

Remote Sensing - Advanced Methods

AI4EO Hackathon

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Agenda

- 1.Introduction
- 2.Meet the data
- 3.Machine learning
- 4.Deep learning
- 5.Open problems
- 6.Challenge

What is artificial intelligence?

It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.

John McCarthy, 2007

AI >> ML > DL

Artificial Intelligence
Mimicking human intelligence

NLP

Speech

Vision

Expert systems

Robotics

Optimization

Machine Learning

The use and development of computer systems that are able to learn

Deep Learning

ML based on artificial neural networks that uses multiple layers to extract high-level features

Biology

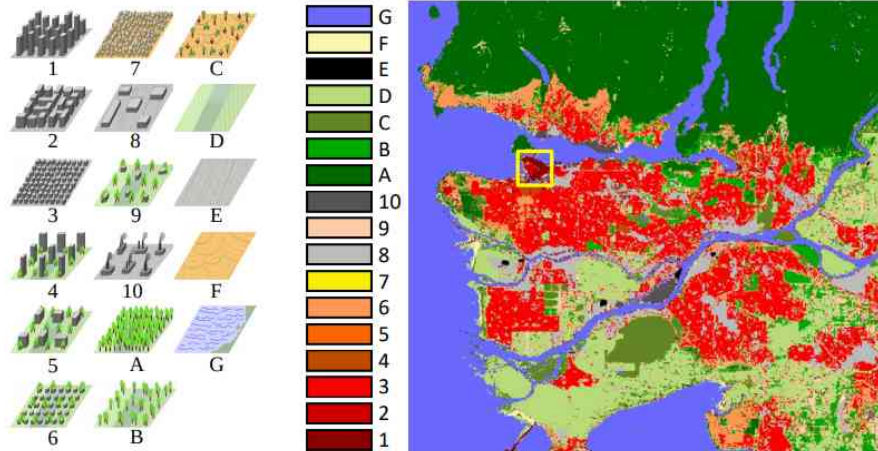
Psychology

So2Sat LCZ42

17 LCZ classes

10 urban

7 natural



42 Cities

32 Train

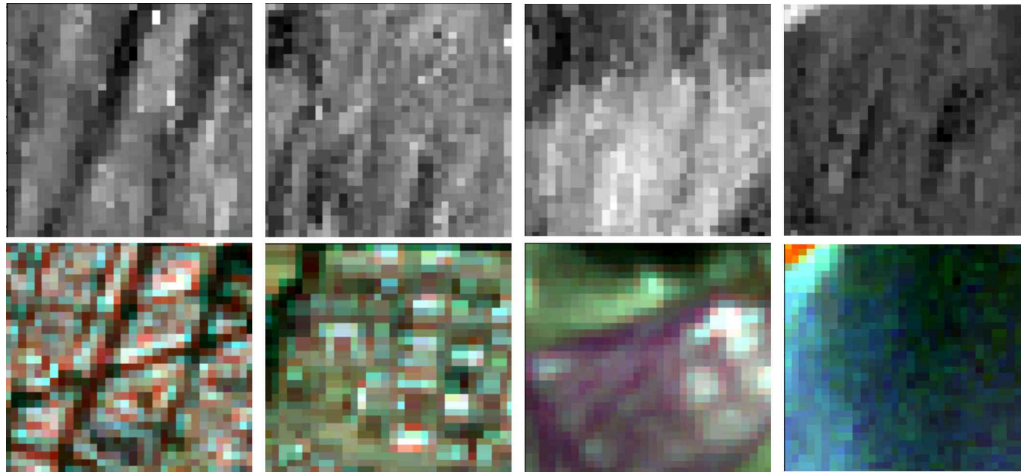
10 Test



Manually labeled by
10 remote sensing experts

So2Sat LCZ42 patches

32x32 pixels



2. Compact midrise

6. Open low-rise

14. Low plants

17. Water

Sentinel-1
8 real-valued bands

Sentinel-2
10 real-valued bands

17 one hot encoded classes

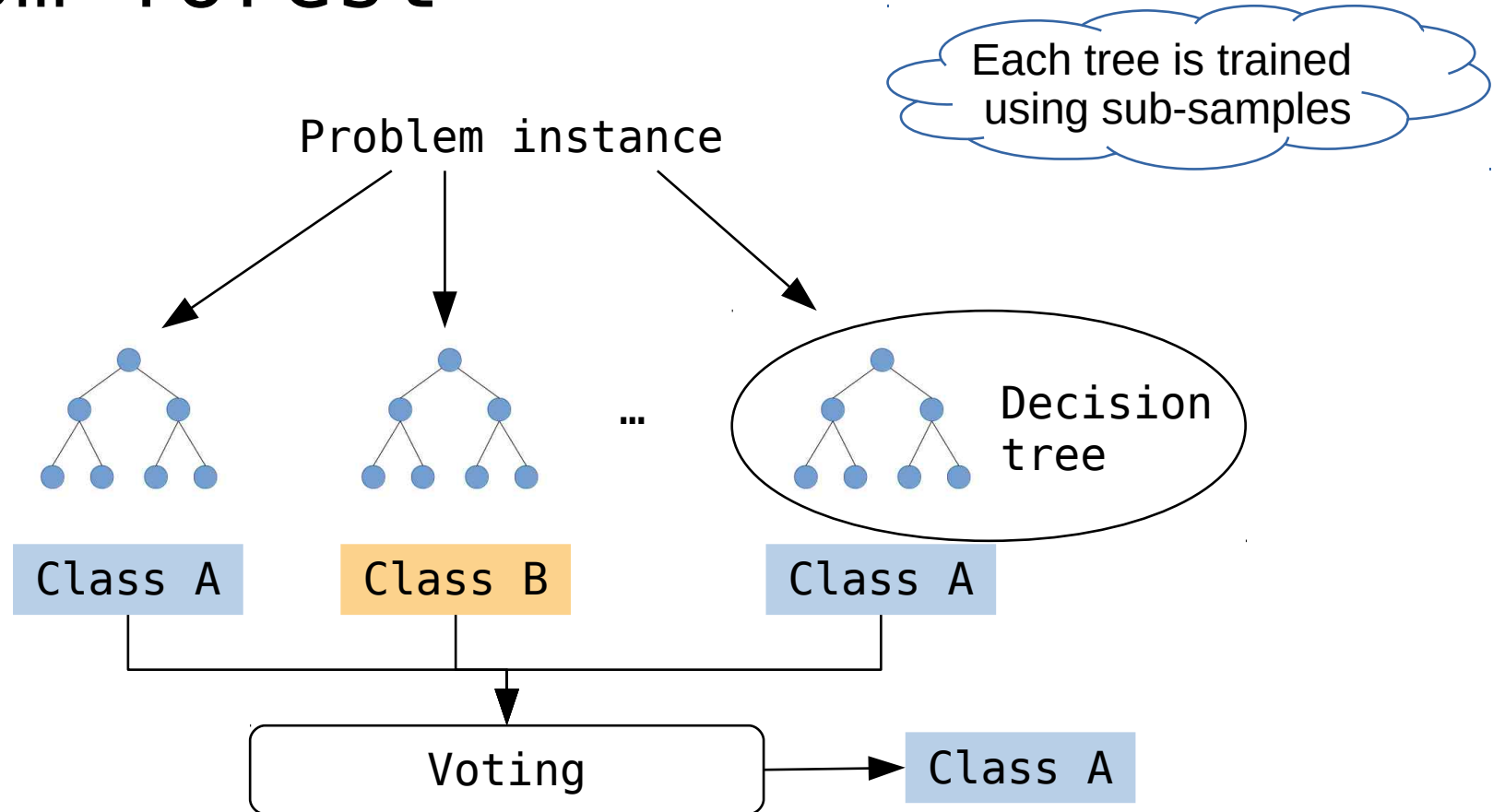
<https://github.com/acamero/rsam-lcz42>

Machine Learning

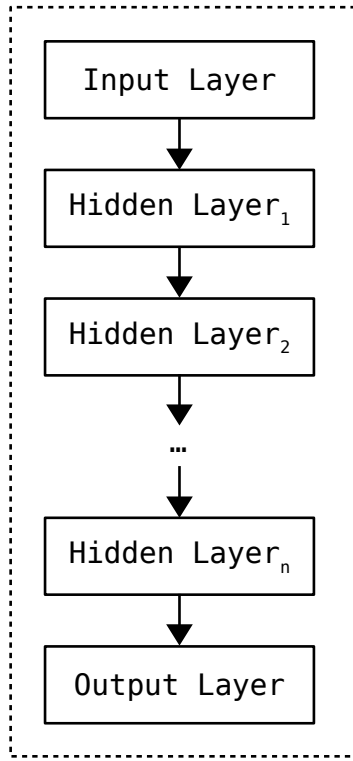
