AI+EM

Farron Wallace NOAA Fisheries SEFSC

SEFSC Innovation Project

In Collaboration

AFSC, University of Washington, NGO’s and the Fishing Industry

AI?


BASED ON YOUR INTERNET HISTORY, YOU MIGHT BE DUMB ENOUGH TO ENJOY EXTREME SPORTS.
Dilbert.com DilbertCartoonist@gmail.com
CLICK HERE TO BUY A TICKET TO BASE JUMP FROM THE INTERNA-TIONAL SPACE STATION.
I THINK THE INTER-NET IS TRYING TO KILL ME.
WE CALL IT "MACHINE LEARNING."

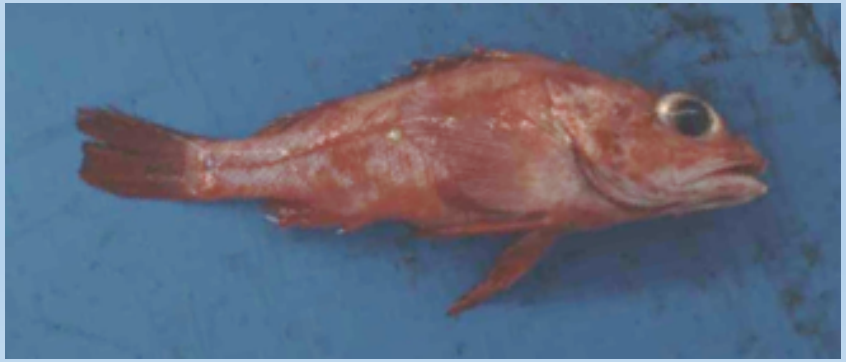
Proof of Concept

- 4 types of rockfish

Blackspotted

Rougheye

Shortraker



Thornyhead

Test on Rockfish Dataset

- Training (*used previous ~15,000 training dataset*)
  - Blackspotted (59), Rougheye (15), Shortraker (21), Thornyhead (9).
- Testing
  - Blackspotted (20), Rougheye (5), Shortraker (7), Thornyhead (4).
- Confusion Matrix (Accuracy=91.7%)

	Blackspotted	Rougheye	Shortraker	Thornyhead
Blackspotted	**18**	1	0	0
Rougheye	0	**4**	0	0
Shortraker	2	0	**7**	0
Thornyhead	0	0	0	**4**

Machine Vision Systems (IMS)

- Remote monitoring systems that support the latest developments in **machine learning (AI) to** improve system functionality, reliability and timeliness of data.
- An automated system that can see, learn, process and transmit data

Cost Categories for Developing Machine Vision?

