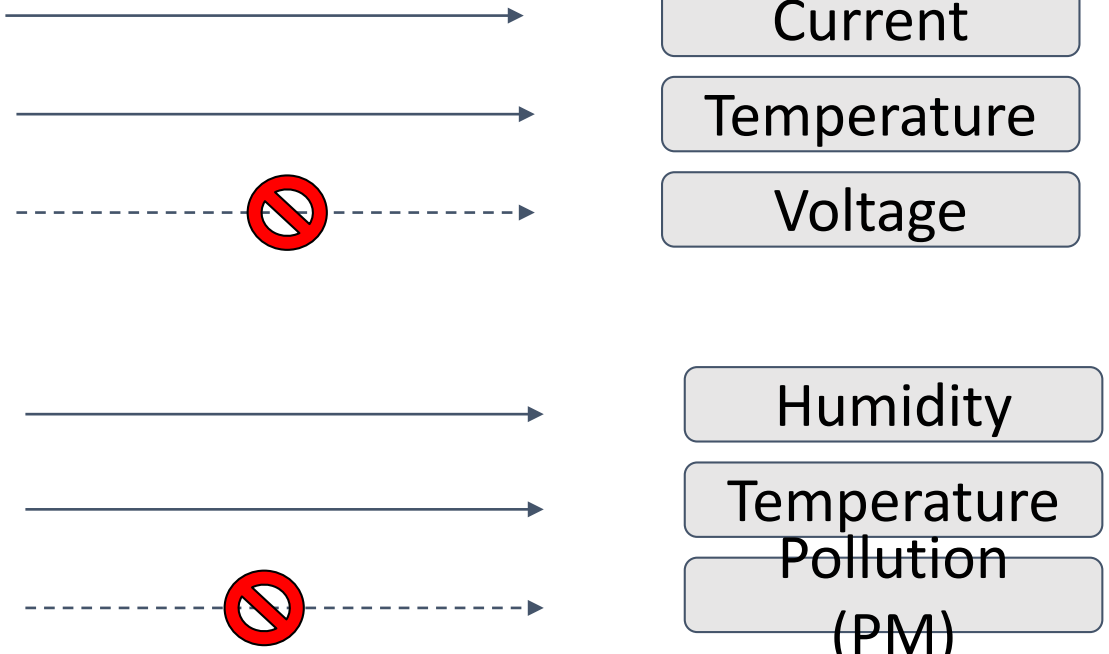
Multimodal Meta-learning for Time Series Regression

Sebastian Pineda Arango

Motivation

Regression is interesting when we do not have sensors for some variables.



Motivation

Current

Temperature

Voltage

Current

Temperature

Model

Voltage

Historical data

Current

Temperature

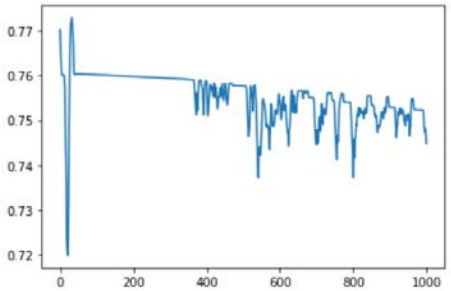
Model

Voltage

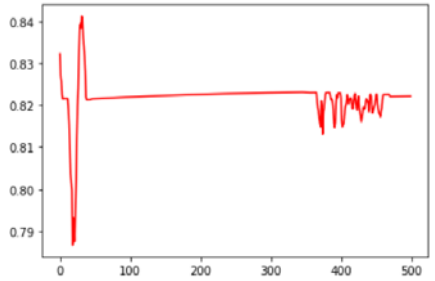
Motivation

We want to **leverage** the data from other **similar** sources (tasks) so that we can learn with less data in **new** sources (tasks).

