



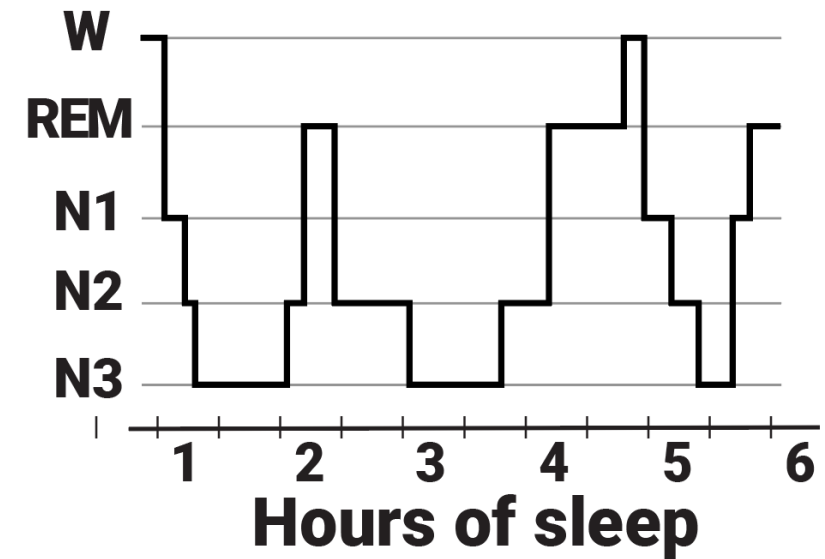
Sleep stage classification using deep learning

Elisabeth Heremans

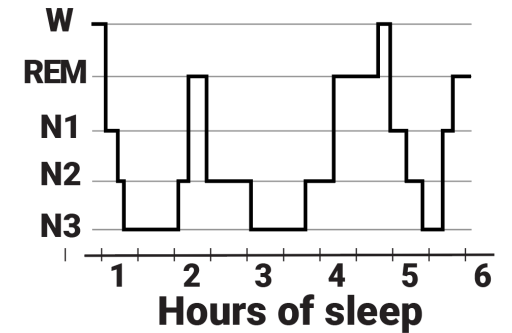
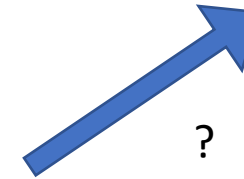
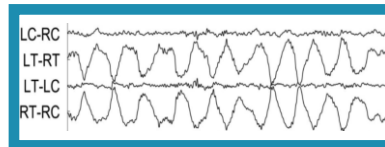
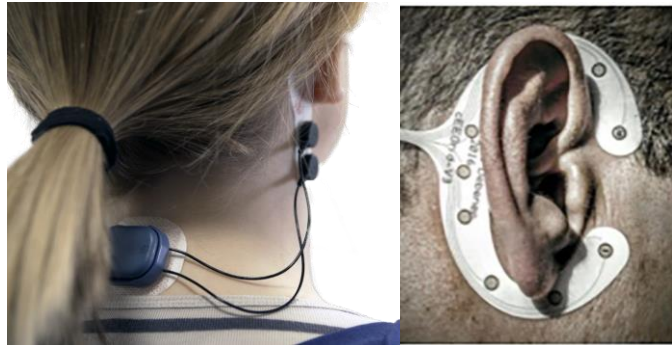
24/02/'23 – VAIA course “Medical Times Series Mining”

Sleep

- 5 sleep stages: W, N1, N2, N3, REM
- Common sleep-wake disturbances
 - Sleep apnea
 - Insomnia
 - Rem Behavior Disorder (RBD)
- Associated with neurological/psychiatric diseases