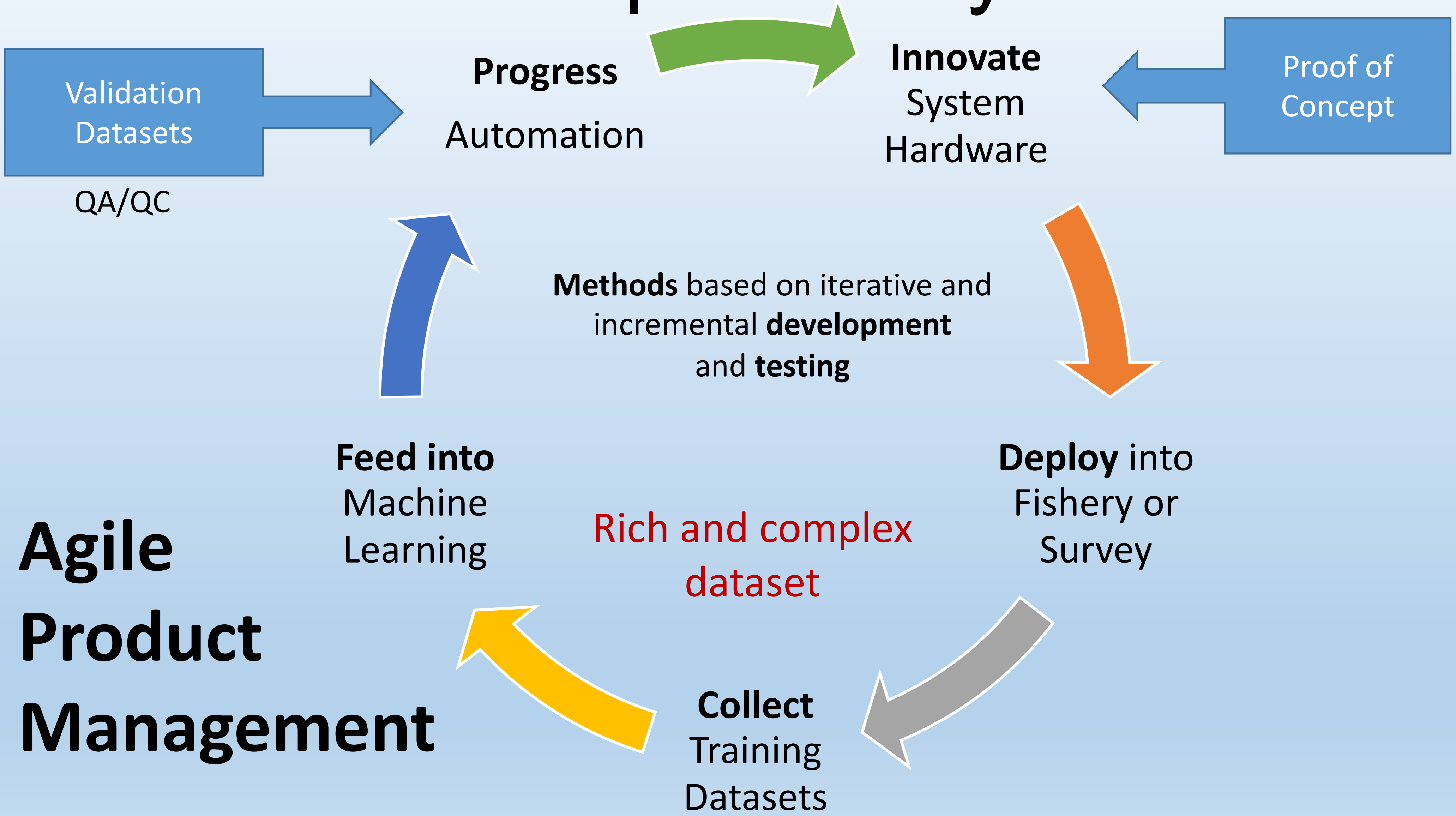
1. Collect Imagery (EM, Chute, Belt Systems, cameras)

