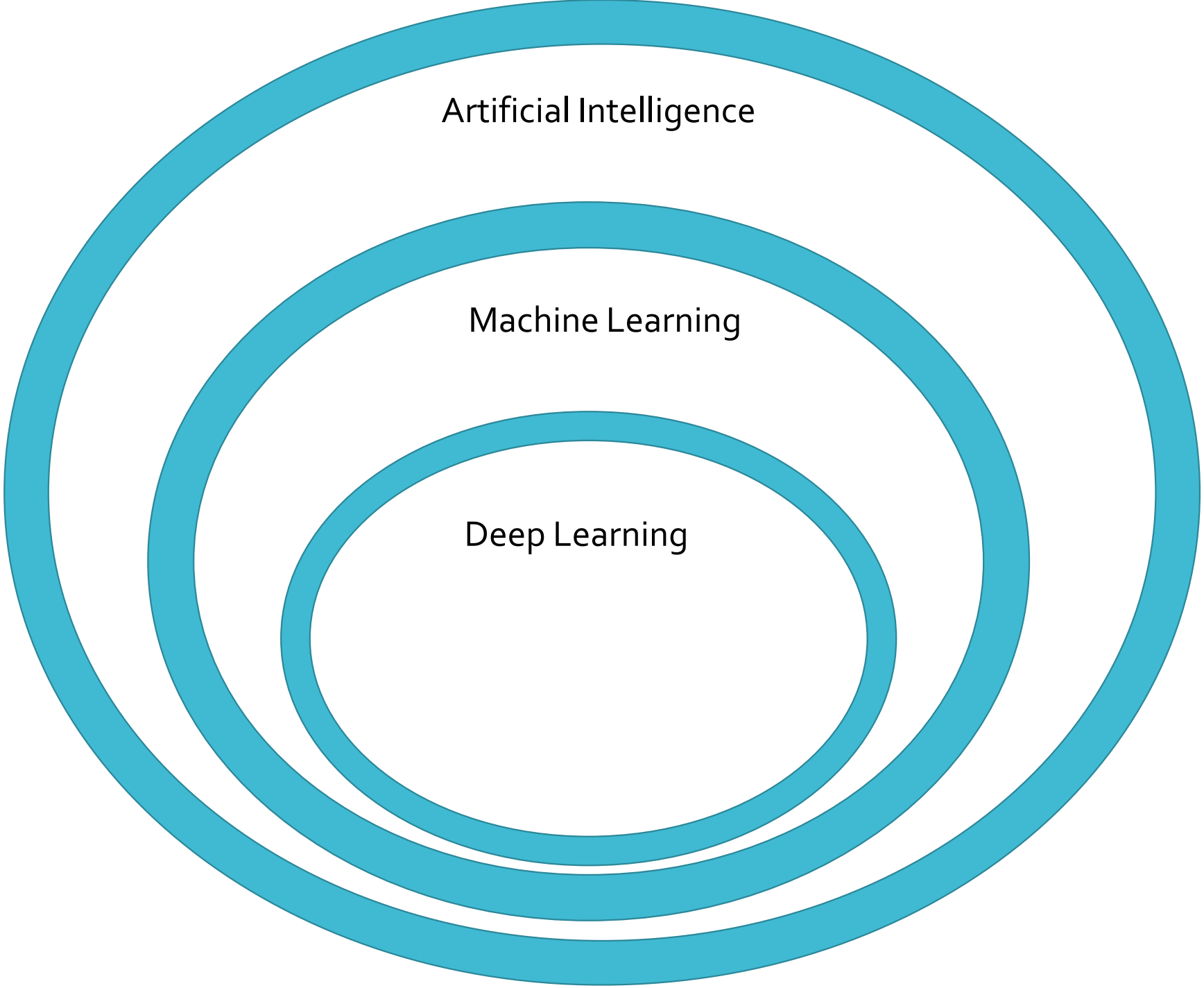



Figure 3: Modified: Figure 1.1 Artificial Intelligence, machine learning, and deep learning. *Deep Learning With R*

# Neural Networks

Figure 4: Visual of Artificial intelligence. *Neural Networks are changing the World. What are they?* Graham Templeton. Extreme Tech.

# Machine learning for forecasts

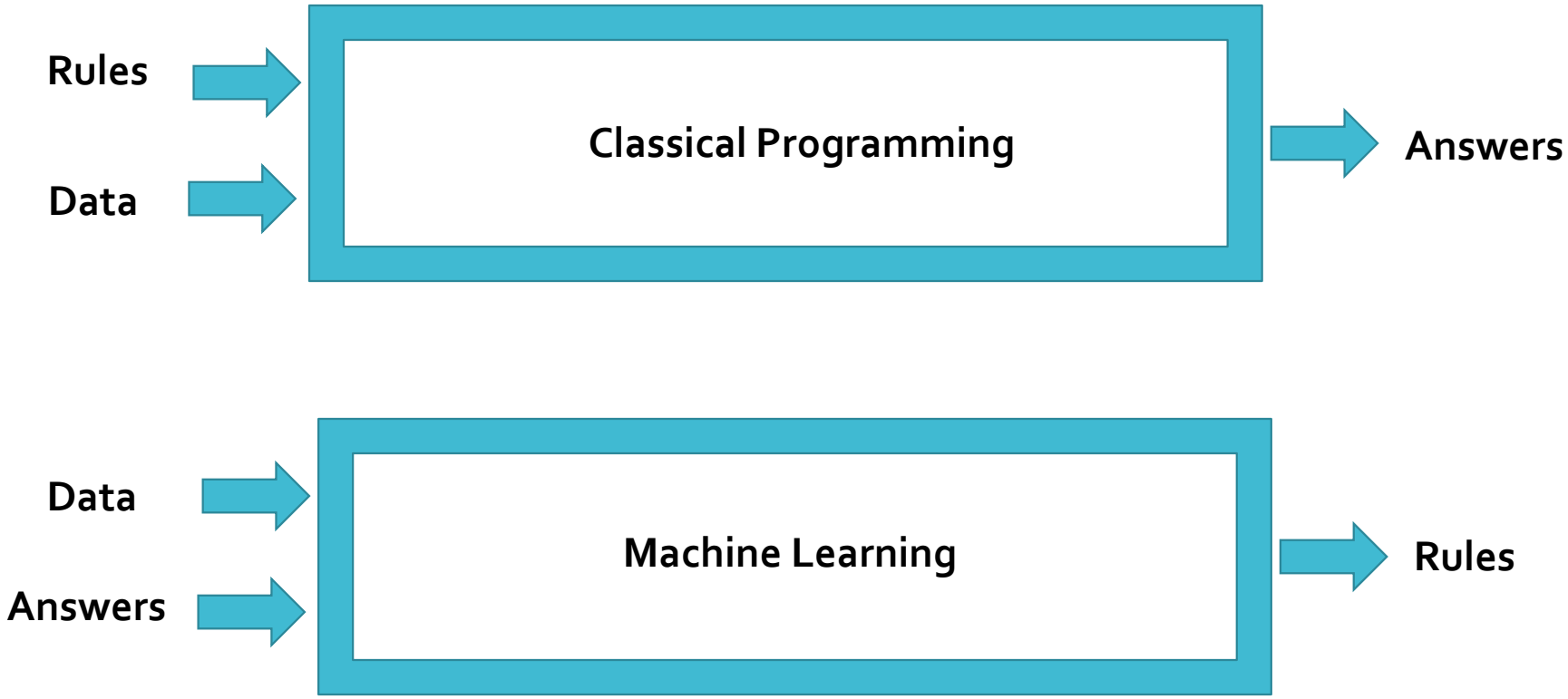
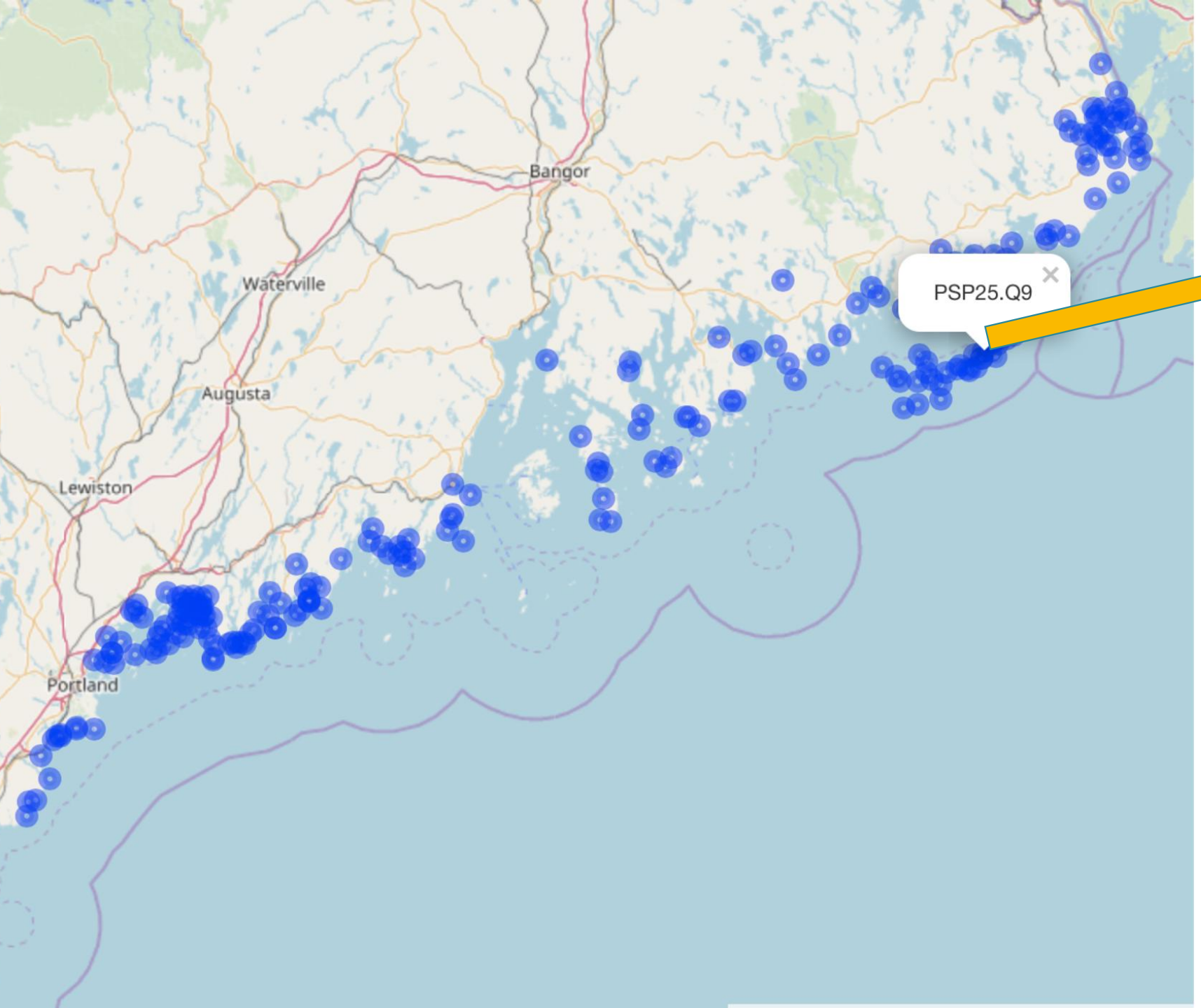
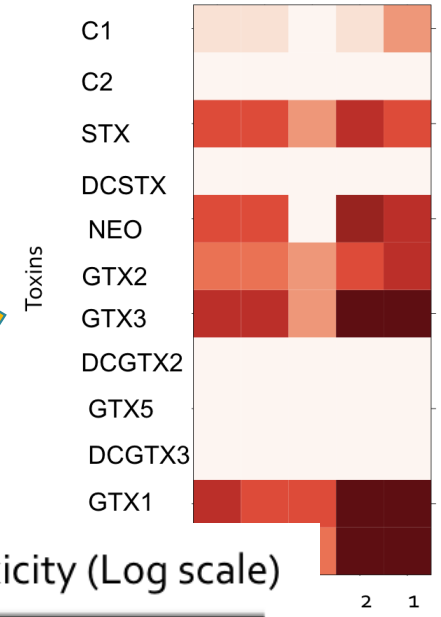
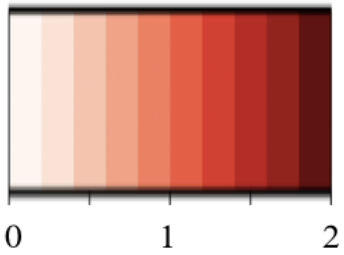



