Image Recognition for Plankton Classification

The Code Connoisseurs

ECM2427 Outside the Box: Computer Science Research and Applications
University of Exeter

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Contents

Definitions

What is AI?

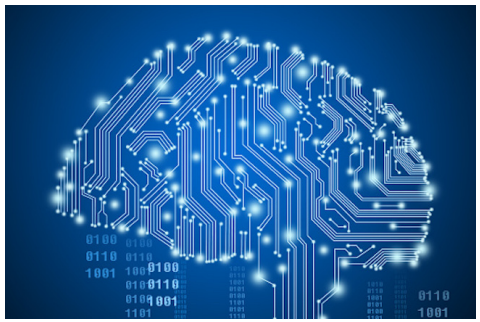

Figure [1]

AI mimics human intelligence in machines, enabling them to learn, solve problems, and make decisions.

What is Image Recognition?

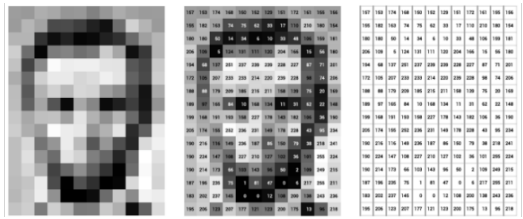

Figure [2]

It's a subset of AI where computers interpret visual data, identifying objects and patterns in images or videos.

Examples

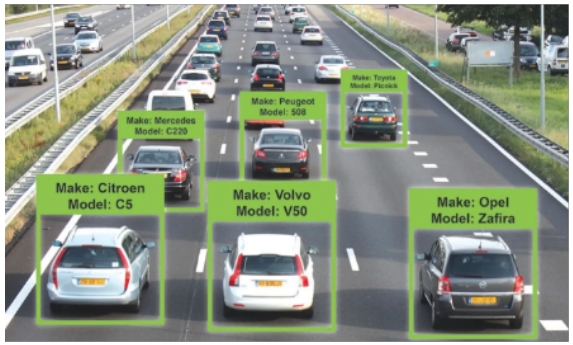

Figure [3]

Automotive: Autonomous vehicle navigation & safety.

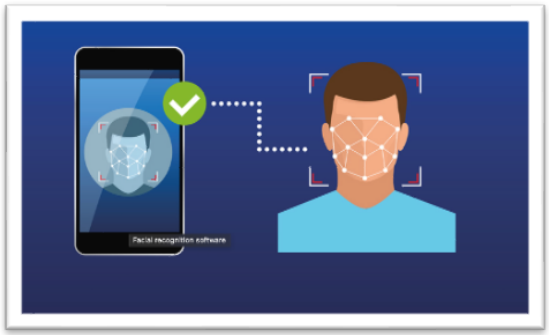

Figure [4]

Security: Surveillance & threat detection.

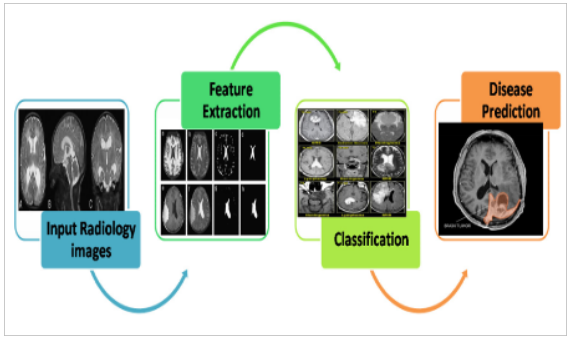

Figure [5]

Healthcare: Medical image analysis for diagnostics.

