

# Alexandre Kirchmeyer

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## EDUCATION

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

## EXPERIENCE

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

## PROJECTS

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

## AWARDS

• <a href="#">Ranked</a> 4 <sup>th</sup> out of 107 at the ACM ICPC SWERC 2020-2021 European Algorithmics Contest (reserve member)	Mar. 2021
• <a href="#">Ranked</a> 3 <sup>rd</sup> out of 12 at the ICPC Ecole Polytechnique Championship 2020	Jun. 2020
• <a href="#">Ranked</a> 8 <sup>th</sup> out of 62 at the French-Australian Regional Informatics Olympiad 2017	Mar. 2017
• <a href="#">USACO Platinum</a> 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