Figure 5: Modified: Figure 1.2 Machine learning: a new programming paradigm. *Deep Learning With R*

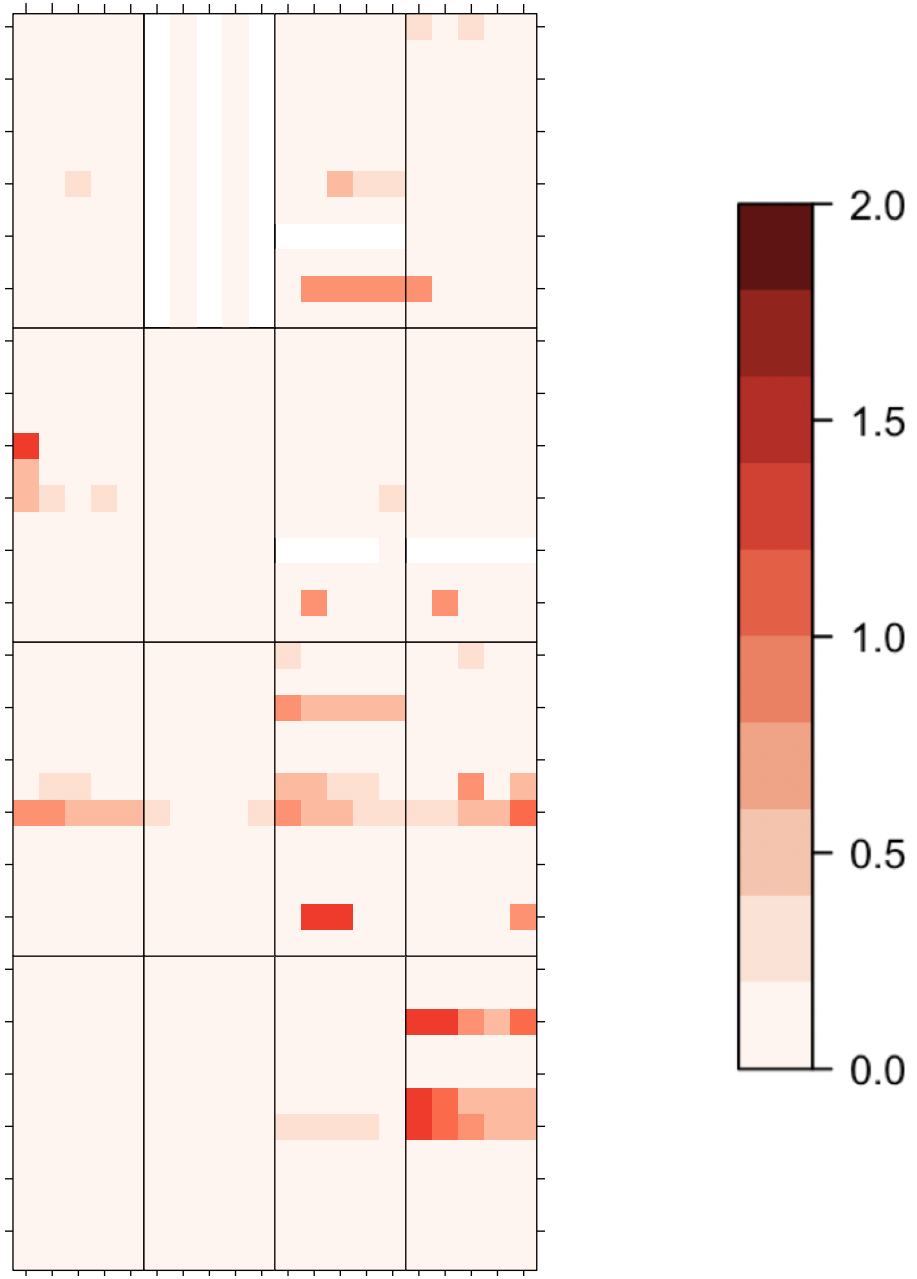

Bangor
Waterville
Augusta
Lewiston
Portland
PSP25.Q9


C1
C2
STX
DCSTX
NEO
GTX2
GTX3
DCGTX2
GTX5
DCGTX3
GTX1
Toxins
2
1
Back


Toxicity (Log scale)
0
1
2

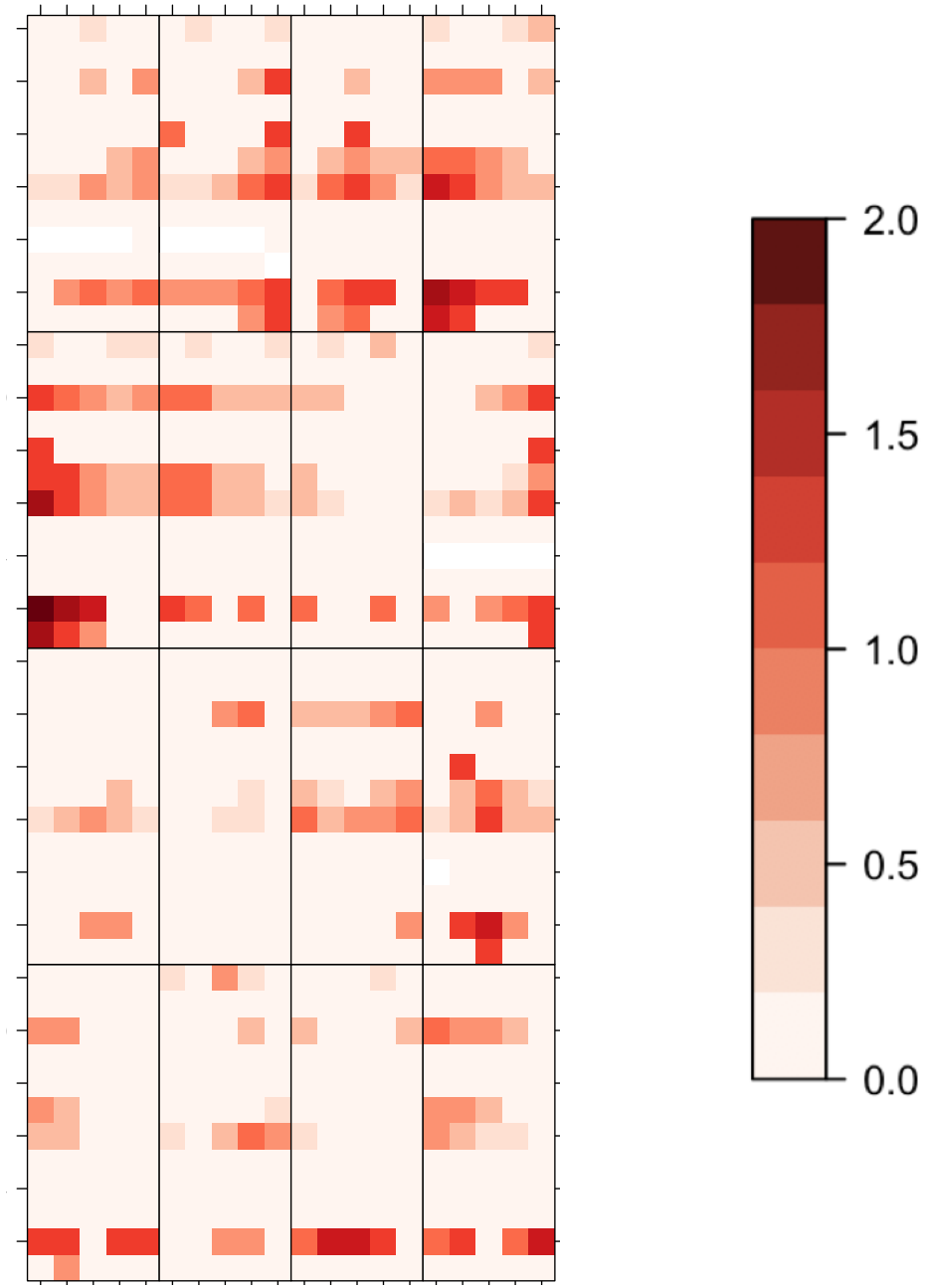
# What is “it” seeing?