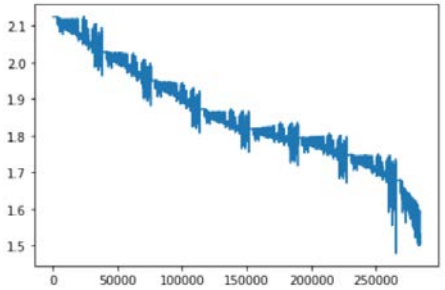
Berlin pollution measurements



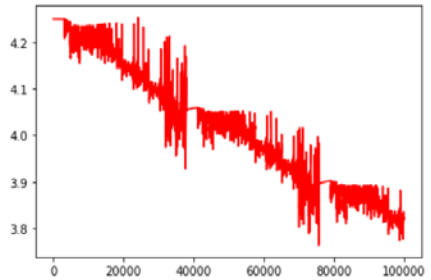
Paris pollution measurements



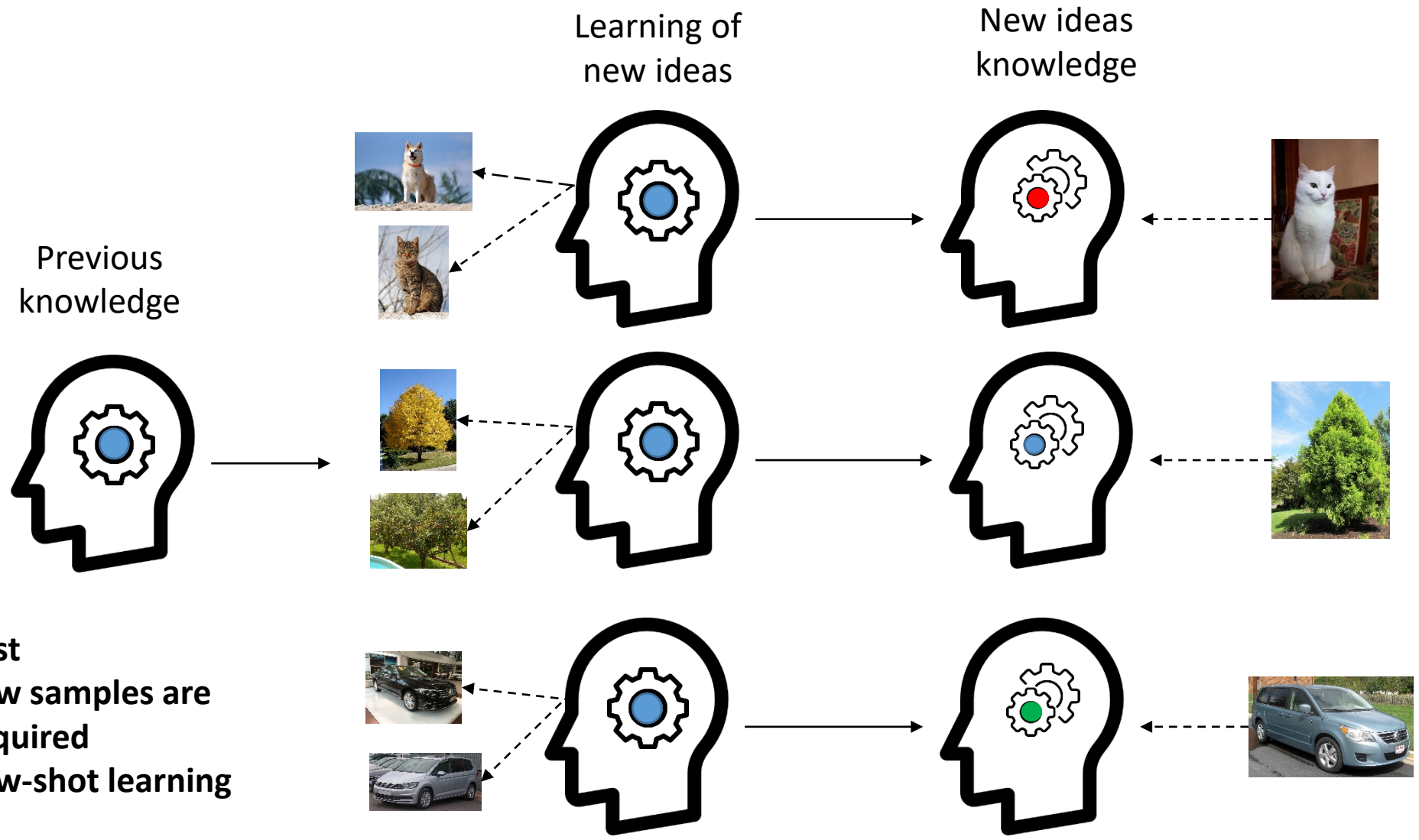
Battery signals (First year)



Battery signals (10 years)



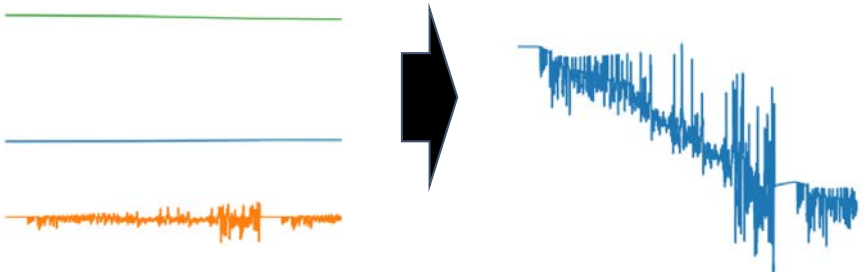
Motivation: How do we learn?



- **Fast**
- **Few samples are required**
- **Few-shot learning**

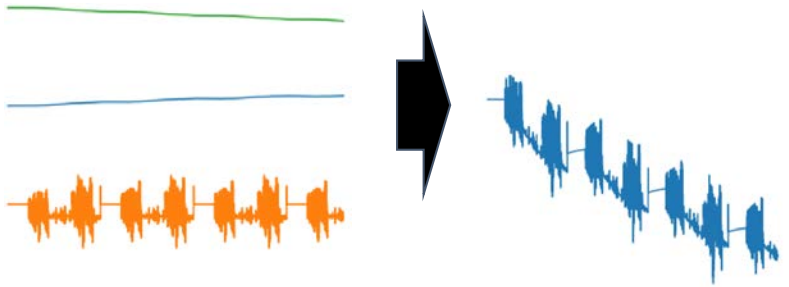
Few-shot Learning for Multivariate Time Series

Domain 1: Electric signals under condition 1



$L = 10000$

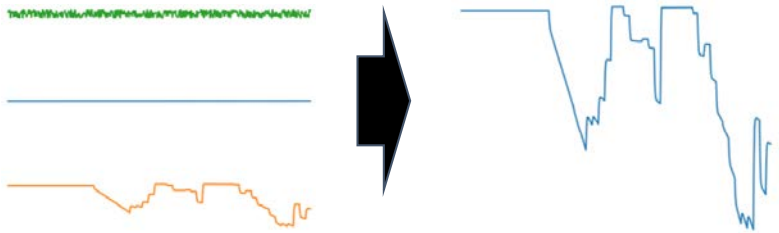
Domain 2: Electric signals under condition 2