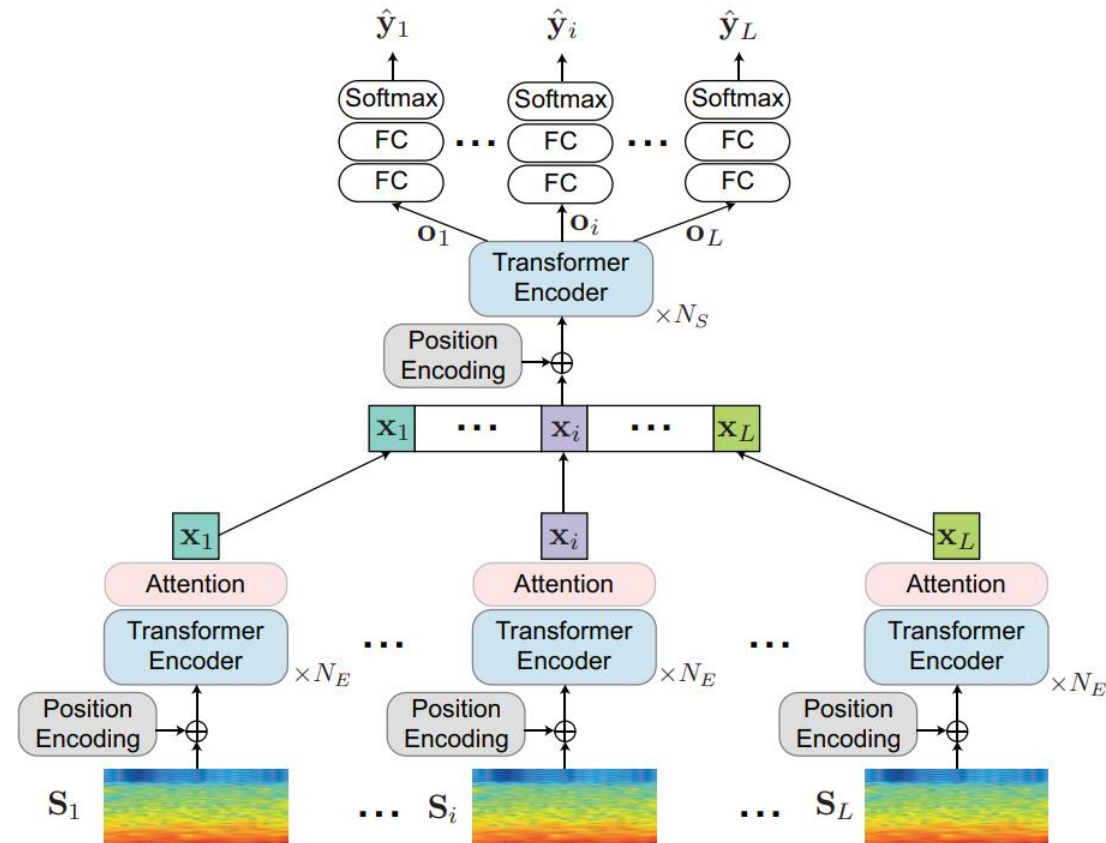


Sleep monitoring with wearables



Sleep staging network

- CNN
- RNN
- Transformers



Challenges

1. Deep learning methods do not **generalize/ adapt** well

Trained on large hospital datasets of healthy participants

Deployment: Wearables? Diseased subjects?

2. Can we **trust** deep learning?

Reliability?

Explainability?

Generalizability

- Issue

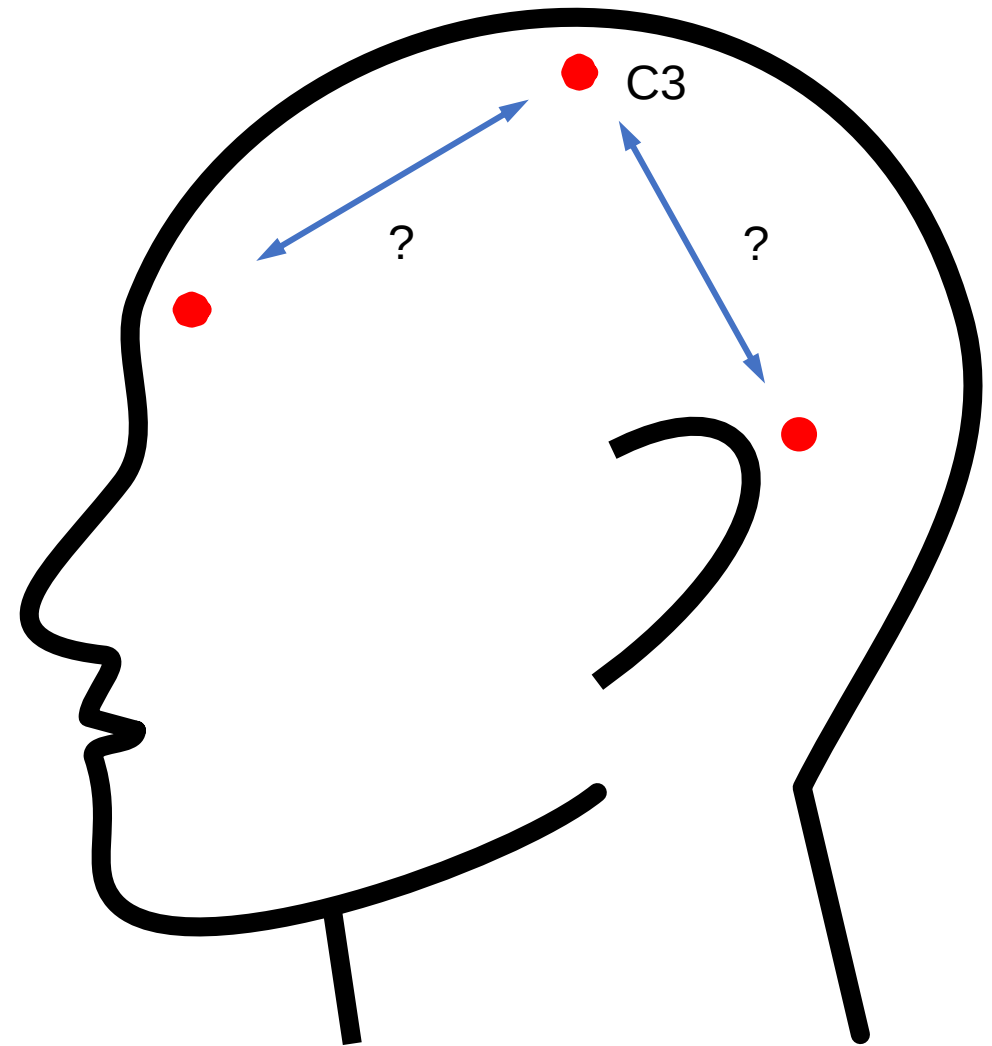
Hard to obtain sleep stage annotations for wearable EEG

