

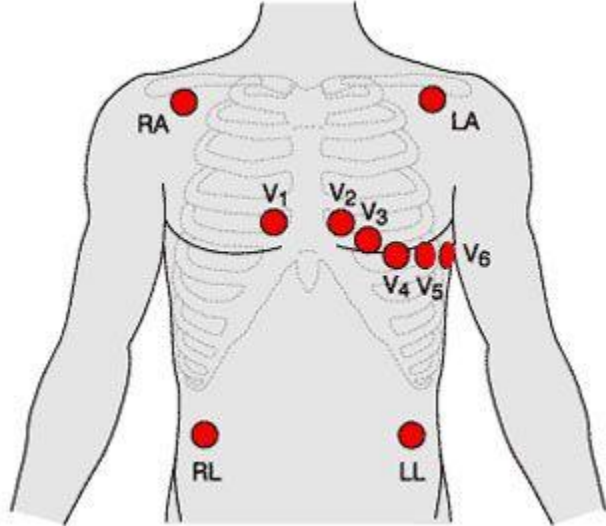
Cardiologist-level Arrhythmia Detection

Work with: Pranav Rajpurkar, Masoumeh Haghpanahi,
Codie Bourn, Geoffrey Tison, Mintu Turakhia, Andrew Ng



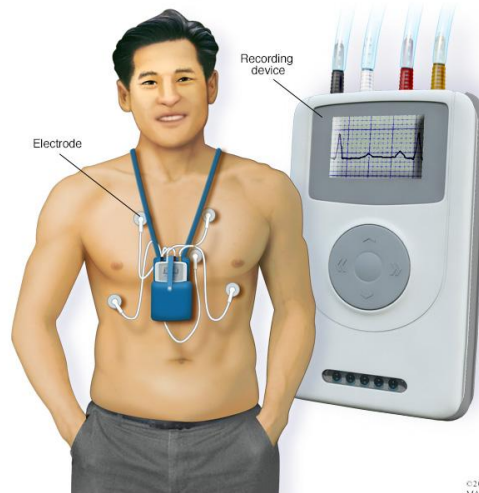
Heart Monitoring

12-lead
“opportunistic” ECG



source: www.firstaidforfree.com/recording-a-12-lead-ecgekg/

Holter monitor,
short-term wearable



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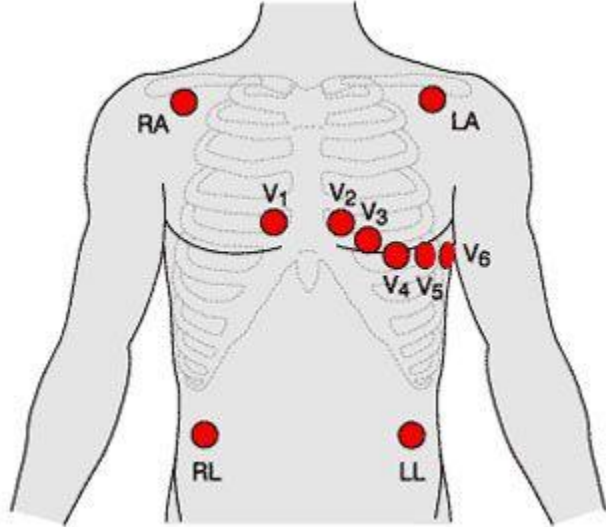
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Long-term wearable



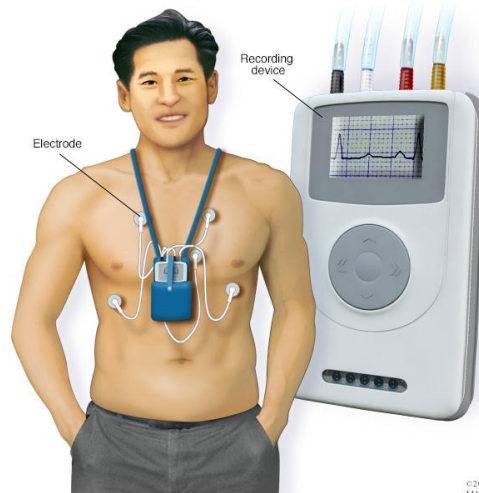
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Long-term wearable

