

Co-Creating Innovation in Machine Learning

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Leuphana Welcome Week





Co-Creating Innovation

“The AI adoption continues to grow steadily” - McKinsey Global Survey on AI (2021) [4]

Co-Creating Innovation




“opening the innovation process to a broader range of voices that are often not heard”

- Explore innovative Applications of Machine Learning Algorithms
- Learn about key considerations and challenges involved in designing Intelligent Machines using Machine Learning algorithms
- critically analyse the buzzwords surrounding AI/ML that you often encounter in the media
- Develop your own creative and innovative applications of Machine Learning




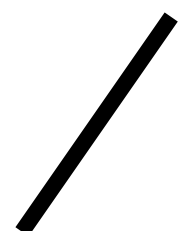

Machine Learning

How do you distinguish a from a 3?

1.  +  = 

BUT



2.  +  = 

BUT



Maybe its something completely different?

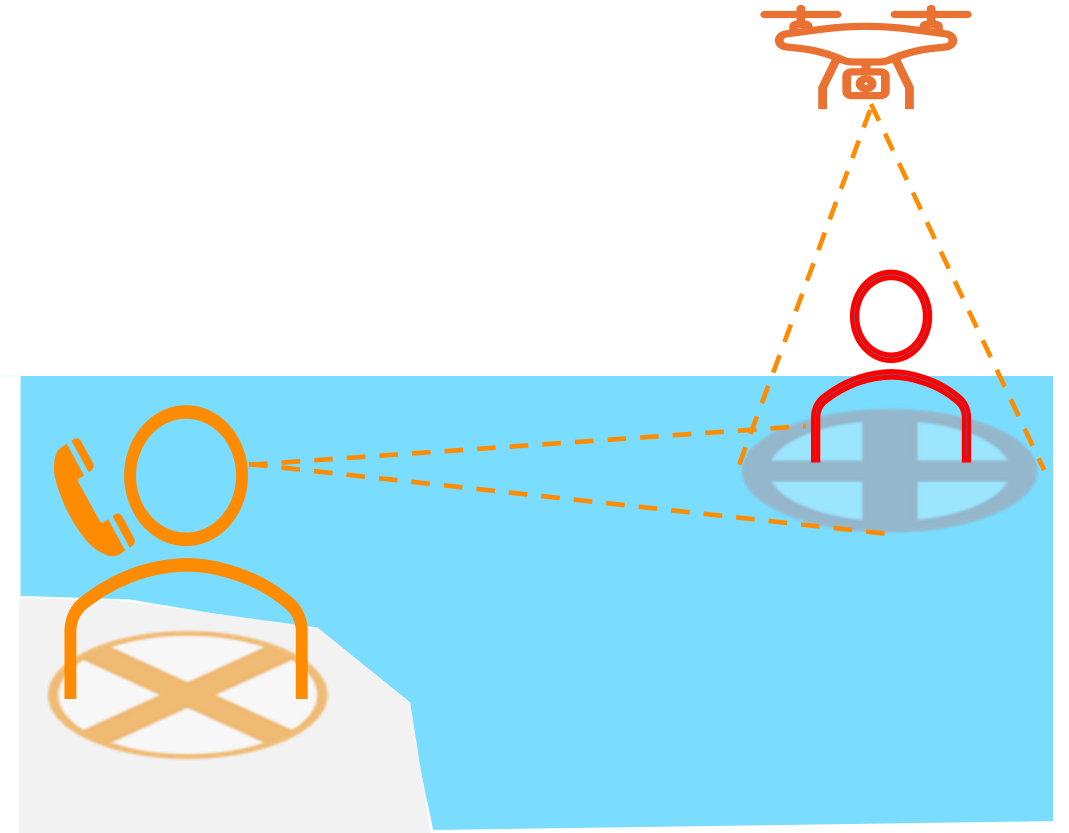
3.  +  = 

BUT

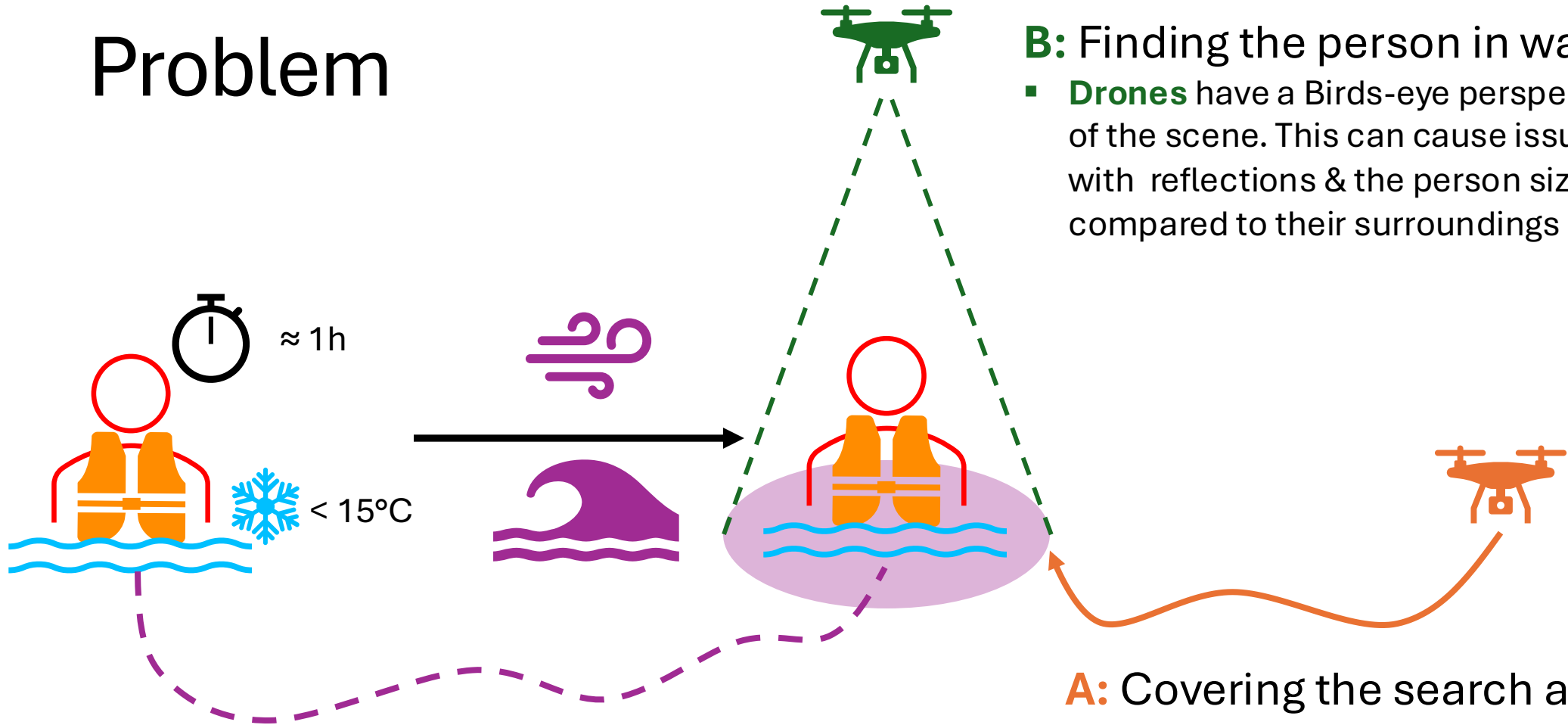


Machine Learning: “learn by analysing existing patterns in an available dataset to formulate a hypothesis for new data”