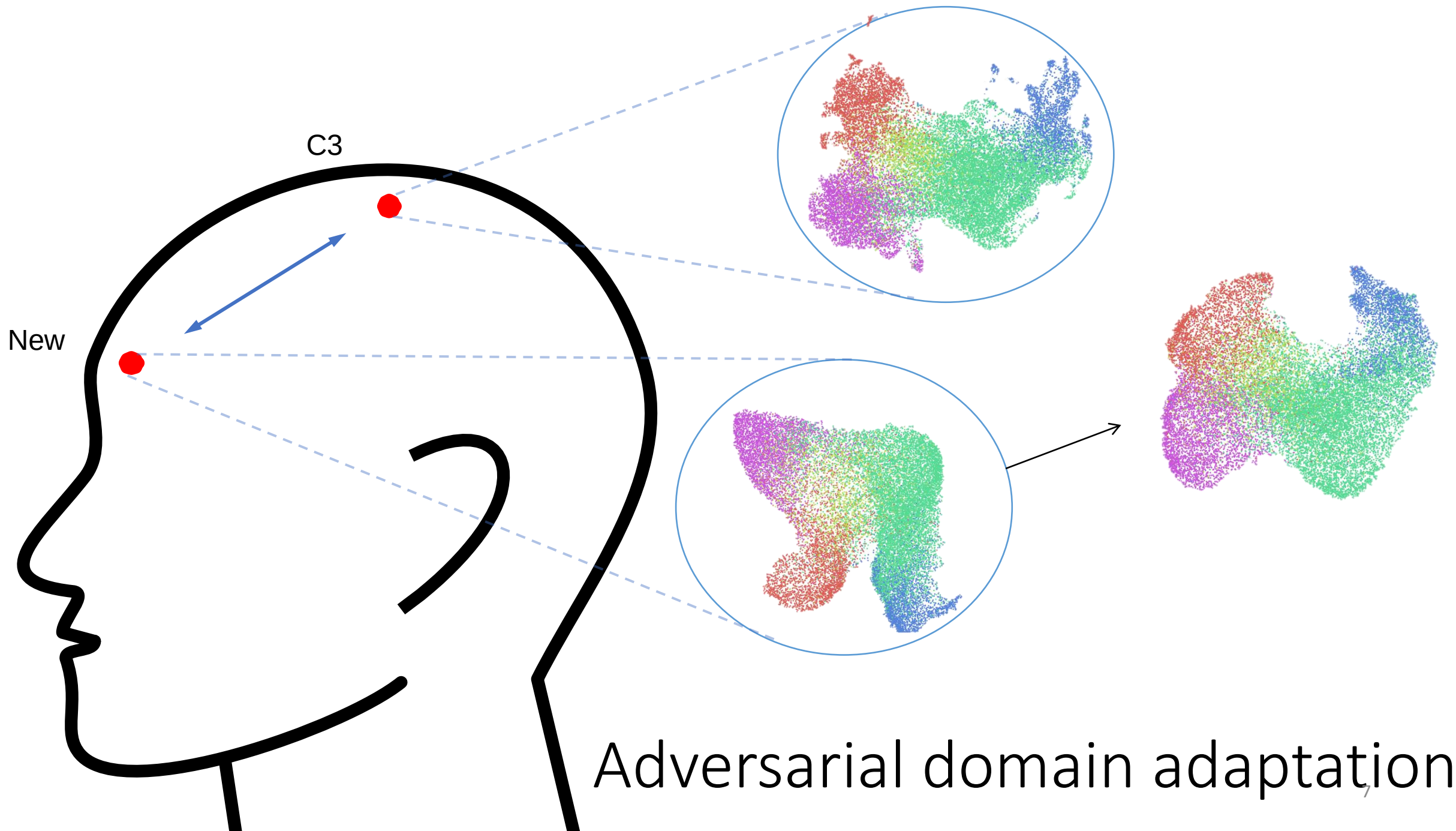
- Goal

Train deep neural network on small labeled / unlabeled wearable dataset

- Means

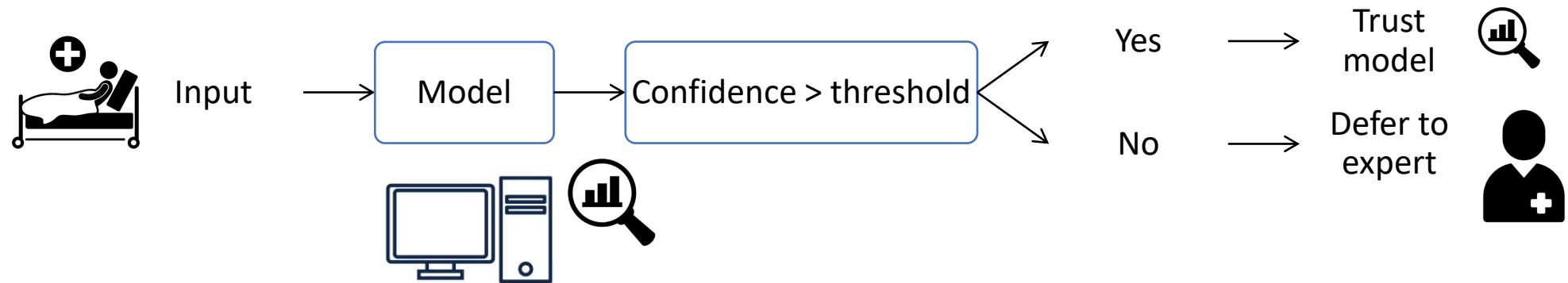
Use information from (labeled) standard EEG





Can we trust deep learning?

- Noise, model inference errors, randomness...
→ When can we trust the A.I.'s prediction?