2. Annotate imagery to create a rich training dataset.

3. Feed these data in ML algorithm(s).

4. Hardware development and implementation.

Iterative Development Cycle



Guidelines for Developing Automation

1. The scale of the data needs to reasonably capture the complexity of the problem.

2. Big data must be accurate.

3. At minimum you need an ML algorithm that captures the discriminating information.

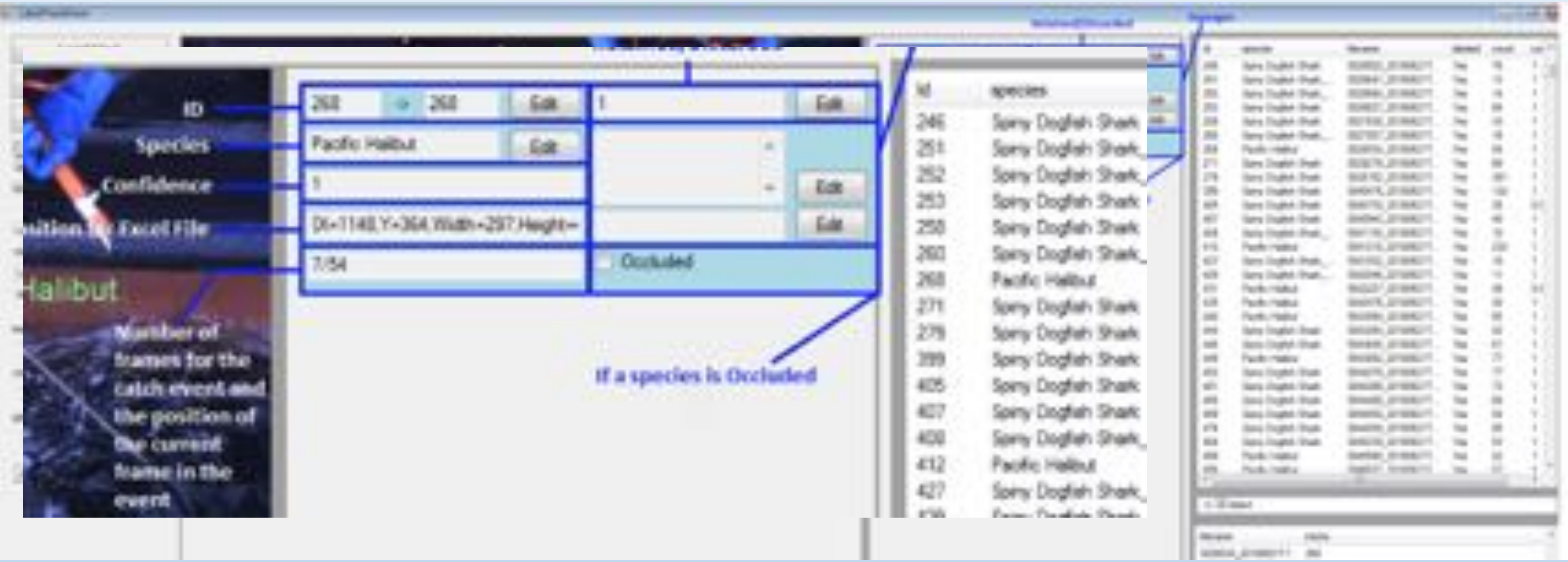
Guidelines for Developing Automation

4. The more complex the algorithm the greater the processing power/time required.