A computer program is said to learn from experience E with respect to some task T and some performance measure P , if its performance on T , as measured by P , improves with experience E .

Tom M. Mitchell, 1997

Random forest



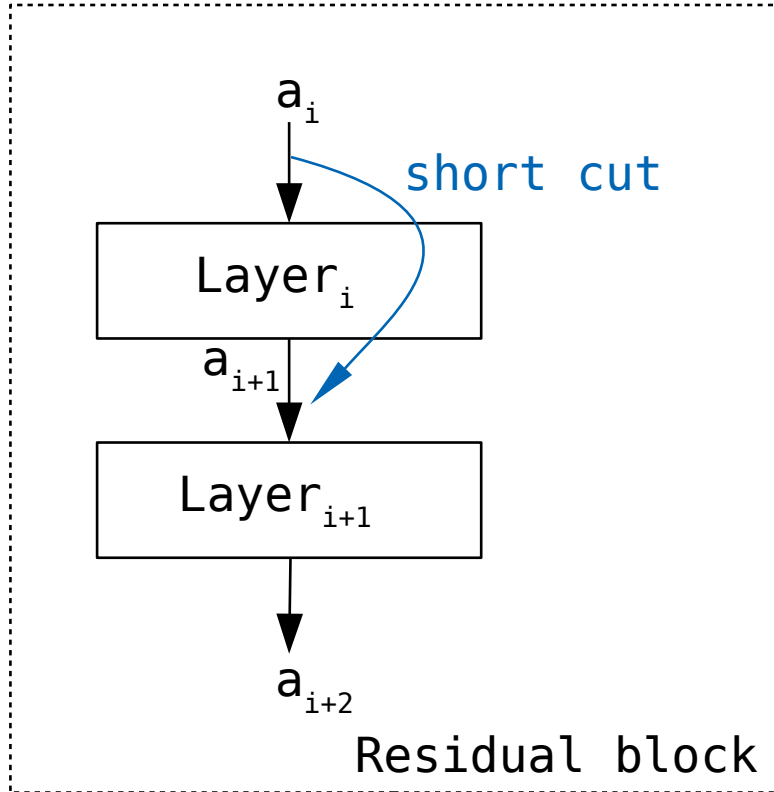
Deep neural networks



Deep-learning methods are representation-learning methods with multiple levels of representation, obtained by composing simple but non-linear modules that each transform the representation at one level (starting with the raw input) into a representation at a higher, slightly more abstract level. With the composition of enough such transformations, very complex functions can be learned.