$L = 10000$

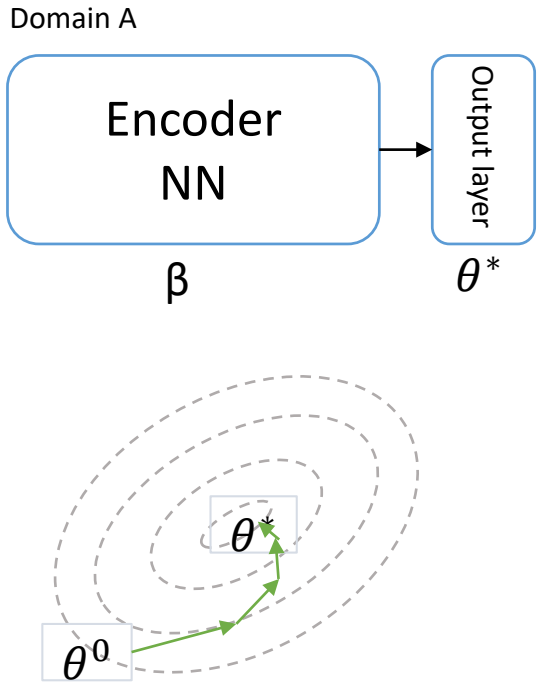
Domain 3: Electric signals under unseen conditions