Contents

Phytoplankton

- The future of image recognition in Marine Biology: Identifying types of Phytoplankton species
- Contribute nearly half of the total global oxygen supply
- Absorb one-third of the CO2 produced globally [6]

Figure [7]
Copepod - Phytoplankton Species

Algal Blooms

- High numbers of phytoplankton ➔ Water Discoloration [8]
- Mass death events affecting humans and sea-life
- Automated Plankton Identification with AI [9]

Figure [10]
Algal Bloom in Ontario, Canada

Figure [11]
Phytoplankton

Gathering Data for AI model

- Underwater images are typically very noisy
- Plankton often obscured in images
- Plankton objects can be deformable
- Plankton can be in any orientation and position

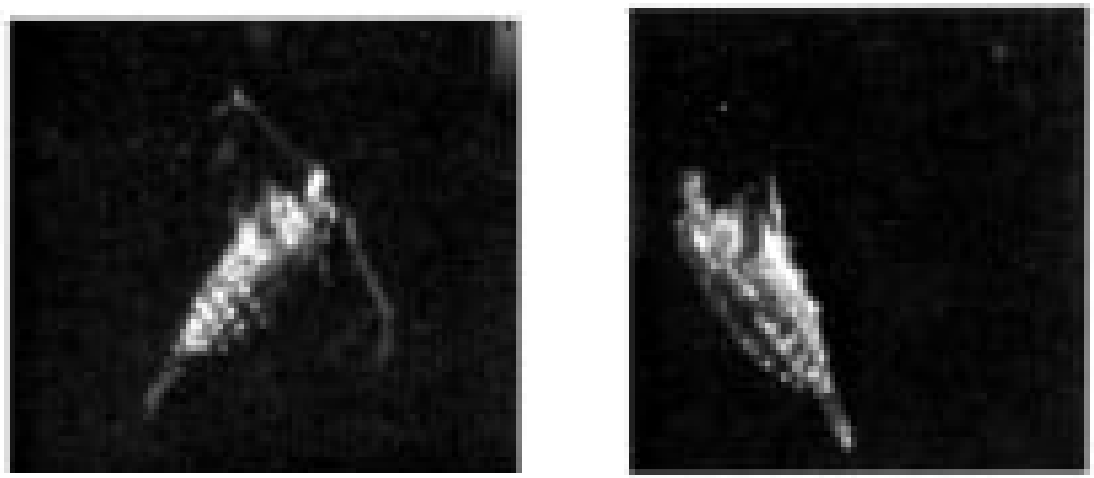

Figure [12]