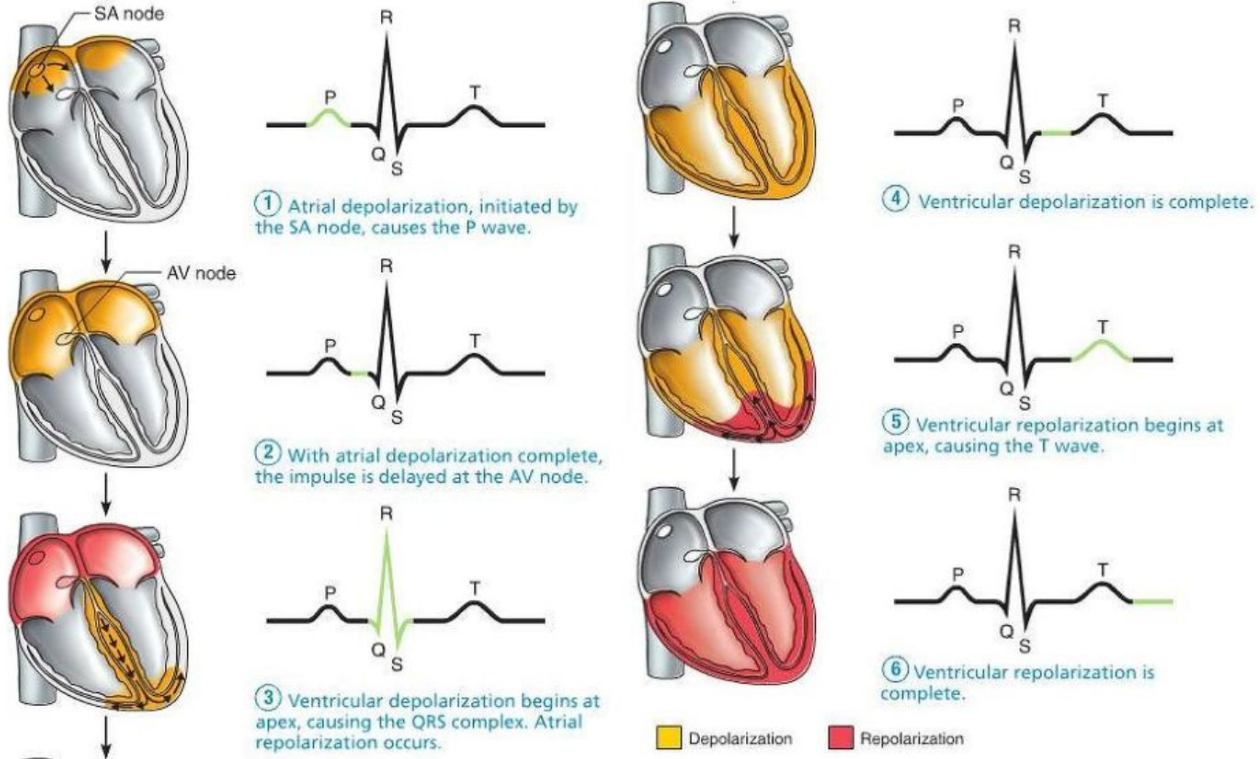


Wearable Heart Monitor

- Irhythm Heart Monitor
- 2 weeks non-stop per patient
- Technician marks arrhythmia start & stop
- Summary report sent to cardiologist



A Single Beat



Detecting Arrhythmias in ECG



Previous Work

- Hand engineered
- **Minimal learning from data**
- Nearly 85% error rates for some difficult arrhythmias (AV Block)