- Fast “domain” adaptation: less model updates
- Less data hungry

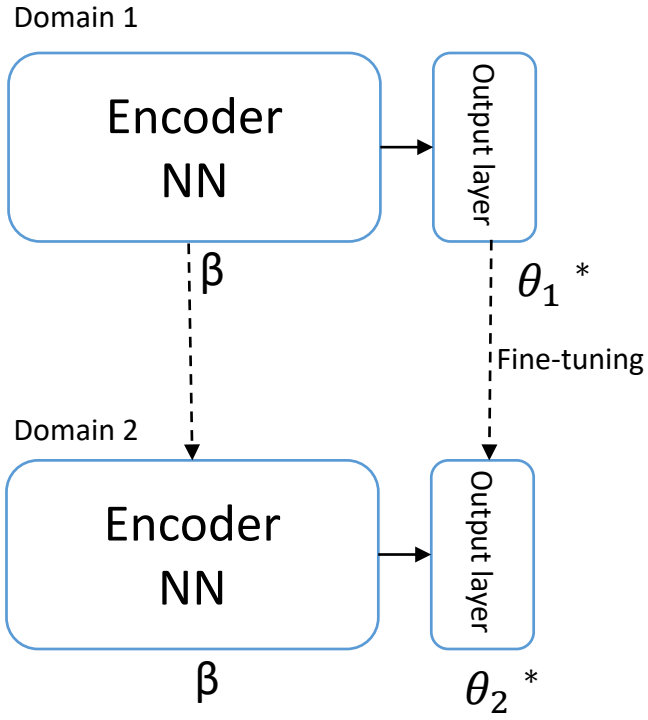


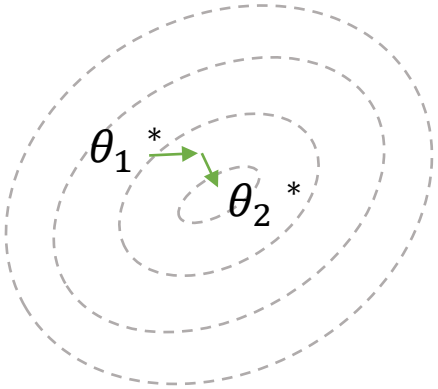
$L = 100$

Transfer learning



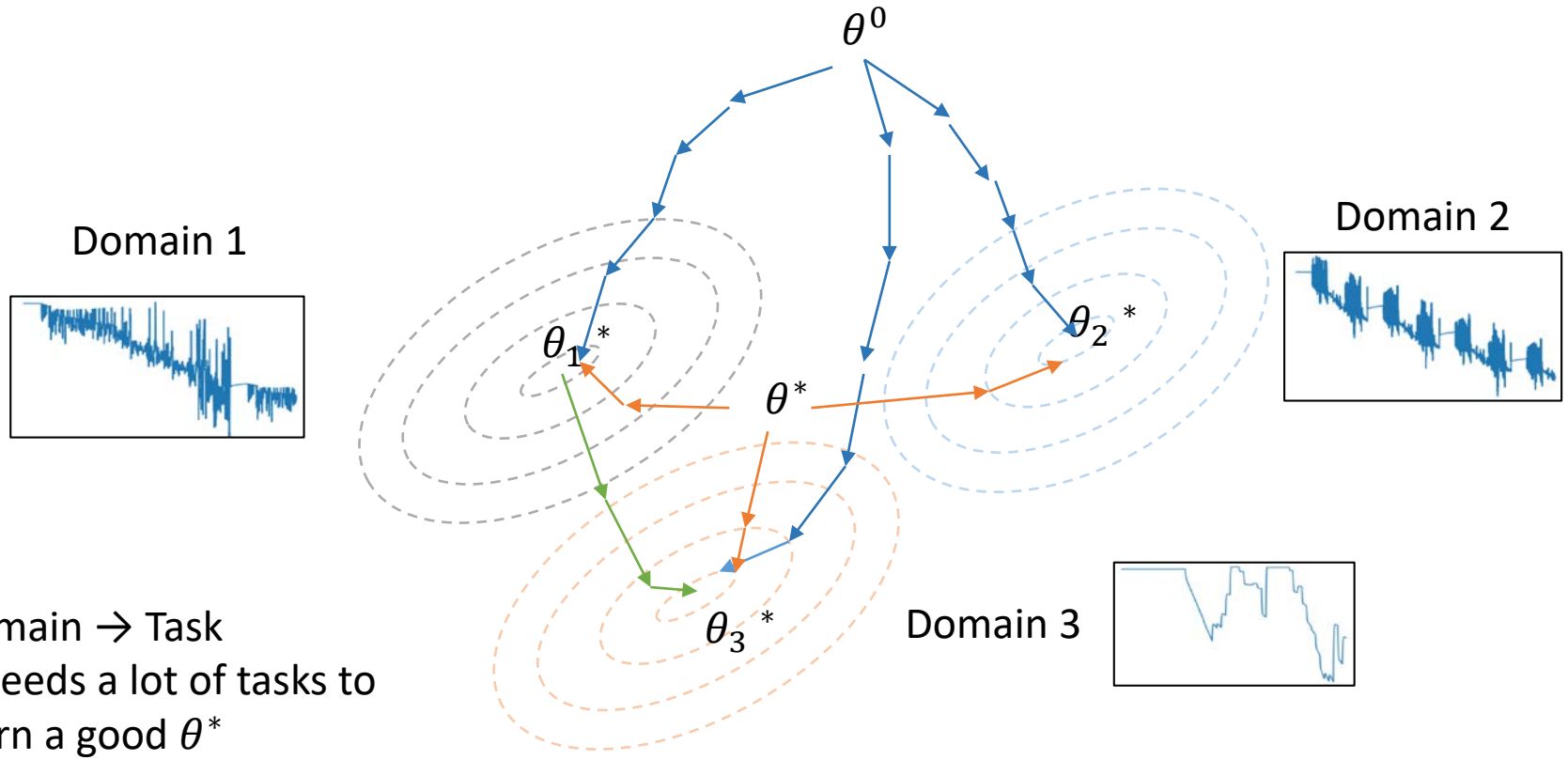
Standard training





Transfer learning

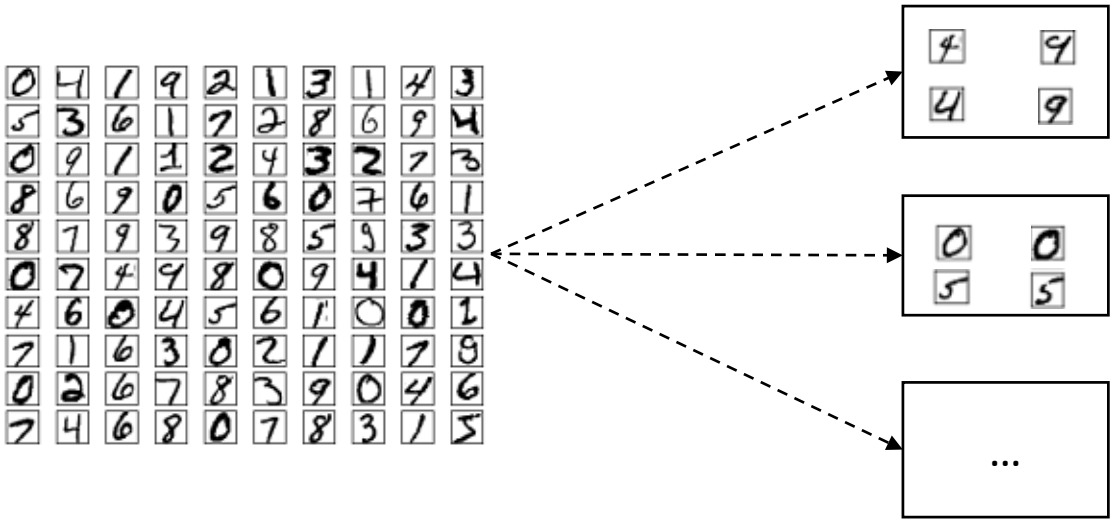
Model-Agnostic Meta-learning (MAML)