Level 0



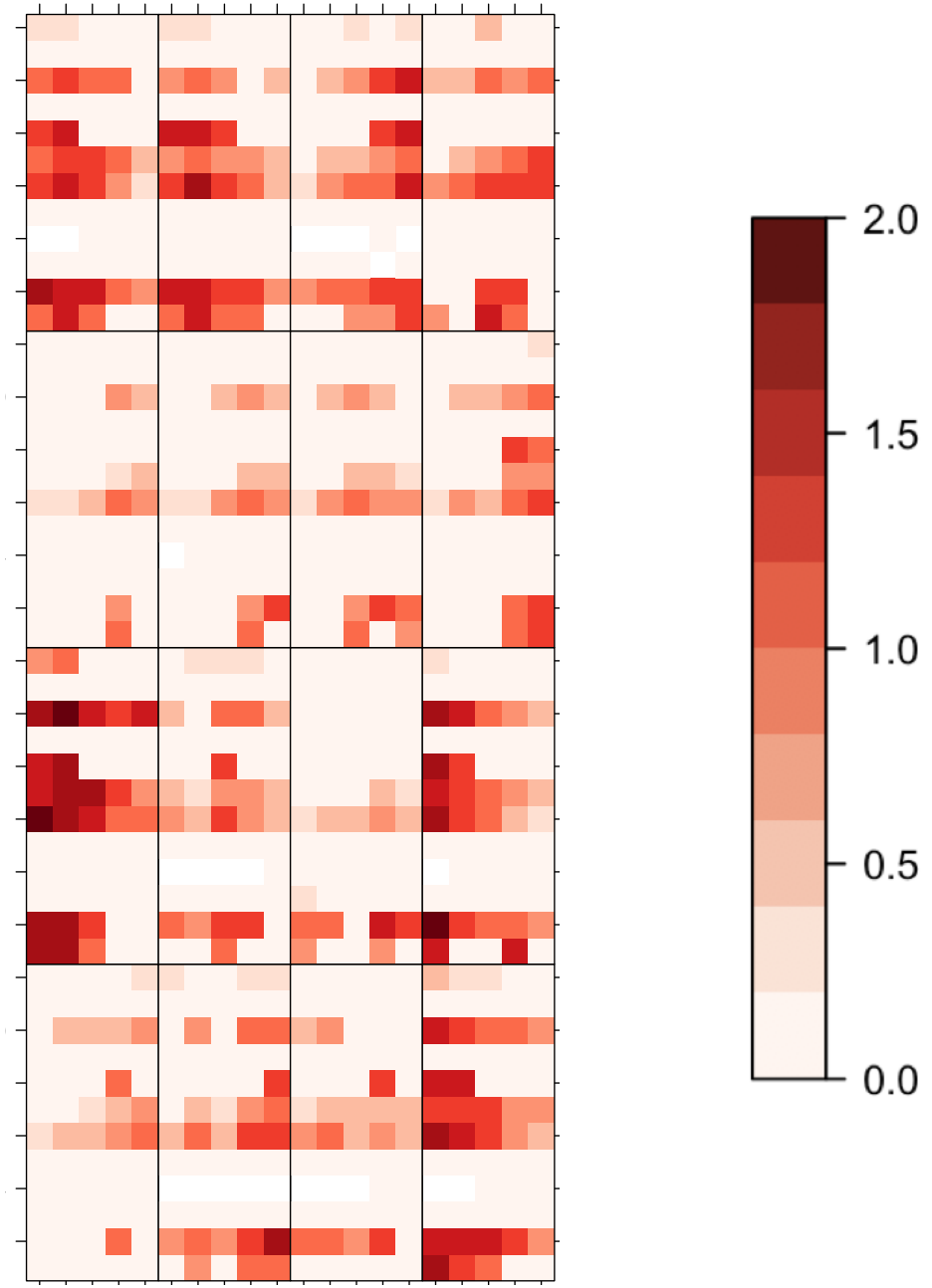
# What is “it” seeing?

Level 1



# What is “it” seeing?

Level 2



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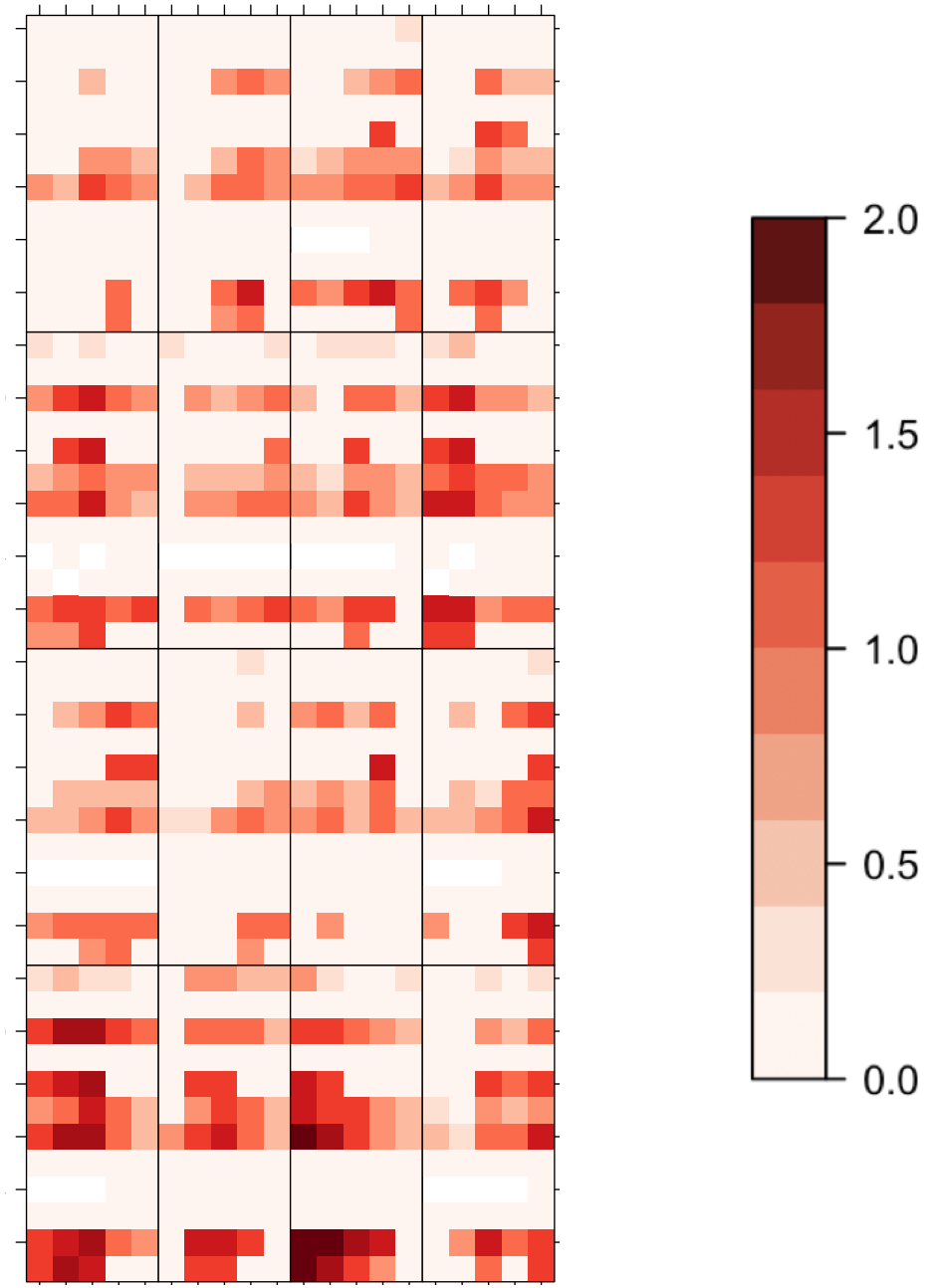
Level 3