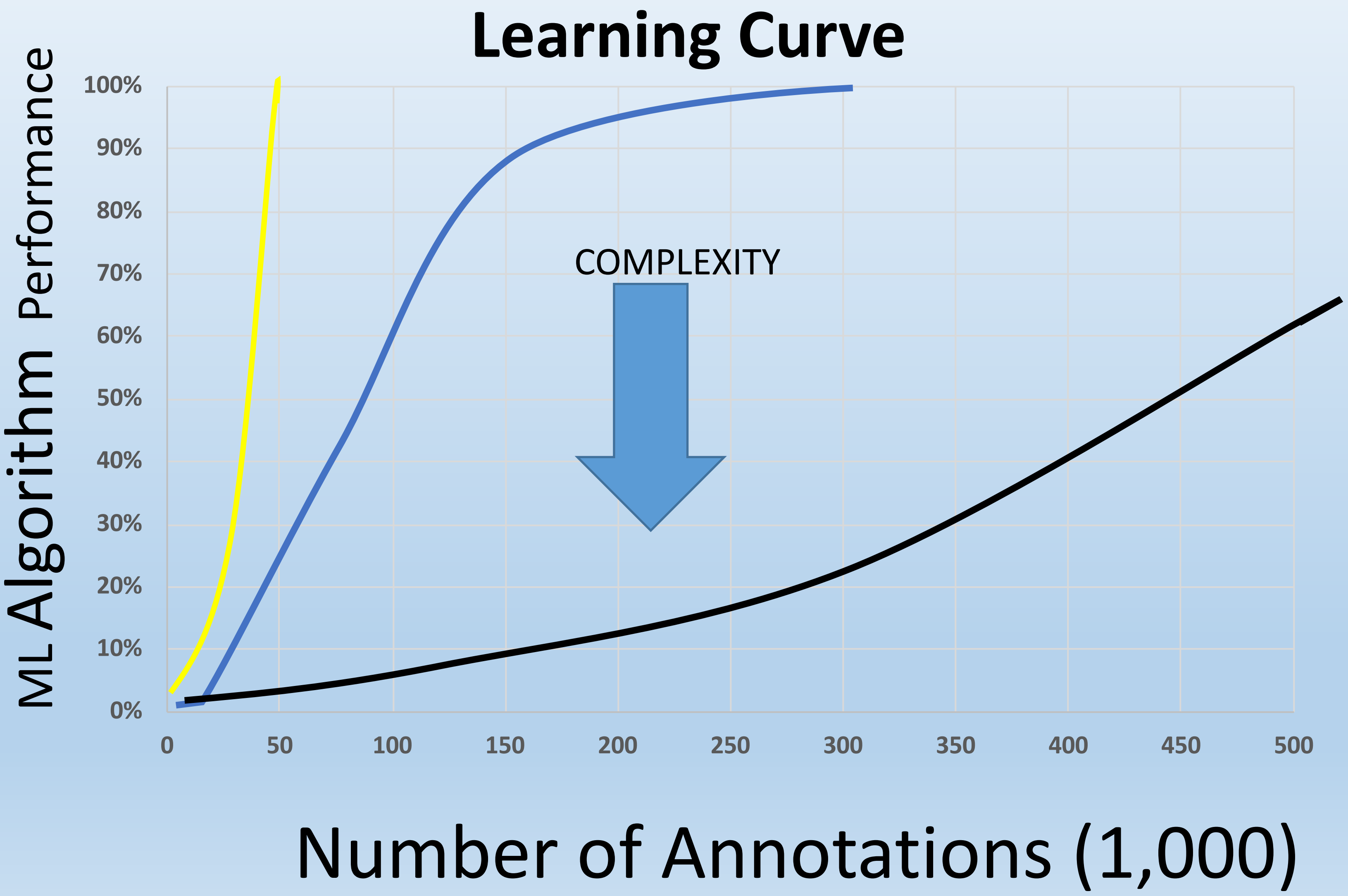
5. There is a delicate balance in **dedicating resources** between Algorithm development and collecting more data.

6. Use multiple sources of information (human versus machine) to **validate your system**

UW Annotation Software



How many annotations do I need for training?



Large Annotated Datasets Required: Longline Fisheries

- 35,300,000 # frames collected from 184 hauls
- 50,000 # frames processed per week
- 706 # of weeks to process
- 14 # of years to process

How do you annotate all those images?