Dataset Issues

- Rare Groups of plankton
- Bias in AI model
- Poor performance on rare groups

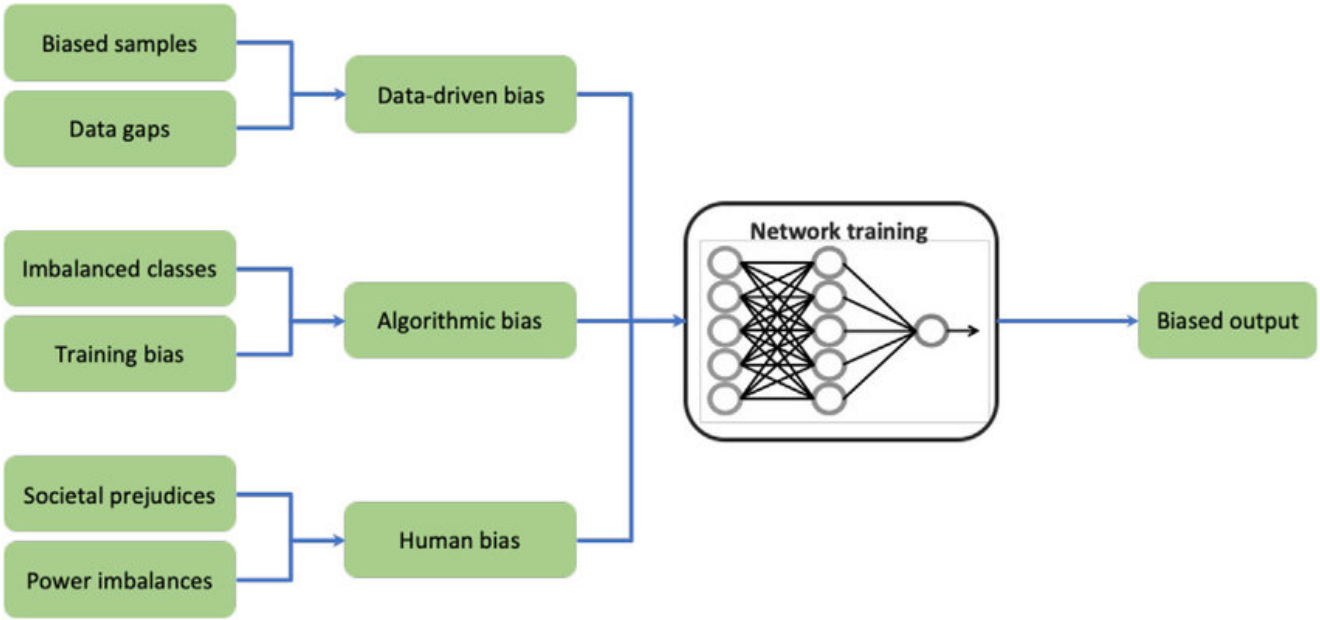

Figure [13]

Contents

Obtain Data from Underwater Images

DeepLOKI : New deep learning Approach

- Higher illumination levels images
- Synthesising new images

Figure [16]

Figure [17]

Identifying Plankton Classes (1)

Probability Filtering

- Automatic classification
- Reduces incorrect images
- Leaves some images unclassified

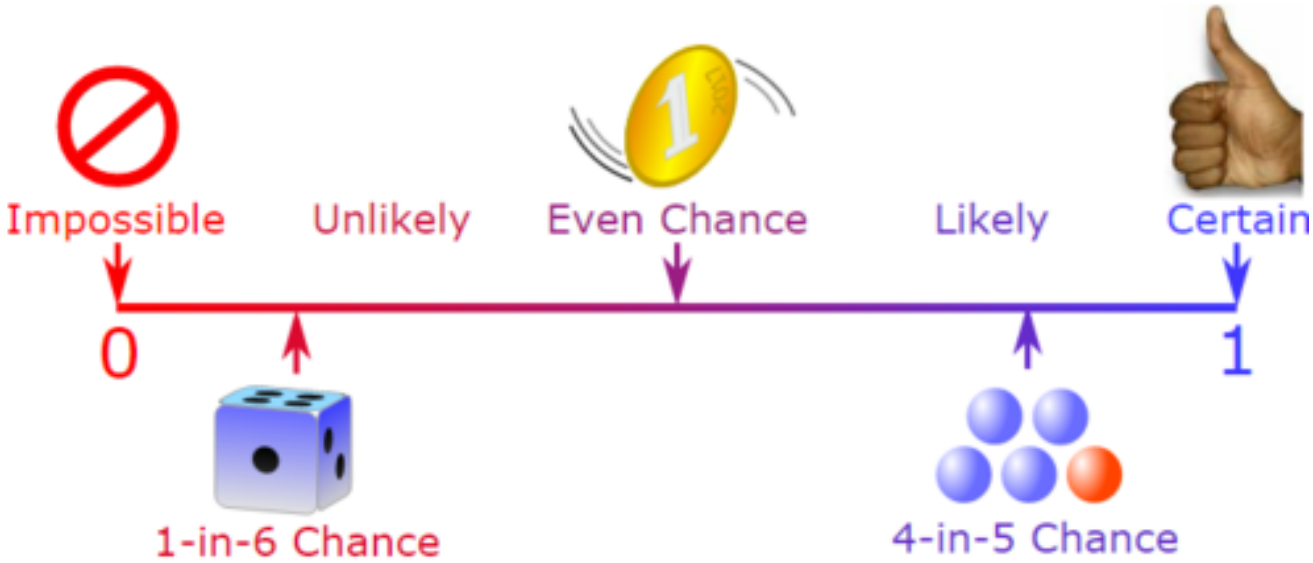

Figure [18]

Identifying Plankton Classes (2)

CNN (Convolutional Neural Network)