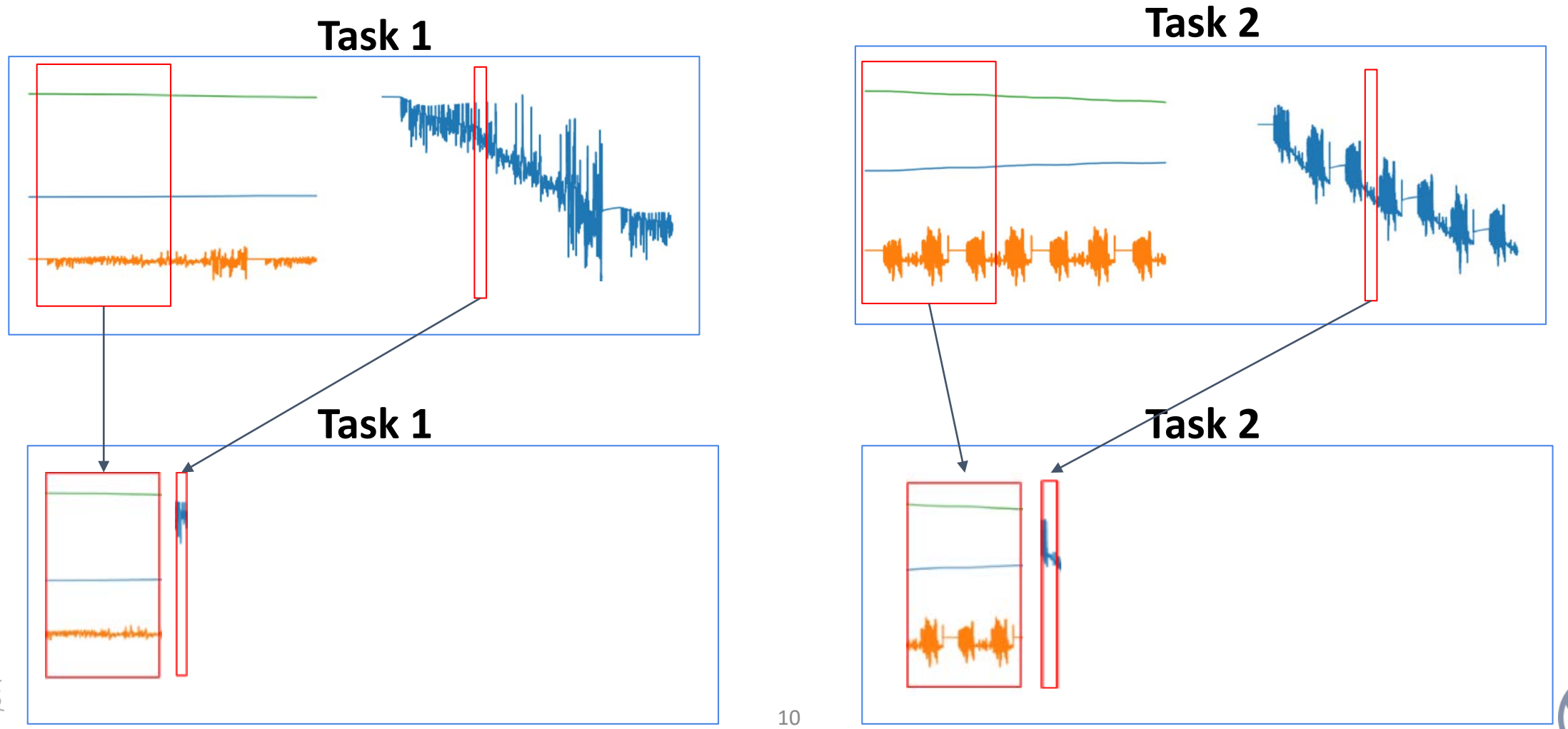
- Domain → Task
- It needs a lot of tasks to learn a good θ^*

* Finn et al. *Model-agnostic meta-learning for fast adaptation of deep networks*, ICML (2017).