Semi-automated annotation tools

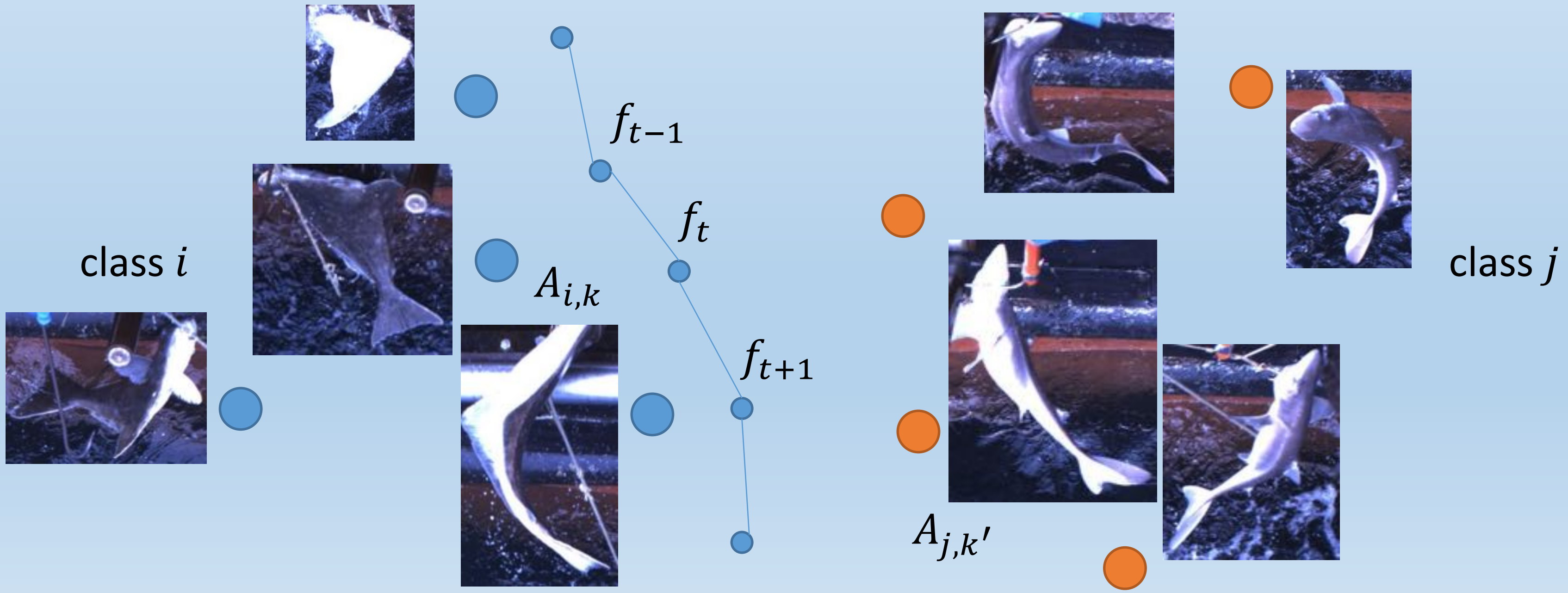
Strategic sub-sampling of data

Query Learning/Unsupervised Learning (DL)

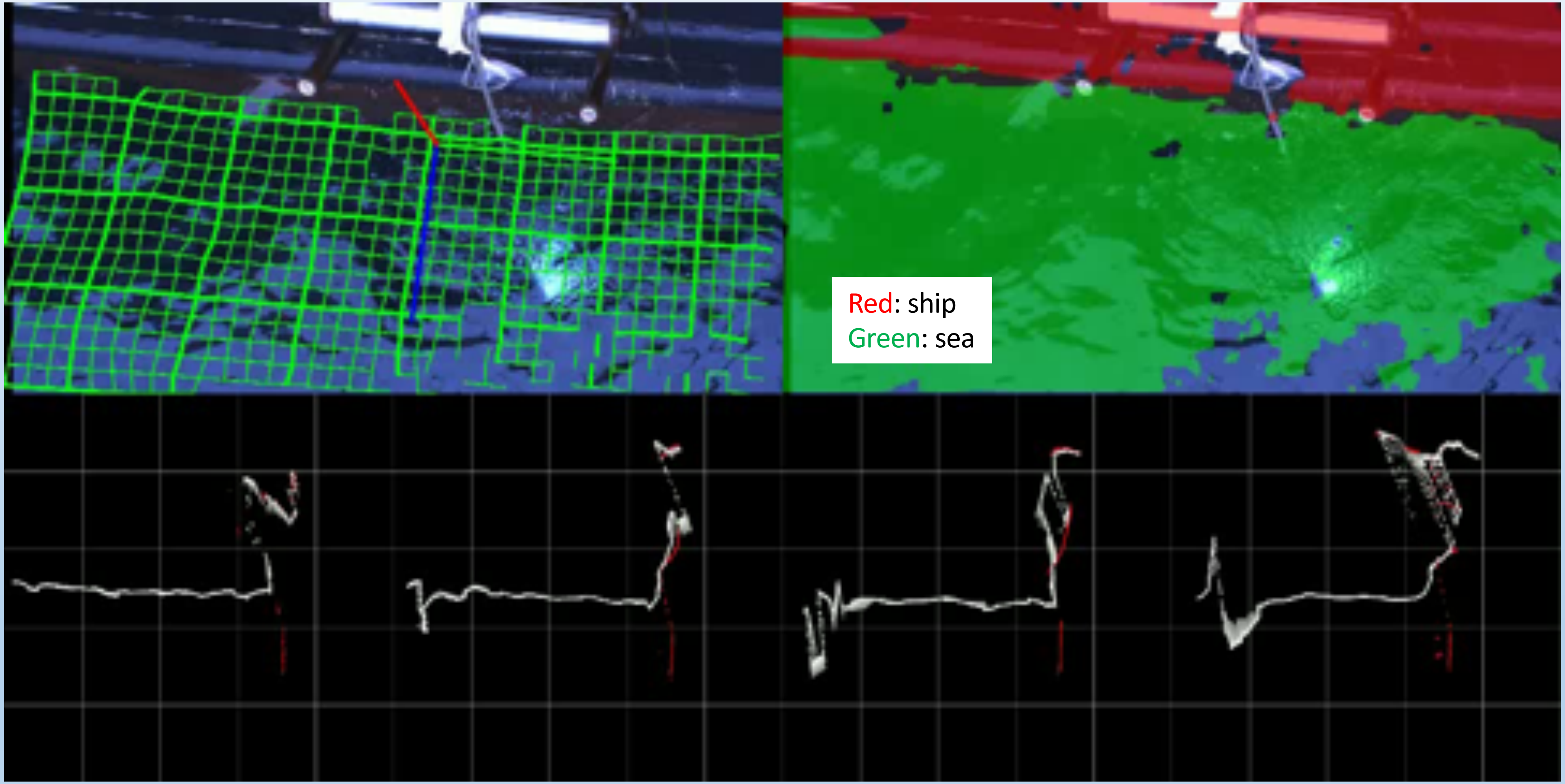
Metric Learning with Multiple Representative Features

