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Self-Supervised Learning of Electrocardiogram (ECG) Signals

Stanford researchers have developed a contrastive learning approach that can significantly reduce the amount of labeled electrocardiogram (ECG) data required for downstream healthcare tasks, such as arrhythmia identification. Today, the 12-lead ECG is a common non-invasive test for diagnosing and monitoring cardiovascular conditions, and recent studies have demonstrated the ability of deep learning to predict conditions using ECG data. However, existing supervised learning methods depend on tens of thousands of high-quality labels to achieve strong generalization performance. Stanford's technology, called 3KG, is a physiologically-inspired contrastive learning approach shown to outperform previous models on an arrhythmia diagnosis dataset. It uses the spatiotemporal properties of the ECG to generate and select positive views for contrastive learning. It can reduce the time that health specialists spend labeling data – they only need to label a fraction of the data. Even fractions as small as 1% are comparable to 100%.

Stage of Development
The researchers have demonstrated that 3KG outperforms previous self-supervised ECG strategies and closes the gap to achieving fully supervised performance when only using a subset of the labeled data.

Applications

- Identification of arrhythmias (or other downstream healthcare task) from a given ECG recording using self-supervised trained models
- Related product development

Advantages

- Can dramatically reduce the time that health specialists spend labeling data
- Existing methods require a label for every ECG recording that is incorporated in an artificial intelligence setting

Publications

- Gopal, Bryan, et al. "3KG: Contrastive Learning of 12-Lead Electrocardiograms using Physiologically-Inspired Augmentations." *Machine Learning for Health.* PMLR, 2021.
- Gopal, B., Han, R., Raghupathi, G., Ng, A., Tison, G. & Rajpurkar, P.. (2021). 3KG: Contrastive Learning of 12-Lead Electrocardiograms using Physiologically-Inspired Augmentations. *Proceedings of Machine Learning for Health, Proceedings of Machine Learning Research 158:156-167*

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