Megha Nawhal

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AREAS OF EXPERTISE	Machine Learning; Computer Vision: video understanding, transformer models for computer vision, image and video generation

EDUCATION

Simon Fraser University, Burnaby, Canada
Ph.D., Computing Science, 2017 - Present
Advisor: Greg Mori

- Proposed novel algorithms for compositional modeling of human activity videos with a focus on temporal localization, action prediction and human-object interaction understanding.
- Designed Transformer-based models for understanding long-form videos.
- Developed GAN-based model designs for generation of human-object interaction videos.

Indian Institute of Technology (IIT), Kanpur, India
B.Tech. - M.Tech. (Dual Degree), Electrical Engineering, 2010 - 2015
Advisor: K S Venkatesh

- Dissertation: *High dynamic range (HDR) imaging using conventional cameras.*
- Proposed novel imaging solutions to improve scene capture in unfavorable lighting conditions.

WORK EXPERIENCE

IBM Research   Jul'15 - Jul'17
Research Scientist - Cognitive Industry Solutions Group

- Designed data-driven solutions and developed PoCs and prototypes in different domains such as retail shopping, real estate operations, and smart grid.
- Developed interactive systems to enhance the in-store consumer shopping experience by integrating ambient intelligence technologies and Computer Vision techniques.
- Developed multimodal representation learning models for image-based and text-based search on fashion e-commerce portals. The proposed methods improved customer satisfaction by 20%.
- Led a project with IBM-RESO (Real Estate Site Operations) to design algorithms for optimization of energy utilization in office buildings based on past consumption profiles.

INTERNSHIP EXPERIENCE

Google, Pittsburgh, USA   May'22 - Aug'22
Research Intern - Perception (Google Research)

- Worked on the problem of text-guided segment retrieval from long-form video content.
- Designed multimodal Transformer models that receives a video sequence and a natural language text query to retrieve relevant segment timestamps from the video.
- Designed segment-level curriculum learning approaches to learn segment-level representations and leverage different types of breakpoints in long-form videos.
- Developed a framework using JAX to train the models on various datasets and evaluate the models on realistic egocentric videos and in-the-wild videos.

Meta   Sep'21 - Feb'22
Research Intern - Reality Labs Research

- Focused on the research problem of action anticipation for long-range egocentric activities.
- Designed Transformer models and self-supervised learning approaches to train models to predict actions in a partially observed activity video over long timescales.
- Implemented a framework based on PyTorch Lightning to train the models and evaluate the models on benchmarks relevant to augmented reality use cases.

Google   Apr'21 - Aug'21
Research Intern - YouTube/Perception (Google Research)

- Defined machine learning formulations to detect scene boundaries in long-form videos.
- Designed multimodal Transformer-based models to identify semantic changepoints in videos.
- Developed a TensorFlow based framework to train the models and evaluate them on realistic videos containing professionally produced media content.

Adobe Research, San Francisco, USA   Jun'19 - Sep'19

Research Intern - Creative Intelligence Lab

- Defined the idea of environment awareness in Augmented Reality (AR) platforms using multiple modalities of data streams.
- Integrated Computer Vision techniques with ARKit to process multiple sources of visual information of the overall scene of interactions with the AR device.
- Developed an AR sketching application that uses the phone bearer's pose information in 3D to address the problem of drift in AR applications.

Borealis AI, Vancouver, Canada   Oct'18 - May'19, Sep'19 - Mar'20

Machine Learning Research Intern

- Worked on research problems in the domain of Computer Vision and Machine Learning that were published at top-tier conference venues.
- Developed novel GAN-based algorithms for zero-shot compositional generation of human-object egocentric interaction videos (published at ECCV'20).
- Designed generative flow based models to learn complex distributions of graph-structured data (published at ICML'20 Workshop).

Sony Corporation, Japan   May'13 - Jul'13

Software Developer Intern - Professional Solutions Team

- Developed software modules for Sony's imaging hardware - videocams and camcorders.
- Designed an algorithm for detection of flashband in videos, an undesirable non-uniform brightness occurring in some frames of the video. Implemented a module based on the algorithm which was included as part of the software for camcorders.
- Implemented a color corrector plugin for Vegas Pro and subsequently, executed extensive performance comparison of the developed module with other video editing tools.

KEY
PROJECTS

Action Affordances for Long Term Action Prediction   Mar'21 - Feb'22

Collaborators: Akash Abdu Jyothi, Greg Mori (Simon Fraser University)   [webpage]

We designed a two-stage training approach for long-term action prediction in human activity videos. We proposed a transformer model that learns action affordances of short clips across videos; it then leverages this affordance information along with the context of a partial video to predict future actions over long timescales. This work was presented at ECCV'22.

Temporal Action Localization in Videos using Graph Transformers   Apr'20 - Nov'20

Collaborators: Greg Mori (Simon Fraser University)   [webpage]

We built an end-to-end learnable encoder-decoder graph transformer model for the task of temporal action localization in long-form human activity videos. Our approach models the non-linear temporal structure in such videos using graph-based self-attention mechanisms.

Video Generation of Zero-shot Egocentric Interactions   Oct'18 - Dec'19

Collaborators: Leonid Sigal, Greg Mori, Andreas Lehrmann (Borealis AI)   [webpage]

We introduced the task of generating human-object interaction videos in a zero-shot compositional setting. To generate human-object interaction videos, we proposed a novel GAN-based framework focusing on different aspects of a video such as pixel level information and object-centric scene graphs derived from the video. This work was presented at ECCV'20.

