Learning from Few Subjects with Large Amounts of Voice Monitoring Data

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Challenges of Many Medical Time Series

- Few subjects and large amounts of data
  → Overfitting to subjects
- No obvious mapping from signal to features
  → Feature engineering is labor intensive
- Subject-level labels
  → In many cases, no good way of getting sample specific annotations

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Unsupervised feature extraction

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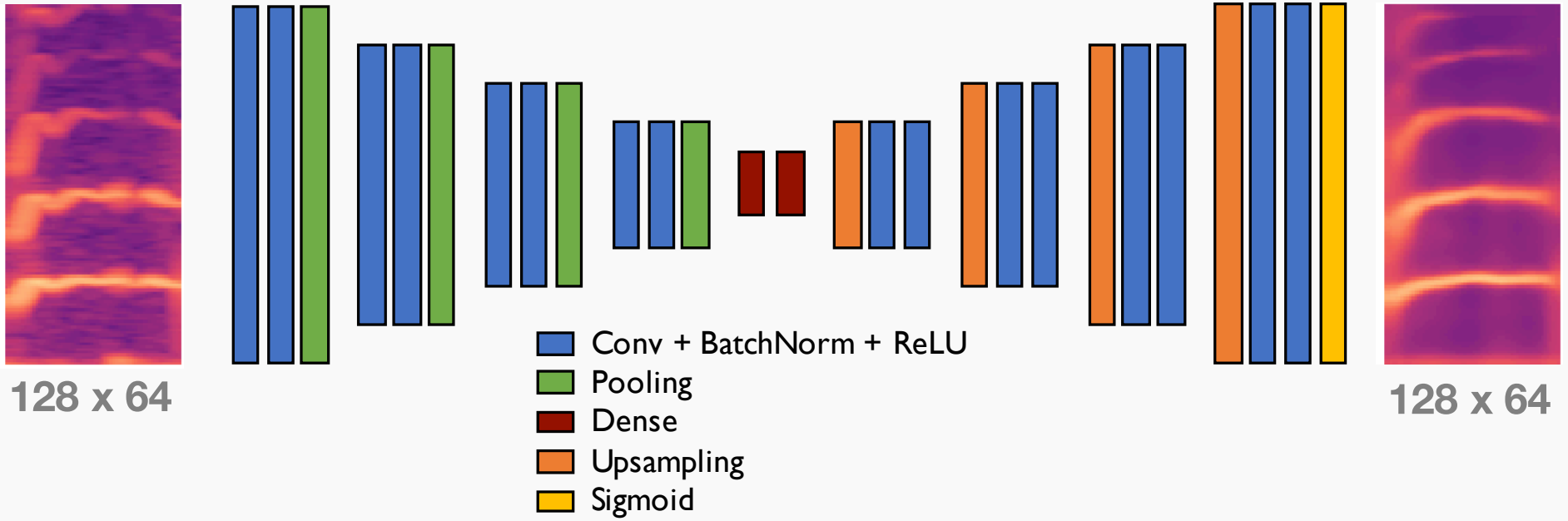
Multiple Instance Learning

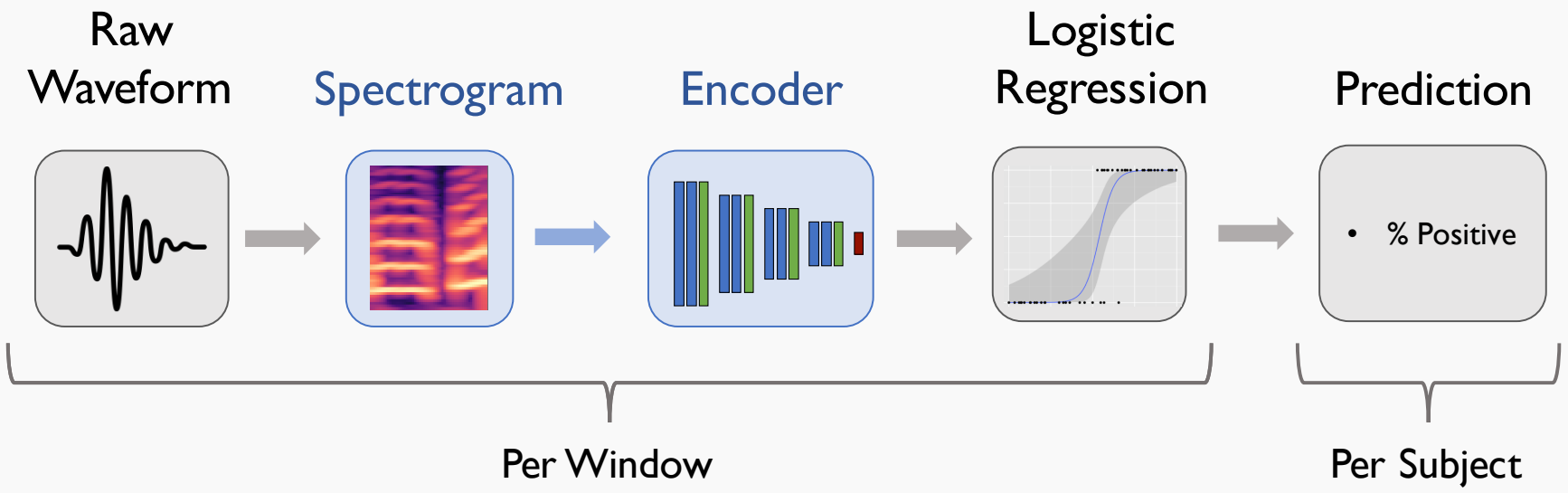
Learning Features

- Segment signal into windows
- Compute time-frequency representation
- Unsupervised feature extraction



