KUMAIL ALHAMOUD

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Research Interests

General areas of interest: **Multimodal LLMs, Large-scale Evaluation Benchmarks, Synthetic Data**

My work focuses on benchmarking to identify limitations in existing models and proposing intuitive solutions to address them. Currently, I'm particularly interested in the intersection of vision and language learning, with a focus on aligning computer vision tasks to human intent expressed through natural language instructions. This requires a generalist multimodal LLM (MLLM) with a flexible interface. Recently, I've been working on projects that involve generating synthetic multimodal data to improve MLLM alignment with user requests.

References can be sought from: **Prof. Philip Torr, Prof. Marzyeh Ghassemi, Prof. Bernard Ghanem**

Education

Massachusetts Institute of Technology (MIT)   **September 2023 – Present**
PhD, Computer Science and Artificial Intelligence Lab (CSAIL); GPA: 5.0/5.0   *Cambridge, MA*
- PhD Supervisor: Prof. Marzyeh Ghassemi

King Abdullah University for Science and Technology (KAUST)   **July 2023**
M.S, Computer Science; GPA:3.96/4.00   *Thuwal, Saudi Arabia*
- Thesis Advisor: Prof. Bernard Ghanem

Cornell University   **May 2021**
B.S, Electrical and Computer Engineering; GPA: 4.13/4.30 (A+)   *Ithaca, NY*
- *Summa Cum Laude*
- Dean's List, all semesters

Publications

(* indicates equal contribution; clicking on paper title links to paper)

- ***Kumail Alhamoud***, Shaden Alshammari, Yonglong Tian, Guohao Li, Philip Torr, Yoon Kim, Marzyeh Ghassemi. "Vision-Language Models Do *Not* Understand Negation", *In Submission.*

- ***Kumail Alhamoud****, Yasir Ghunaim*, Motasem Alfarra, Thomas Hartvigsen, Philip Torr, Bernard Ghanem, Adel Bibi, Marzyeh Ghassemi. "FedMedICL: Towards Holistic Evaluation of Distribution Shifts in Federated Medical Imaging", *MICCAI 2024.*

- ***Kumail Alhamoud****, Yasir Ghunaim*, Abdulelah Alshehri, Guohao Li, Bernard Ghanem, Fengqi You. "Leveraging 2D Molecular Graph Pretraining for Improved 3D Conformer Generation with Graph Neural Networks", *Computers and Chemical Engineering 2024.*

- ***Kumail Alhamoud****, Hasan Abed Al Kader Hammoud*, Motasem Alfarra, Bernard Ghanem. "Generalizability of Adversarial Robustness Under Distribution Shifts", *Transactions on Machine Learning Research (TMLR) 2023.* [**awarded a Featured Certification → presented in ICLR 2024**]

- Yasir Ghunaim*, Adel Bibi*, ***Kumail Alhamoud***, Motasem Alfarra, Hasan Abed Al Kader Hammoud, Ameya Prabhu, Philip Torr, Bernard Ghanem. "Real-Time Evaluation in Online Continual Learning: A New Hope", *CVPR* 2023. [**Highlight Paper, *top 2.5%***]

- Andrés Villa, Juan C. Alcazar, Motasem Alfarra, ***Kumail Alhamoud***, Julio Hurtado, Fabian Caba, Alvaro Soto, Bernard Ghanem. "PIVOT: Prompting for Video Continual Learning", *CVPR* 2023.

- Andrés Villa, ***Kumail Alhamoud***, Juan C. Alcazar, Fabian Caba, Victor Escorcia, Bernard Ghanem. "vCLIMB: A Novel Video Class Incremental Learning Benchmark", *CVPR* 2022. [**Oral Paper, *top 2.5%***]

- Akshay Ajagekar, ***Kumail Alhamoud***, Fengqi You. "Hybrid Classical-Quantum Optimization Techniques for Solving Mixed-Integer Programming Problems in Production Scheduling", *IEEE Transactions on Quantum Engineering* 2022.

Employment

MIT, Healthy ML Group   **August 2023 – Present**
PhD Student   *Cambridge, MA*

Enhancing Negation Understanding of Vision-Language Models with Synthetic Data
- Proposed a benchmark to evaluate negation understanding in VLMs, which involves recognizing what is *not* present in an image. Highlighted a severe limitation in current models and innovated a synthetic data approach to mitigate this issue.