- Training AI model [19]
- Deep learning

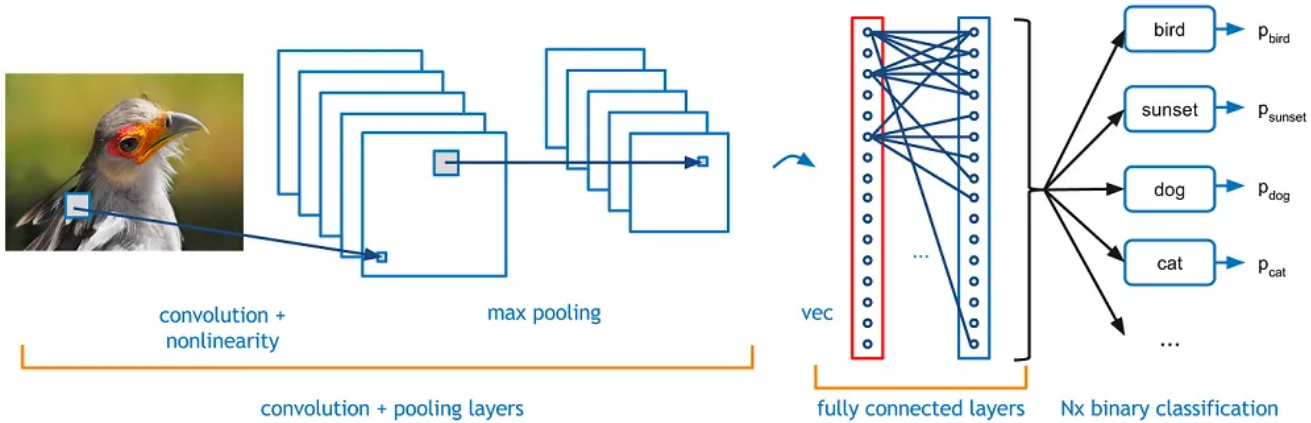

Figure [20]

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Example 1: Learning Vector Quantization Model

- Designed by Xiaoou Tang, W. Kenneth Stewart 1998
- Traditional model: only one neuron updated each iteration
- Trained on 6 classes of plankton
- Trained on around 2000 images
- 95% classification accuracy

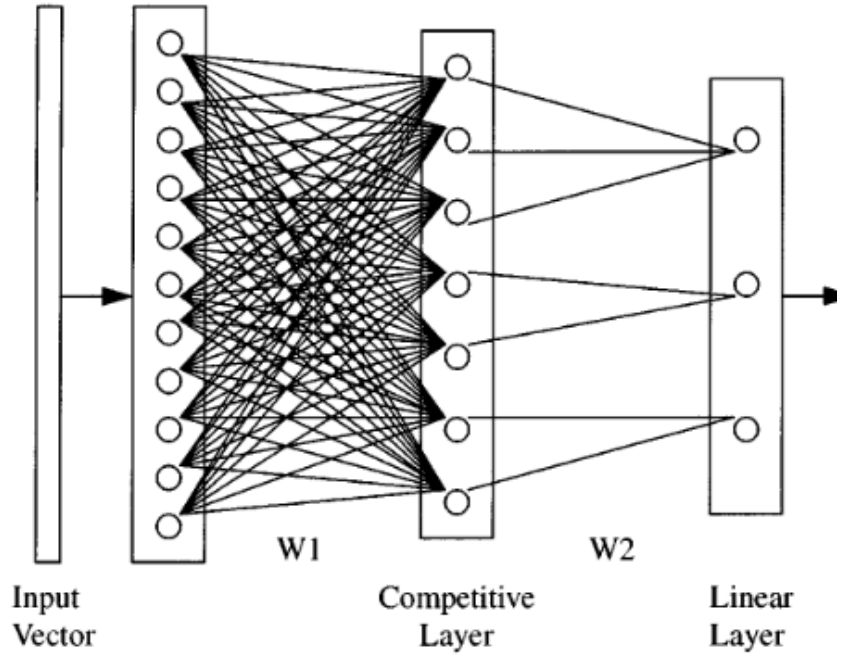

Figure [21]

Example 2: Sosik and Olson

- Designed by Sosik and Olson, 2007
- 3330 images used for performance analysis
- 88% average classification accuracy
- 12 classes with 90%+ accuracy
- 22 classes total

