

HONOURS PROJECT PROPOSAL (PROJECT CUM SEMINAR GROUP)

SUPERVISOR'S INFO

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PROJECT ID: PS2420-06

TITLE

Applying Group Representation Theory in Machine Learning

PREFERRED GROUP SIZE (MIN. 6, MAX. 12)

6

BRIEF DESCRIPTION OF PROJECT

The use of group representation theory in machine learning models is an exciting and upcoming development.

Part 1 involves teaching each other (or brushing up on) basic representation theory, including some concrete examples such as the symmetric group and the orthogonal group. We will also learn about harmonic analysis on groups.

After that, we will look at some ideas of implementing knowledge from part 1 to selected machine learning problems.

EXPECTATION/S

Students are expected to give around 2 to 3 talks each, with the aim of helping each other understand the content.

You are expected to have a basic grasp of group representation theory and Fourier analysis by the end of week 2 (can be achieved by self-studying sections 1.1, 1.2 and 2.1 of reading reference 1). Prior exposure to some machine learning and ability to write ML code is a bonus.

At the end of the project, you should have attained working knowledge of representation theory in order to implement it in machine learning models. It is also hoped that you will be able to appreciate the different contexts where representation theory can be used to potentially improve current ML models.

PREREQUISITE/S

MA2202

RELEVANT MA4000 MODULES/CO-REQUISITES

MA3209, MA4201, MA4229, MA5218, MA5251



READING REFERENCE/S

Kondor IR. Group theoretical methods in machine learning. Columbia University; 2008.

Kondor, Risi, and Shubhendu Trivedi. "On the generalization of equivariance and convolution in neural networks to the action of compact groups." In *International Conference on Machine Learning*, pp. 2747-2755. PMLR, 2018.

Cohen, Taco S., Mario Geiger, Jonas Köhler, and Max Welling. "Spherical cnns." *arXiv preprint arXiv:1801.10130* (2018).