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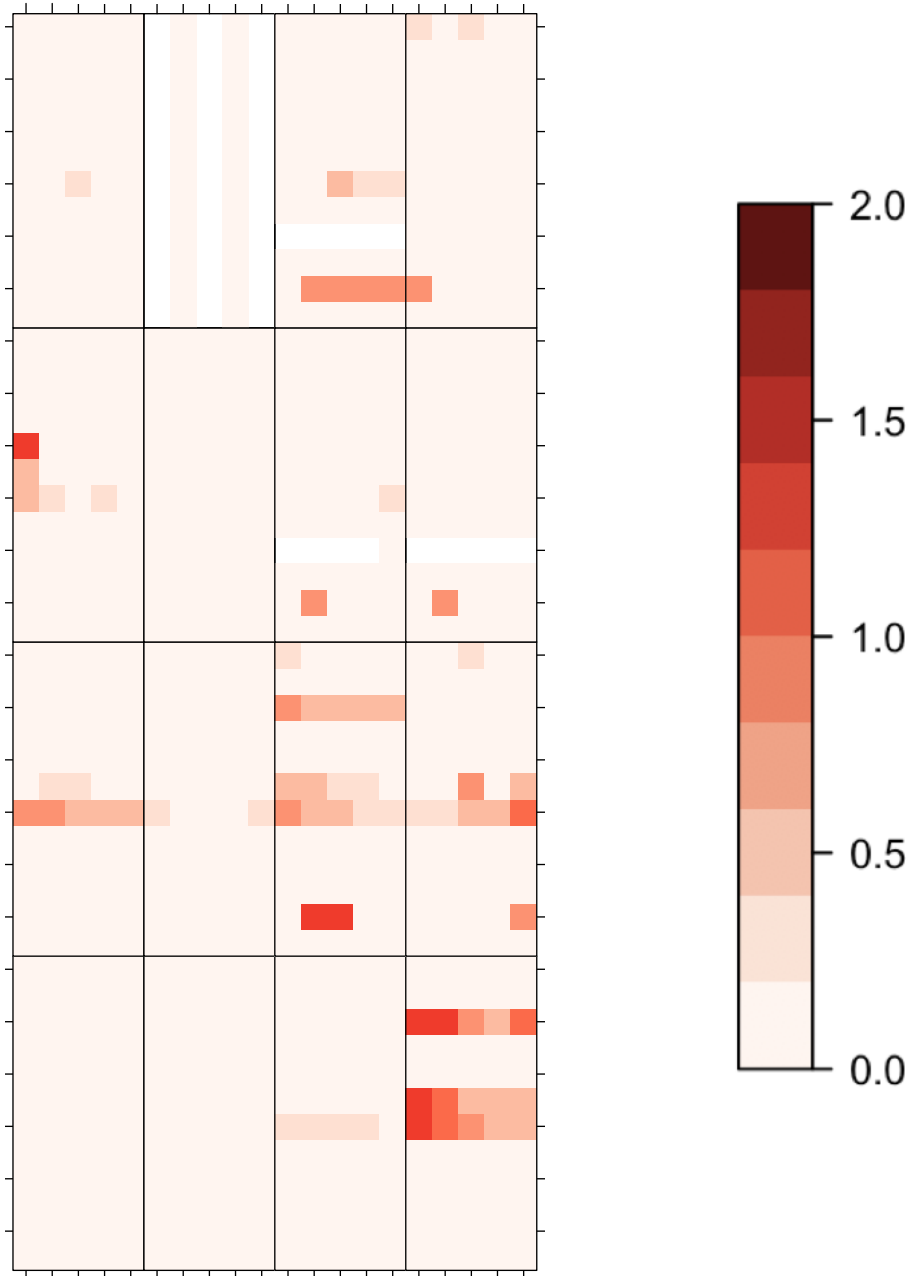

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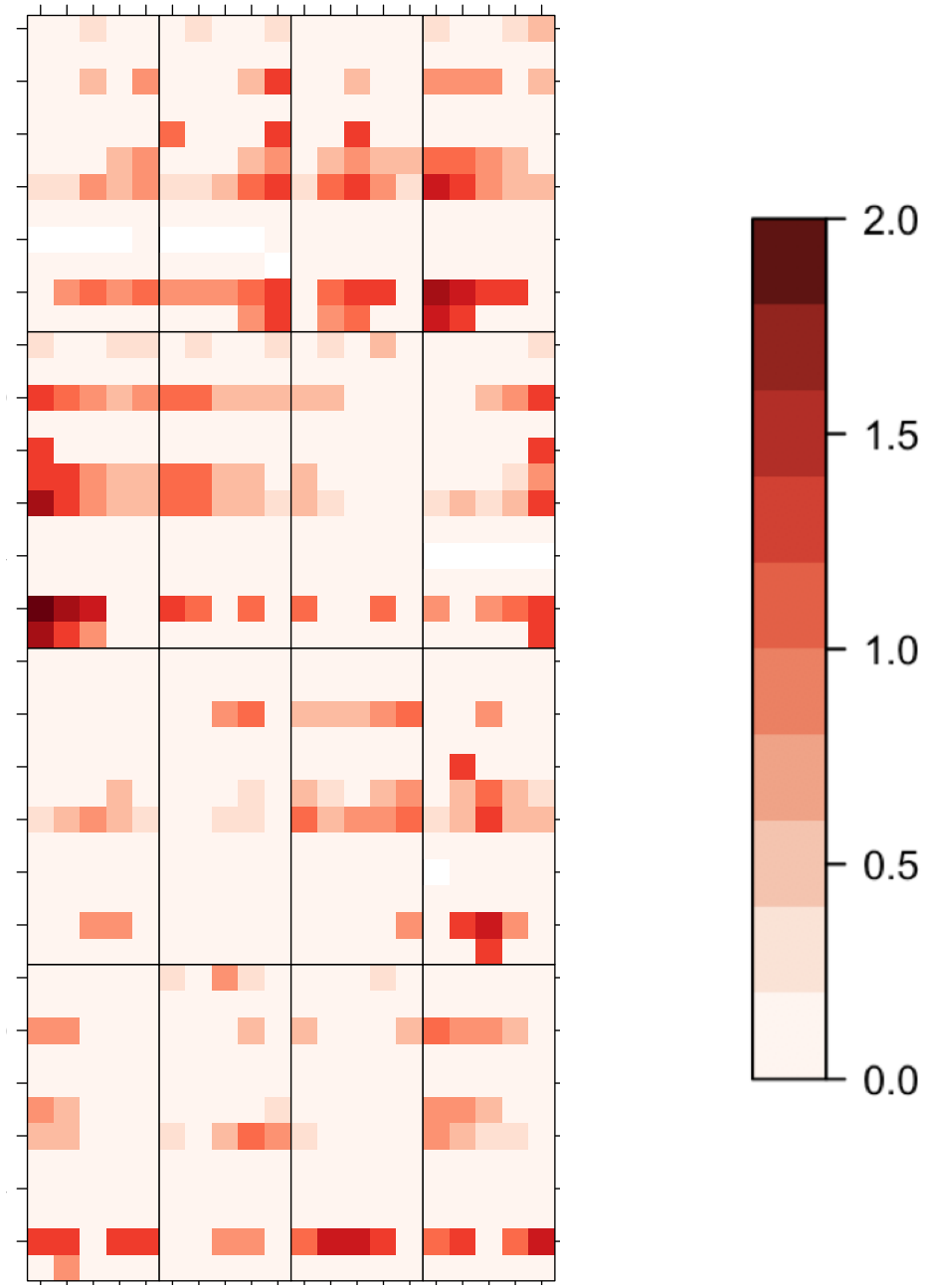

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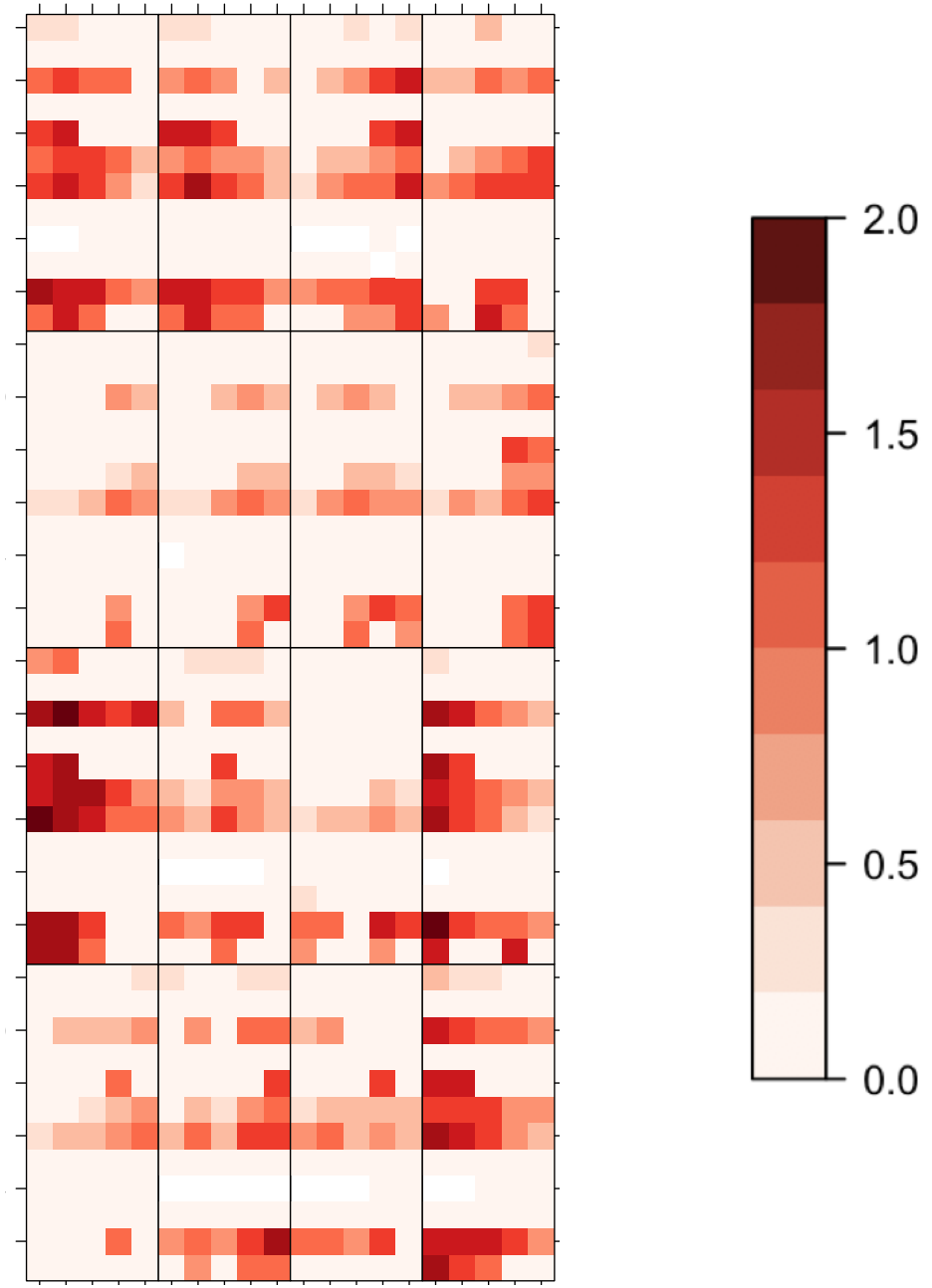