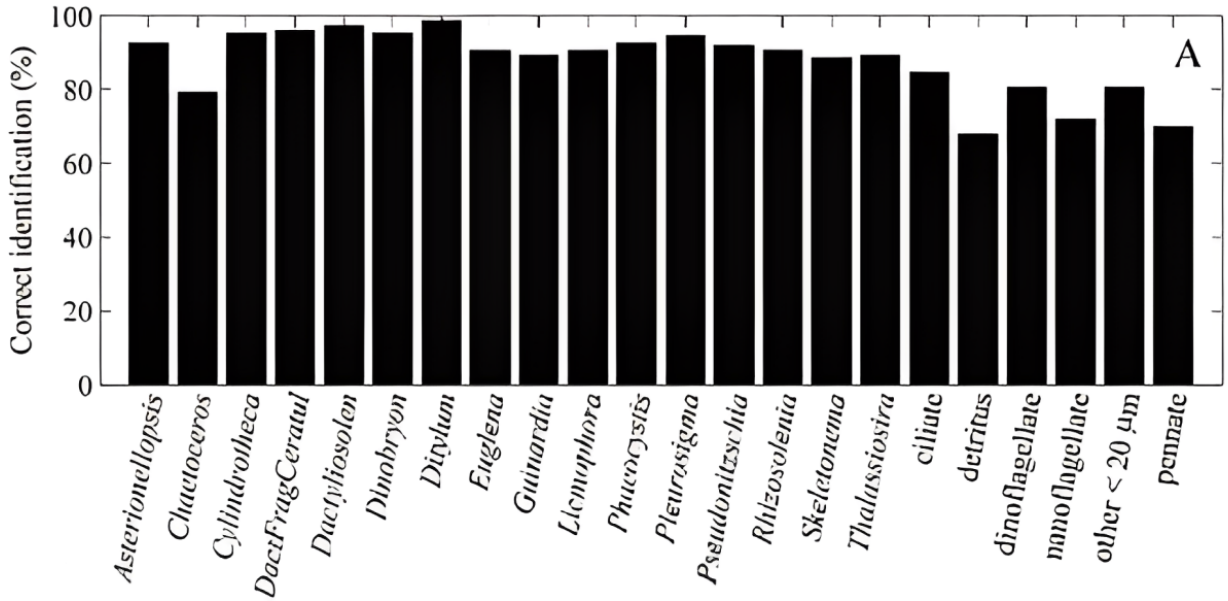

Figure [22]

Example 3: Rawat, Bisht and Nijhawan

- Designed by Rawat, Bisht and Nijhawan, 2019
- Tested AI designs on 5 plankton classes
- Feature Extraction Models: VGG-16, VGG-19 and Inception v3
- Convolutional Neural Network and Inception v3 performed best
- 99.5% accuracy with CNN and Inception v3

ML Algorithm	Accuracy	Precision	Recall
CNN	99.5%	91.1%	90.6%
SVM	99.5%	91.1%	90.3%
Logistic Regression	99.4%	91.1%	90.6%
KNN	97.7%	88.9%	88.3%

Figure [23]

Comparison of machine learning algorithms with interception v3

Contents

Limitations and the Future (1)

- Optimal Design
- Optical Sensors
- Power Consumption
- Image Quality [24]

