Remote Sensing - Advanced Methods

AI4EO Hackathon

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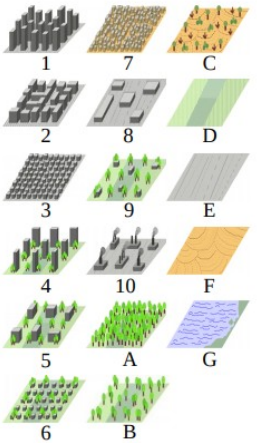
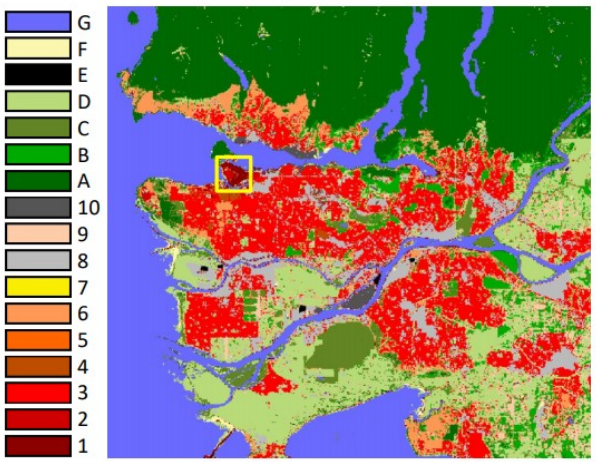
Agenda

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

So2Sat LCZ42

- 17 LCZ classes
  - 10 urban
  - 7 natural





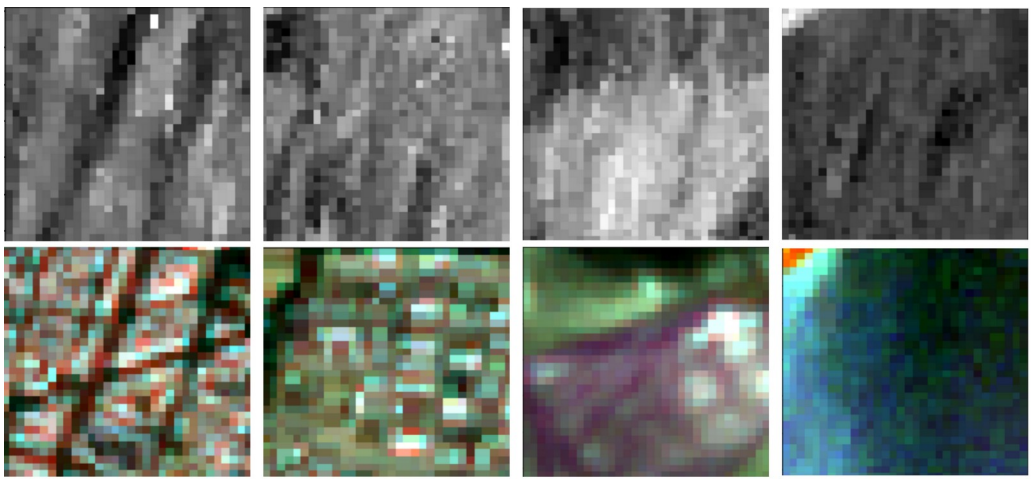
- 42 Cities
- 32 Train
- 10 Test

Manually labeled by
10 remote sensing experts

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.

So2Sat LCZ42 patches

32x32 pixels



Sentinel-1
8 real-valued bands

Sentinel-2
10 real-valued bands

17 one hot encoded classes

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.