Neural Networks: Generalization Knobs

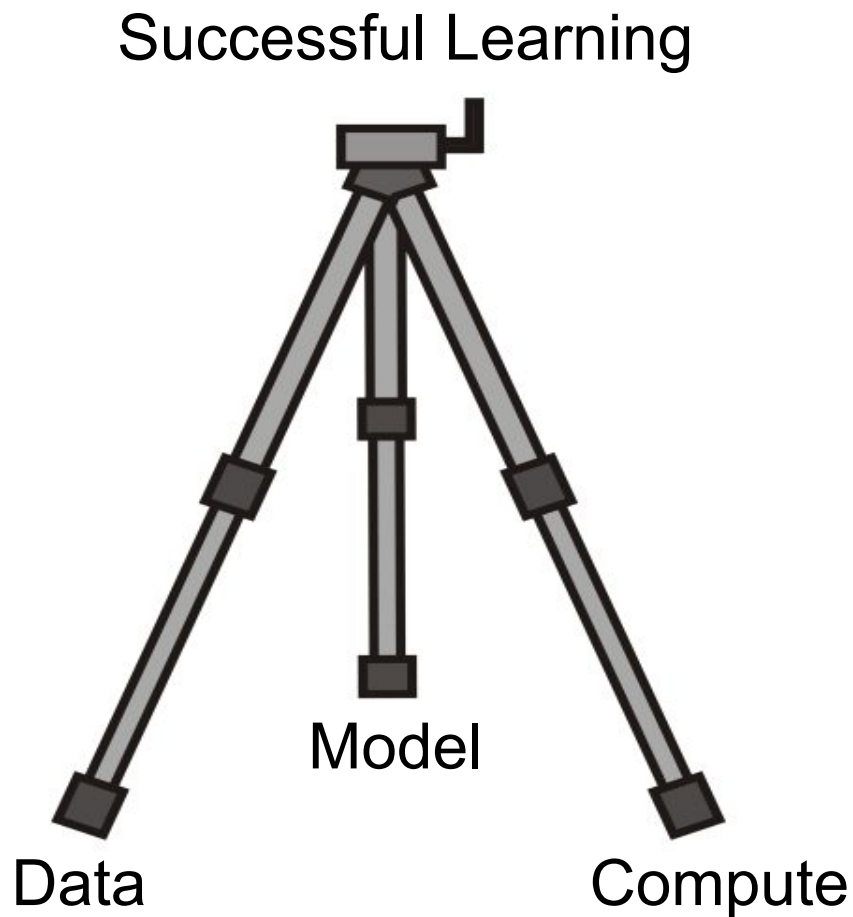


Annotated Data



Architecture /
Hyperparameters

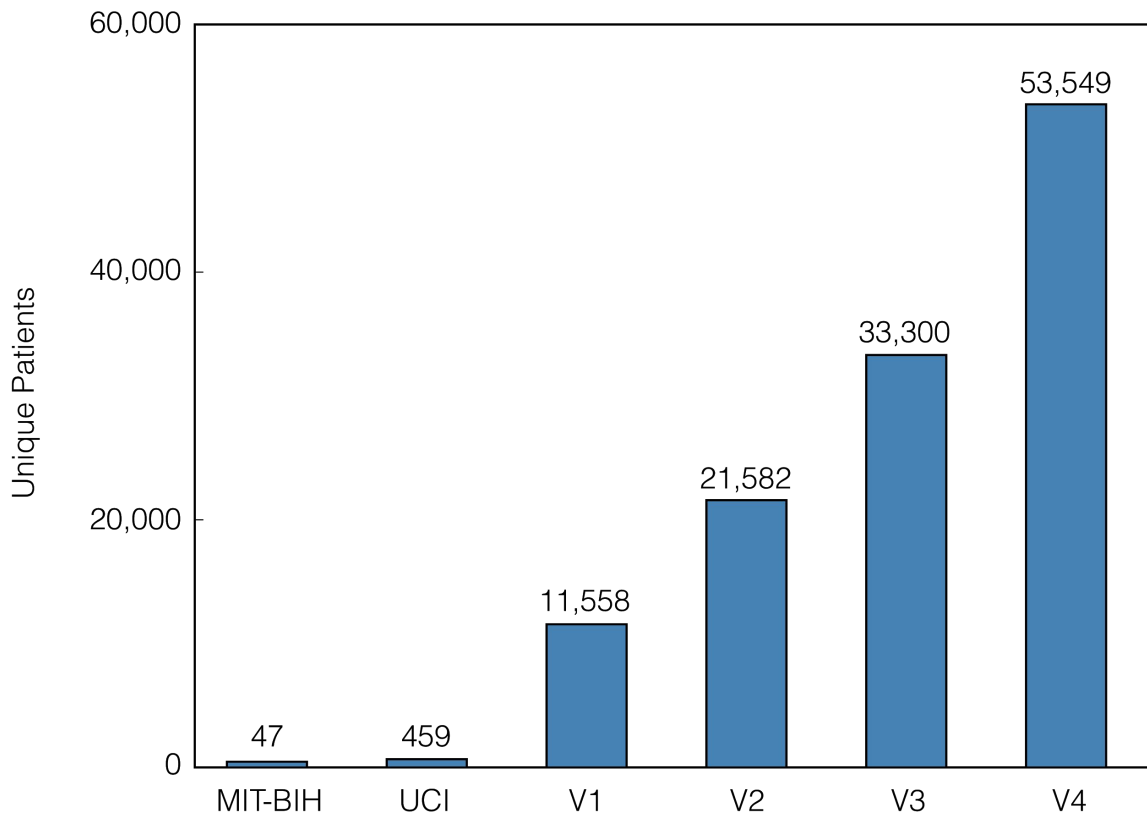
Challenges /
Key Ingredients