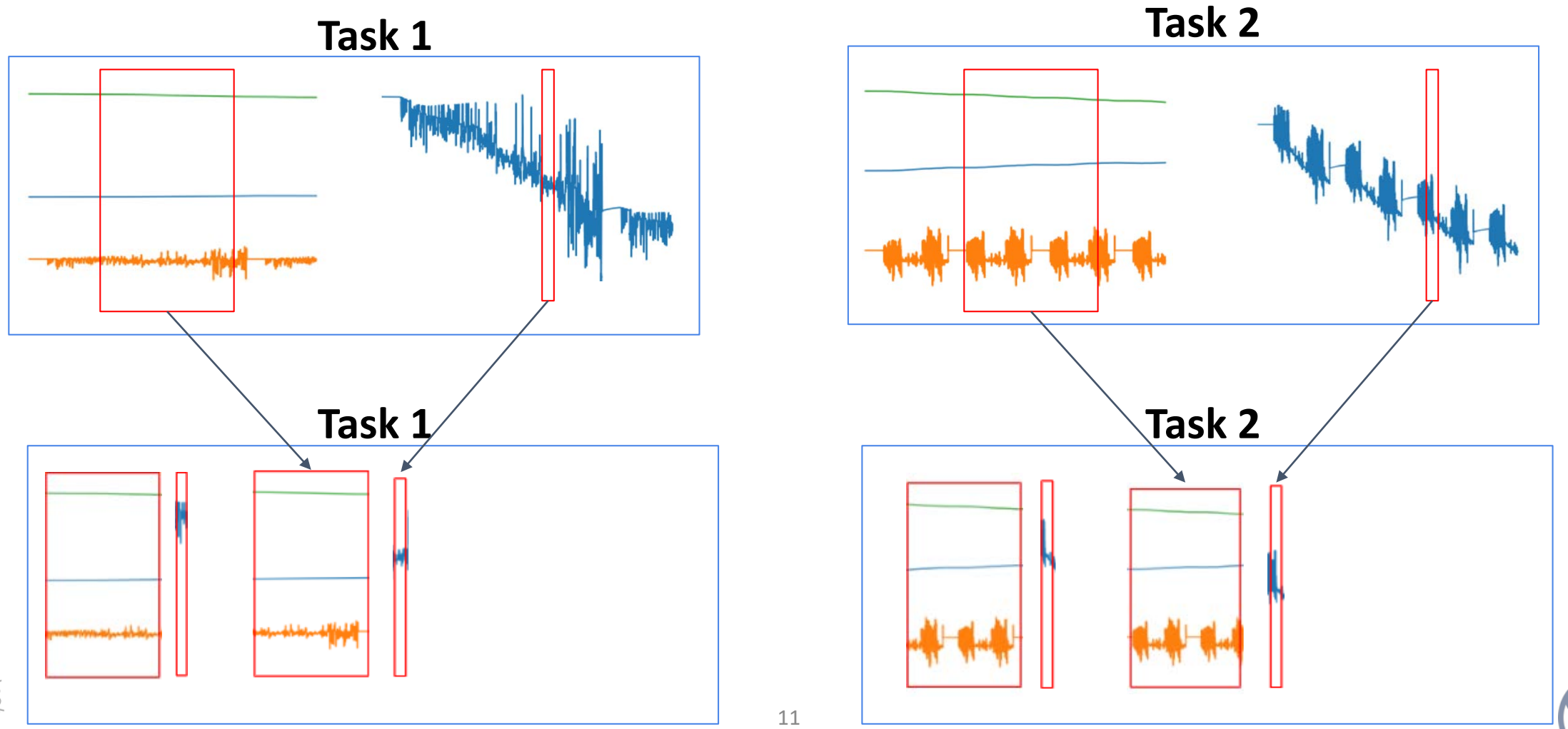
Task Design in Image Classification



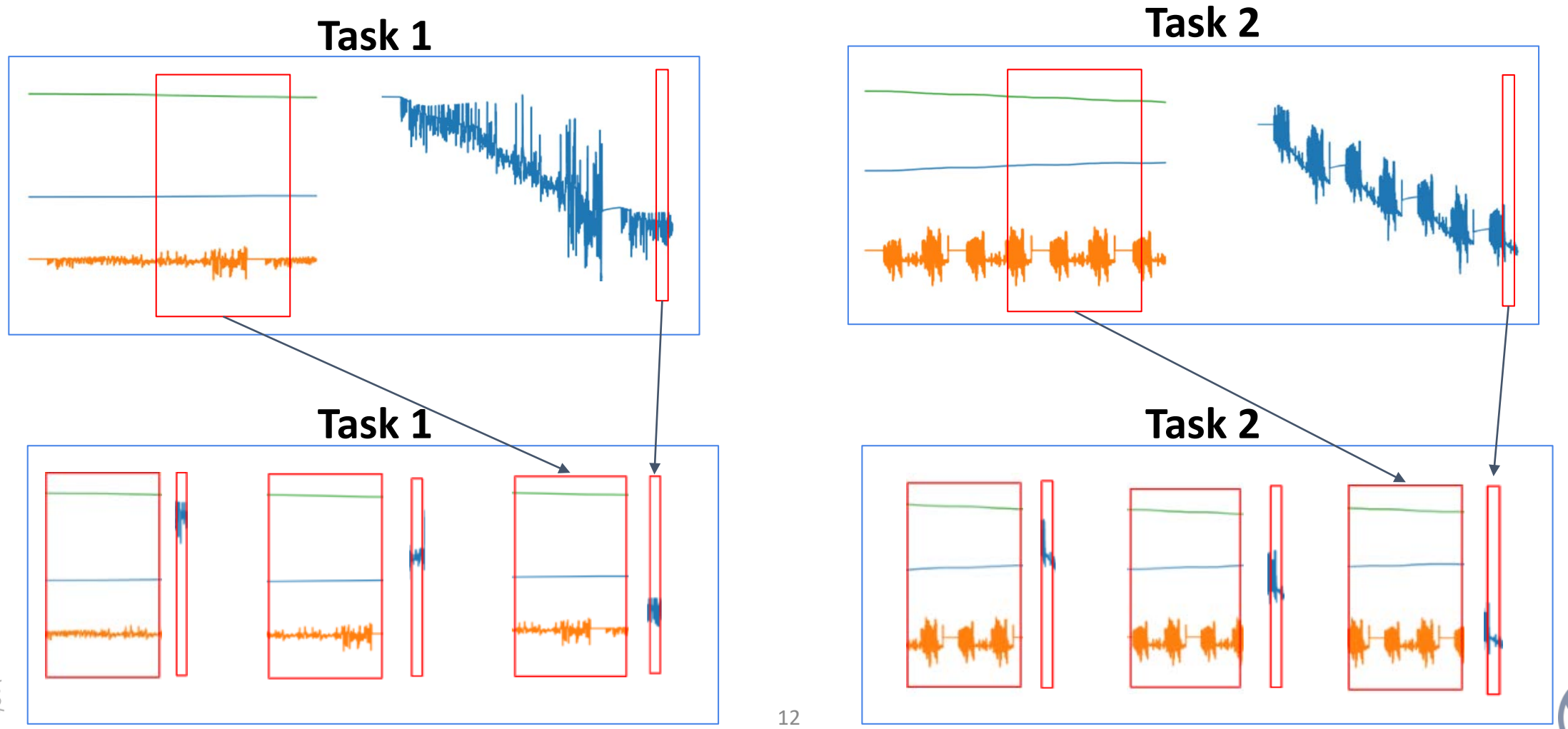
Time Series Regression (TSR) Task



Time Series Regression (TSR) Task

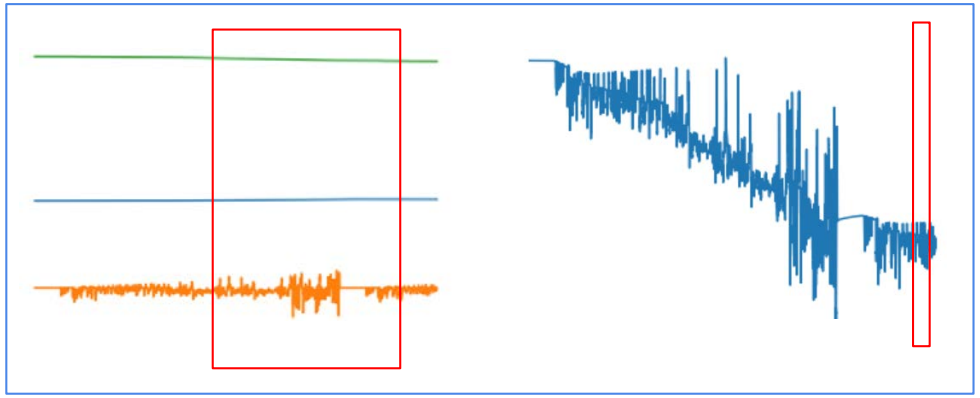


