

Ramprasaath R. Selvaraju

INTERPRETABILITY · COMPUTER VISION · DEEP LEARNING

Ph.D Student, Georgia Tech

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Research Interests

Developing algorithms for making AI Interpretable, Transparent and Unbiased

Education

Georgia Tech

PH.D IN COMPUTER SCIENCE

- Advised by Dr. Devi Parikh and working closely with Dr. Dhruv Batra.

Atlanta, GA, USA

Aug. 2017 - Present

Virginia Tech

PH.D IN COMPUTER ENGINEERING

- Advised by Dr. Devi Parikh and working closely with Dr. Dhruv Batra.

Blacksburg, VA, USA

Aug. 2015 - July. 2017

Birla Institute of Technology & Science (BITS)-Pilani

BACHELOR OF ENGINEERING (HONOR) IN ELECTRICAL AND ELECTRONICS

MASTER OF SCIENCE (HONOR) IN PHYSICS

Hyderabad, India

Aug. 2010 - May. 2015

Publications

1. **Choose Your Neuron: Incorporating Domain Knowledge into Deep Networks via Neuron Importance**
Ramprasaath R. Selvaraju*, Prithvijit Chattopadhyay*, Mohamed Elhoseini, Tilak Sharma, Dhruv Batra, Devi Parikh, and Stefan Lee. In Proceedings of **ECCV, 2018**. arXiv:1808.02861.
2. **"Grad-CAM: Visual Explanations from Deep Networks via Gradient-based Localization."**
Ramprasaath R. Selvaraju, Michael Cogswell, Abhishek Das, Ramakrishna Vedantam, Devi Parikh, and Dhruv Batra. In Proceedings of **ICCV, 2017**. arXiv:1610.02391.
3. **"Diverse Beam Search: Decoding Diverse Solutions from Neural Sequence Models."**
Vijayakumar Ashwin K., Michael Cogswell, **Ramprasaath R. Selvaraju**, Qing Sun, Stefan Lee, David Crandall, and Dhruv Batra. In Proceedings of **AAAI, 2018** arXiv:1610.02424.
4. **"Counting Everyday Objects in Everyday Scenes."**
Prithvijit Chattopadhyay, Ramakrishna Vedantam, **Ramprasaath R. Selvaraju**, Dhruv Batra, and Devi Parikh. In Proceedings of **CVPR, 2017**. arXiv:1604.03505.
5. **"The semantic paintbrush: Interactive 3d mapping and recognition in large outdoor spaces."**
Miksik Ondrej, Vibhav Vineet, Morten Lidegaard, **Ramprasaath R. Selvaraju**, Matthias Nießner, Stuart Golodetz, Stephen L. Hicks, Patrick Pérez, Shahram Izadi, and Philip HS Torr. In Proceedings of **CHI, 2015**.
6. **"Automated colorimetric analysis in paper based sensors."**
Sanyam Garg, **Ramprasaath R. Selvaraju**, Suman Kapur, and Kunda MM Rao. In Proceedings of **ICIP, 2014**.

Work Experience

Samsung Research America.

RESEARCH INTERN

Developing algorithms for grounding and unbiasing deep vision and language models

CA, USA

May 2018 - Jul. 2018

Facebook Inc.

RESEARCH INTERN

Developing framework for interpreting and visualizing Facebook's deep models

CA, USA

Jan 2017 - May. 2017

Virginia Tech

UNDERGRAD THESIS WORKING WITH **DEVI PARIKH**

- Worked on building curious systems that ask Natural Language open-ended questions about an image

VA, USA

Jan. 2015 - Aug. 2015

University of Oxford

UNDERGRAD THESIS WORKING WITH **PHILIP TORR** AND **STEPHEN HICKS**

- Developing interactive augmented reality system where a carer helps the user understand the scene better. (Oral at CHI, 2015)

Oxford, UK

May. 2014 - Dec. 2014

Brown University

SUMMER INTERNSHIP WORKING WITH **BENJAMIN KIMIA**

- Designing a vision-based navigation system to help the blind navigate indoor environments, through using stereo cameras and IMUs