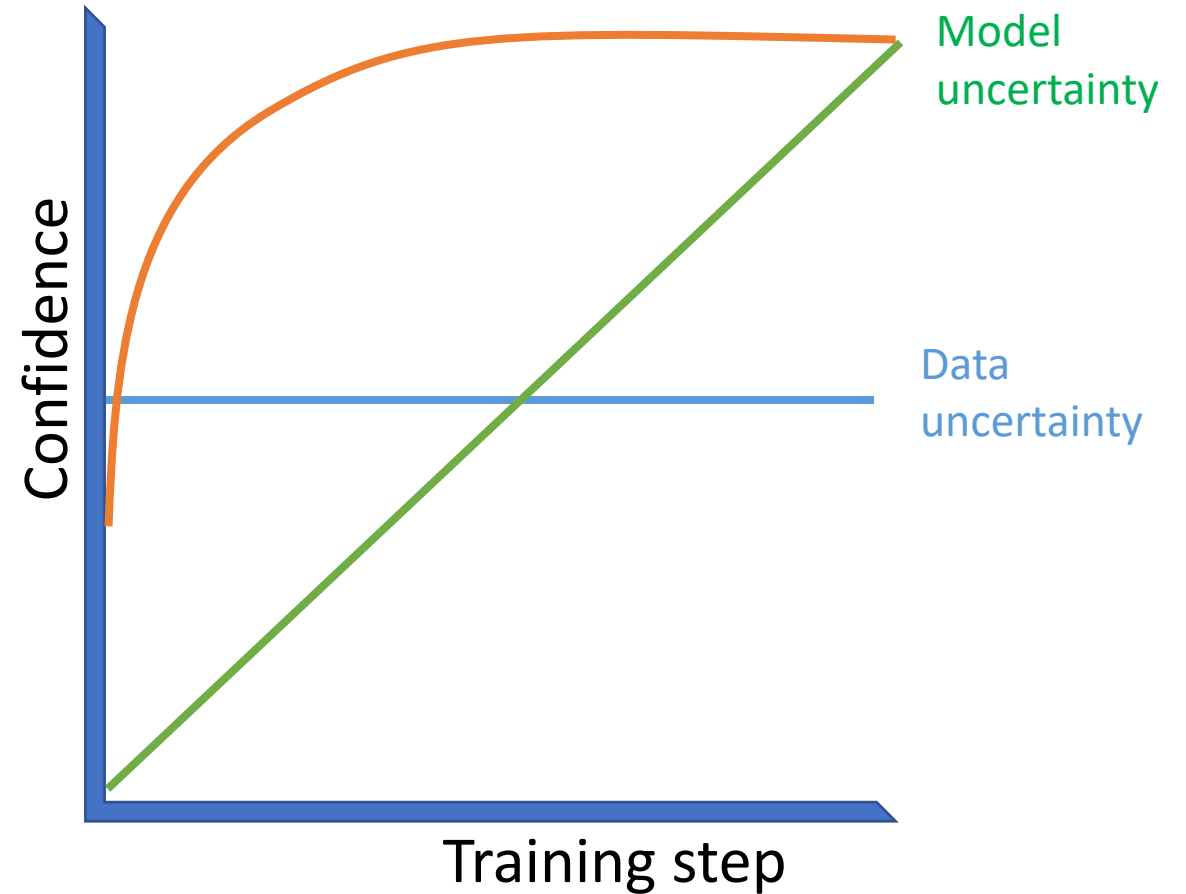


Estimating model & data uncertainty

- Aleatoric uncertainty
= data uncertainty