Time Series Regression (TSR) Task

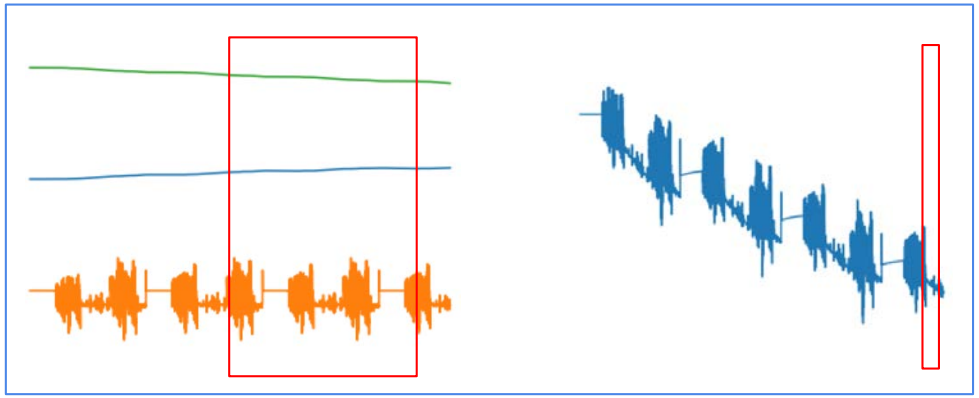


Time Series Regression (TSR) Task

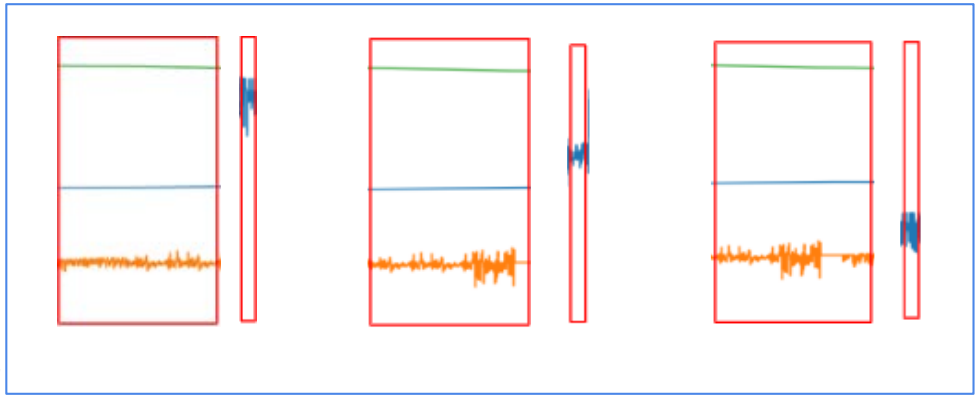
Task 1



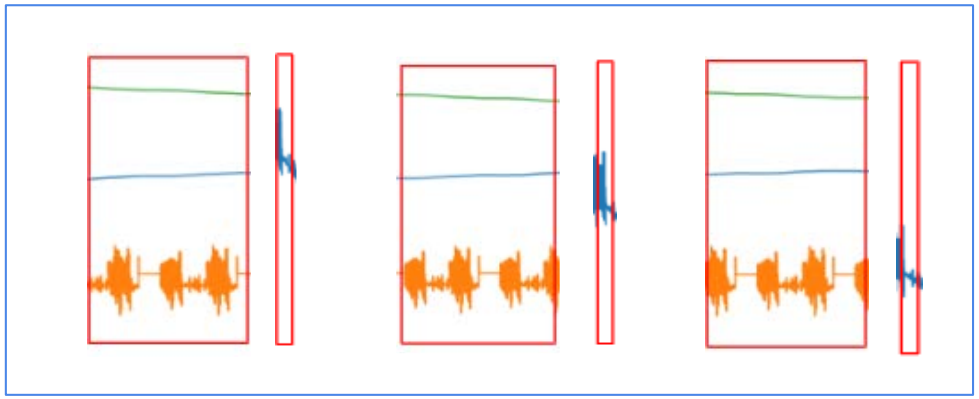
Task 2



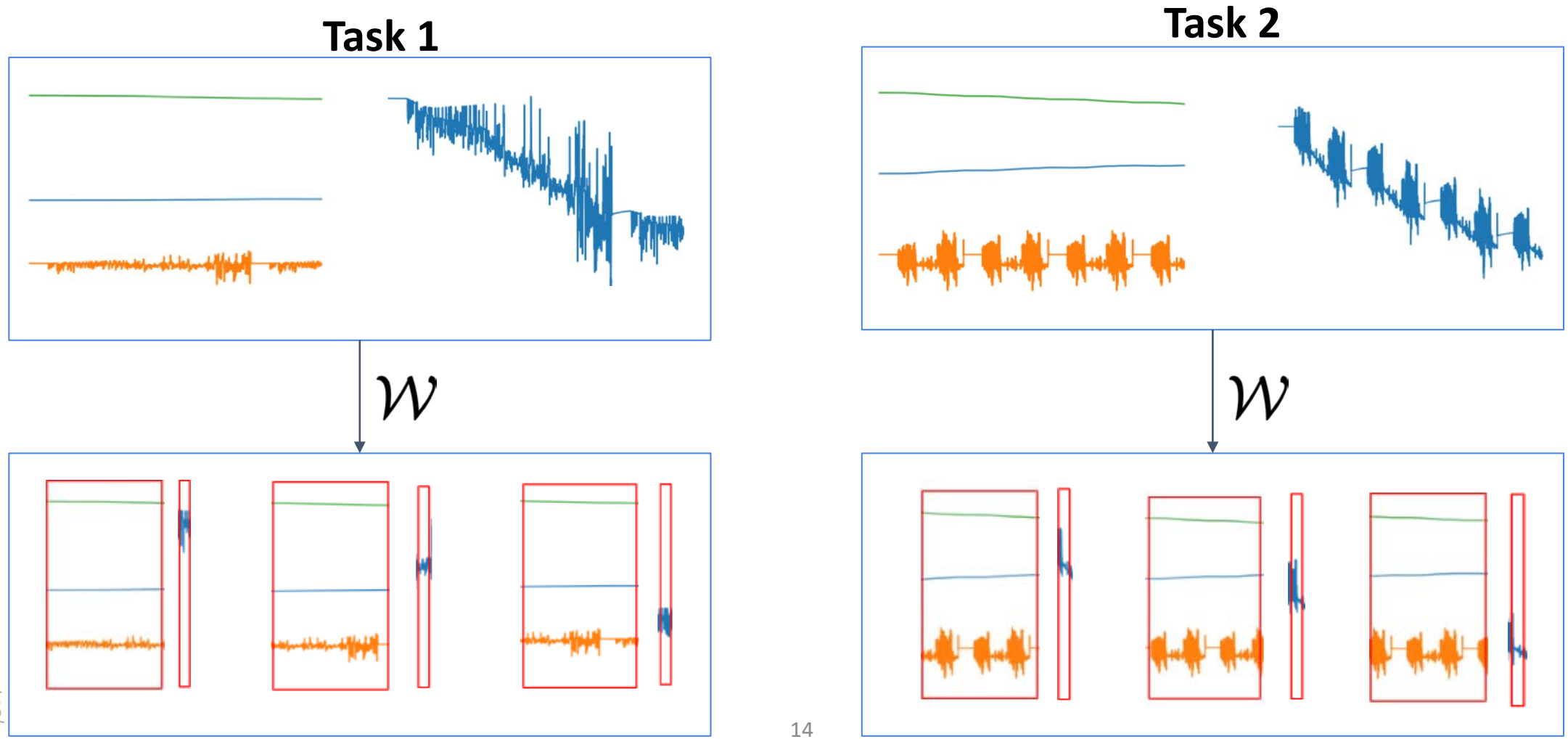
