

Alexandre Kirchmeyer

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EDUCATION

Carnegie Mellon University – Pittsburgh, PA	QPA: 4.0/4.0	Sep. 2022 – Dec. 2023
M.S. in Machine Learning		
École Polytechnique – Palaiseau, France	GPA: 3.9/4.0	Sep. 2019 – Aug. 2022
M.S. in Mathematics and Computer Science (CS)		
Lycée Sainte Geneviève - Versailles, France	GPA: 3.98/4.0	Sep. 2017 – Aug. 2019
2-year undergraduate program in Math & CS leading to nationwide entrance exams to the Grandes Ecoles for scientific studies.		

EXPERIENCE

Research Intern - Cartesia.ai , San Francisco	Feb. 2024 - Present
<i>Training multimodal foundation models using state-space models (SSMs). Working with Prof. Albert Gu on modeling.</i>	
Visiting Student – advised by Prof. Jia Deng , Princeton University	Mar. 2022 – Oct. 2022
<i>Researched the use of a novel oriented 1D convolution operator, to improve the long-range scaling of CNNs at linear cost.</i>	
<ul style="list-style-type: none">Introduced a novel 1D convolution operator to improve the long-range scaling of CNNs at linear cost.Implemented CUDA kernels from scratch which are up to 1.5x faster than PyTorch 1D and 30x faster than 2D.Trained state-of-the-art fully 1D ConvNeXt model, demonstrating that our 1D approach can match 2D on image classification, semantic segmentation and object detection. 1st author publication at ICCV 2023. [paper][poster][code]	
Research Assistant – advised by Prof. Deepak Pathak , Carnegie Mellon University	Dec. 2022 – Jan. 2024
<i>Explored sim2real transfer by learning to catch dynamic objects with lab-designed hardware.</i>	
<ul style="list-style-type: none">Trained state-based RL catching policy in simulation with 80% success rate.Designed a 60-FPS low-latency infrastructure for catching objects in the real-world with a LEAP hand and xArm, and a 2-camera epipolar fusion system for precise estimation of object state.	
<i>Investigated the use of diffusion models for zero-shot 3D reconstruction from one image using a DreamFusion approach.</i>	
<ul style="list-style-type: none">Created a large synthetic dataset of multiview images with partial point clouds using StableDiffusion, MiDaS & inpainting.Tested ControlNet/InstructPix2Pix conditioning for small-scale fine-tuning of StableDiffusion on multiview images.	
Research and Development Intern – HarfangLab Cybersecurity Startup	Jun. 2021 – Sep. 2021
<i>Implemented HarfangLab's first intrusive antivirus method to detect malicious behavior using DLL injection & API hooking.</i>	
<ul style="list-style-type: none">Coded a C/C++ Windows driver & DLL from scratch and automated testing of 10+ malicious behaviors with virtual machines.	

PROJECTS

Carnegie Mellon University	Sep. 2022 – Dec. 2023
<i>Introduced concepts to improve model robustness on visual question answering – advised by Prof. Louis-Philippe Morency</i>	
<ul style="list-style-type: none">Proposed to use concepts (color, ...) to improve task performance using auxiliary learning and pseudo-labeling.Mined unsupervised multimodal concepts with prefix tuning & contrastive learning, and analyzed explainability with clusters.Introduced diffusion-based synthetic causal interventions as data augmentations on the Visual7W dataset. Measured the sim2real and causal gaps and showed that causal interventions improve robustness on the ViLT model.Selected as one of the two <i>Best Midterm Presentation</i> for the course out of 24 groups. [report][poster][code]	
<i>Studied the relationship between masking and cross-entropy loss in masked language models. – advised by Prof. Andrej Risteki</i>	
<ul style="list-style-type: none">Proved that higher masking leads to higher statistical efficiency for a pseudo-likelihood estimator. Submitted to ICML 2024.	
Ecole Polytechnique	Sep. 2020 – Mar. 2022
<i>Examined the use of hyper-networks and implicit fields for non-rigid 3D shape correspondence. – advised by Pr. Maks Ovsjanikov</i>	
<ul style="list-style-type: none">Re-implemented Microsoft DIF-Net on JAX and evaluated shape correspondence performance on KeypointNet dataset.Devised hybrid correspondence approach, halving error threshold to achieve 50% keypoint accuracy. [report][code]	
<i>Built an electrically powered rocket for vertical landing optimization.</i>	
<ul style="list-style-type: none">Designed the electronic layout and PCB, programmed the sensor/actuator logic and LQR control algorithm.Presented work at the <i>International Astronautical Congress (IAC) Student Conference</i>, October 2021.	

AWARDS

• Ranked 4 th out of 107 at the ACM ICPC SWERC 2020-2021 European Algorithmics Contest (reserve member)	Mar. 2021
• Ranked 3 rd out of 12 at the ICPC Ecole Polytechnique Championship 2020	Jun. 2020
• Ranked 8 th out of 62 at the French-Australian Regional Informatics Olympiad 2017	Mar. 2017
• USACO Platinum level	Dec. 2016

PUBLICATIONS

- [Convolutional Networks with Oriented 1D Kernels](#)
Alexandre Kirchmeyer, Jia Deng
Accepted at ICCV, 2023
- [Promises and Pitfalls of Generative Masked Language Modeling: Theoretical Framework and Practical Guidelines](#)
Yuchen Li, **Alexandre Kirchmeyer**, Aashay Mehta, Yilong Qin, Boris Dadachev, Kishore Papineni, Sanjiv Kumar, Andrej Risteski.
Under review at ICML 2024.
Accepted at ICLR 2024 Workshop on Reliable and Responsible Foundation Models.
- [Learning from Humans on Low-Cost Dexterous Robot Hands](#)
Kenneth Shaw, Ananye Agarwal, Shikhar Bahl, Mohan Kumar Srirama, **Alexandre Kirchmeyer**, Aditya Kannan, Aravind Sivakumar, Deepak Pathak.
Under review at RSS 2024
- [Design, development and testing of an electrically powered rocket for vertical landing optimization](#)
Arnaud Ballande, Ruben Di Battista, **Alexandre Kirchmeyer**.
Accepted at International Astronautical Congress 2021, Student Conference

SKILLS

Programing Languages: C, C++, Python, CUDA, JavaScript, OCaml, Lua, Java, OpenGL, OpenCL, Vulkan, SQL
Frameworks: PyTorch, JAX, Slurm, Git, WandB, transformers, diffusers, Isaacgym, Cutlass, ArchLinux, ROS, ReactJS, Dash, Streamlit

RELEVANT COURSEWORK

Machine Learning (PhD)	Competitive Programming	Computer Vision (PhD)	3D Computer Vision
Deep Learning	Convex Optimization (PhD)	Natural Language Processing	General Algebra & Galois Theory
Reinforcement Learning (PhD)	Probabilistic Graphical Models (PhD)	Multimodal ML (PhD)	Advanced Quantum Physics