HALLO

Humans and ALgorithms Listening for Orcas

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(on behalf of the HALLO team)

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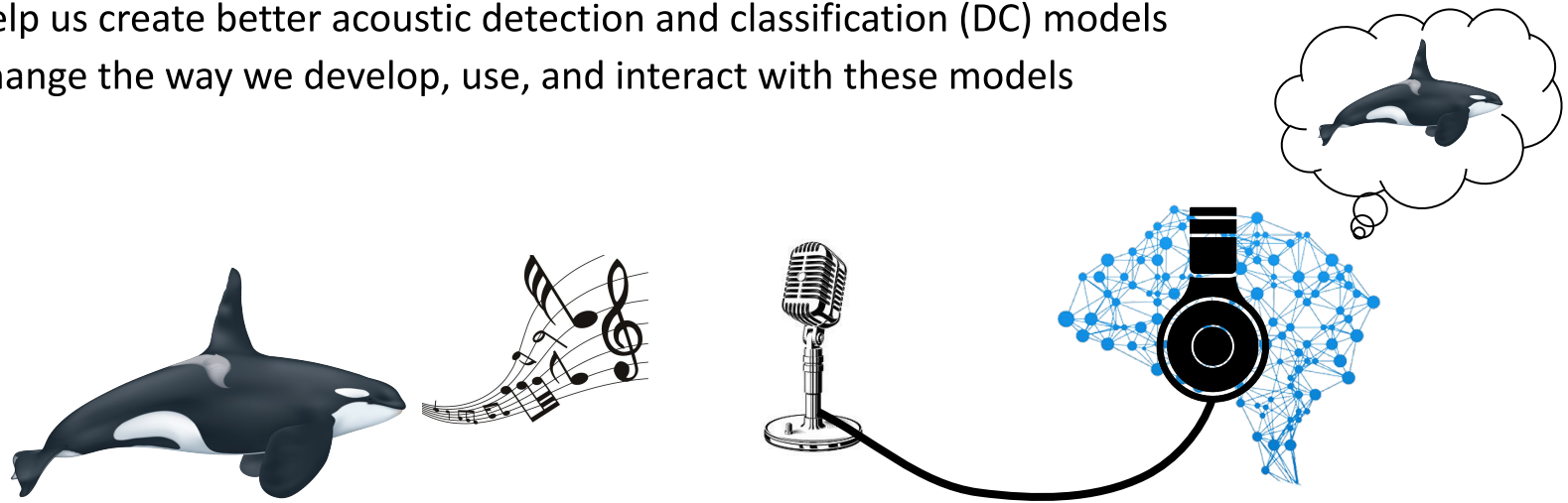
Introduction

- HALLO = Humans and ALgorithms Listening for Orcas
- Two-year R&D project
- $550k in support from DFO
- Multi-institutional & multi-disciplinary team
- Goal: Develop **deep learning** software for detecting and classifying the vocalisations of killer whales (esp. Southern Residents) to support researchers and conservationists in BC.

Deep learning can ...

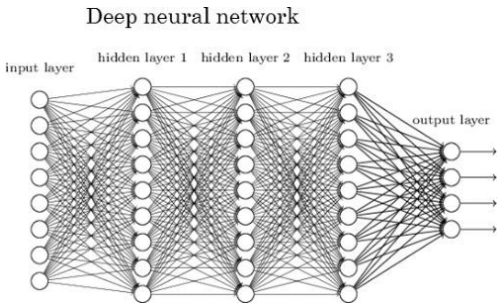
- help us create better acoustic detection and classification (DC) models
- change the way we develop, use, and interact with these models



Deep Learning

What is **deep learning** ?

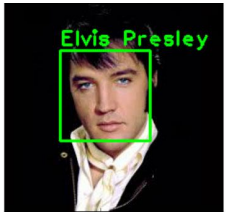
Deep learning is an approach to **machine learning** that utilizes **deep neural networks**



Everyday applications:

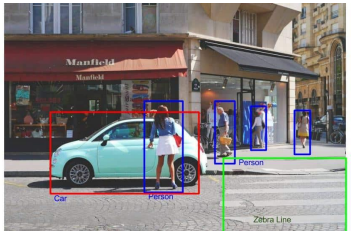
Speech recognition & synthesis

Face Recognition

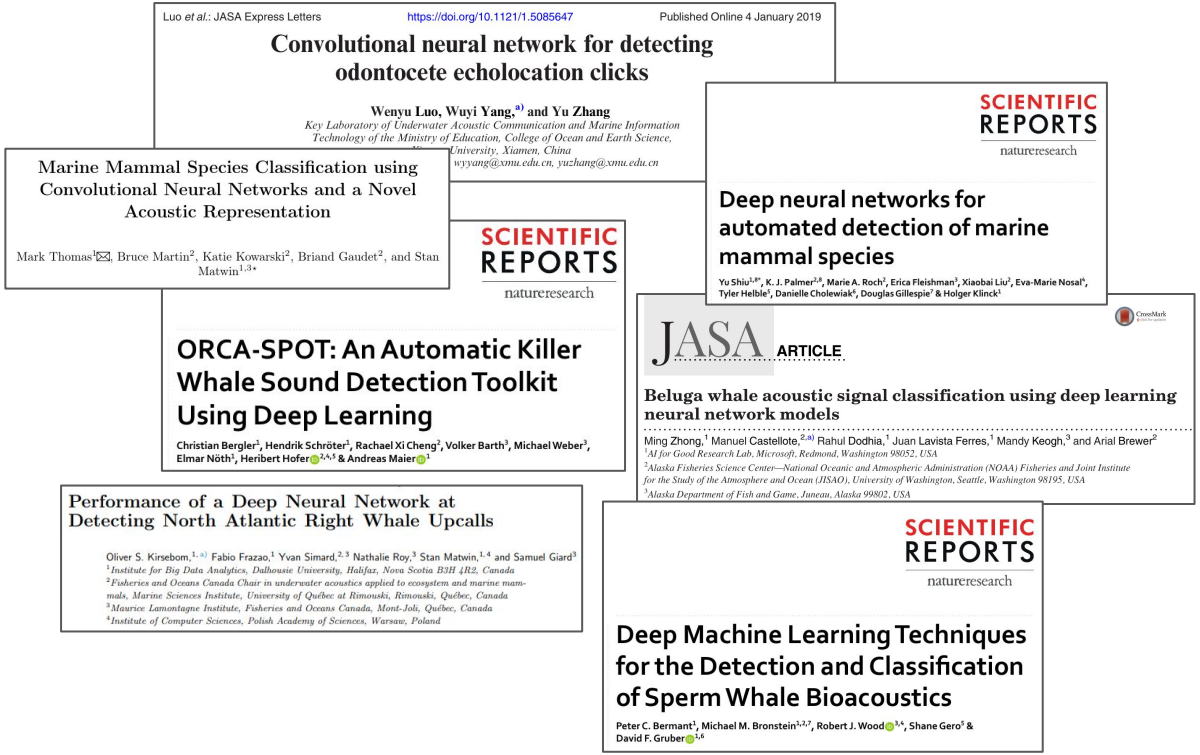


Translation

Object detection



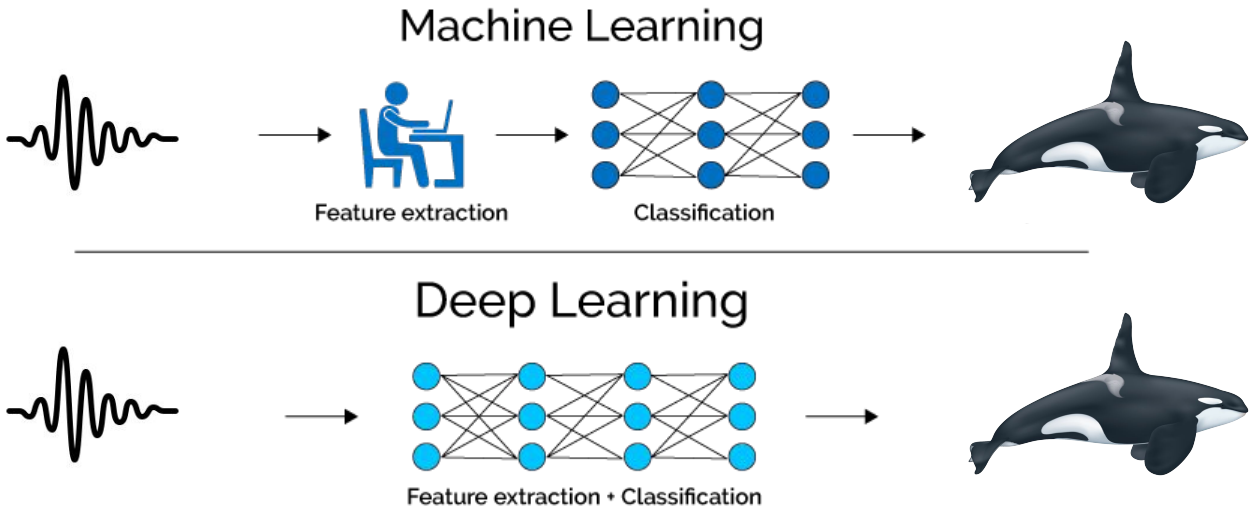