Machine Learning in Maritime Search and Rescue



Problem



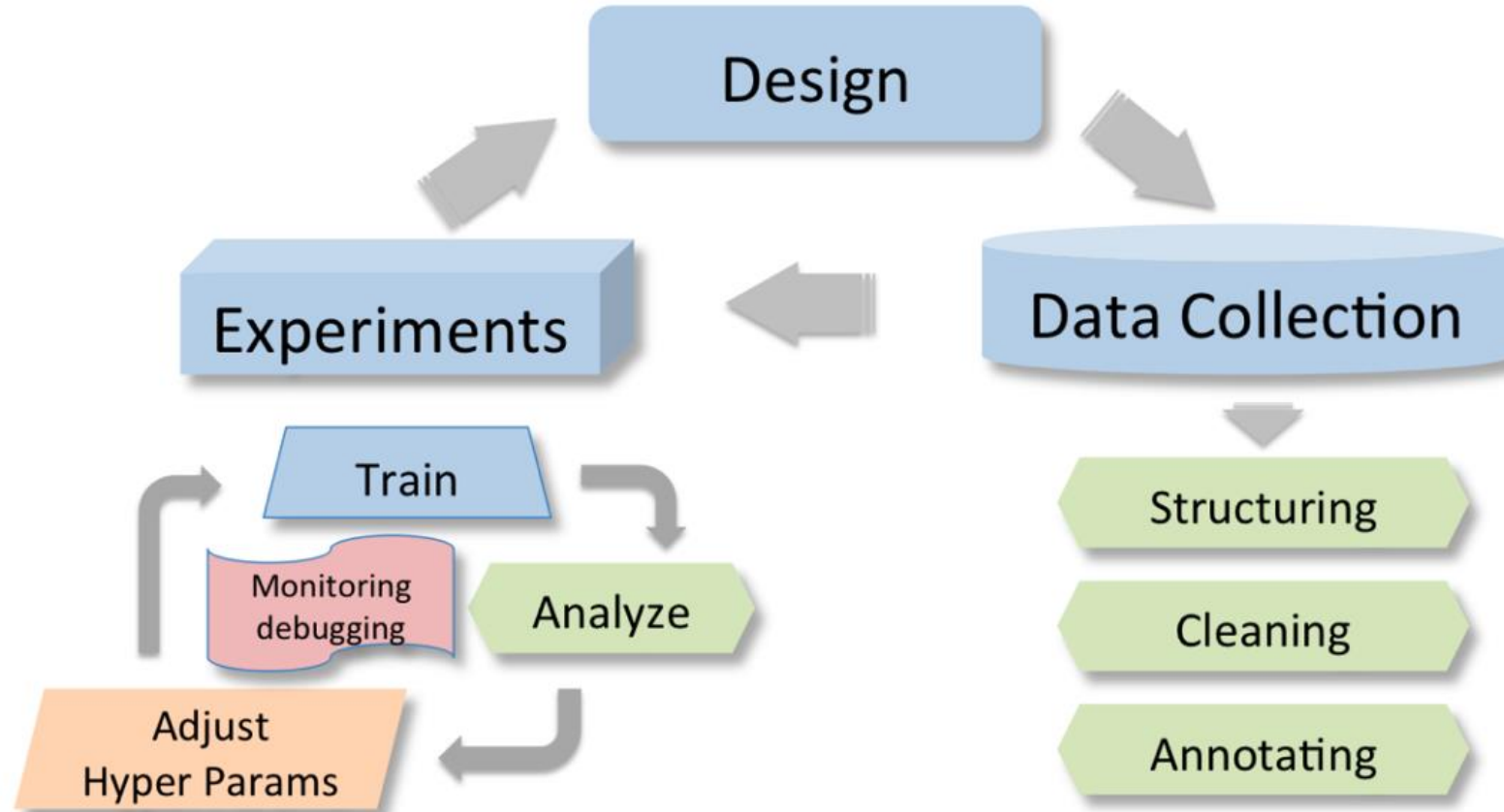
B: Finding the person in water

- **Drones** have a Birds-eye perspective of the scene. This can cause issues with reflections & the person size compared to their surroundings

A: Covering the search area

- **Drones** take ≈ 3 min to prepare for launch and can freely choose between standard search patterns or determine more optimal pathings

Design Process for Machine Learning Systems



[2]

1. Design

A: Covering the search area

- Number of drones: $1 < x < n$
- Ideal search paths are unknown and cannot be determined in a single action (dynamic problem)
- Adjust Algorithm Rewards to reflect penalty of not finding the target!