- To deal with intra-class variance
- For class i, define K representative feature vectors $A_{i,k}$ for intra-class variance:

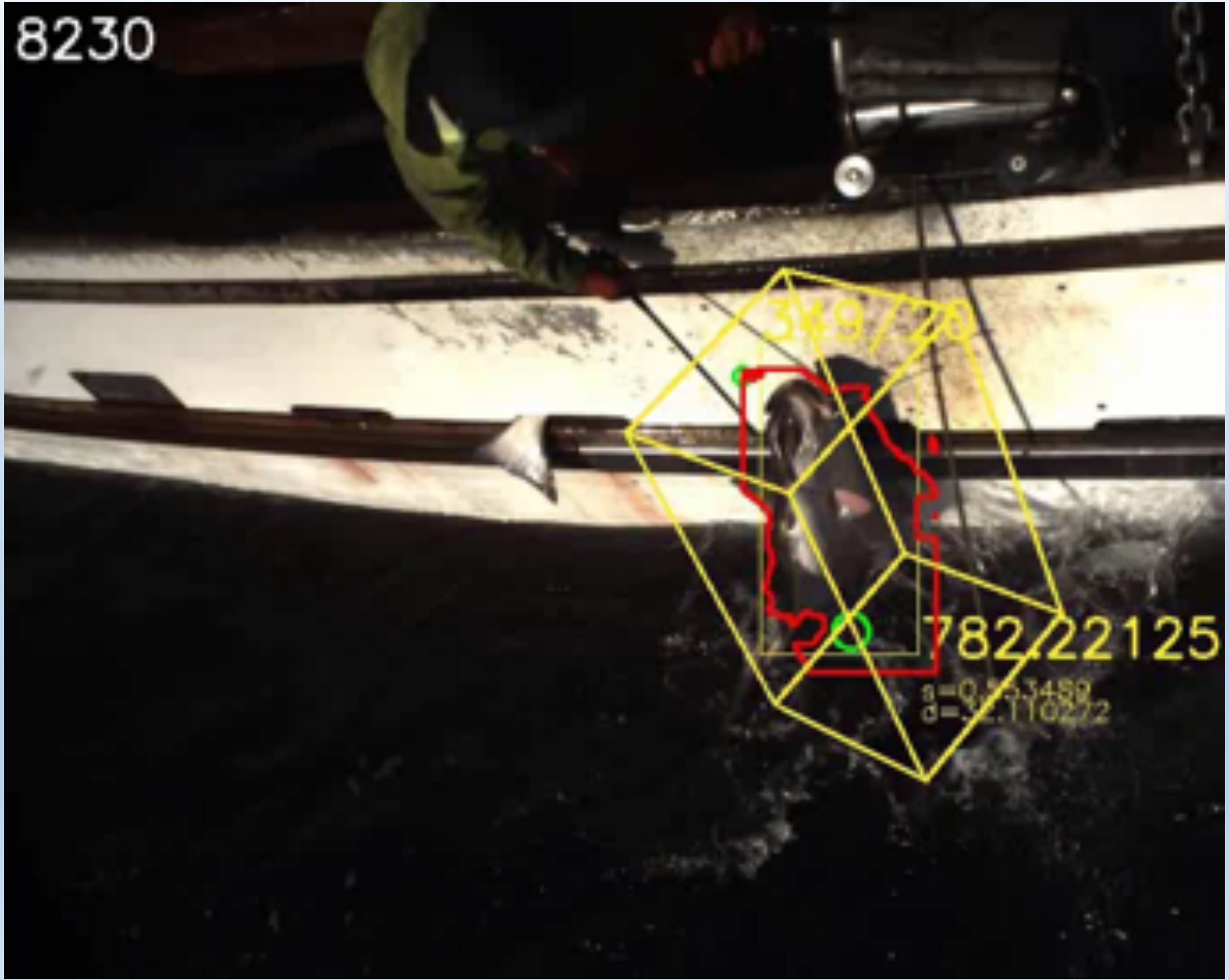
$$L_R(f_t) = \max\left(\min_k d(f_t - A_{i,k}) - \min_{j,k'} d(f_t - A_{j,k'}) + \beta, 0\right)$$