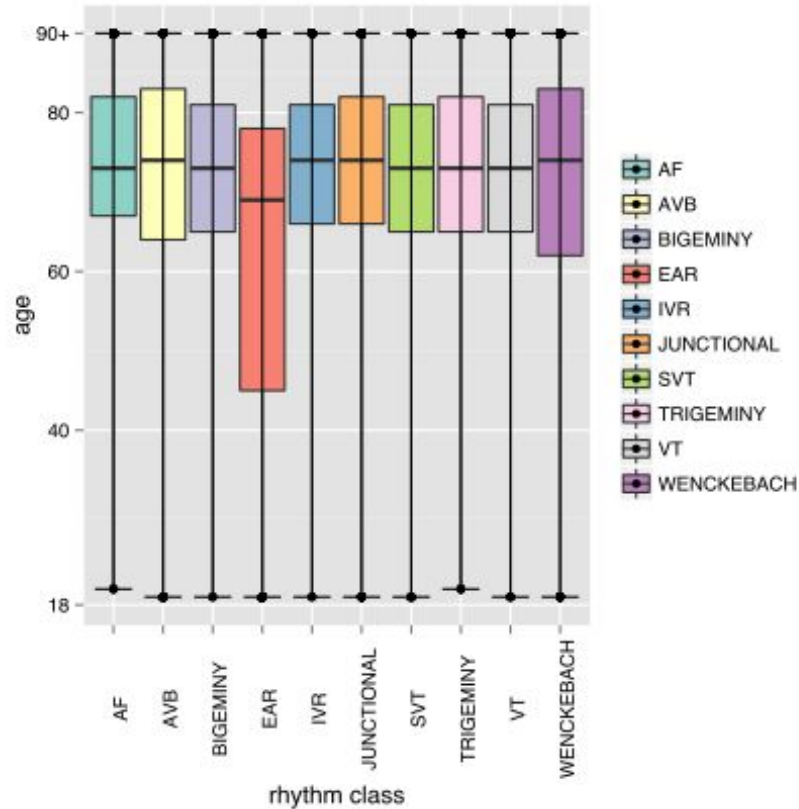
Training Data



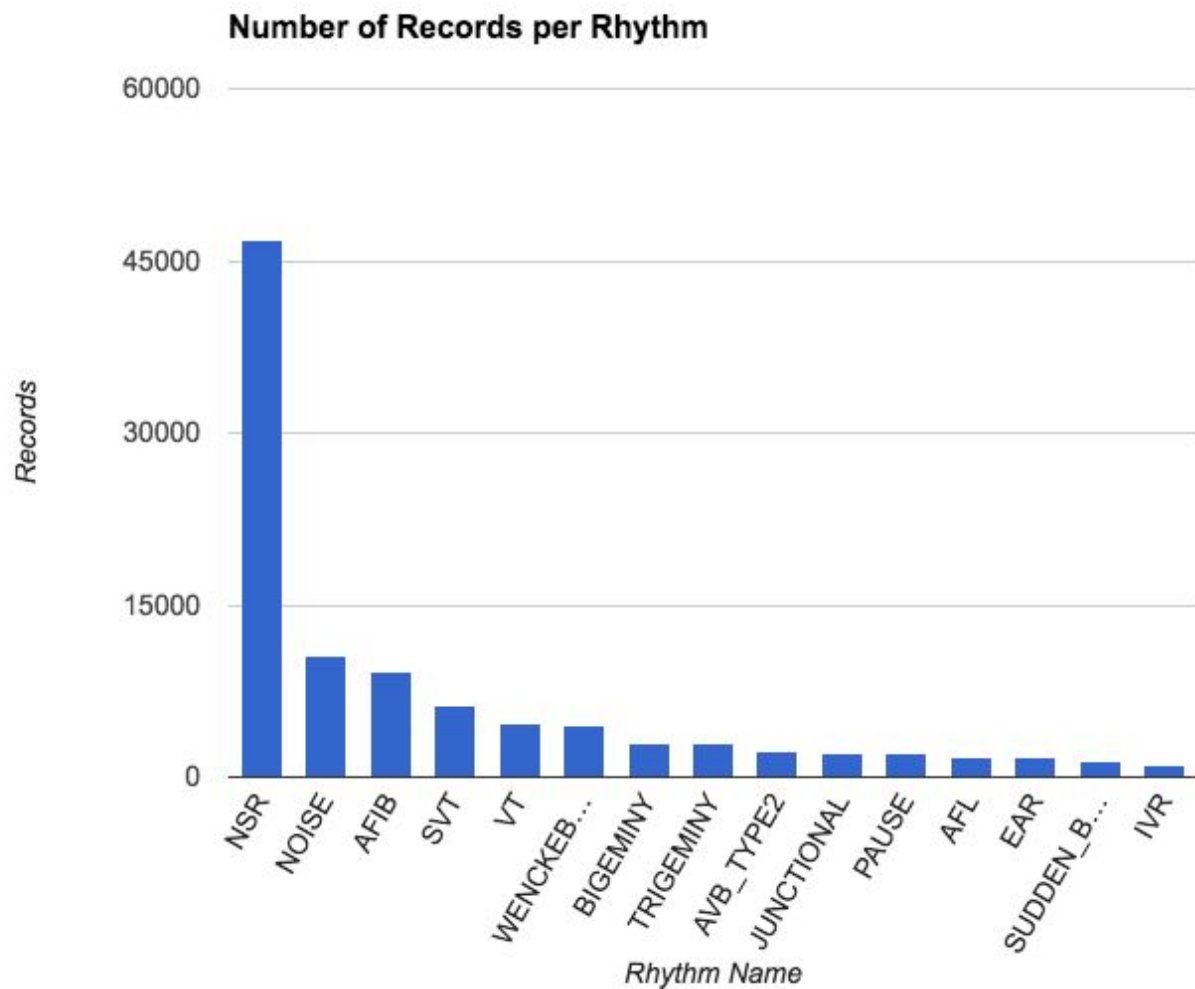
Annotated Data



Training Data

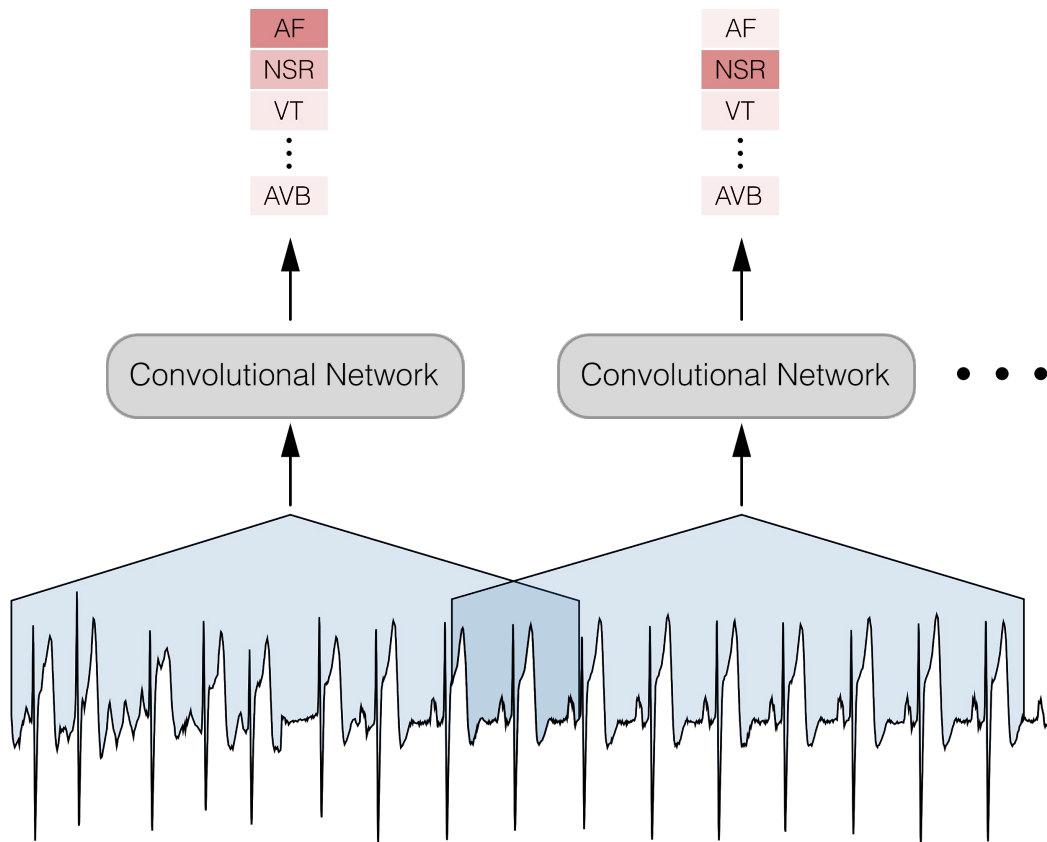


Data



Model

- Input raw EKG
- Prediction over 12 classes