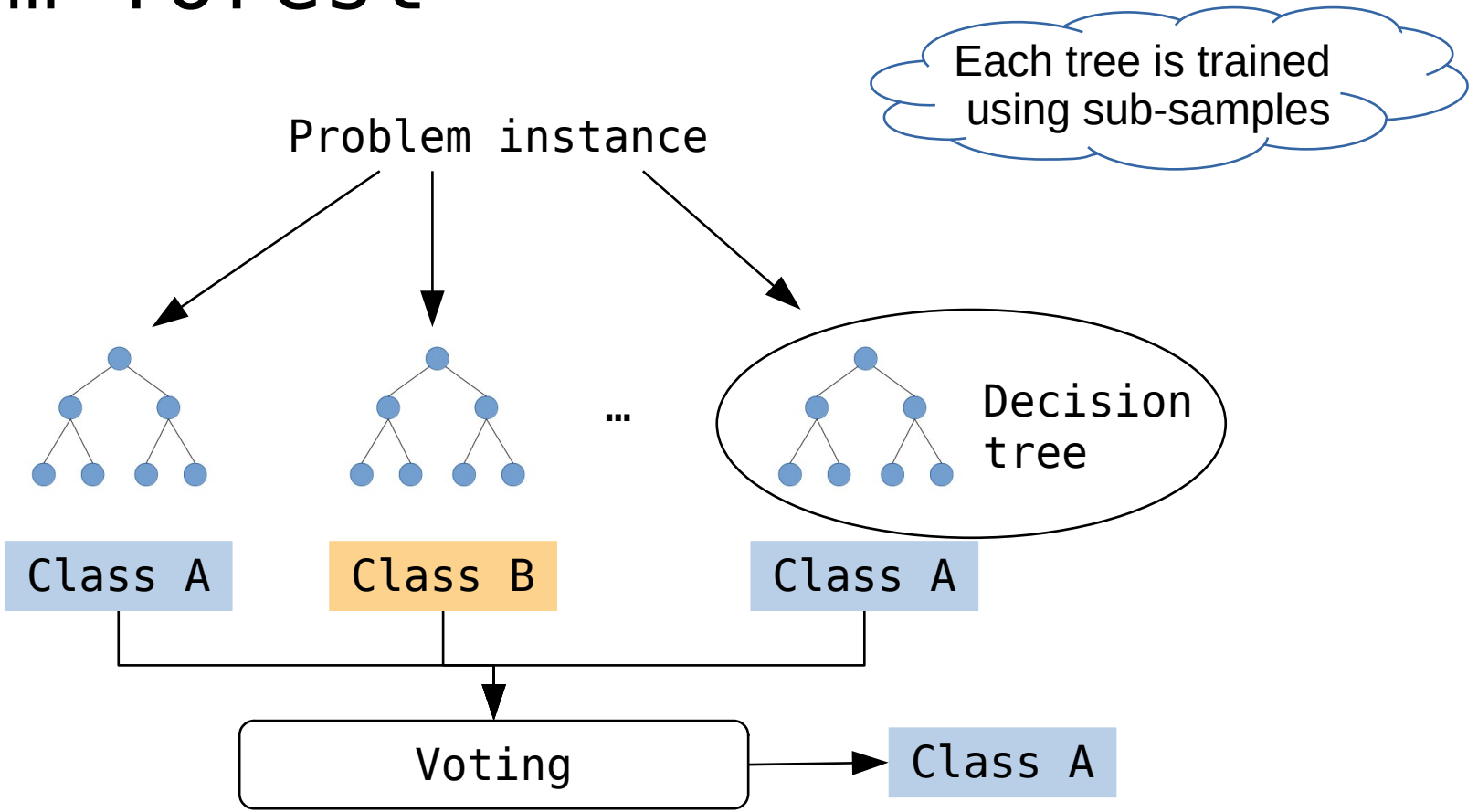
https://github.com/acamero/rsam-lcz42

Machine Learning

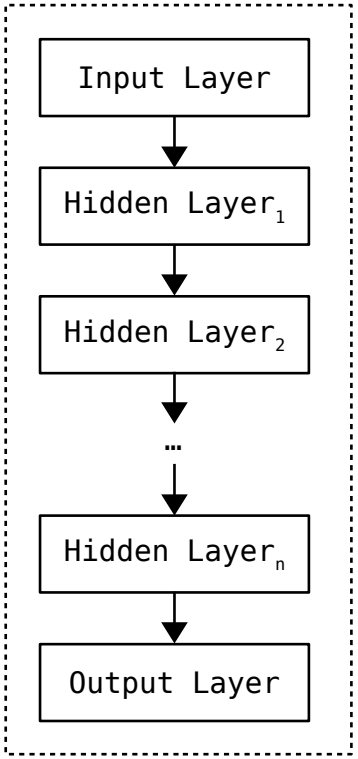
A computer program is said to learn from experience ***E*** with respect to some task ***T*** and some performance measure ***P***, if its performance on ***T***, as measured by ***P***, improves with experience ***E***.