Addressing Domain and Temporal Shifts in Healthcare with Federated and Continual Learning
- Proposed novel learning strategies to harness decentralized patient data across hospitals, aiming to develop a generalizable model adaptive to evolving medical practices and diverse patient populations.

University of Oxford, Torr Vision Group   **May 2024 – September 2024**
Visiting PhD Student   *Oxford, UK*

Uncertainty Quantification for Better Decision-Making with Multimodal Large Language Models (MLLMs)
- Developing new techniques to provide certainty scores associated with MLLM outputs, helping decision makers understand when to trust MLLM judgment.

KAUST, Image and Video Understanding Lab (IVUL)   **September 2021 – August 2023**
Graduate Researcher   *Thuwal, Saudi Arabia*

Generalization and Transferability of Neural Network Representations
- Developed a chemistry-informed representation learning technique to improve generalizability of molecular embeddings.
- Investigated the generalizability of empirical and certified robustness to unseen visual domains.

Video Continual Learning
- Innovated a methodology to allow deep learning models to efficiently learn from continuous streams of video.

Extended Abstract Presentations

ECCV24 Workshop on Emergent Visual Abilities and Limits of Foundation Models   *September 2024*
- **Vision-Language Models Do *Not* Understand Negation**
  Kumail Alhamoud, Shaden Alshammari, Yonglong Tian, Guohao Li, Philip Torr, Yoon Kim, Marzyeh Ghassemi

*KAUST Conference on Scientific Computing and Machine Learning [**Best Poster Award**]*   *November 2022*
- **Chemistry-informed Graph Representation Learning for Molecular Conformation Generation and Beyond**
  Kumail Alhamoud, Yasir Ghunaim, Guohao Li, Bernard Ghanem

Cornell Engineering Learning Initiatives Summer Presentation   *August 2020*
- **Harnessing Quantum Computing to Improve the SOTA in Solving Industrial-Scale Scheduling Problems**
  Kumail Alhamoud, Akshay Ajagekar, Fengqi You

Boston University 22nd Annual UROP Undergraduate Research Symposium   *October 2019*
- **DNA Sequence Alignment Framework for Sequence Pathogenicity Screening**
  Kumail Alhamoud, Samuel M.D. Oliveira, Douglas Densmore

Academic and Teaching Experience

Academic Reviewer for Top-Tier ML Publication Venues   *2022 – Present*
- Including CVPR, ECCV, NeurIPS, ICLR, MICCAI, ML4H, JAMIA, and TPAMI

Teaching Assistant   *2019 – 2022*
- CS 323 Deep Learning for Visual Computing, Prof. Bernard Ghanem, KAUST
- CS 4300 Language and Information, Prof. Cristian Danescu-Niculescu-Mizil, Cornell (Received the Best TA Award)
- CS 2800 Discrete Structures, Prof. Anke van Zuylen, Cornell
- ECE 3250 Mathematics of Signals and System Analysis, Prof. David Delchamps, Cornell
- MA 226 Differential Equations, Prof. Glen R. Hall, Boston University

Awards & Recognition

SACM Fellowship for PhD Studies (up to four years of Funding)   **2023-2027**

MIT Jameel Clinic PhD Fellowship for ML and Health ($100,000 **award for one year**)   **2023**

Saudi Leadership Society Fellowship   **2022**
- The most prestigious fellowship in Saudi Arabia; offers months of leadership training and connects fellows with CEOs and managers in the government and private sectors.

KAUST Fellowship for MSc Studies   **2021**
- A full-ride, merit-based scholarship for MSc studies

MISK Fellowship (among 70 awardees from Saudi Arabia)   **2021**
- A 6-month program for exceptional Saudi students who want to lead a positive change and work on leadership potential

Outstanding Teaching Assistant Award at Cornell University   **2021**
- Awarded by the Information Science Department; nominated by professor for taking lead of all in-class activities

2021 Rhodes Scholarship Finalist (only 8 finalists from my constituency)   **2021**

KAUST Gifted Student Program Scholar   **2016 − 2021**
- A 5-year full-ride, merit-based scholarship for undergraduate studies in the US

Top 10 Student in Saudi Arabia's National Exams   **2016**