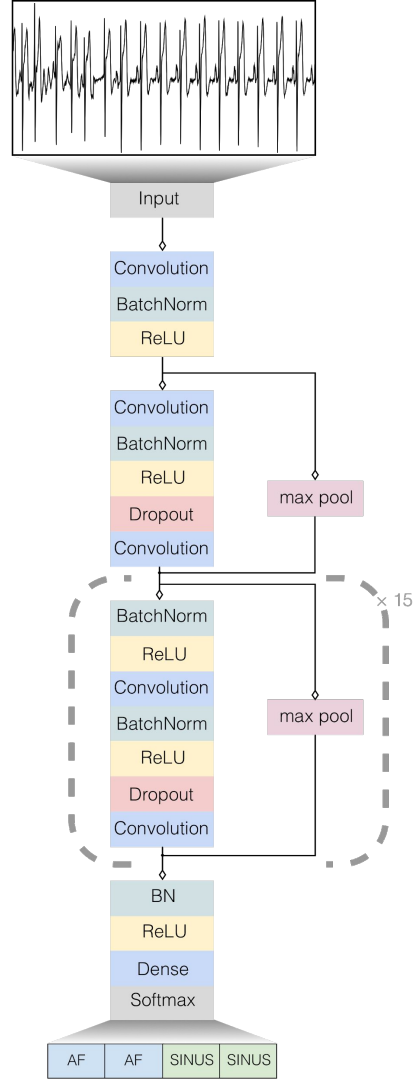
Model



Architecture

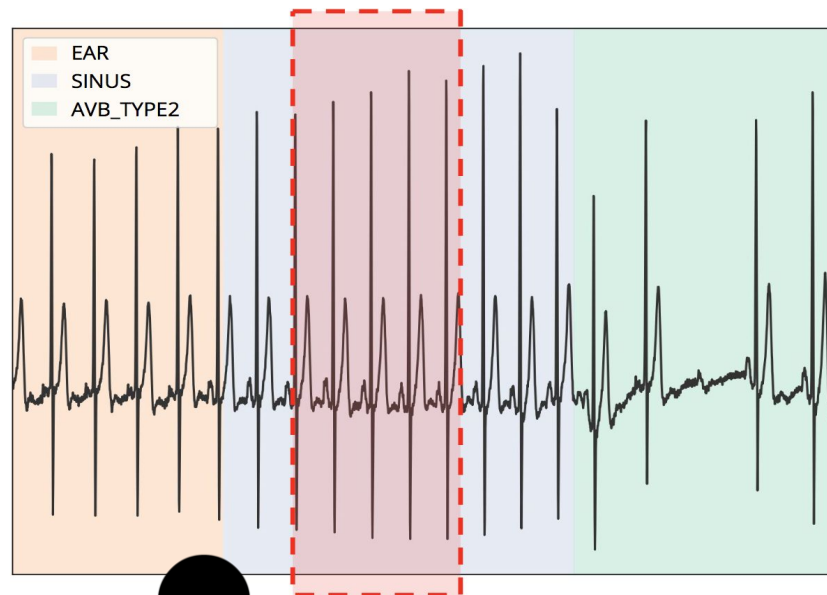
8 Layers \Rightarrow 34 Layers

- + Batch Normalization
- + Residual Connections
- + Dropout
