

INFERRING BEHAVIOURAL CHANGES FROM SMARTPHONES

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Problem statement

Regular physical activity is efficacious for improving metabolic health in overweight and obese individuals, yet, many adults lead sedentary lives. By combining biomedical, technological and humanistic approaches, we aim to understand the health benefits of physical activity in different domains of everyday life, as well as how to improve adherence to physical activity. By sampling both clinical and smartphone data we further hope to validate the smartphones usefulness in this regard.

Randomized controlled trial

A 6-month randomized controlled trial was designed to investigate the effects of increased physical activity in transport (bicycling) or leisure time domains (moderate or vigorous intensity endurance exercise). At baseline and after 3 and 6 months, participants underwent a rigorous 3-day biomedical test regimen followed by free-living measurements.

Data

Smartphone

Accelerometer
Location
Steps
Activity Recognition

Clinical

Accelerometer
Heart Rate
Insulin sensitivity
Physical tests
Biopsy
Blood analysis
Labelled water
MRI
Weight
Sleep diary

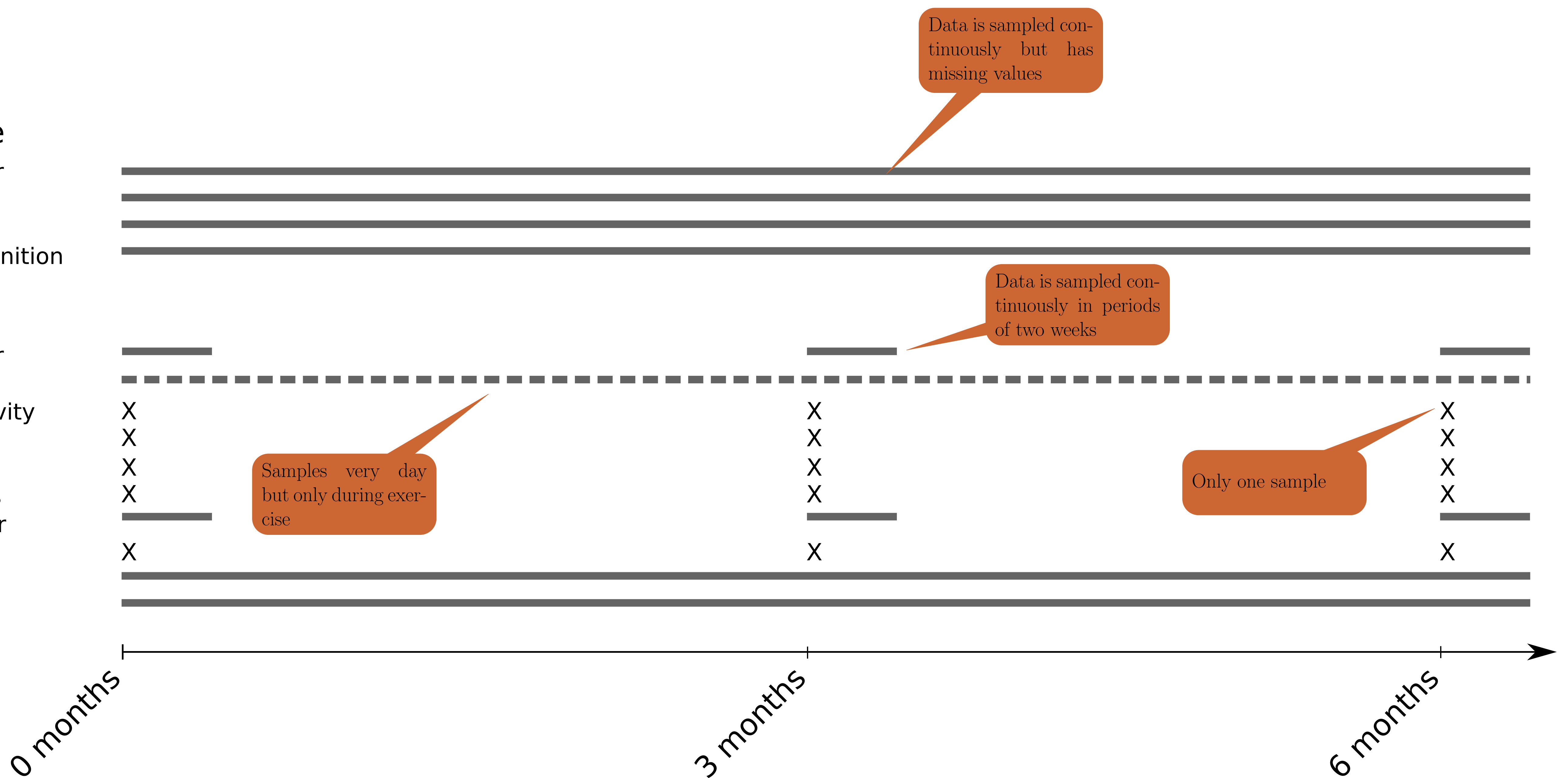


Fig. 1: Data collection timeline

Problems

- Going from raw data to higher level representations
- Integrating modalities
- Handling missing data
- Detecting change points/states