Yann LeCun, Yoshua Bengio and Geoffrey Hinton, 2015

Residual block

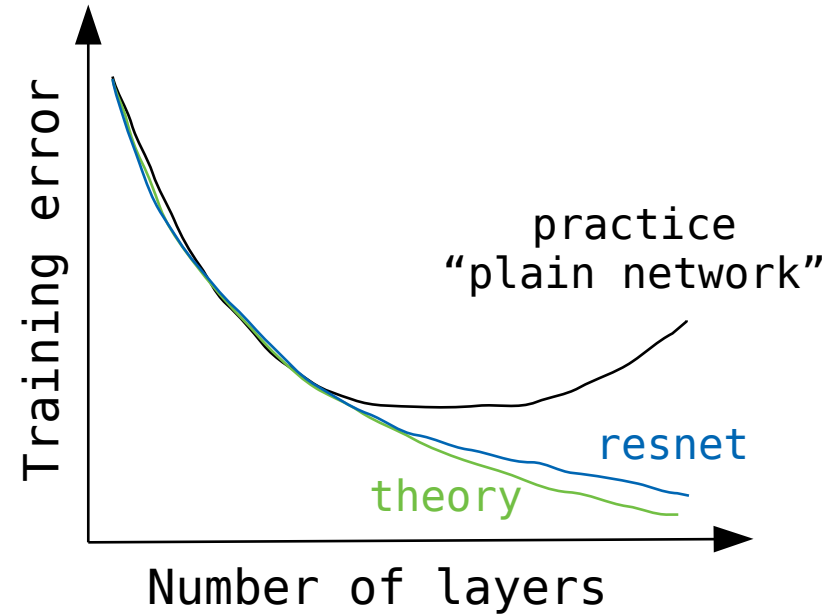
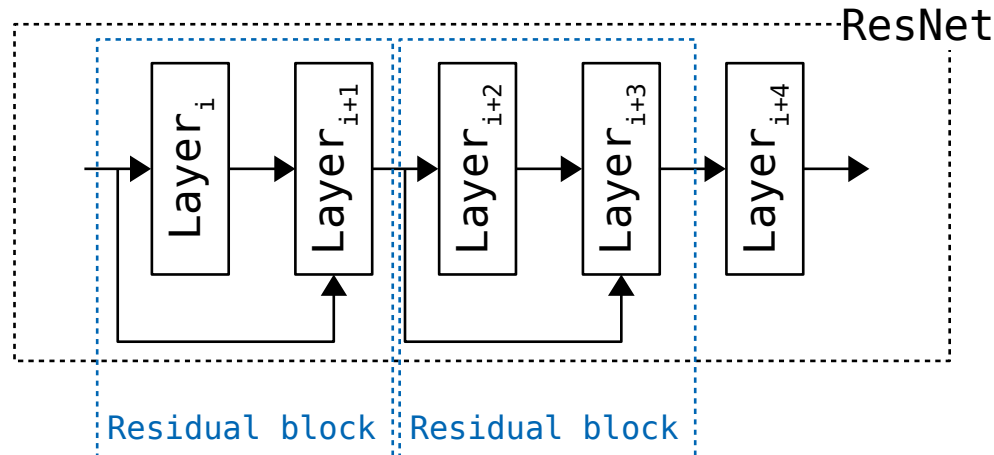
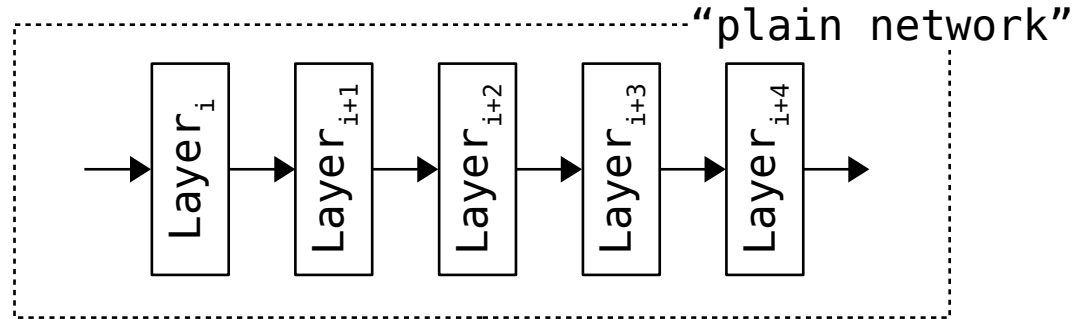


$$a_{i+1} = g(W_i \cdot a_i + b_i)$$

$$a_{i+2} = g(W_{i+1} \cdot a_{i+1} + b_{i+1}) \quad \text{"Plain network"}$$

$$a_{i+2} = g(W_{i+1} \cdot a_{i+1} + b_{i+1} + a_i) \quad \text{"Short cut"}$$

Residual network: ResNet



Remote sensing data is...

