Inverse Modeling of 2D Trees Using Graph Neural Networks

An Attempt To Encode Tree Geometry

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INTRODUCTION

The most established and widely used **methods** for **analysing tree images** for tasks such as geometry analysis, segmentation and classification **often rely on pixels**. In this paper, the applicability of **analyzing tree geometry based on a graph representation rather than a pixel-based approach** is pursued.

Two independent Graph Convolutional Network algorithms which learn node (coordinate) features are then applied on the obtained dataset to assess the reliability of graph based analysis.

The **first experiment** explores a GCN for **assigning correct species** labels **to the skeleton graph** of the original tree im age, demonstrating the **association between geometry and tree metadata.**

The **second experiment**, an unsupervised representation learning, is conducted by using **Graph Auto Encoders** to obtain **an embedding** for each skeleton graph which can be used **to reconstruct partially the same graph**, demonstrating the **association between GCE latent representation and geometry.**

OBJECTIVES

Are GCNs Helpful In **Capturing Tree Geometry** ?

Can GCNs **label** tree **skeleton** graphs **to** their correct **species** in a supervised manner ?

Can GCNs learn a **low-dimensional encoding** of tree skeleton **geometry** ?

METHOD

120 Tree Renders

6 Species

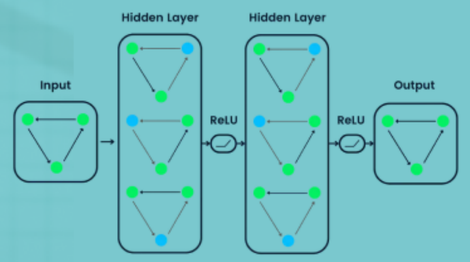
Skeletonized

Graphed

MSTd

-> Fed Into

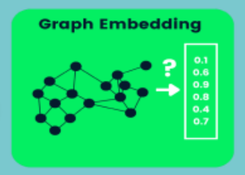
GCN



For

1.

2.



Experiment 1: Skeleton Classifier

95%

Accurate Labeling of Skeleton Graphs (To Original Tree Species)

Using the **PointNet++** [1]Architecture

Contrary to a pixel-based approach in which attributes such as color might be mapped to a label, in this approach only geometry is mapped to labels.

Experiment 2: Graph Embeding

84%

Accurate Reconstruction of the adjacency matrix of the skeleton graphs with a 4 dimensional embedding

Showcasing the capability of GCNs to capture geometry in a compressed form, independent of metadata, and capable of partially reconstructing the original graph.

Using **Variational Graph Auto Encoders [2]**

References

- [1] Qi, Charles Ruizhongtai, et al. "Pointnet++: Deep hierarchical feature learning on point sets in a metric space." Advances in neural information processing systems 30 (2017).
- [2] Kipf, Thomas N., and Max Welling. "Variational graph auto-encoders." arXiv preprint arXiv:1611.07308 (2016).