Inferring states unsupervised

By modelling the dynamics of multimodal timeseries it is possible to infer the state s which the system is in at certain times. Hopefully this state represents a state related to the current activity of the person from which the data is acquired.

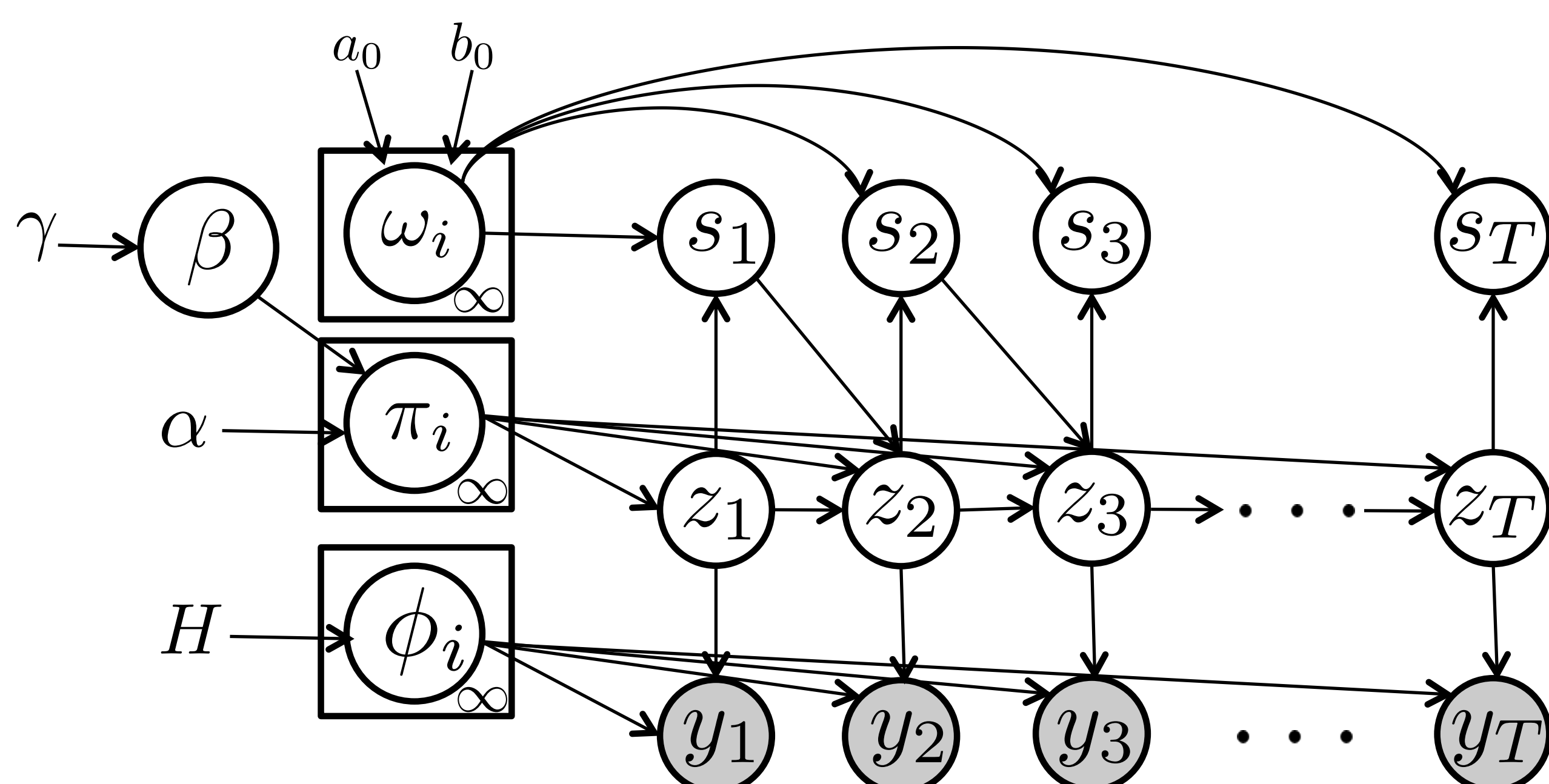


Fig. 2: Segmented Infinite Hidden Markov Model [1]