Classification Using Multiple Instance Learning

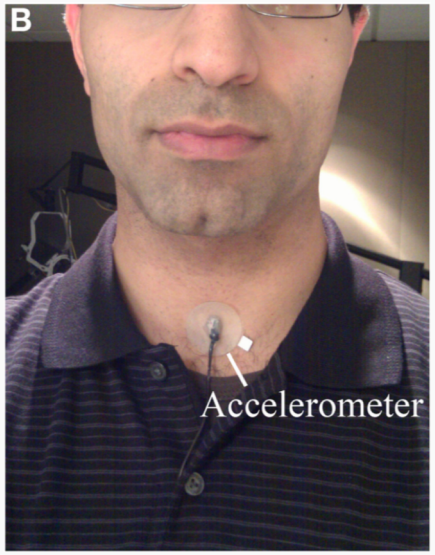
- Logistic regression on learned features with subject labels

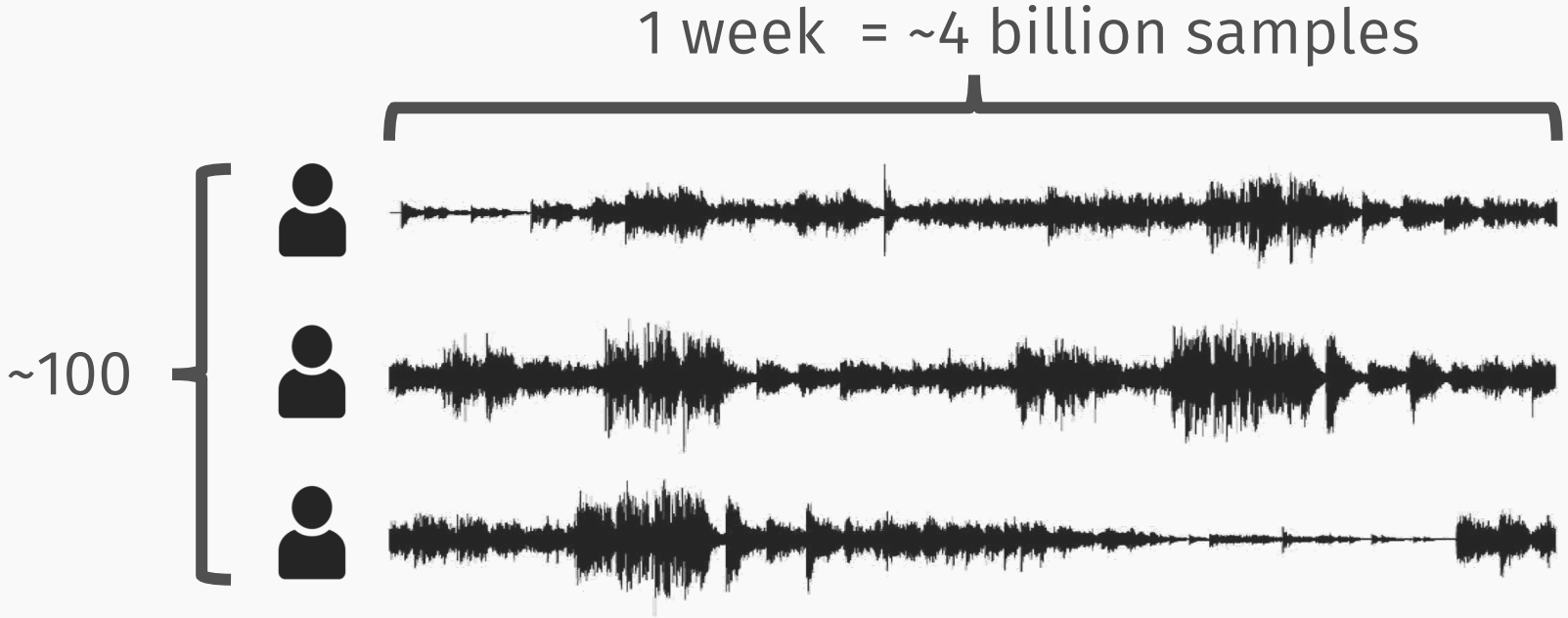


- Aggregate prediction using % positive windows per subject

Application: Voice Monitoring Data

- Voice disorders affect 7% of the US population
- Data collected through neck placed accelerometer





Results

Previous work relied on expert designed features[1]

		AUC	Accuracy
Expert LR	Train	0.70 ± 0.05	0.71 ± 0.04
	Test	0.68 ± 0.05	0.69 ± 0.04
Ours	Train	0.73 ± 0.06	0.72 ± 0.04
	Test	0.69 ± 0.07	0.70 ± 0.05

Comparable performance **without** task-specific feature engineering!

[1] Marzyeh Ghassemi et al. Learning to detect vocal hyperfunction from ambulatory neck-surface acceleration features: initial results for vocal fold nodules. IEEE Trans. Biomed Engineering

Summary

- Our method learns features from large time series data
- Reduces the need for laborious task-specific feature engineering
- Applied to large voice monitoring dataset
  - Comparable performance to previous work that relied on expert engineered features