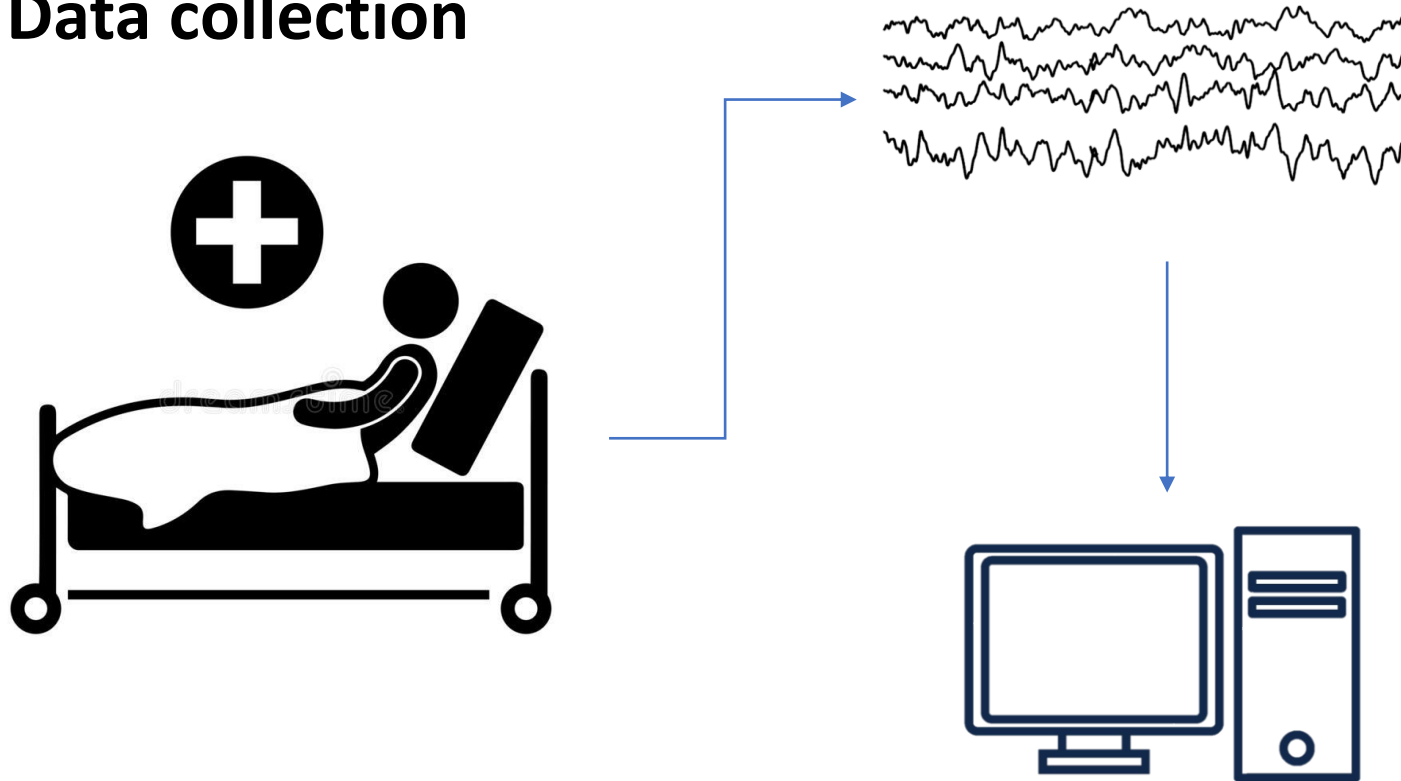


- Epistemic uncertainty
= model uncertainty



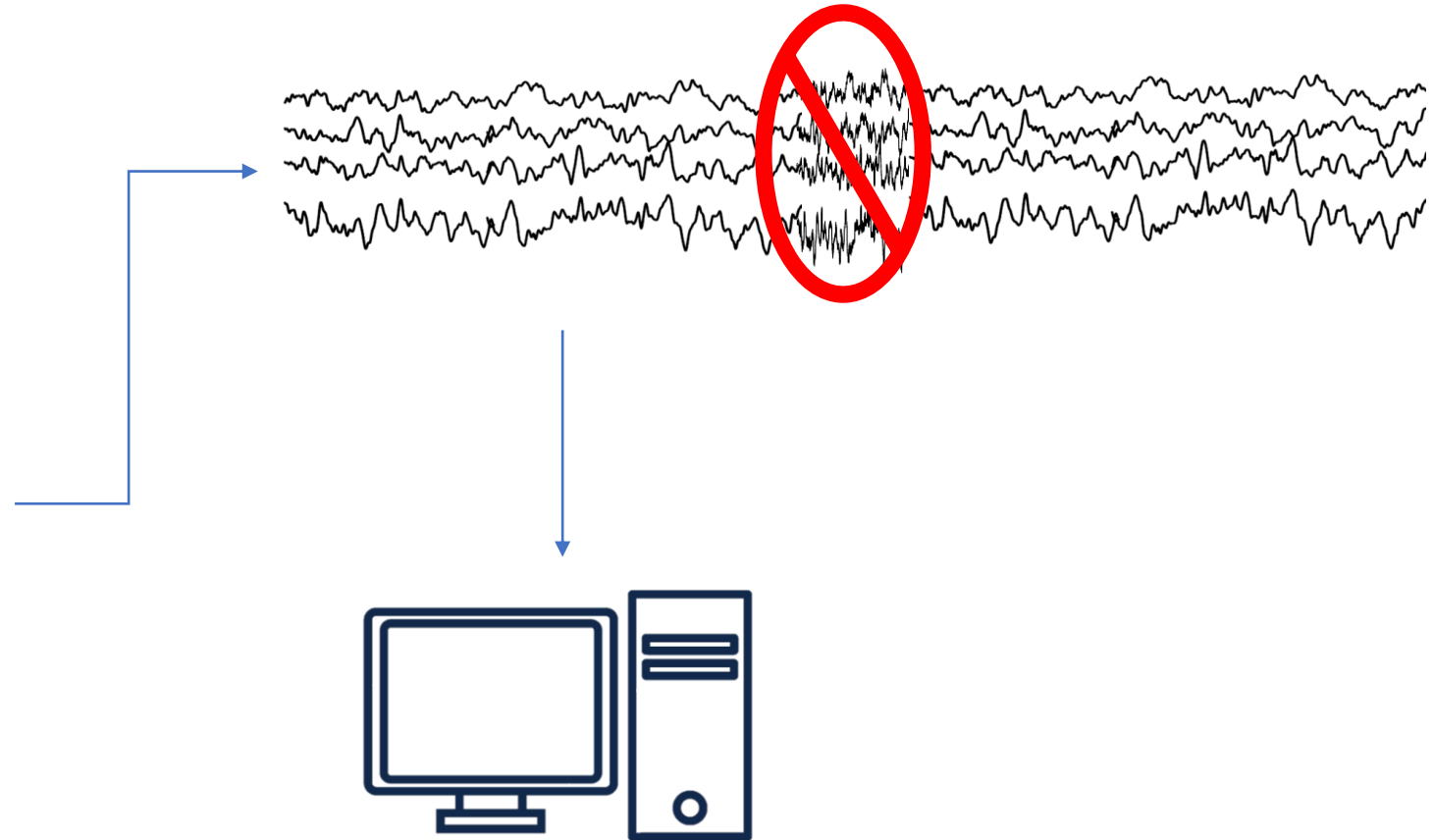
