Rahul Vigneswaran

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Research Intern
Indian Institute of Technology Hyderabad
Advisors : Dr Makarand Tapaswi & Dr Vineeth N Balasubramanian

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Research Interests

Major Interests[‡]	Deep learning, Computer Vision
Others	Natural Language Processing

Education

Amrita University — India
Bachelor of Technology in Mechanical Engineering - CGPA: (8.34/10) - Graduated with Distinction (Top 5%)

Selected Publications[†]

1. Adepu Ravi Shankar, Yash Khasbage, **Rahul-Vigneswaran K**, Vineeth N Balasubramanian. **A Deeper Look at the Hessian Eigen spectrum of Deep Neural Networks and its Applications to Regularization**. **(AAAI 2021)** [arXiv]

Research Experience

Indian Institute of Technology Hyderabad - Research Intern — India
Advisor : Dr Vineeth N Balasubramanian — *July'19 - Present*

- Explored ways to tackle the problem of long-tail distribution in an image classification setting.
- Worked on understanding the various properties of loss landscapes of Deep Neural Networks through the lens of Hessian's Eigen Spectrum (Hessian Decomposition). Along the way, explored its unique inherent properties like mode connectivity, flatness, induced noise and how they affect the generalization properties for image classification tasks.
- Worked on setting a theoretical base for continual learning. Followed by gaining insights by looking at catastrophic forgetting in terms of loss landscape and ways these insights can help the community understand the nature of continual learning better in order to formulate better algorithms.

★ Published 1 work at **AAAI**.

Hazy Research, Stanford (Remote) — California, USA
Advisor : Piero Molino (Started working when he was at Uber AI) — *May'20 - Dec'20*

- Worked on Natural Language Generation (NLG) by extending the work "Plug and Play Language Models: A Simple Approach to Controlled Text Generation[1]".

Research Projects

Long-tail distribution — *Oct'20 - Present*
Advisors : Dr Makarand Tapaswi (Wadhwani AI) & Dr Vineeth NB (IIT Hyderabad)

∗ Recent work[1] indicates a large difference in angular variance between head and tail classes and closing this variance gap has proven effective.
∗ In this work, we leverage the same to formulate a method influenced by Prototypical Networks[2] and Hyperspherical Prototype Networks[3] in which the representations are mapped onto a hypersphere in such a way that it mitigates problems related to long-tail distributions.

[‡] In no particular order.
[†] For full list of publications, kindly check the website.

Incremental Loss Landscape *Jan'20 - Oct'20*

Advisor : Dr Vineeth N Balasubramanian, IIT Hyderabad

* The theoretical literature on continual learning is minimal, and in this work, we try to fix the same. Worked on understanding how catastrophic forgetting translates to loss landscape and how it can pave the way for more theoretically grounded continual learning methods.
* Worked on understanding how regularization based catastrophic forgetting mitigation techniques behave in loss landscapes and why some methods are more successful in achieving the same than others. Analyzed whether tools like, to name a few - Hessian's Eigen Spectrum, intrinsic dimensionality can aid in understanding continual learning better.

Layer-wise Hessian Analysis *July'19 - Jan'20*

Advisor : Dr Vineeth N Balasubramanian, IIT Hyderabad

* Recent works[4,5] have demonstrated a bulk and outlier trend in their Hessian's Eigen Spectrum. In this work, we have discovered a similar trend in the layer-wise spectrum, too, which indicates an implicit similarity between the overall loss landscape and layer-wise loss landscape, which is a community first.
* We leverage this observation and formulate a regularizer that forces the optimizer to converge to a minima of better generalization properties. Further, through this analysis, we have substantiated that studying the layer-wise loss landscape is worth the community's efforts.

★ Work accepted at **AAAI** 2021.

Relevant skills

Languages	Python, C, C++
Frameworks	JAX, Pytorch, Keras, Scikit-learn, MATLAB

Extras

1. *Teaching Assistant* to Dr Vineeth N Balasubramanian for the course CS6360 : Advanced Topics in Machine Learning at Indian Institute of Technology, Hyderabad.
2. *Teaching Assistant* to Dr Vineeth N Balasubramanian for the course : Deep Learning for Computer Vision at NPTEL.
3. *Sub-reviewer:* IJCAI'20, ICLR'21, SDM'21.
4. *Student volunteer*: ICML'20.

References

1. *Dr Makarand Tapaswi*, Wadhwani AI - India.
2. *Dr Vineeth N Balasubramanian*, Head of Department - Department of Artificial Intelligence / Associate Professor - Department of Computer Science and Engineering, Indian Institute of Technology, Hyderabad - India.