David Fan

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I do foundational research in multimodal representation learning and video understanding that pushes state-of-the-art and generates product impact.

Education

Princeton University *2015 - 2019*

B.S.E in Computer Science *Magna Cum Laude (High Honors)*

Minor in Statistics and Machine Learning

Thesis Advisor: Prof. Jia Deng

Select Publications

Peer-Reviewed

1. **David Fan**, Jue Wang, Shuai Liao, Yi Zhu, Vimal Bhat, Hector Santos Villalobos, Xinyu Li. Motion-Guided Masking for Spatiotemporal Representation Learning. *ICCV*, 2023.
   Novel masking alg. for video masked autoencoder achieves state-of-the-art with 3x less pretraining.
2. **David Fan**, Deyu Yang, Xinyu Li, Vimal Bhat. Nearest-Neighbor Contrastive Learning from Unlabeled Videos. *ICLR Workshop on Mathematical and Empirical Understanding of Foundation Models*, 2023.
   Nearest-neighbor sampling for contrastive learning expands positive pairs beyond single videos.
3. Shixing Chen, Xiaohan Nie†, **David Fan**†, Dongqing Zhang, Vimal Bhat, Raffay Hamid. Shot Contrastive Self-Supervised Learning for Scene Boundary Detection. *CVPR*, 2021.
   Multimodal representation learning for movie segmentation achieves state-of-the-art with 4x less data.
4. Weifeng Chen, Shengyi Qian, **David Fan**, Noriyuki Kojima, Max Hamilton, Jia Deng. OASIS: A Large-Scale Dataset for Single Image 3D in the Wild. *CVPR*, 2020.
   The first large-scale dataset for single-image 3D reconstruction with dense open-world annotations.

Under Review

1. Video Token Merging for Long-Form Video Understanding.
   Long-video is expensive. Merging video tokens reduces memory by 84% and improves throughput 7x.
2. Iterative Attention for Hierarchical Video-Language Pretraining.
   Improves vision-language pretraining with hierarchical video-text pairs (long-short, short-long, etc.).

Professional Experience

Amazon Prime Video *Seattle, WA and New York, NY*

Applied Scientist *July 2020 - current*

- [Prod] Trained 1B param multimodal foundation model with large-scale vision-language-audio pretraining. Outperforms OpenAI CLIP by 25% on internal zero-shot classification and retrieval benchmarks.
- [Prod] Enabled automated video advertisement insertion (CEO-level goal) with novel video segmentation model.
- [Prod] Developed embeddings for visual search and recommendation which outperform baseline recsys by 5%.
- [Prod] Trained multimodal transformers for automated content moderation and compliance.
- [Prod] Built distributed PyTorch training codebase and managed compute infrastructure for larger org of 30+ ICs.
- [ICCV 2023 (1st auth)] Improves SOTA video masked autoencoders by 5% in action recognition. Amazon blog.
- [ICLR 2023 (1st auth)] Nearest-neighbor sampling improves positive pair diversity for video contrastive learning.
- [CVPR 2021] Self-supervised learning improves state-of-the-art movie segmentation by 13% while reducing annotation by 75% (saving $200K/yr) and speeding up training by 84%. Amazon blog.
- Mentored two research interns to full-time offer.

Amazon Web Services *Seattle, WA*

Software Engineer *Aug. 2019 - July 2020*

- Launched Elastic Inference-enabled PyTorch (blog post) for SageMaker, EC2, ECS.
- Implemented TorchScript graph validation, shipped updated AWS Deep Learning Conda environments and Docker containers, benchmarked performance, wrote blog post.
- Created proof-of-concept for building and integrating TensorRT-enabled TensorFlow into the inference engine. Reduced latency by up to 70% compared to FP32 native TensorFlow in benchmarks.

Princeton Vision and Learning Lab (Prof. Jia Deng) *Princeton, NJ*

Undergraduate Researcher *Sept. 2018 - July 2019*

- Created OASIS - the first dataset for single-image 3D vision in the wild with dense annotations of detailed 3D geometry at scale. Dataset improves performance in multiple single-image 3D tasks.
- Implemented novel annotation pipeline for crowdsourcing dense pixel-wise 3D ground truths from sparse annotations. Implemented annotation quality control and reward workflows.
- Trained state-of-the-art models for monocular surface normal estimation (hourglass network), planar semantic segmentation (DeepLab), fold and occlusion boundary detection (HED). Evaluated downstream generalization.
- [CVPR 2020 Paper]. Senior thesis won CS department Sigma Xi award.

Honors & Awards

Nominated to Princeton University Alumni Council Executive Committee	2024
President of Princeton Club of Western Washington	2021-2023
Kaggle Bronze Medal (Google Open Images – Object Detection)	2019
Sigma Xi Award for Outstanding Undergraduate Research, Princeton University	2019
Class of 1901 Medal Finalist, Princeton University	2019
Graduating senior who has done the most for Princeton University. Princeton Innovation Magazine 25 under 25	2016
Intel Science Talent Search Semifinalist	2015

Invited Talks

Motion-Guided Masking for Spatiotemporal Learning

- Amazon Foundation Model Symposium (December 2023)

From Bioinformatics to Machine Learning

- National Science Olympiad Tournament (May 2022)

Building Computer Vision Models with Limited Labeled Data

- Amazon Research (March 2021)

3D Surfaces in the Wild

- Princeton Research Day (May 2019)
- Princeton Computer Science Independent Work Poster Session (May 2019)

Visualizing geographic trends in insurance claims data

- Harvard Medical School DBMI Summer Symposium (July 2016)

Service

Peer-Reviewing

CVPR (2023, 2024), ECCV (2024), ICCV (2023)

STEM Education

- Asian-American Scholar Forum (2024)
- Washington State Science Olympiad Supervisor (2020-2021)
- NJ State Science Olympiad Supervisor (2018-2019)
- MIT Science Olympiad Supervisor (2016)

Leadership

Princeton Club of Western Washington *Seattle, WA*

President *Oct. 2021 - Oct. 2023*

- President of 2,000-person regional Princeton alumni association (8th largest). Organized social and networking events and helped coordinate alumni interviewing for prospective students.

HackPrinceton
Princeton, NJ

Director
Sept. 2016 - Apr. 2018

- Led 30 organizers and raised $130,000 in funding as head director of HackPrinceton Fall 2017 and Spring 2018, which hosted 1,100 students from around the world.
- Organized logistics and hacker experience for Fall 2016 and Spring 2017.
- Developed competition website: https://f17.hackprinceton.com

Princeton University Science Olympiad Tournament
Princeton, NJ

Co-founder
Sept. 2016 - Feb. 2019

- Founded one of the USA's premier high school science competitions. Hosts 800 high school students annually.
- Directed a team of 20 organizers and 100+ volunteers to organize 23 competition events.
- Created website and built organization brand from ground-up: https://scioly.princeton.edu

Princeton University Math Competition
Princeton, NJ

Logistics Director
Sept. 2016 - Nov. 2016

- Directed logistics for one of the nation's premier high school math competitions.