How can we **use** uncertainty?

- **Data collection**



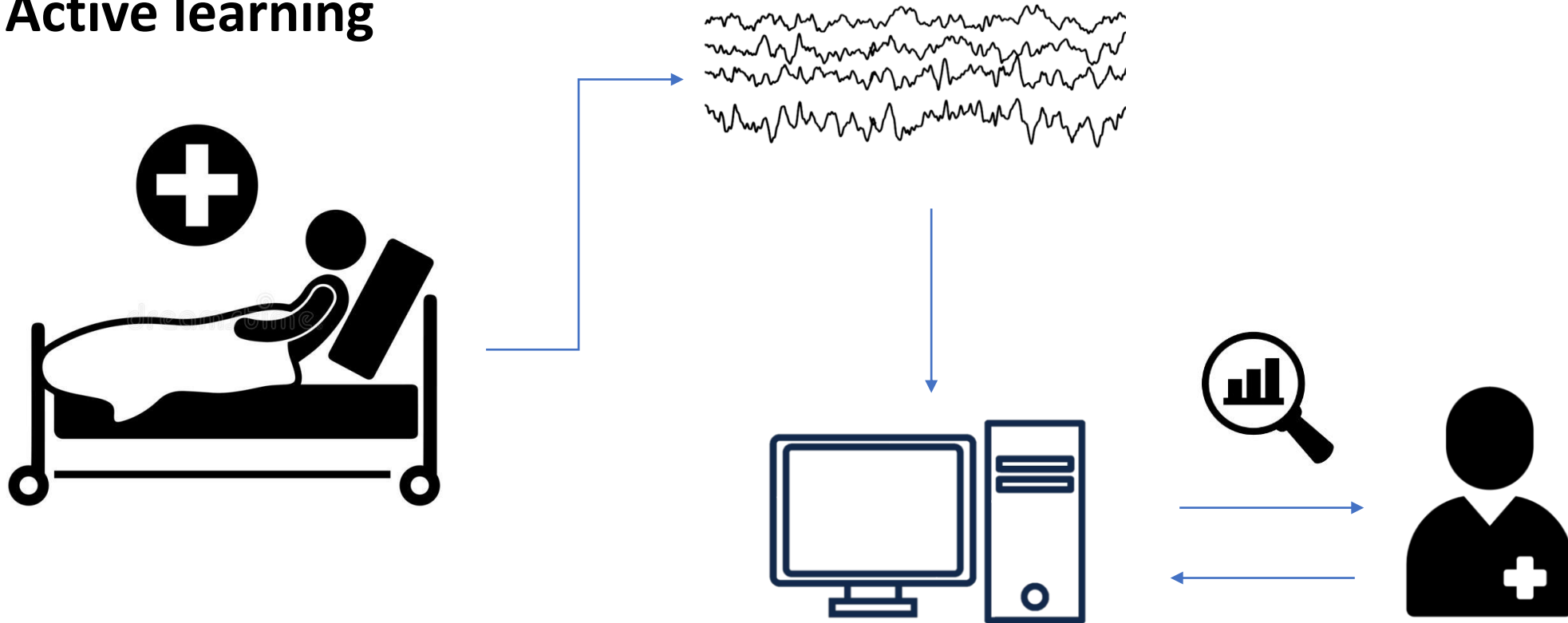
How can we **use** uncertainty?

