

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 algorithm 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.
Introduces nearest-neighbor sampling for contrastive learning to expand 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.

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] Developed “Motion-Guided Masking” which improves video representation learning by conditioning masked video pretraining with motion-guided masks. Leveraged motion-vectors to achieve efficient motion guidance directly from MP4 video. Up to 5% better performance on video action recognition benchmarks. **First-author paper** accepted to ICCV 2023. **Blog post** on Amazon Research website.
- [CVPR 2021] Developed self-supervised method for scene boundary detection that improves state-of-the-art by 13% while reducing data labeling requirements by 75% (saving 200K a year) and improving inference time by 84%. **Second-author paper** accepted to CVPR 2021. **Blog post** on Amazon Research website.
- 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-art models to benchmark dataset for monocular surface normal estimation (hourglass network), planar semantic segmentation (DeepLab), fold and occlusion boundary detection (HED). Evaluated cross-dataset generalization with OASIS pretraining.
- [Paper](#) accepted to CVPR 2020. Senior thesis won 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
<i>Graduating senior who has done the most for Princeton University.</i>	
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.