Task 1



Task 2

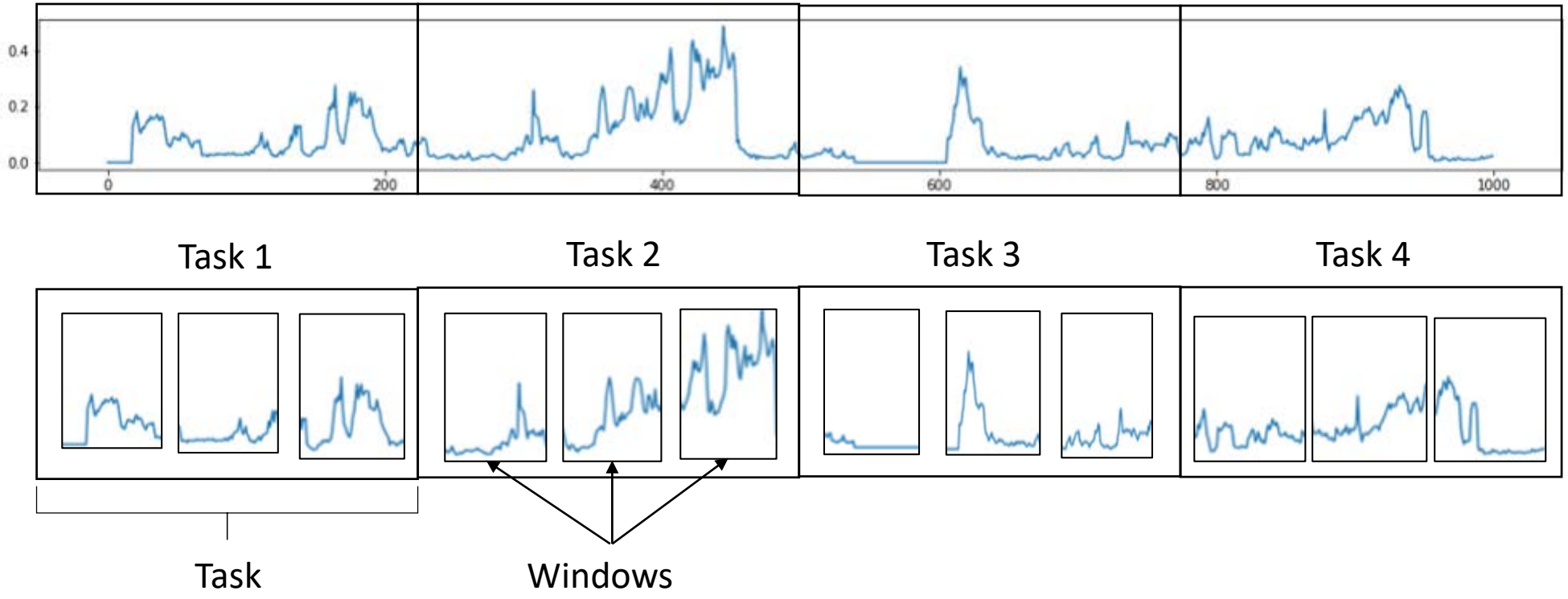


Time Series Regression (TSR) Task



Time Series Regression (TSR) Task

- One long time series can be discomposed in several tasks.



Evaluation protocol

Data Foundation

Some results