Deep learning in marine bioacoustics



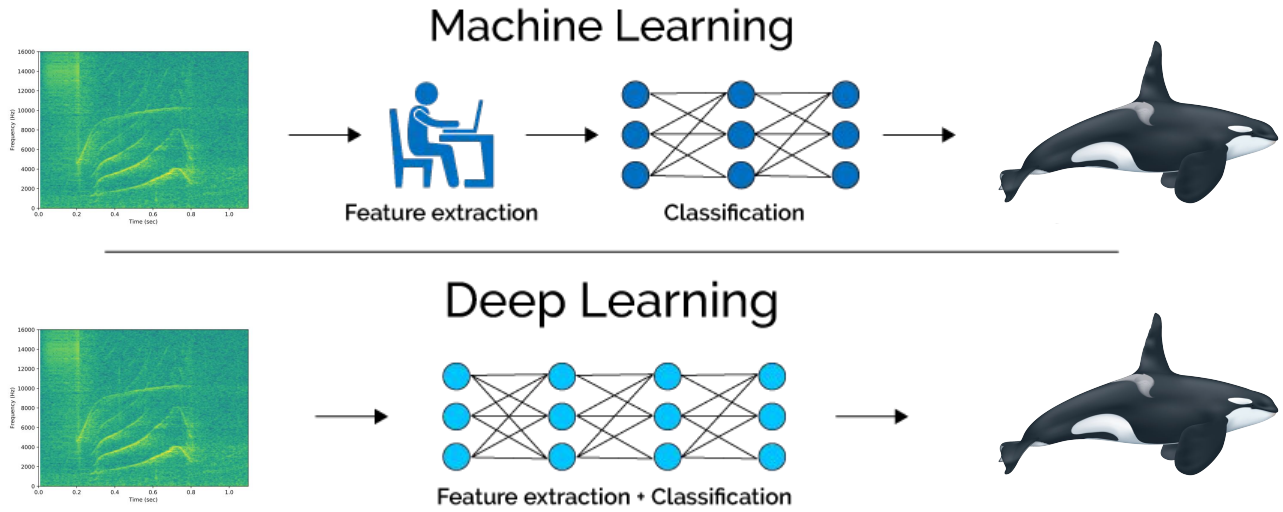
Deep learning works!

It's time to build software tools that makes deep learning accessible to researchers and conservationists.