➤ **Learning Method:**
Unsupervised Learning

➤ **Model Type:**
Multi-Agent Reinforcement Learning Models

B: Finding the person in water

- Drone captures images
- Person with “known” features needs to be found/located against surroundings

➤ **Learning Method:**
Supervised Learning

➤ **Model Type:**
Convolutional Neural Network

2. Data Collection

A: Covering the search area

- Collecting **Environment** data
 - Wind data (location, speed, direction)
 - Tidal Current data (location, speed, direction)
 - Drone telemetry (flight height, position, speed, orientation)
 - Search Area (location, assoc. probabilities)
- Data is **structured, unlabeled** and **dynamic**

B: Finding the person in water

- Collecting images containing / and not containing search targets
 - Search target data (size, location)
 - **CNN-Networks** can have more than 62,400,000 parameters, consider the “*Rule of 10*” to prevent model overfitting to training data [1],[3]
- Data is **unstructured, labelled** (requires **pre-processing & cleaning**), and must be **checked for bias**

3. Experiments

A: Covering the search area

- Different parameters/ incentives can drastically change the resulting search paths
- MARL models can be long and difficult to train and fine-tune
 - How successful is the model compared to traditional methods?
 - What happens if we don't find the search target?

B: Finding the person in water

- Training with large datasets can require us to train in batches
- Also Train with augmented (fuzzed, rotated, ...) datasets
- Identify adversarial examples (e.g. seal detected as person)
 - How many false positives compared to false negatives do we receive?

What happens if the Design Process goes wrong?

Amazon ditched AI recruiting tool that favored men for technical jobs

Specialists had been building computer programs since 2014 to review résumés in an effort to automate the search process



Amazon's automated hiring tool was found to be inadequate after penalizing the résumés of female candidates. Photograph: Brian Snyder/Reuters

Amazon's machine-learning specialists uncovered a big problem: their new recruiting engine did not like women.

Racial Bias Found in a Major Health Care Risk Algorithm

Black patients lose out on critical care when systems equate health needs with costs

By Starre Vartan on October 24, 2019

MIT
Technology
Review

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ARTIFICIAL INTELLIGENCE

Facebook's ad-serving algorithm discriminates by gender and race

Even if an advertiser is well-intentioned, the algorithm still prefers certain groups of people over others.

By Karen Hao

April 5, 2019

Slide Sources

- [1] K. Mikolajczyk and D. Gunduz, "ELEC60019 Machine Learning: Types of Learning," Imperial College London, 2023. [Online]. Available: http://intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/course_content.asp?c=ELEC60019&s=J3.
- [2] K. Mikolajczyk and C. Ciliberto, "ELEC60009 Deep Learning: Practical Development Process," Imperial College London, 2023. [Online]. Available: http://intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/course_content.asp?c=ELEC60009&s=D3.
- [3] S. Moosavi, "ELEC60009 Deep Learning: Reliability of Deep Learning," 2023. [Online]. Available: http://intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/course_content.asp?c=ELEC60009&s=D3..
- [4] M. Chui, B. Hall, A. Singla and A. Sukharevsky, "The state of AI in 2021," 8 December 2021. [Online]. Available: <https://www.mckinsey.com/capabilities/quantumblack/our-insights/global-survey-the-state-of-ai-in-2021>. [Accessed 25 September 2024].
- [5] R. Hoppe, "A novel user interface for the management of Maritime Search and Rescue Missions," Imperial College London, London, 2024.
- [6] R. Kline and T. Pinch, "Users as Agents of Technological Change: The Social Construction of the Automobile in the Rural United States," October 1996. [Online]. Available: <https://www.jstor.org/stable/3107097>. [Accessed 27 September 2024].
- [7] Y. S. Abu-Mostafa, M. Magdon-Ismail and H.-T. Lin, Learning From Data : A Short Course, AMLbook.com, 2012.

Find out more about how Machine Learning models learn:

(Neural Networks) <https://www.3blue1brown.com/lessons/neural-networks>

(Genetic Algorithms) <https://www.youtube.com/watch?v=R9OHn5ZF4Uo>