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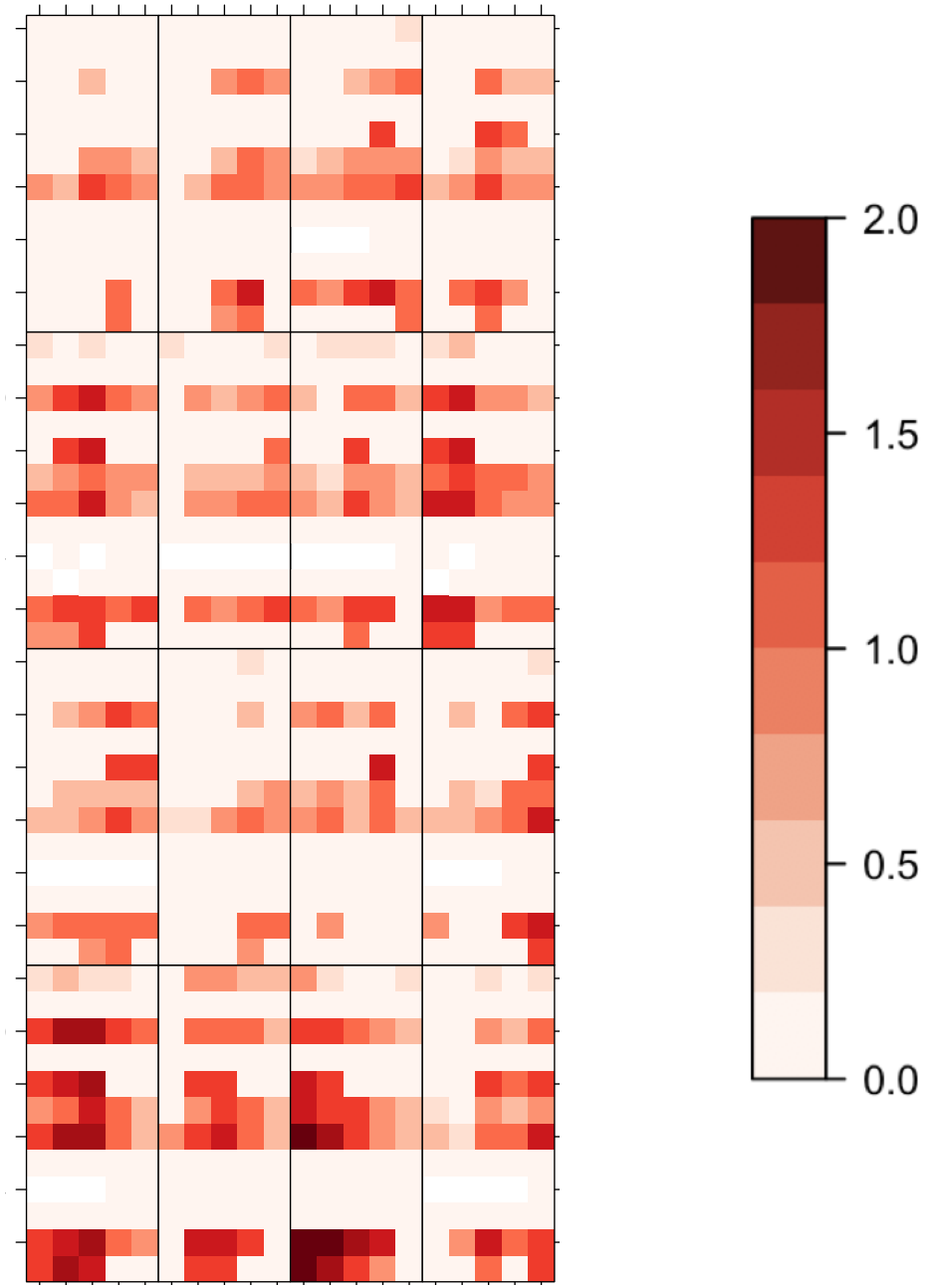
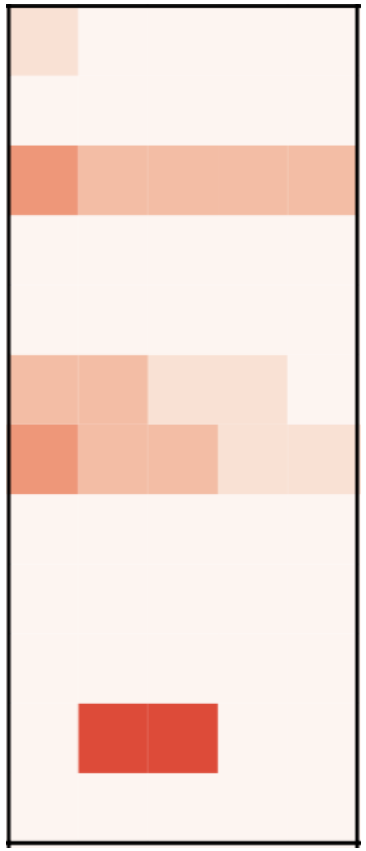
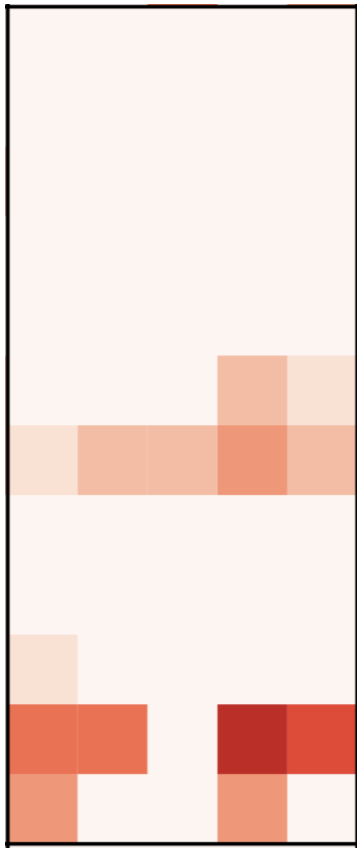
Level 3



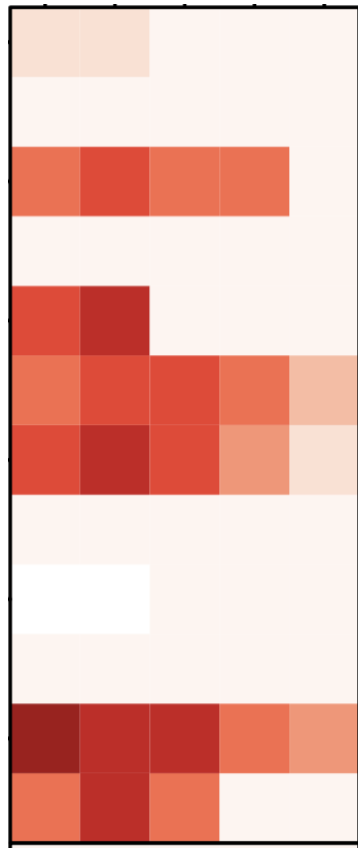
# Quiz Time!