Deep learning aims to be end-to-end

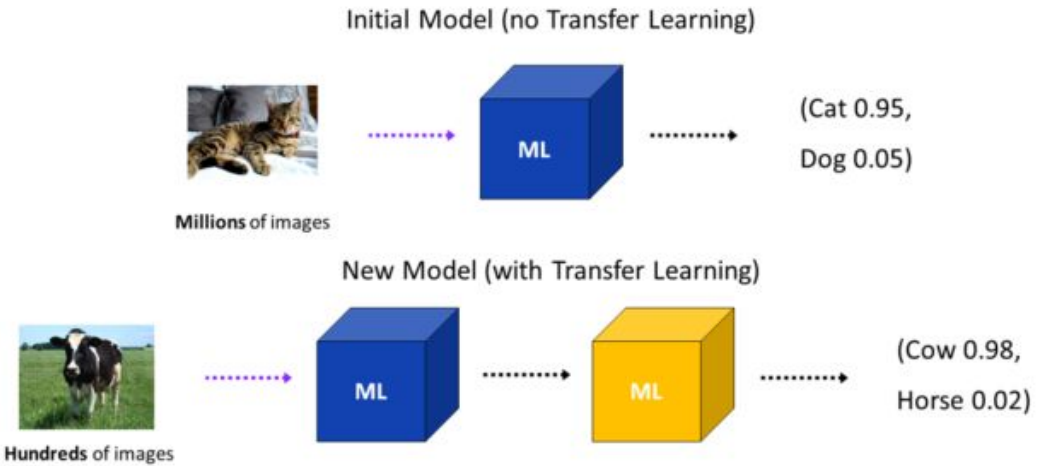


Deep learning aims to be end-to-end

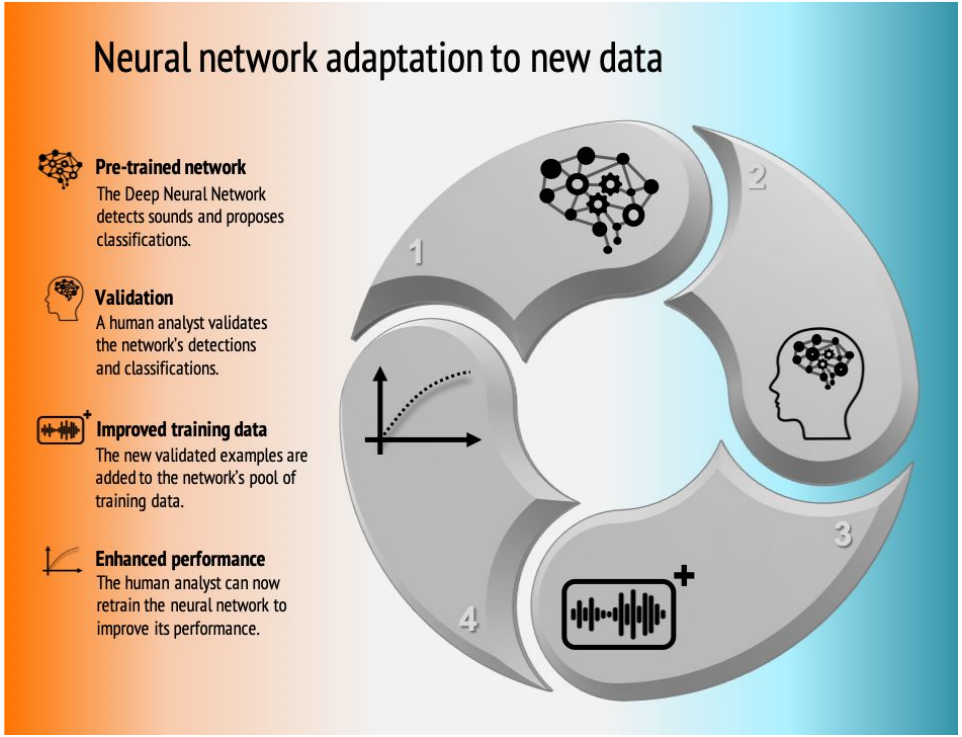


Transfer learning (model adaptation)

- Transfer learning can ...
  - drastically reduce amount of training data and training time
  - make models more adaptable and reusable



The deep learning workflow



p. 144-145:
"Towards Versatile and Adaptive Detection Algorithms in Underwater Acoustics"

The HALLO Project

HALLO - at a glance

- HALLO = Humans and ALgorithms Listening for Orcas
- Two-year R&D project
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- **Goal:** Develop deep learning software for detecting and classifying the vocalisations of killer whales (esp. Southern Residents) to support researchers and conservationists in BC.

- Marine bioacousticians
- Data scientists
- Deep learning experts
- Data managers
- Software developers
- System administrators

Say hello to the HALLO team!

Ruth Joy
Steven Bergner
Alex Harris
Emma Cummings
Kaitlin Palmer
Jennifer Wladichuk

Amalis Riera
Fabio Frazao
Bruno Padovese
Oliver Kirsebom

Dave Campbell
Paul Nguyen Hong Duc

Scott Veirs
Val Veirs

Related studies and projects

1. Academic studies

SCIENTIFIC REPORTS
nature research

ORCA-SPOT: An Automatic Killer Whale Sound Detection Toolkit Using Deep Learning

Christian Bergler[1], Hendrik Schröter[1], Rachael Xi Cheng[2], Volker Barth[3], Michael Weber[3], Elmar Nöth[1], Heribert Hofer[2,4,5] & Andreas Maier[1]

Applied Acoustics 150 (2019) 169–178

Contents lists available at ScienceDirect

Applied Acoustics

journal homepage: www.elsevier.com/locate/apacoust

Whistle detection and classification for whales based on convolutional neural networks

Jia-jia Jiang[a,*,1], Ling-ran Bu[a,1], Fa-jie Duan[a], Xian-quan Wang[a], Wei Liu[b], Zhong-bo Sun[a], Chun-yue Li[a]

