MSc in Advanced Computer Science
FHS Computer Science; Mathematics and Computer Science;
Computer Science and Philosophy

GEOMETRIC DEEP LEARNING

Hilary Term 2023

Submission deadline 12 noon, Tuesday 11th April 2023, via Inspera.

There is a total of 100 marks available for this paper, you should attempt all parts of the paper.

NB: You must not discuss this examination paper with anyone.

TURN OVER

Geometric Deep Learning

Question 1

In this question, you are expected to investigate a research question related to geometric deep learning models studied in the course (deepsets, graph neural networks, transformers, CNNs, group-equivariant CNNs, intrinsic/mesh CNNs). You can choose one of the following:

- Implementation and detailed experimental study of existing models.
- Theoretical analysis on an existing model, e.g. focusing on some phenomenon such as over-smoothing or over-squashing.
- Propose an extension or improvement of an existing model.
- Use of a geometric deep learning model in a problem from an applied field.

The report should not exceed *six* pages. If the study involves an implementation, please include a link to your anonymous code-base (i.e., a github repository). The study will be assessed based on the following criteria: (i) motivation, clarity, and presentation (20 marks), (ii) originality and novelty (20 marks), (iii) coherence and depth of the study (20 marks), (iv) scholarship, i.e., framing in the existing literature (15 marks) (v) relations to the concepts discussed throughout the course (10 marks), (vi) balanced critical self-evaluation (15 marks). (*Please ensure that the resources are used in a balanced and well-justified manner: The study is not evaluated according to the number of experiments, or datasets, but according to its merits in accordance to the outlined criteria. Please follow the notation from the lecture slides whenever applicable.*)

(a) State a research question related to geometric deep learning and explain your motivation for the proposed study. *(Example: How can the use of graph direction help message passing?*

(b) Propose means to study the research question and give an outline of the overall approach, clearly identifying the goals of the chosen study. *(Example: An experimental setup which aims to test different ways of directed message passing on graphs, using a synthetic dataset or using existing datasets.)*

(c) Clearly state your methodology: theoretical framework and empirical setup, hyper-parameters, and the assumptions underpinning the study.

(d) Report your empirical/theoretical/conceptual findings, identifying whether or not the results support the initial hypothesis. You can use visuals, figures, and tables to present your findings in a structured manner. You are expected to relate and compare your results to the relevant literature and to the concepts from the course.

(e) Provide a detailed discussion relating the results to the original motivation, as well as a critical perspective regarding the study.

(f) The report should conclude with an outlook stating any additional studies that need to be conducted to reach to more conclusive statements.

(100 marks)

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