Identifying Catch Events



3D bounding box for size estimation



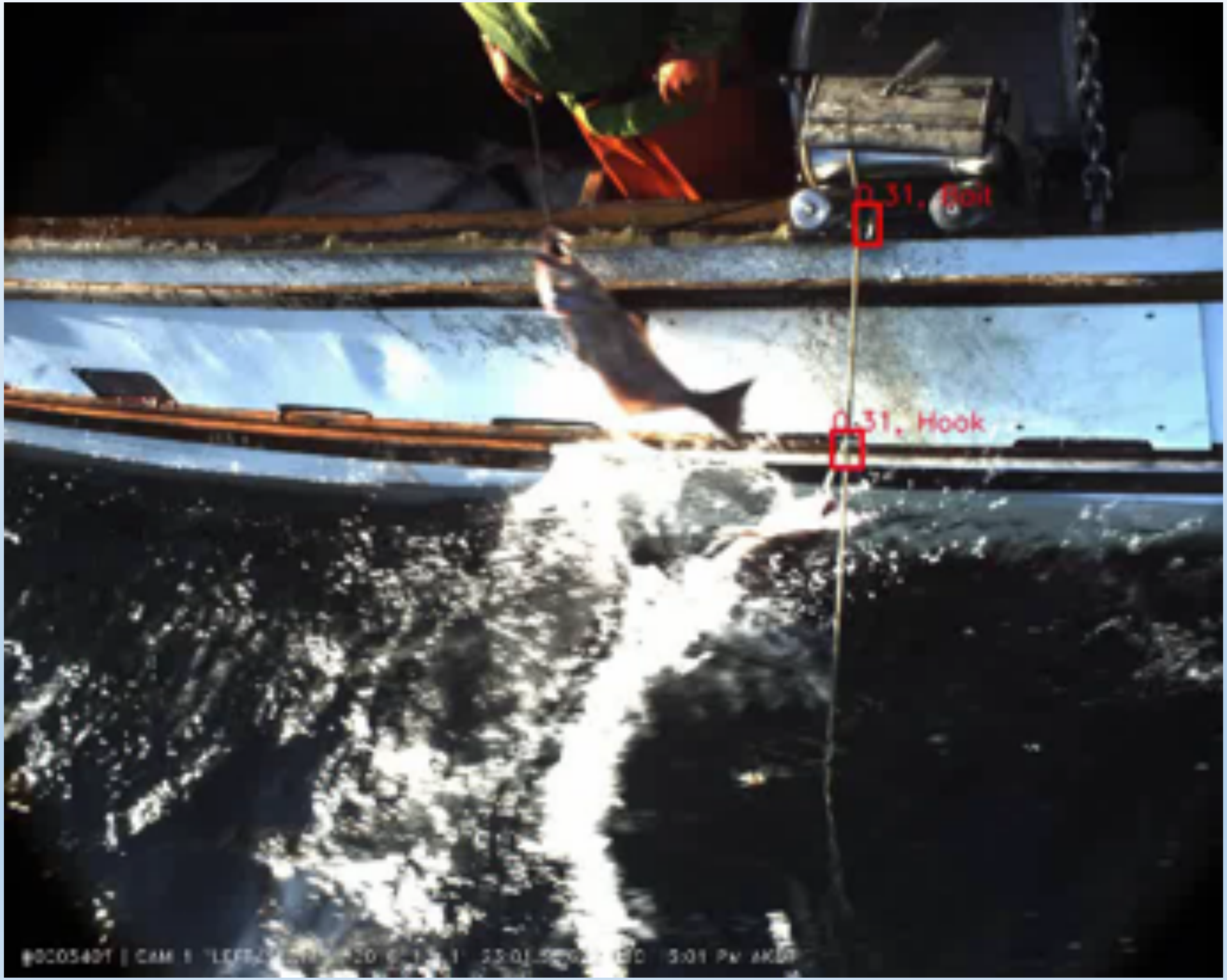
What’s Next?