[a] The State Key Lab of Precision Measuring Technology and Instruments, Tianjin University, 92 Weijin Road, Nankai District, Tianjin, China
[b] The Department of Electronic and Electrical Engineering, University of Sheffield, United Kingdom

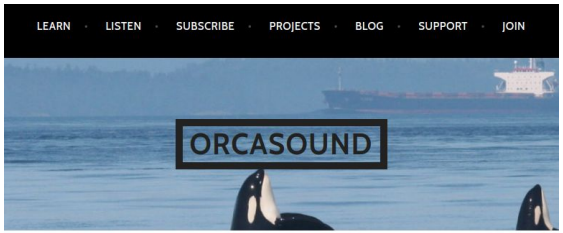
Deep Learning and Domain Transfer for Orca Vocalization Detection

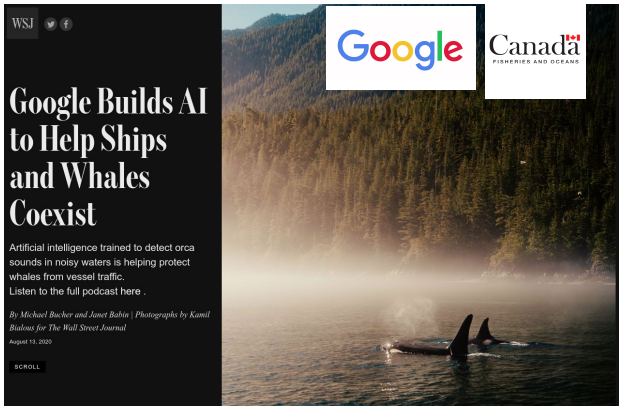
Paul Best*, Maxence Ferrari*†, Marion Poupard*‡, Sébastien Paris*, Ricard Marxer*, Helena Symonds § and Paul Spong §, Hervé Glotin *

*Univ. Toulon, Aix Marseille Univ. CNRS, LIS, DYNI Marseille, France
†LAMFA, CNRS Amiens France
‡BIOSONG SARL France
§OrcaLab Alert Bay
Email: paul.best@univ-tln.fr

2. Collaborations between big tech and NGO/government

ai4orcas.net Microsoft





Related studies and projects

Results:

- The "CNN binary classifier" approach has produced impressive results (on restricted data sets)
- But models generalize poorly to new acoustic environments

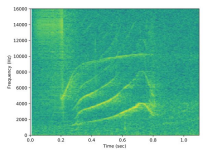
Open questions:

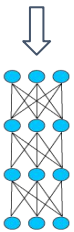
- Can we make models generalize better? (e.g. by enlarging the training dataset)
- And/or can we develop methods (e.g. transfer learning) that allow us to readily adapt models to new environments?
- Can we teach models to distinguish between KW ecotypes, and pods?

Still missing:

- Ready-to-use tools

CNN binary classifier





CNN

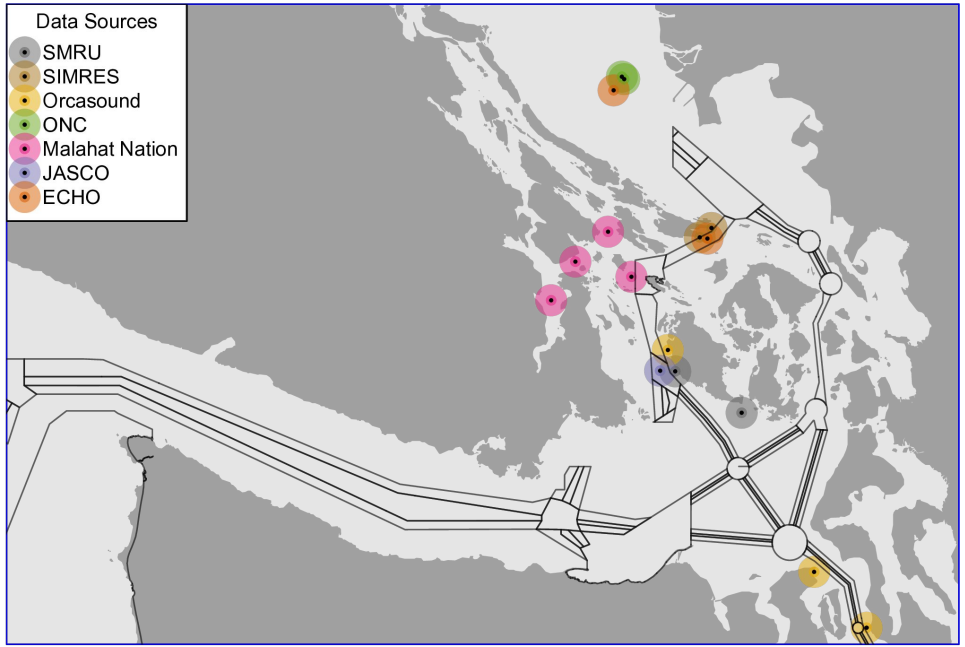
(Convolutional Neural Network)

