Alma Mater Studiorum · Università di Bologna

Scuola di Scienze
Dipartimento di Fisica e Astronomia
Corso di Laurea in Fisica

GEOMETRIC DEEP LEARNING

Relatore:
Prof.ssa. Rita Fioresi

Presentata da:
Tommaso Lamma

Anno Accademico 2020/2021

Abstract in italiano...

Abstract in english...

Contents

1 Introduction

1.1 Abstract simplicial complexes

Definition 1.1.1. ***Abstract simplicial complex***
Let $\mathcal{F}$ be a family of sets we then define an abstract simplicial complex $\mathcal{A}$ to be

$$\mathcal{A} := \{\sigma_j = \{A_i\}_{i \in I_j} \subset \mathcal{F} : \tau_j \subset \sigma_j \Rightarrow \tau_j \in \mathcal{A}\}_{j \in J}$$

where I_j and J are sets of indexes, we shall call σ_j abstract simplexes of $\mathcal{A}$.

Definition 1.1.2. ***Dimension of an abstract simplicial complex***
Let $\mathcal{A} = \{\sigma_j\}_{j \in J}$ be an abstract simplicial complex we define its dimension to be

$$dim\mathcal{A} := max_{\sigma_j \in \mathcal{A}} dim(\sigma_j),$$

where $dim(\sigma_j) := |\sigma_j| - 1$.

Definition 1.1.3. ***Abstract graph***
An abstract graph $\mathcal{G} = \{\sigma_j\}_{j \in J}$ is a 1-dimensional abstract simplicial complex whose vertexes and edges are respectively

$$\mathcal{V} := \{\sigma_j \in \mathcal{G} : dim(\sigma_j) = 0\} \text{ and}$$
$$\mathcal{E} := \{\sigma_j \in \mathcal{G} : dim(\sigma_j) = 1\} \ .$$

In Definition 1.1.1. we tacitly assumed the definition of the abstract simplex σ_j invariant with respect to permutations of the indexes I_j, this assumption establishes the difference between directed and undirected graphs.

1.2 Differential forms on abstract simplicial complexes

1.3 Integration on simplicial chains

1.4 Smooth real manifolds and abstract graphs

1.5 Convolutional neural networks on euclidean domains