- + More context (15 seconds)



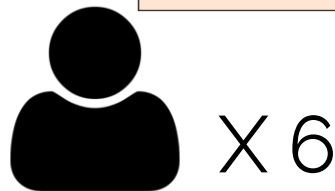
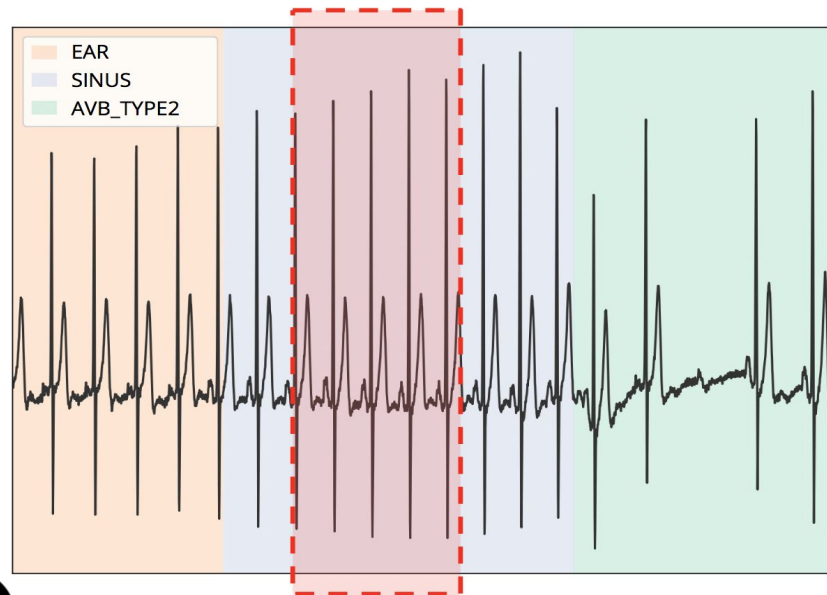
Evaluation

- 336 ECG records with 328 patients
- Committee of experts to determine ground truth on test set