Yes/No

HALLO contributions

1. High-quality annotated KW acoustic data
2. Improved deep learning models; ecotype- and pod-level classification
3. Ready-to-use tools
4. Open-source software, developed with reusability and extensibility in mind
5. Collaborative approach; data and code publicly available

Data sources



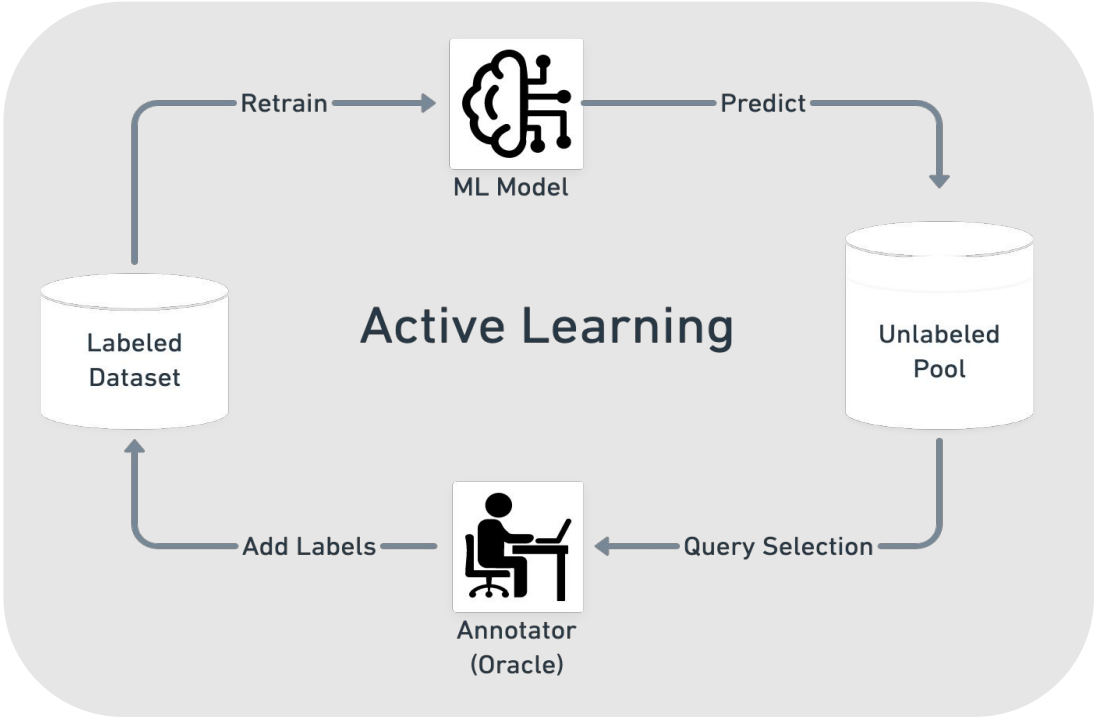
Also, ongoing conversations about data sharing with

- Cetacean Research Program, DFO Science (T. Doniol-Valcroze)
- Harald Yurk

among others ...

Multiple data sources ⇨ large variance

Active learning approach

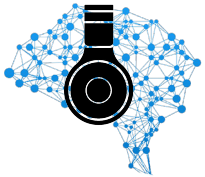


Credits:
Kunal Mehta

HALLO products

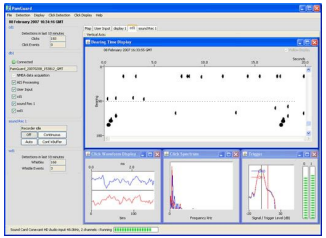
1. Training and test datasets (accessible via web portal)

2. Trained deep learning models



3. Ready-to-use tools

- Plug-in for PAMGuard
- Active learning & transfer learning application



4. Workshops

5. Scientific papers

Thank you!