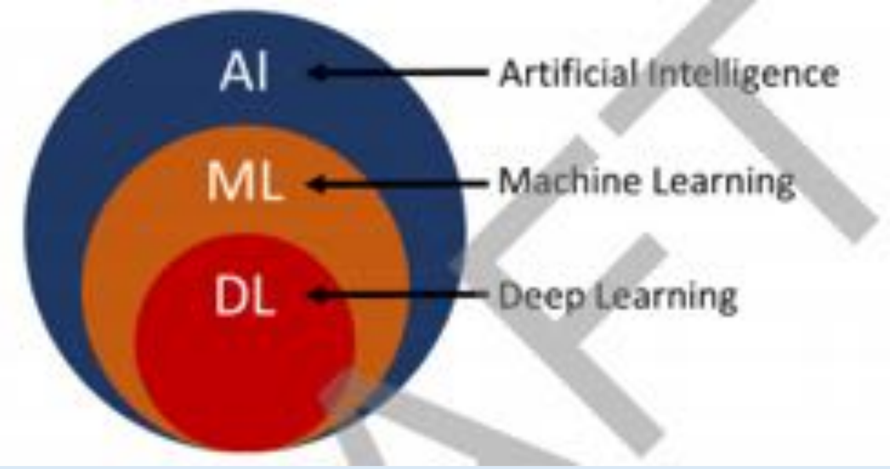
- Distribute the knowledge and design of systems that collect and analyze imagery.

- Provide access to open source Machine Learning algorithms to promote development of automation in other fisheries (VIAMI, GitHub)

- Provide Access to machine vision Stereo Camera systems to promote automation and development of 3D vision systems to estimate size and volume measurements.

Questions?





The NOAA AI Strategy will dramatically expand the application of artificial intelligence (AI) in every NOAA mission area by improving the efficiency, effectiveness and coordination of AI development and usage across the agency.

AI methods will provide transformative advancements in the quality and timeliness of NOAA science, products, and services: are already demonstrating significant improvements in performance and skill at vastly reduced costs and compute time.