RI, USA

May. 2013 - Aug. 2013

Teaching Experience

Teaching Assistant

DATA STRUCTURES AND ALGORITHMS

Virginia Tech

Aug. 2015 - May. 2016

Course Work

- Mathematical Foundations of ML
- Computer Vision (Intro and Adv.)
- Adv. Machine Learning
- Deep Learning
- Optimization in High-dim Spaces
- Bayesian Statistics

Skills

Programming Python, MATLAB, C/C++

DL Frameworks Pytorch, Tensorflow, Caffe, Torch

Operating Systems Linux (Ubuntu), MacOS, Windows and Android

Projects

Leveraging explanations to teach Deep models through focused feedback

IN PROGRESS

Georgia Tech

- Today's state-of-the-art deep models are known to rely heavily on superficial correlations in training data.
- Models are often biased by language priors, and do not make predictions sufficiently grounded in the image content.
- We propose a generic approach, Human Importance aware Network Tuning (HINT) to ground deep networks by constraining them to look at the same regions as humans, thereby correcting for the incorrect biases learned during training.

Incorporating Domain Knowledge into Deep Networks via Neuron-Importance

PUBLISHED AT ECCV, 2018

Georgia Tech

- We propose an approach Neuron Importance-Aware Weight Transfer (NIWT) that learns to map domain knowledge from a human expert about novel "unseen" classes onto a dictionary of concepts learned by the network.
- Our approach then optimizes for network parameters that can effectively combine these concepts – essentially learning classifiers by discovering and composing learned semantic concepts in deep networks.
- NIWT can provide visual and textual explanations and also name network's neurons
- Code: <https://github.com/ramprs/neuron-importance-zsl>
- Arxiv Paper: <https://arxiv.org/abs/1808.02861>

Grad-CAM: Visual Explanations from Deep Networks via Gradient-based Localization

PUBLISHED AT ICCV, 2017

Virginia Tech

- Developed a Deep Neural Network Visualization technique called, Grad-CAM (Gradient-weighted Class Activation Mapping) that:
 - is class-discriminative and can make any CNN-based model interpretable
 - requires no change in architecture → no need for retraining → no compromise on accuracy
- Grad-CAM provides tools for:
 - understanding networks (eg. debugging), uncover bias and instill trust in user
- Can visualize models for a variety of applications: Image Classification, Image Captioning and Visual Question Answering
- Code: <https://github.com/ramprs/grad-cam>
- Arxiv Paper: <https://arxiv.org/abs/1610.02391>
- Demo: <http://gradcam.cloudcv.org>

Diverse Beam Search: Decoding Diverse Solutions from Neural Sequence Models

PUBLISHED AT AAAI, 2018

Virginia Tech

- Traditional Beam Search explores the search space in a greedy left-right fashion – resulting in sequences that differ only slightly from each other.
- To overcome this problem, we propose Diverse Beam Search (DBS), an alternative to BS that decodes a list of diverse outputs by optimizing for a diversity-augmented objective.
- In addition to generating diverse predictions, it also helps finding better top-1 solutions.
- Code: <https://github.com/ashwinkalyan/dbs>
- Arxiv Paper: <https://arxiv.org/abs/1610.02424>
- Demo: dbs.cloudcv.org

Counting Everyday Objects in Everyday Scenes

Virginia Tech

PUBLISHED AT CVPR, 2017

2015

- The goal of this project is to count the number of occurrences of Common Everyday occurring categories in real-world scenes
- Arxiv paper: <https://arxiv.org/abs/1604.03505>

Reviewing

- Reviewer for NIPS, CVPR, ICCV and ECCV since 2016

Extra-curricular Achievements

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|------|---|---------|
| 2016 | First Place , Virginia Division Table-Tennis Championship | VA, USA |
| 2016 | Second Place , US Mid-Atlantic Region Table-Tennis Championship | NC, USA |
| 2016 | Represented Virginia Tech , US-Canada National Table-Tennis Championship | TX, USA |

References

- Dr. Devi Parikh, Assistant Professor, Georgia Tech - parikh@gatech.edu
- Dr. Dhruv Batra, Assistant Professor, Georgia Tech - dbatra@gatech.edu
- Dr. Stefan Lee, Research Scientist II, Georgia Tech - steflee@gatech.edu
- Dr. Mohamed Elhoseiny, Manager, Facebook Inc - elhoseiny@fb.com