Multimodal

Geo-located

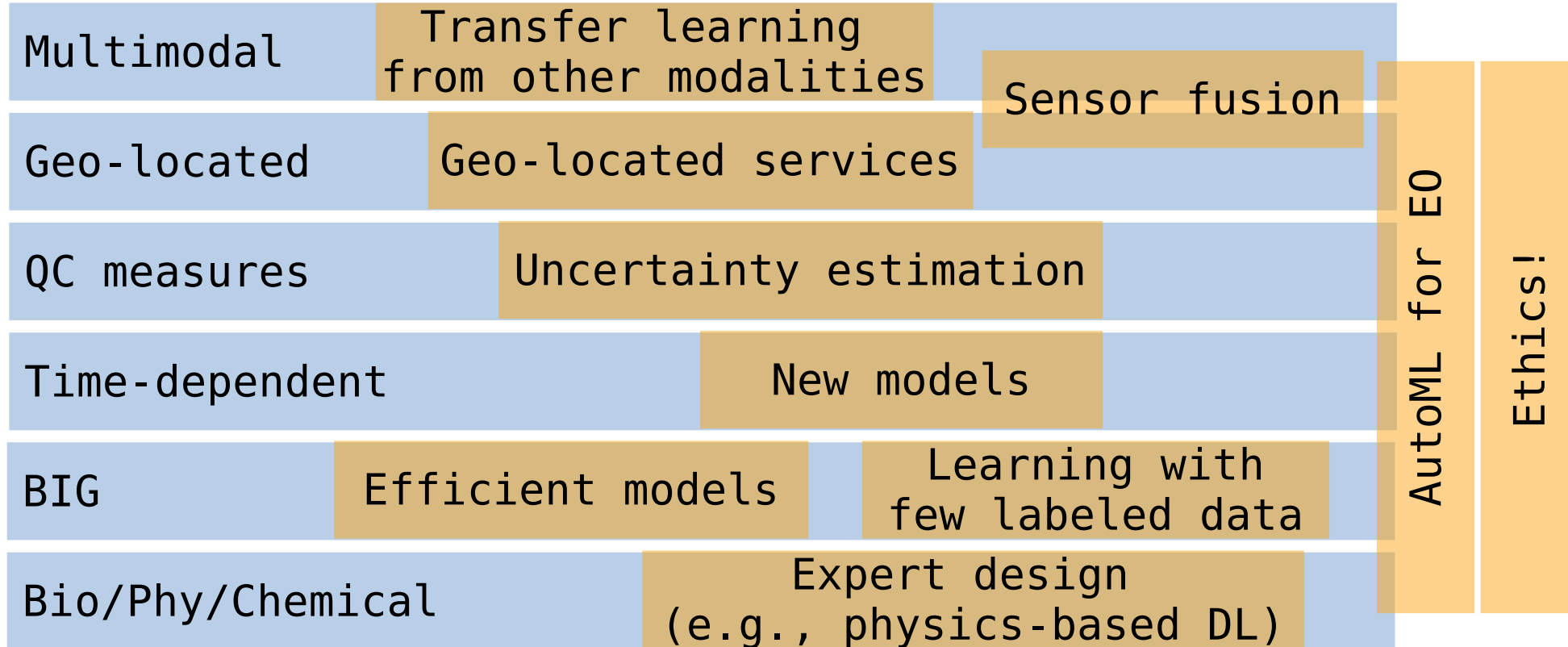
QC measures

Time-dependent

BIG

Bio/Phy/Chemical

Thus, requires...



Propose the best DL model to predict LCZ!

You may...

- ✓ start from the simple model or the ResNet50,
- ✓ use Sentinel-1 and/or 2,
- ✓ modify the architecture by adding/removing/modifying layers,
- ✓ changing the optimizer parameters, ...

References

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3. McCarthy, J., 2007. What is artificial intelligence?
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5. Zhu, X.X., Hu, J., Qiu, C., Shi, Y., Kang, J., Mou, L., Bagheri, H., Haberle, M., Hua, Y., Huang, R. and Hughes, L., 2020. So2Sat LCZ42: a benchmark data set for the classification of global local climate zones [Software and Data Sets]. IEEE Geoscience and Remote Sensing Magazine, 8(3), pp.76-89.
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