- **Data selection**



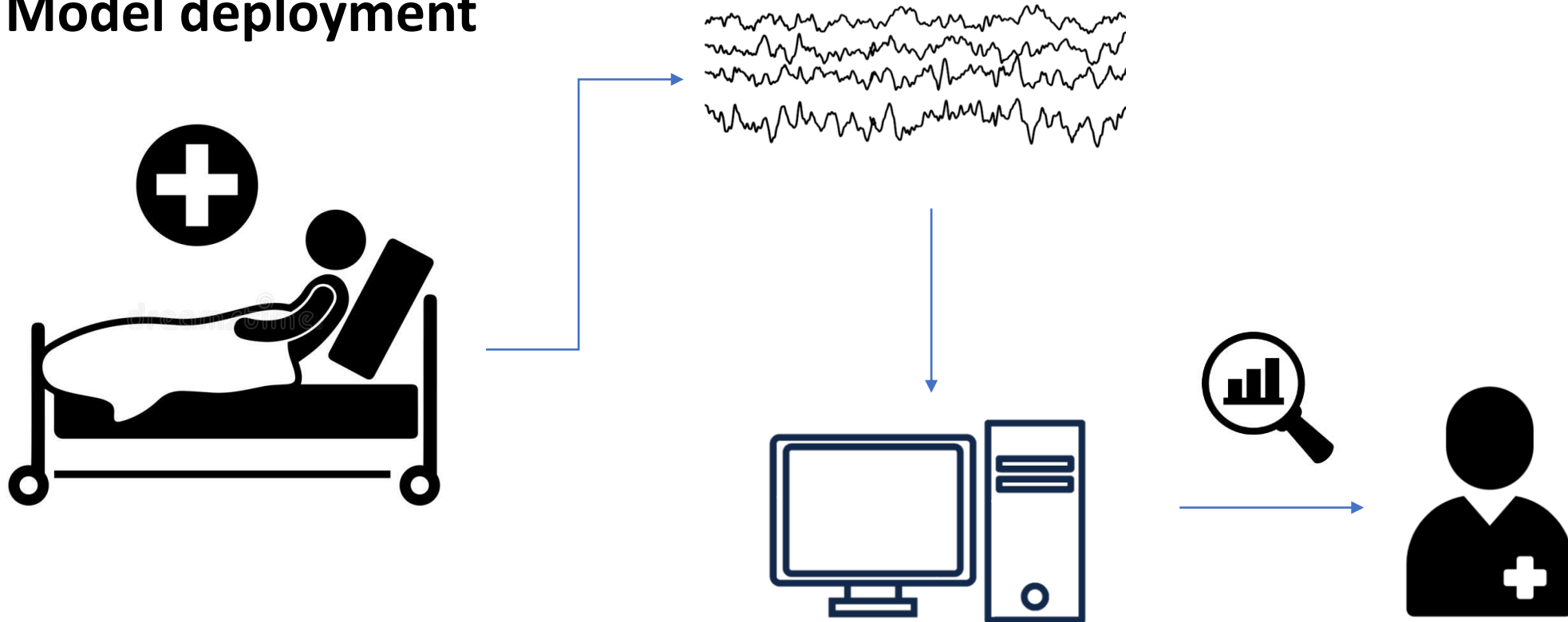
How can we **use** uncertainty?