0

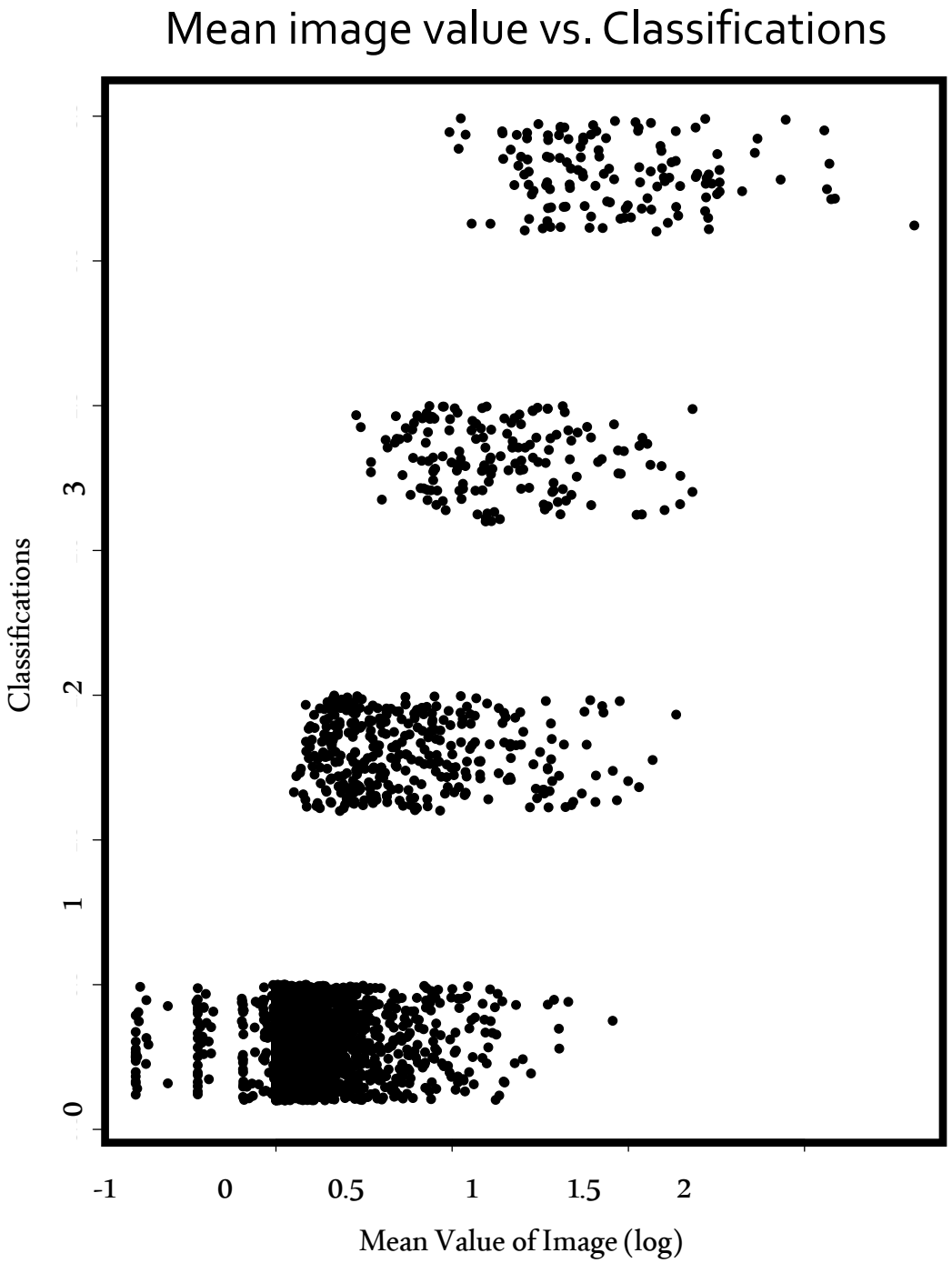


2



2

# Why so difficult to distinguish?




0 = 0-10 µg per 100g tissue
1= 10-30 µg
2 = 30-80 µg
3 = 80+ (Closure)

Figure 6:Mean value of images vs. known Labels.

# Current Predictive Power

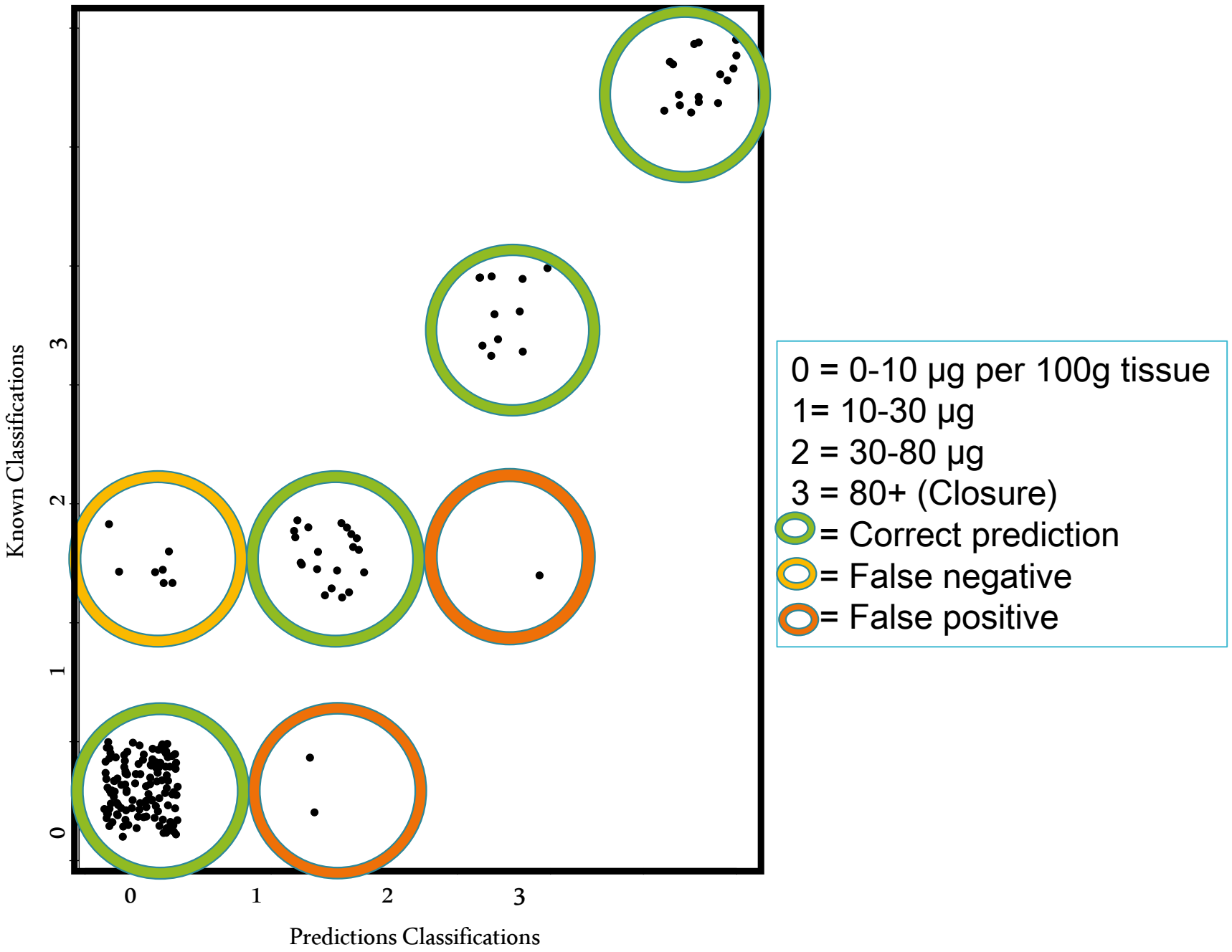



Figure 7: Predictions vs. known Labels. 2014-2016 data to predict 2017.

# Current Predictive Power

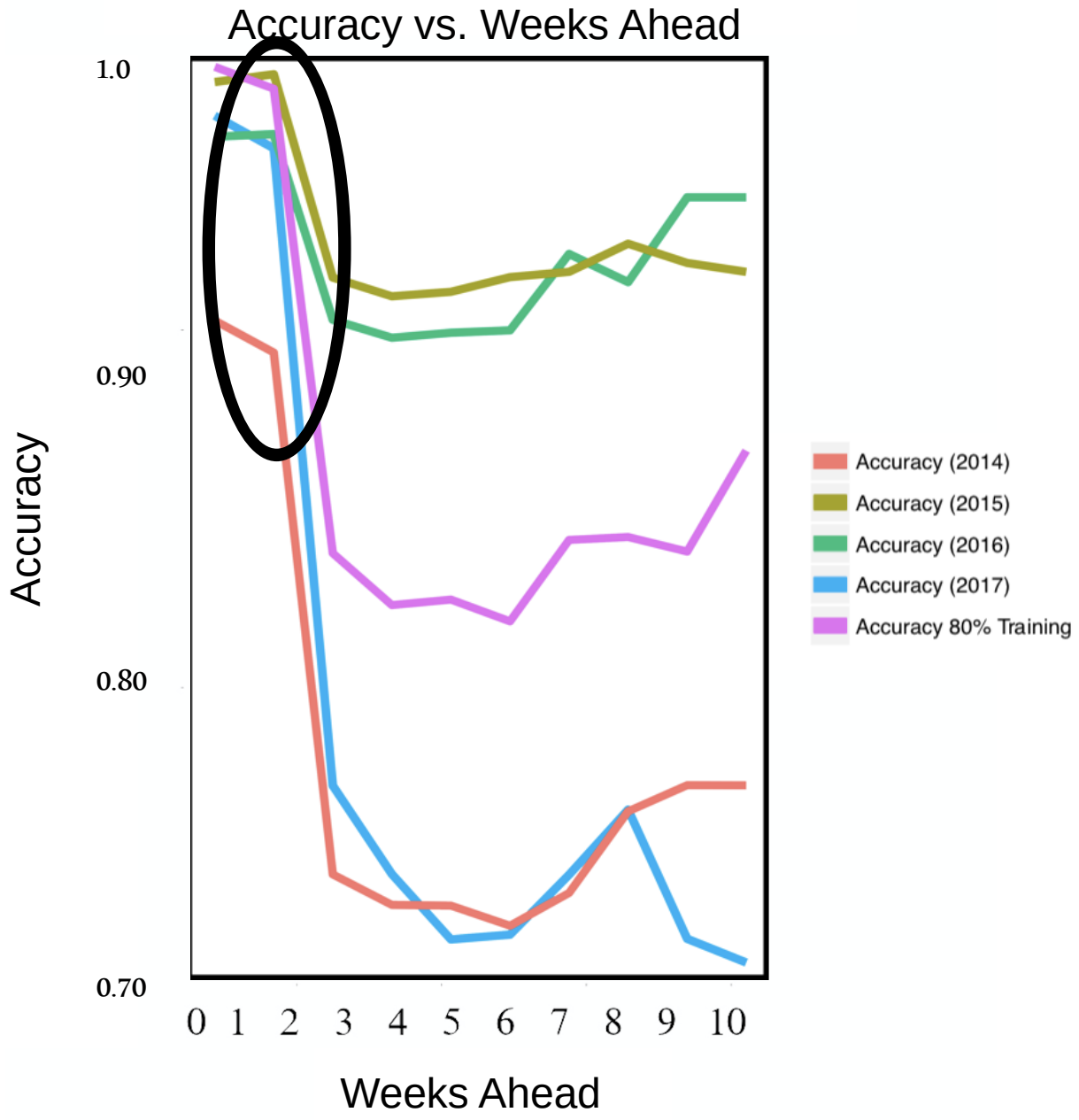



Figure 8:Weeks ahead vs Accuracy.