Supervised Hierarchical RNN classification

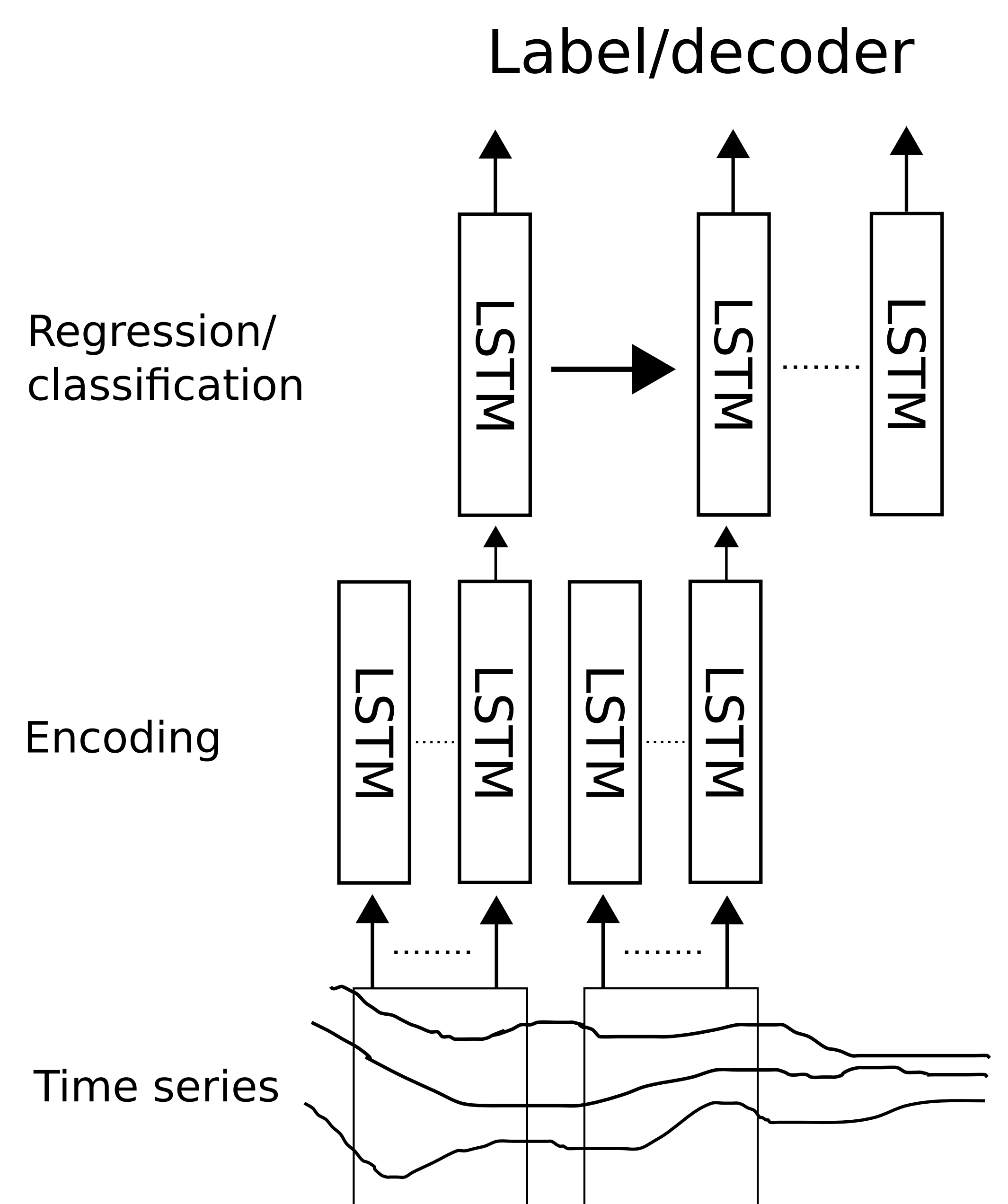


Fig. 3: Hierarchical Recurrent LSTM [2]

References

- [1] Saeedi, Ardavan, Matthew Hoffman, Matthew Johnson, and Ryan Adams. 2016. *The Segmented iHMM: A Simple, Efficient Hierarchical Infinite HMM*.
- [2] Yang, Zhilin, Ruslan Salakhutdinov, and William Cohen. 2016. *Multi-Task Cross-Lingual Sequence Tagging from Scratch*.