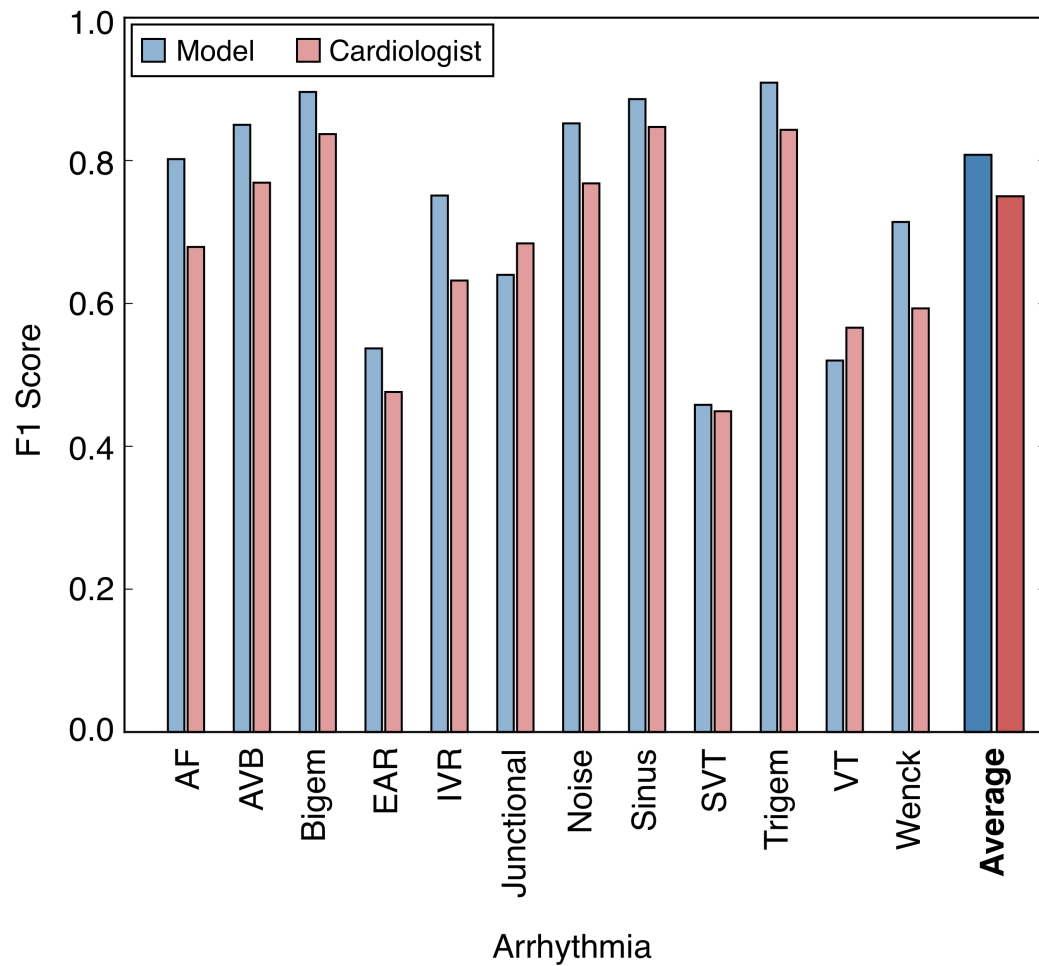


Evaluation

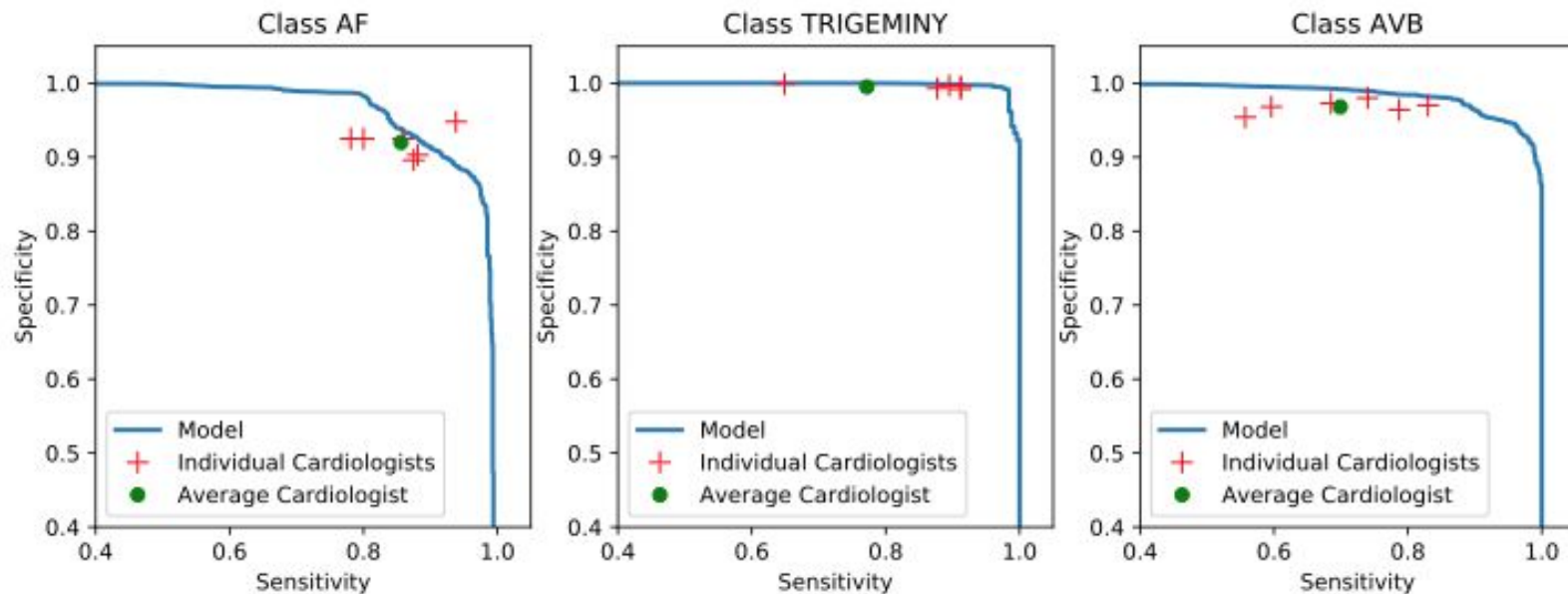
- Compare model to individual cardiologists.
- Each record annotated by 6 individuals