# Past Data Only

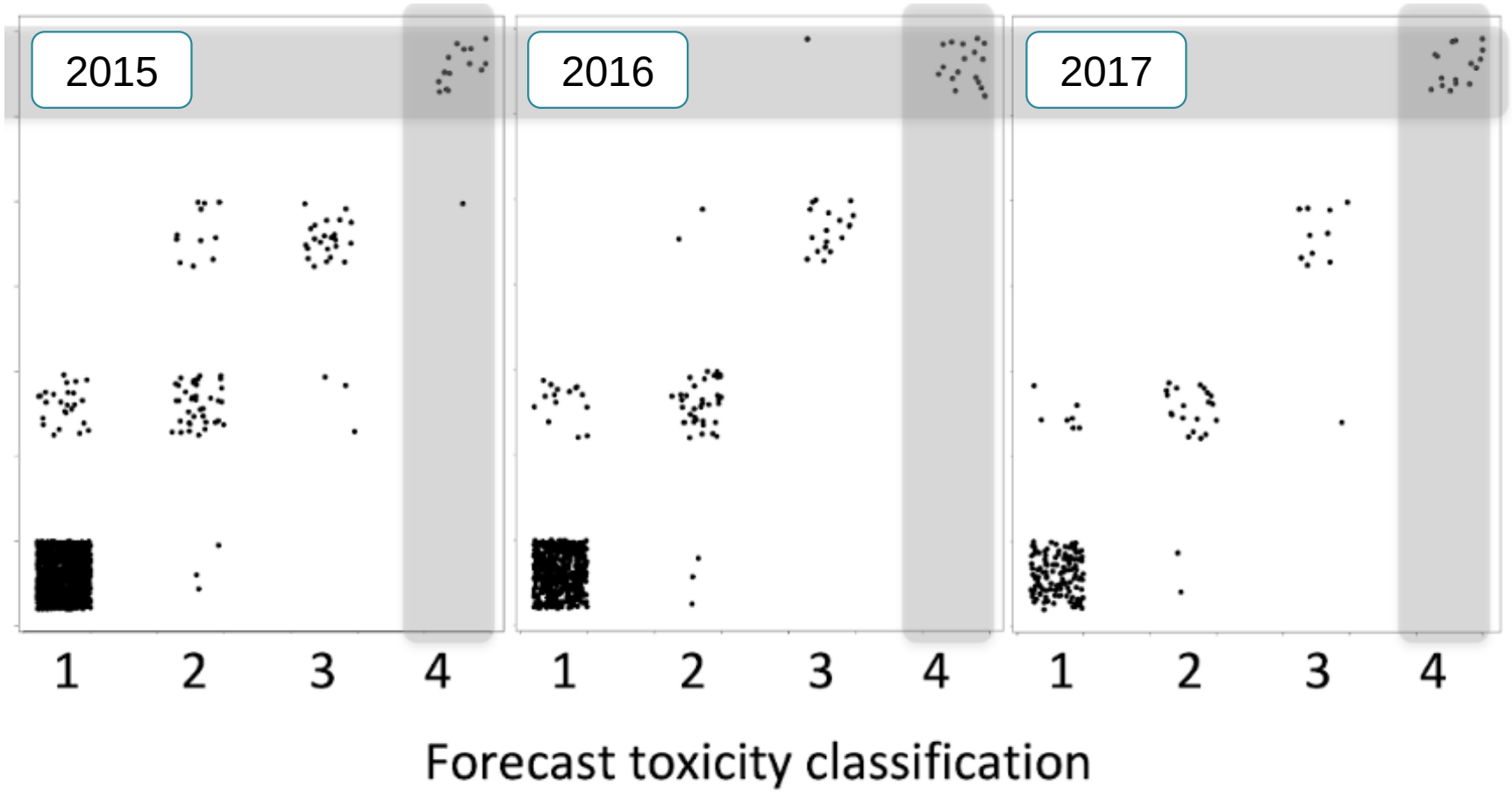



Figure 9: Forecast using past data only.

# Further Research

- Data layers
- Unpacking the “black box”
- Subsets of toxins
- Expand regionally
- Any ideas?

# How can Neural Networks aid ecology?

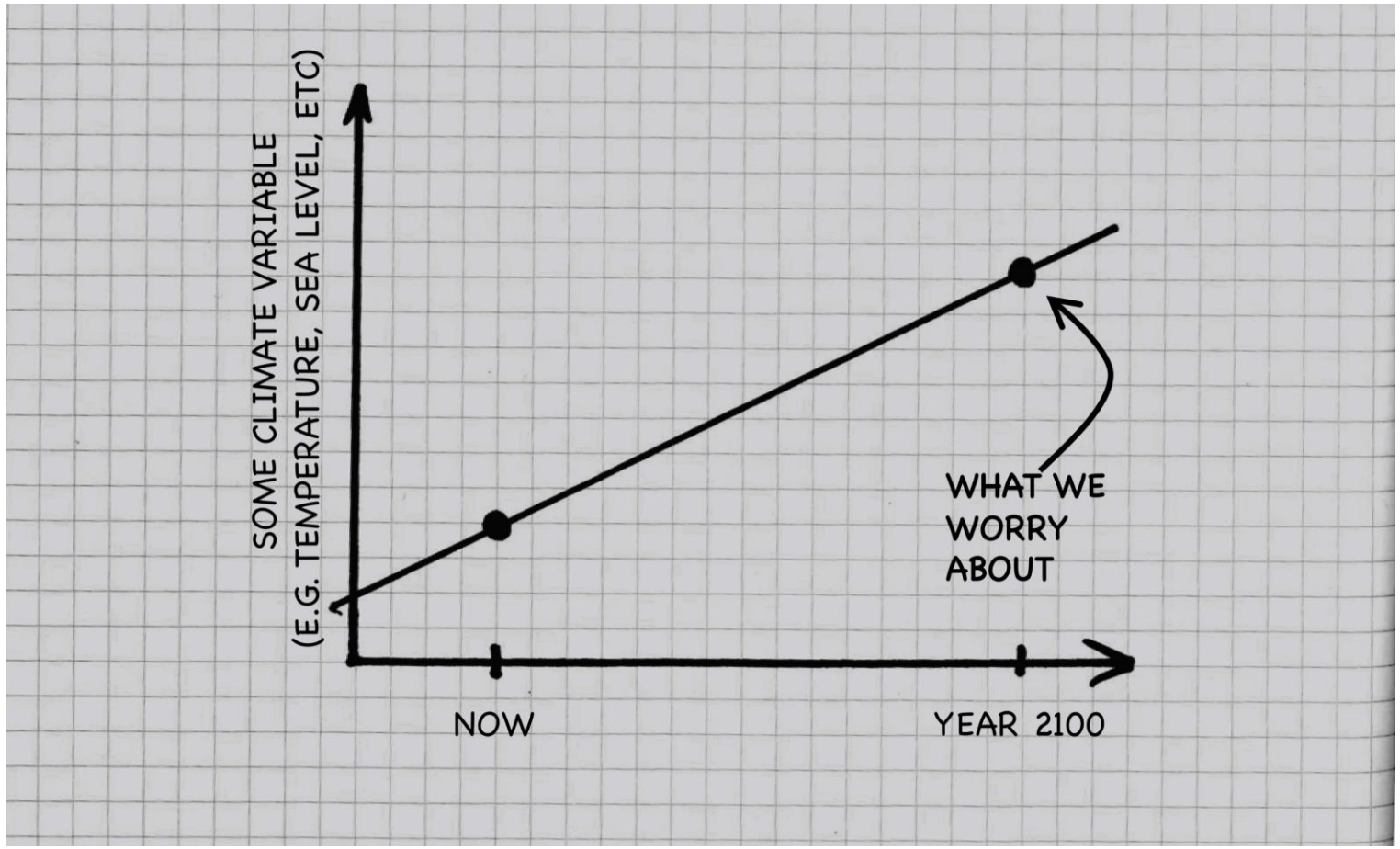



Figure 11: *Forget 2100*, Nick Record. Visual aid to expose the variation in the short term within long term climate trends