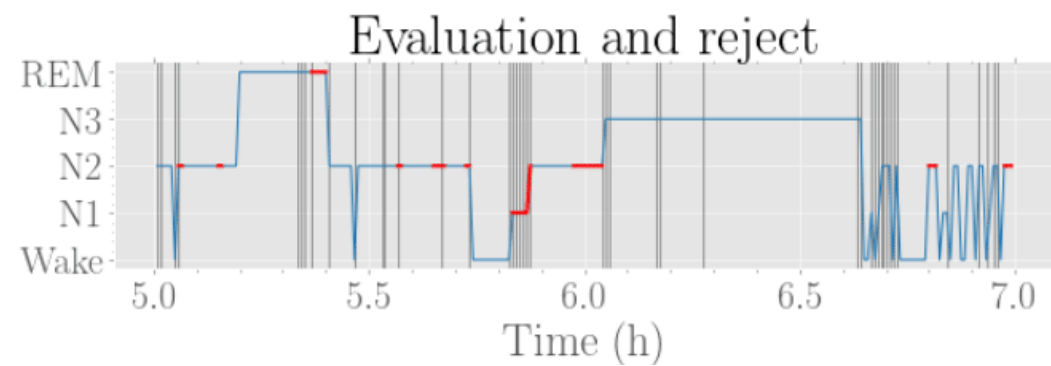
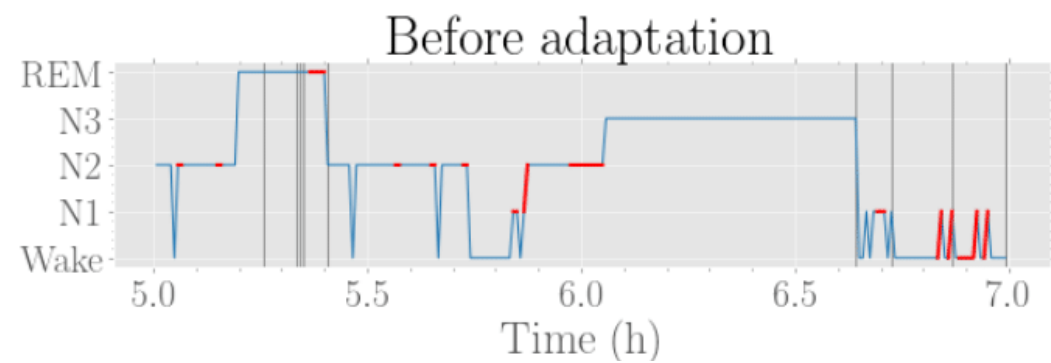
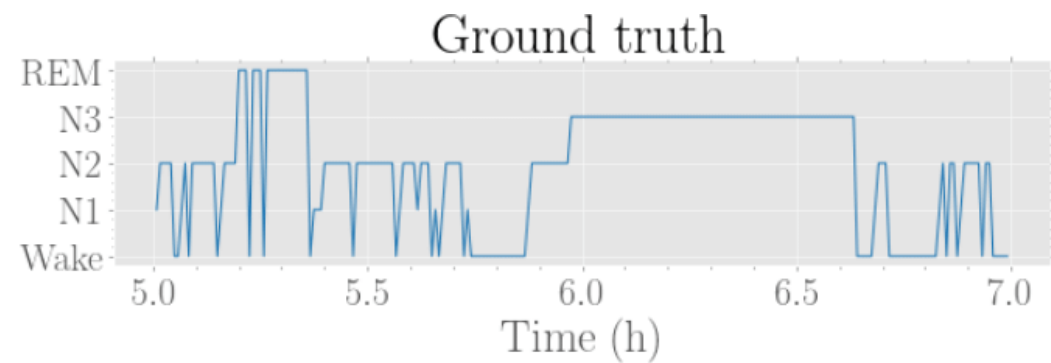
- **Active learning**



How can we **use** uncertainty?

- **Model deployment**





Conclusions

Bringing A.I. in the clinic requires

Adaptability

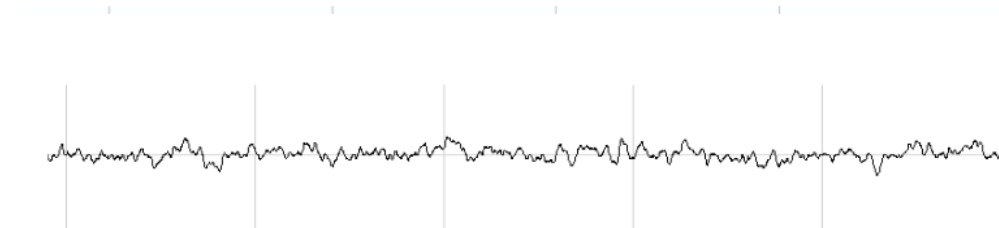
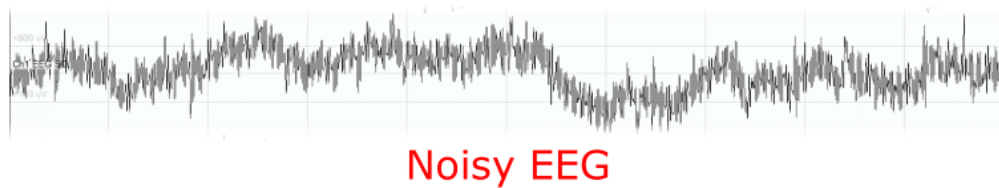
Learning from new data

Reliability

Knowing what it doesn't know

Building A.I. with qualities of a good doctor
and working together with doctors.

EEG signal



Hypnogram