Tom M. Michell, 1997

Random forest



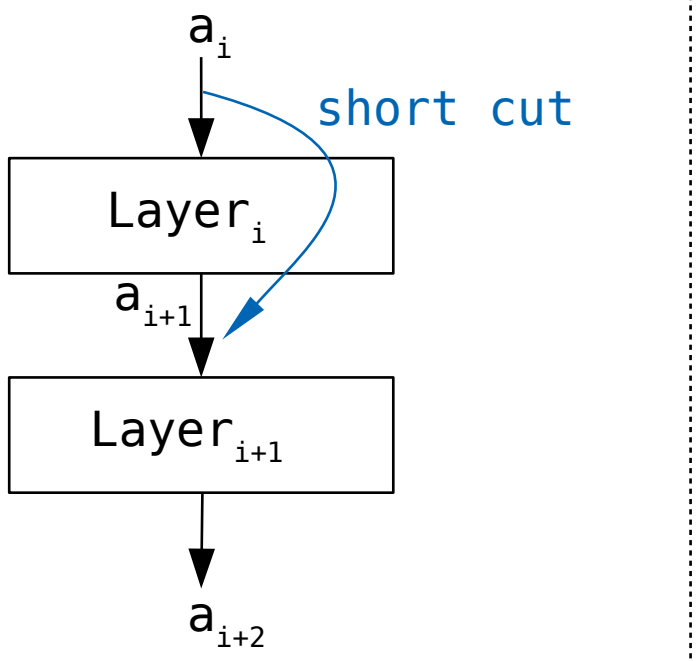
Deep neural networks



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

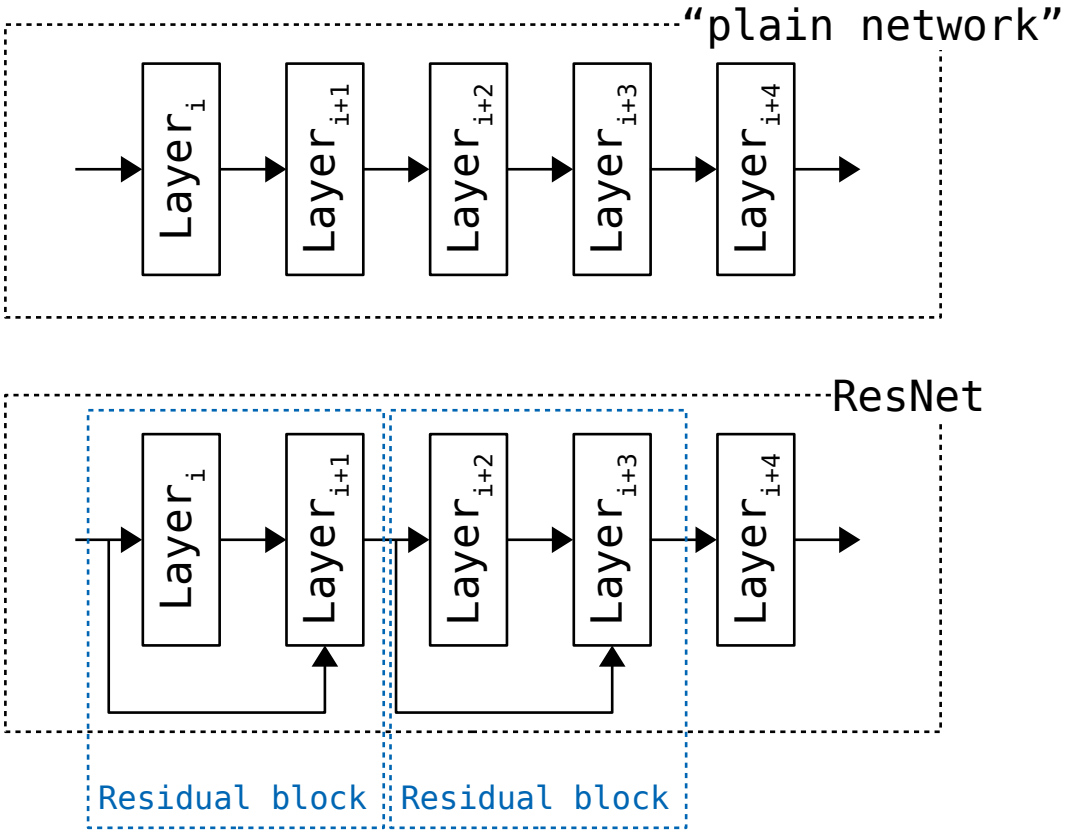


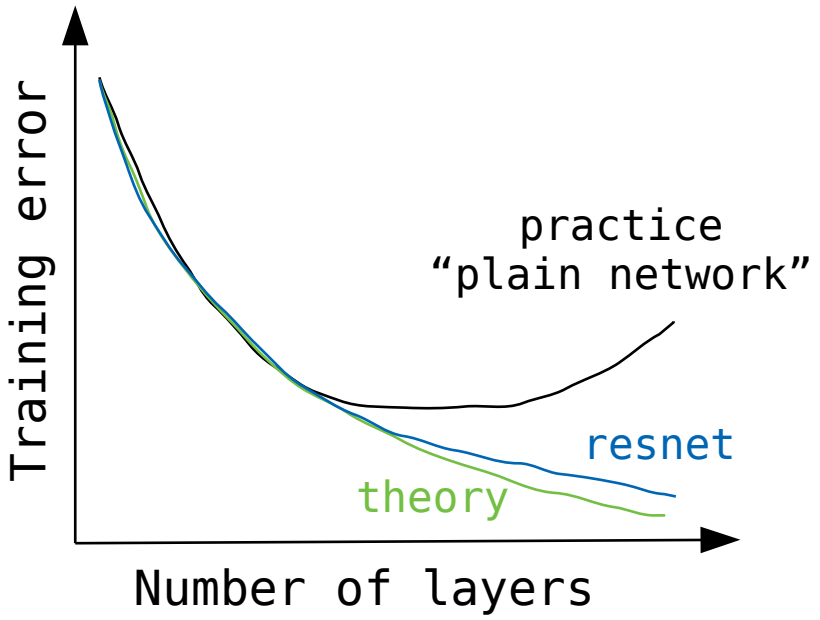
$$a_{i+1} = g(W_i \cdot a_i + b_i)$$

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

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

Residual network: ResNet

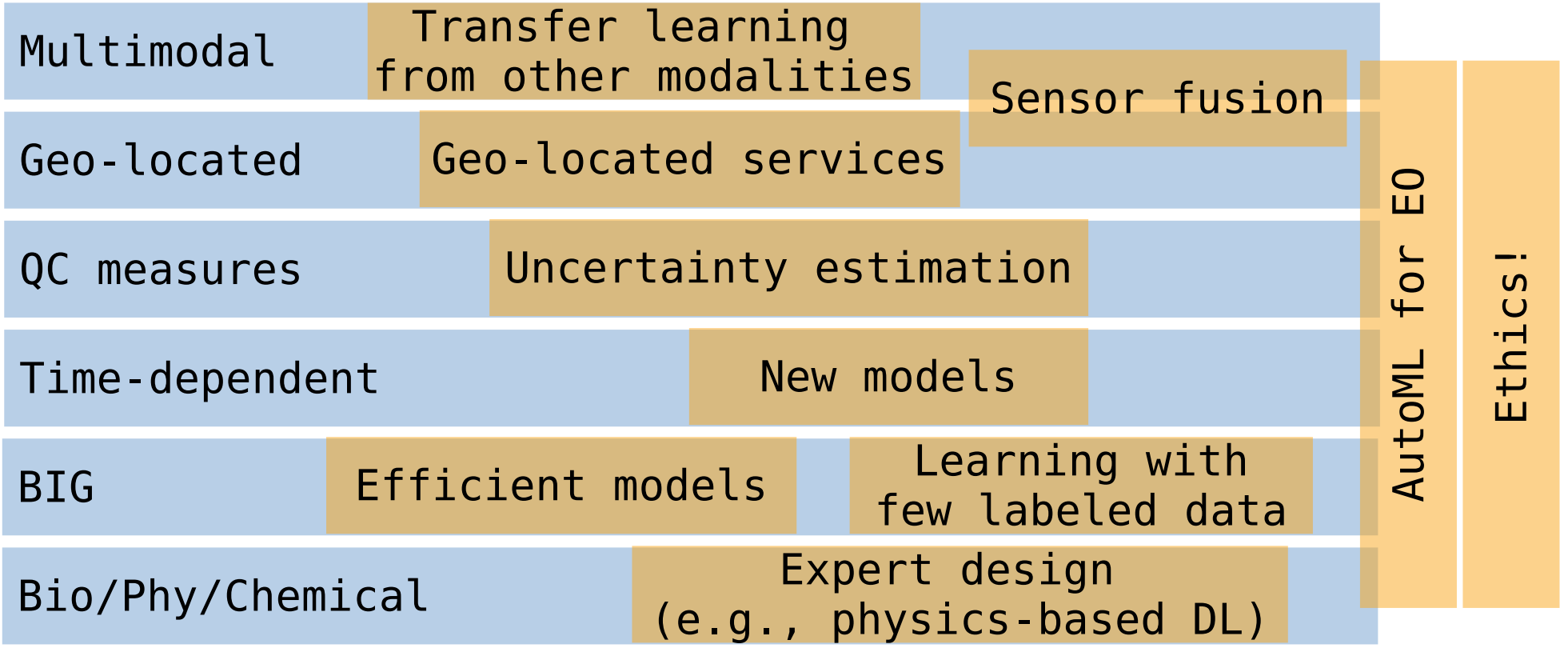




Remote sensing data is…

- 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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2. LeCun, Y., Bengio, Y. and Hinton, G., 2015. Deep learning. nature, 521(7553), pp.436-444.
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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.
6. Zhu, X.X., Tuia, D., Mou, L., Xia, G.S., Zhang, L., Xu, F. and Fraundorfer, F., 2017. Deep learning in remote sensing: A comprehensive review and list of resources. IEEE Geoscience and Remote Sensing Magazine, 5(4), pp.8-36.