Cutting Annotation Cost for Biomedical Imaging by Integrating Active Learning and Transfer Learning

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Technology description

Deep convolutional neural networks (CNN) are useful in a variety of applications ranging from computer vision to signal processing. There is increasing interest in applying CNN to biomedical image analysis, but success is impeded by the lack of large annotated datasets in biomedical imaging. Expert annotation is tedious, time consuming and expensive and the diseases are scarce in the datasets. There is a need to reduce the cost of annotation so that CNNs can be applied in biomedical imaging analyses.

Researchers at Arizona State University have developed methods to reduce annotation costs utilizing active learning and transfer learning in CNN for medical image analyses. These methods work with a pre-trained CNN to find worthy samples from the unannotated for annotation. This method has been evaluated in four different biomedical imaging applications, pulmonary embolism detection, polyp detection, colonoscopy frame classification and carotid intima-media thickness measurements, and have shown that the cost of annotation can be cut by at least half.

These methods enable the usage of fine-tuned CNNs for medical imaging applications that cut the cost of annotation, perform faster and utilize less resources to have an important impact on computer-aided diagnoses.

Application area

• Medical image analyses

Pulmonary embolism detection

Colonoscopy polyp detection

Carotid intima-media thickness measurements

Colonoscopy frame classification

Advantages

• Better “noisy” label handling

• Reduced computation time for selecting training images

• Integrates active learning into fine-tuning CNNs in a continuous fashion – more amicable to biomedical image analysis

• Cuts annotation costs dramatically
• Groups of pixels or patches can be labeled independently of the entire image
• Faster analysis times
• Does not require initial seed labeled samples
• Incrementally improves the learner rather than repeatedly re-training
• Utilizes less computational and memory resources
• Does not require extensive expert annotations

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