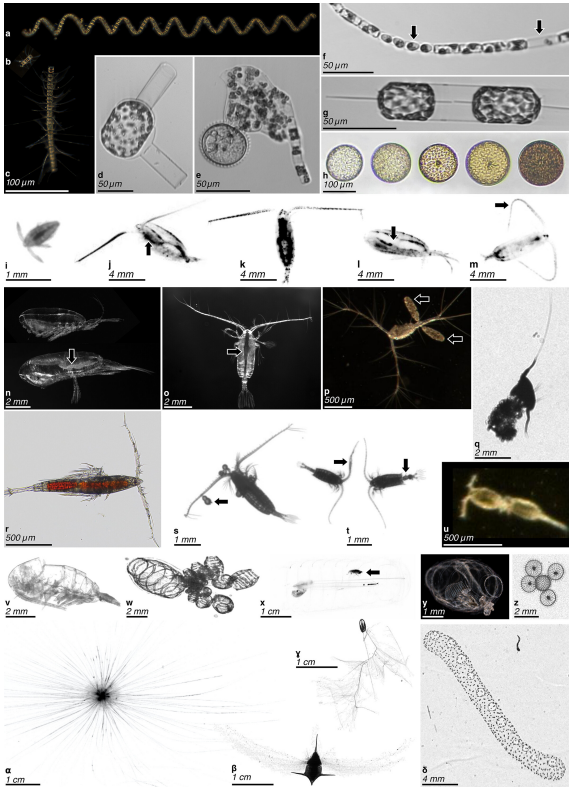

Figure [25]

Limitations and the Future (2)

Software

- Classification algorithms

Future Solutions?

- Improved sensors
- Imaging Technology
- Open source [25]

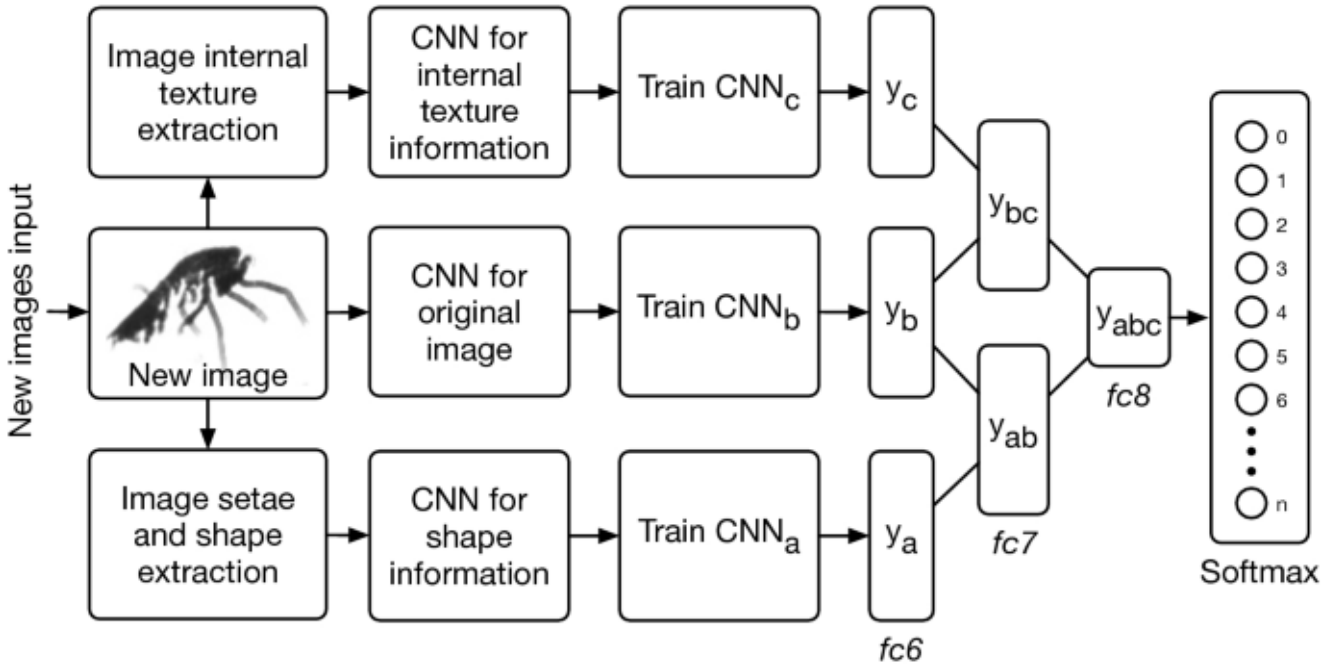

Figure [26]

Summary

- Challenging to identify plankton species
- Importance of identifying plankton
- Solutions
- Future

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