Multimodal Representations for Cross-modal Search in Fashion Catalogues Jan'16 - Jul'17

Collaborators: Vikas Raykar, Mitesh Khapra, Amrita Saha (IBM Research)   [webpage]

We proposed novel correlational autoencoder based models for jointly learning disentangled multimodal representations for cross-modal image retrieval, visual search, and image tagging applications. The PoC was built and deployed on the portal of a e-commerce fashion giant. This work was also presented at WACV '18.

PUBLICATIONS
- **M. Nawhal**, A.A Jyothi, G. Mori, *Rethinking Learning Approaches for Long Term Action Anticipation.* In: Proceedings of European Conference on Computer Vision (ECCV), 2022.

- **M. Nawhal**, M. Zhai, A. Lehrmann, L. Sigal, G. Mori, *Generating Videos of Zero-Shot Compositions of Actions and Objects.* In: Proceedings of European Conference on Computer Vision (ECCV), 2020.

- M. Zhai, L. Chen, J. He, **M. Nawhal**, F. Tung, G. Mori, *Piggyback GAN: Efficient Lifelong Learning for Image Conditioned Generation.* In: Proceedings of European Conference on Computer Vision (ECCV), 2020.

- Z. Deng*, **M. Nawhal***, L. Meng, G. Mori, *Continuous Graph Flow.* In: Proceedings of International Conference on Machine Learning (ICML) Workshop on Graph Representation Learning and Beyond, 2020.

- M. Zhai, L. Chen, F.Tung, J. He, **M. Nawhal**, G. Mori, *Lifelong GAN: Continual Learning for Conditional Image Generation.* In: Proceedings of International Conference on Computer Vision (ICCV), 2019.

- Y. Gong, H. Hajimirsadeghi, J. He, **M. Nawhal**, T. Durand, G. Mori, *Variational Selective Autoencoder.* In: Proceedings of Symposium on Advances in Approximate Bayesian Inference (AABI), 2019.

- **M. Nawhal**, J. Lang, G. Mori, P. Chilana, *VideoWhiz: Milestone-Driven Overviews for Non-Linear Navigation of Visually-Rich Instructional Videos.* In: Proceeding of Graphics Interface (GI), 2019.

- A. Saha, **M. Nawhal**, M. Khapra, V. Raykar, *Learning Disentangled Multimodal Representations for the Fashion Domain.* In: Proceedings of IEEE Winter Conference on Applications of Computer Vision (WACV), 2018.

- M. Jain, **M. Nawhal**, S. Dechu, S. Dupatti, *MobiCeil: Cost-free Indoor Localizer for Office Buildings.* In: Proceedings of ACM International Conference on Human Computer Interaction with Mobile Devices and Services (MobileHCI), 2018.

- **M. Nawhal**, S. Bhattacharya, K. S. Venkatesh, *Improved Scene Capture in Unfavourable Lighting Conditions.* In: Proceedings of IEEE International Conference on Image Processing (ICIP), 2017.

- **M. Nawhal**, H. Bansal, et al. *Unlocking the Hidden Potential of Data Towards Efficient Buildings: Findings from a Pilot Study in India.* In: Proceedings of IEEE PES Innovative Smart Grid Technologies (ISGT), Europe, 2016.

- K. Saurav, H. Bansal, **M. Nawhal**, V. Chandan, V. Arya, R. Sridhar, B. Ramesh, *Optimizing Energy Costs of Commercial Buildings in Developing Countries.* In: Proceedings of ACM International Conference on Future Energy Systems (e-Energy), 2016

PATENTS
GRANTED/FILED
- M. Nawhal, Y. Gong, J. He, T. Durand, Y. Cao, G. Mori, H. Hajimirsadeghi, *System and method for machine learning architecture for partially-observed multimodal data,* 2020.

- M. Nawhal, M. Zhai, G. Mori, A. Lehrmann, *System and method for generation of unseen composite data objects,* 2020.

- M. Nawhal, A. Prakash, P. Kumar, M. Jain, A. Singhee, G. Sharma, A. Shah, *Transforming Jewelry Shopping Experience: Combining Real and Virtual Worlds,* 2017.

- M. Nawhal, M. Jain, S. Dupatti, S. Dechu, *MobiCeil: Indoor Location Detection using Ceiling Patterns,* 2015.

- M. Nawhal, S. Bhattacharya, K. S. Venkatesh, *Gain Swept HDR Imaging,* 2015.

- M. Nawhal, S. Bhattacharya, K. S. Venkatesh, *Colour Filter Array and Process for Real Time Foreground Extraction,* 2015.

- M. Nawhal, B. Narasimhachari, S. Bhattacharya, K. S. Venkatesh, *Controlled Neutral Density Filter for HDRI,* 2014.

AWARDS
- Recipient of the Graduate Dean's Entrance Scholarship at Simon Fraser University (awarded to one student each year).
- Awarded Manager's Choice Award as an appreciation of the work at IBM Research in 2015.
- Recipient of Eaton Pratibha Excellence Award 2015 (awarded to 6 women engineers each year at national level (India) for their research contributions).
- National level finalist of Microsoft Imagine Cup (Software Design Challenge), 2012 along with only 6 other teams for designing an innovative handsfree user interface for the disadvantaged.
- Won 1st prize in IBM Technical Web Contest, 2011 for paper on the development of low latency, inexpensive eye-mouse.

MISCELLANEOUS INITIATIVES
- Serving as a reviewer for AI venues: TPAMI, CVPR, NeurIPS, WACV and BMVC since 2017.
- Project Mentor at Invent the Future 2018, two week summer enrichment camp aimed at providing Grade 11 girls the opportunity to explore the world of Artificial Intelligence through team projects and industry field trips.
- Coordinator of Media and Publicity Cell at Anataragni 2012 & Techkriti 2011, inter-collegiate cultural festival and technology fest of IIT Kanpur respectively.