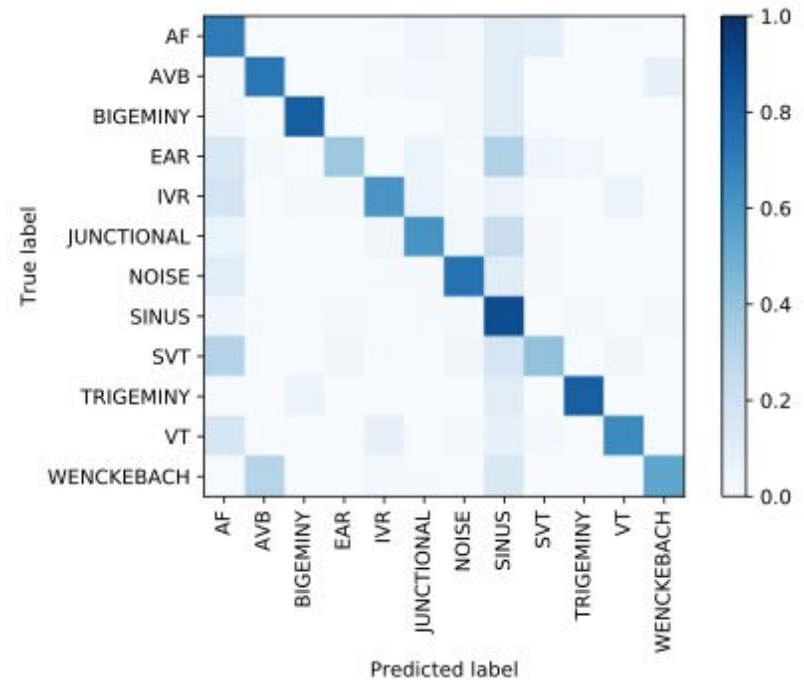
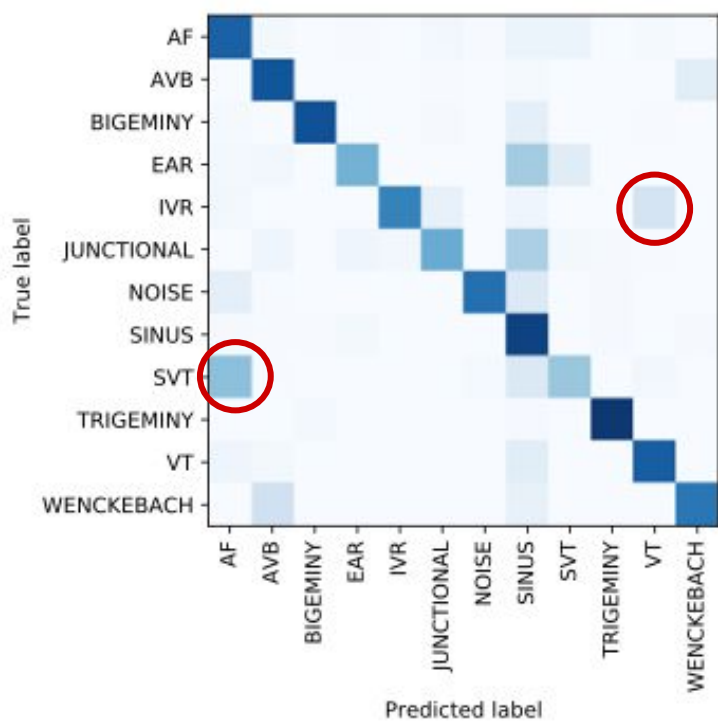
Results



Results



Results: Human and Model Confusions



Thank You!