# How can Neural Networks aid ecology?

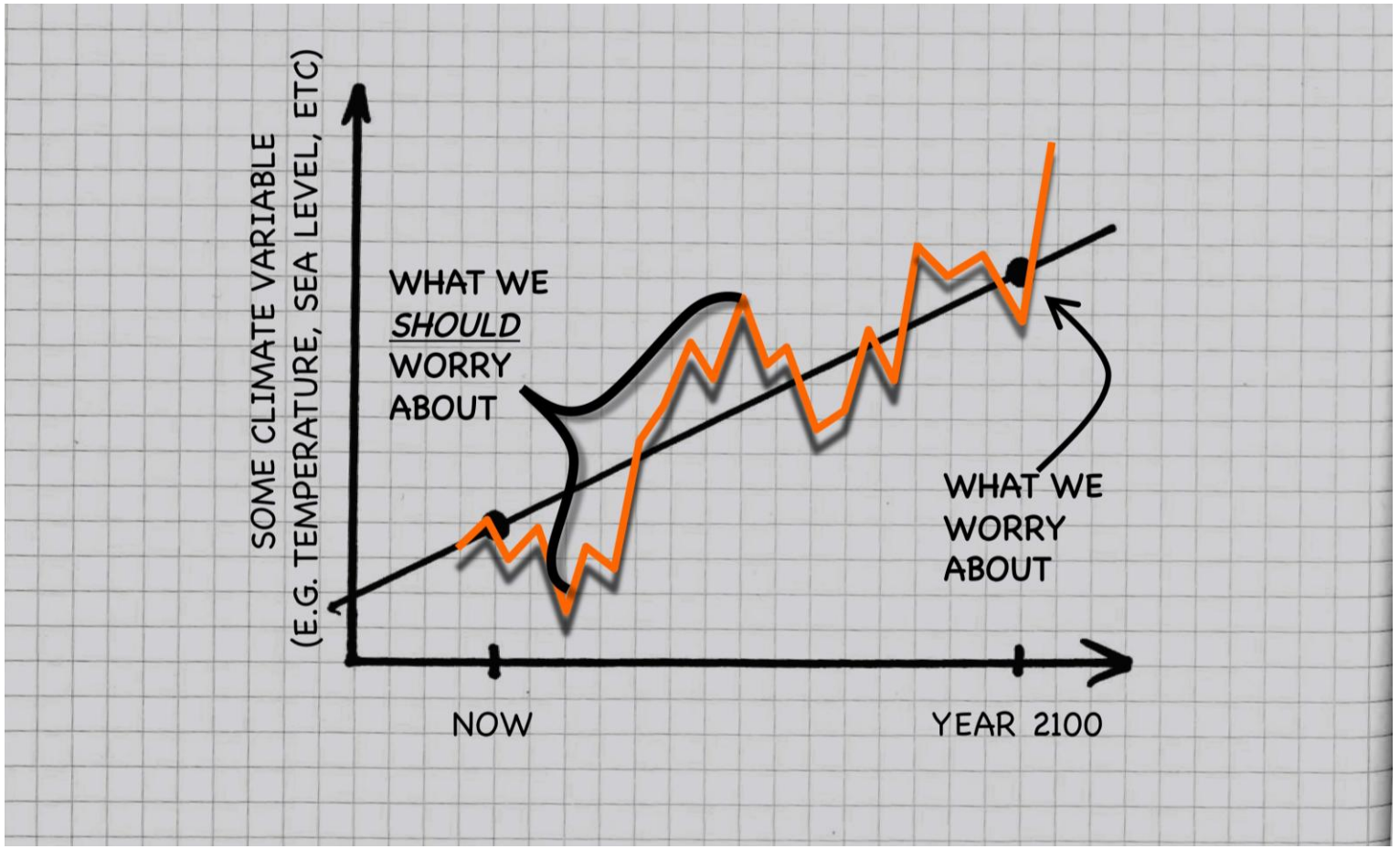



Figure 12: *Forget 2100*, Nick Record. Visual aid to expose the variation in the short term within long term climate trends

# Takeaway

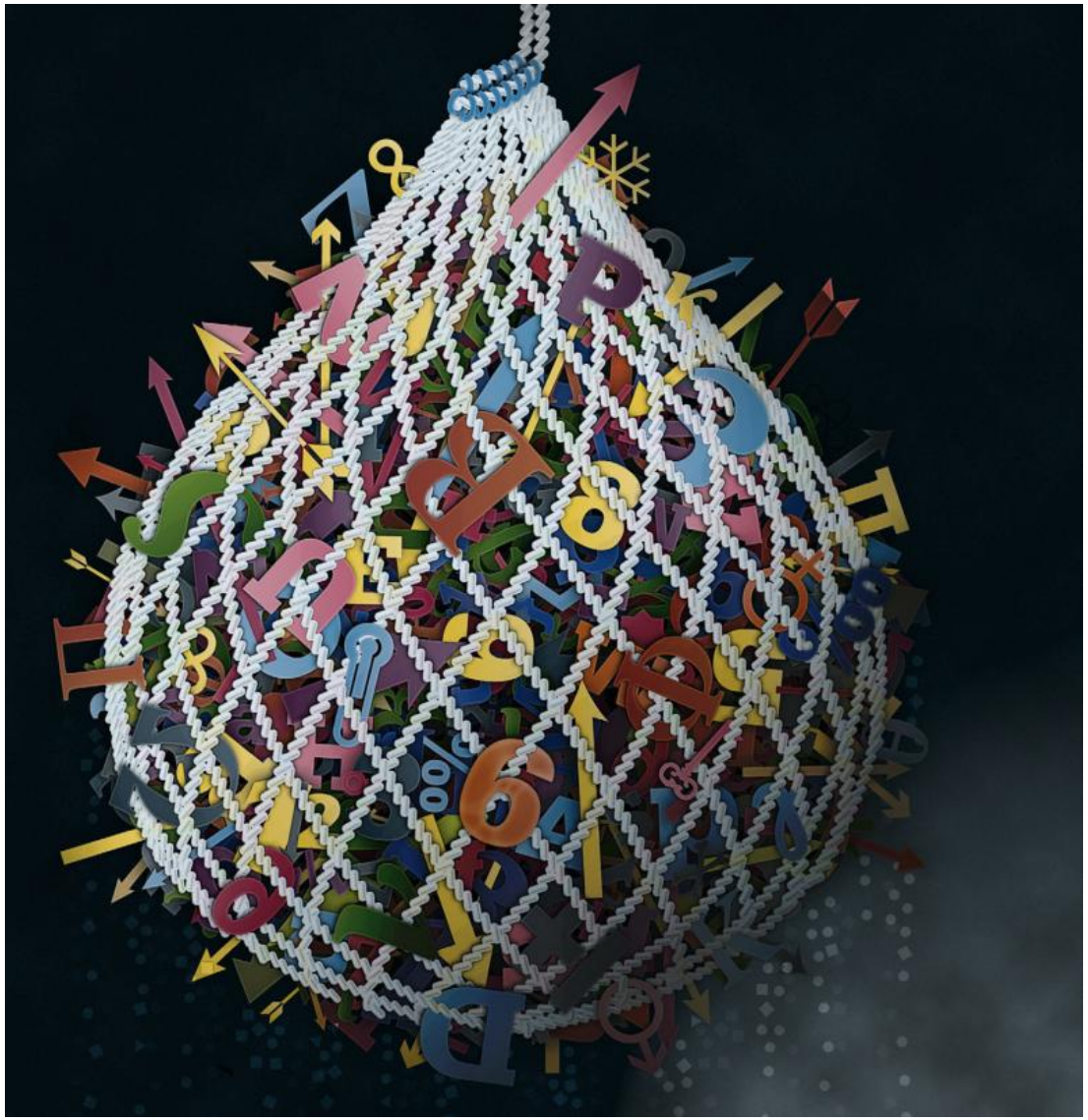


Figure 13: Could Big Data be the end of theory in science? Fulvio,Mazzochi

# Acknowledgments

Please contact us if you have any questions or interest in collaboration!
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Ben Tupper, Technician
Dr. Steve Archer, Preliminary Work
Craig Burnell, Preliminary Work
Dr. David Fields, Program Director
Maine Department of Marine Resources


Bigelow | Laboratory for Ocean Sciences

# Neural Networks

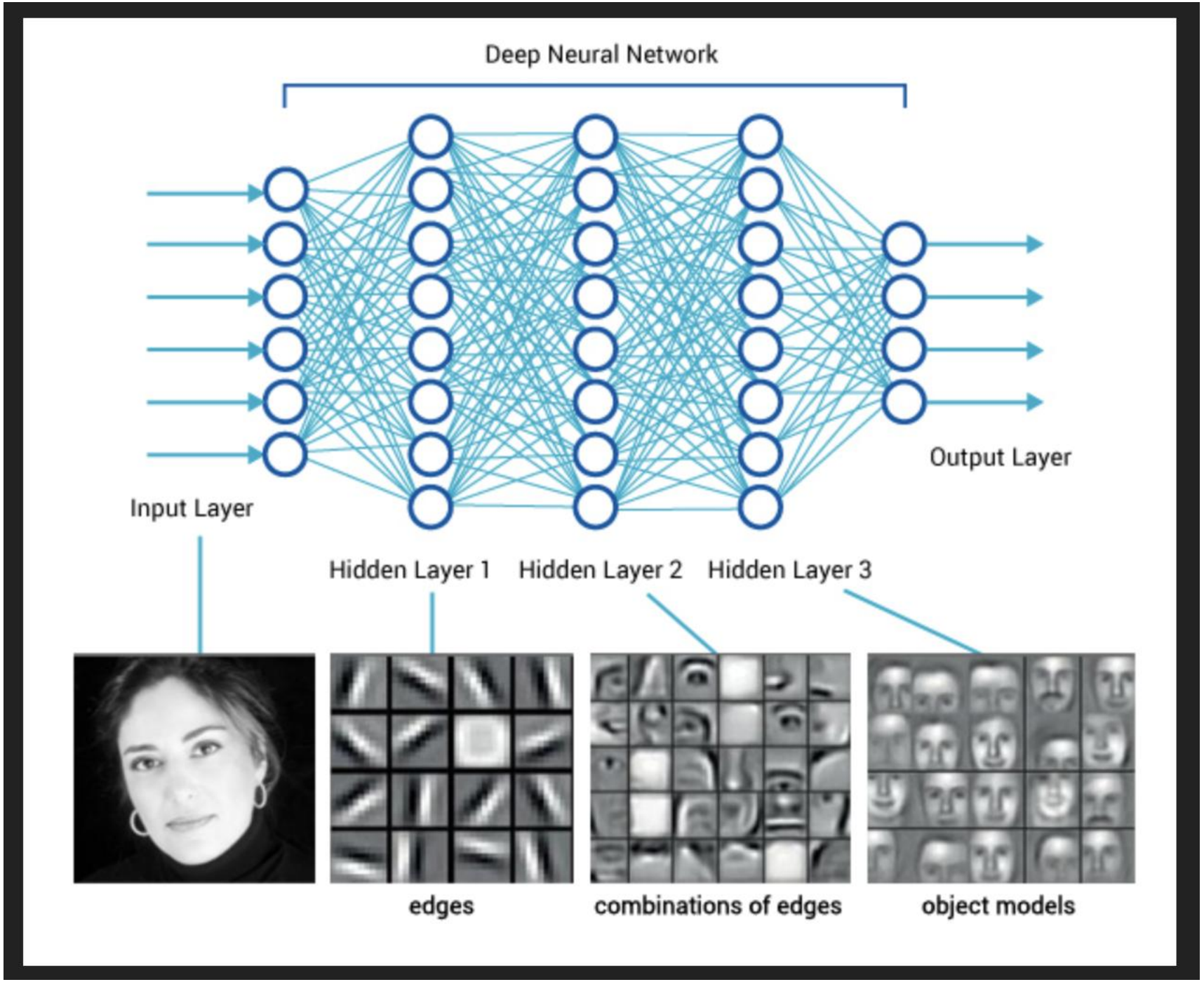


Figure 9: Object detection in Photos. *Saagie*