

# Resumé

David Zhao Akeley

UCLA Engineering undergraduate

**Majors** Computer Science, Mathematics    **GPA** 3.745    **Expected Graduation** August 2020

**Select Engineering Courses** Parallel & Distributed Computing, Advanced Computer Architecture

**Select Mathematics Courses** Complex Analysis Honors, Algebra Honors

## Work Experience

### × Sholari LLC – July - September 2019 – Contractor

1. Worked on a Unity 3D game that simulates tumor growth and provides visualizations of tumor response to various treatment options.
2. Implemented line graphs, waterfall (bar) plots, and the user interface for the timeline (graph x-axis).
3. Wrote a multithreaded C++11 plugin for visualizing tumors & immune system responses as particle clouds, and integrated it with the single-threaded C# Unity Engine.

### × Stanford Aetherling Project – June - September 2018 – Research Assistant

1. Aetherling supports automatic parallelization and static scheduling<sup>1</sup> of hardware image processing pipelines designed using a Haskell-embedded domain-specific language.
2. Contributed to the functional simulator of an early prototype of Aetherling and worked to remove impediments to parallelizing the prototype's line buffers.<sup>2</sup>
3. Collaborated with David Durst (lead author), Dr. Kayvon Fatahalian, and Dr. Pat Hanrahan.

<https://aetherling.org>

<https://github.com/David-Durst/aetherling>

<https://github.com/David-Durst/aetherlingHaskellIR> (early prototype)

### × MediocrePy – March - June 2017 – Independent Project

1. Created an optimized library for reducing stacks of telescope images to a single image using pixel means or medians and optional outlier rejection (sigma clipping) for noise reduction.
2. Multithreaded C core with AVX vectorization; C and Python (numpy) interface. Decreased runtime (compared to the Python implementation replaced) from hours to milliseconds.
3. Collaborated with Dr. Zheng Cai, UC Santa Cruz Astrophysics.

<https://github.com/akeley98/MediocrePy>

### × Tsinghua Astrophysics – July - August 2016 – Summer Intern

1. Designed a library for fitting and plotting standard microlensing event light curves given a set of brightness data for a star.
2. Used Python, C++, SciPy, Matplotlib.
3. Collaborated with Dr. Shude Mao.

### × Jide Technology Co. – June - July 2015 – Summer Intern

1. Product testing for RemixOS, an Android derivative with a desktop-like interface.
2. Wrote international marketing & documentation in English.
3. Collaborated with Jason Zheng and Jeff Zhao (International Marketing Manager).

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<sup>1</sup>i.e. not using ready-valid hardware interfaces.

<sup>2</sup>A line buffer device reads in an image as a stream of pixel values and outputs rectangular portions (“windows”) of the image.

## Other Projects

### × WebGL Jelly Cube Project

Simple mass-spring system simulation written with Javascript, WebAssembly, and WebGL 2.0 (for refractive and reflective effects). Earned third place in the UCLA computer graphics class contest, Fall 2017.<sup>3</sup>

<https://github.com/akeley98/JellyMcJelloFace>

<https://youtu.be/YwvMSeB6NzU>

### × DementedIGPU – Linux Nvidia Setup Script

(Unfortunately, this project no longer works due to Bumblebee’s end-of-support).

Laptops with Nvidia graphics cards often work unreliably with the GNU/Linux operating system, especially when attempting to switch between high-performance discrete graphics and low-power integrated graphics. I wrote a Python 3 script that automatically installs and configures software needed to provide a (relatively) reliable option at boot time between high- and low-power graphics.<sup>4</sup> I documented the script liberally in order to make it as beginner-friendly as a command line application can be.

<https://github.com/akeley98/DementedIGPU>

### × Myricube – Experimental OpenGL Voxel Renderer (WIP)

This experiment in hybrid raycast/mesh voxel rendering was inspired by my discontent with Minecraft’s low render distance, even on high settings.

Conventional voxel renderers such as Minecraft’s work by converting voxel models into a mesh of triangles to draw, possibly with some optimizations like hidden face removal or merging coplanar triangles. This uses the GPU for its designed purpose, but as render distance increases, the GPU is bottlenecked by the large number of small triangles generated. Myricube uses conventional mesh rendering for nearby voxels but draws more distant voxels with an alternative raycasting renderer. This renderer subdivides the voxel model into cubic chunks, computes a minimal AABB<sup>5</sup> for each chunk’s visible voxels, and draws the AABBs themselves with a raycasting fragment shader that only checks for intersections within the drawn AABB. Dividing the model into AABBs reduces my renderer’s memory bandwidth requirements and time wasted raycasting through empty space, compared to a conventional raycasting renderer.

<https://github.com/akeley98/myricube>

### × Proposed gem5 Hardware Simulator Partial Bypassing Patch

This patch is a refactoring of the C++ code I wrote as part of my UCLA “Advanced Computer Architecture” course project.

In an out-of-order CPU, hardware bypassing allows instructions stalled waiting for a register to start execution as soon as the functional unit (ALU, memory port, etc.) writing to said register completes, without waiting for the actual commitment to register file. This is crucial for performance, so mainline **gem5** simulates complete bypassing between all functional units in the simulated CPU. However, this is not practical to realize in modern superscalar hardware, as bypassing costs grow quadratically with the number of functional units. My patch splits the CPU’s functional units into separate pools, with bypassing simulated only between pools. The commit-to-register-file delay is imposed for values communicated between pools.

Although the patch received positive code reviews, it doesn’t look like there’s enough interest in the feature to actually merge it into mainline **gem5**.

<https://gem5-review.googlesource.com/c/public/gem5/+27767>

<https://github.com/akeley98/FU-pools/blob/b4d291429edb6aa4988888656b6867ff99591b90/fu-pools.pdf>

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<sup>3</sup> <https://www.facebook.com/vasilescu.alex/posts/10155206917936588>

<sup>4</sup> This automation depends on the user using a system with **apt**, **systemd**, and the **GRUB** bootloader. Tested with Ubuntu 18.04.

<sup>5</sup> Axis aligned bounding box – requires only 12 triangles to draw.

## UCLA Education – September 2017 - August 2020 (Expected)

First Major	Computer Science	Second Major	Mathematics	GPA	3.745 (April 2020)
	Title ( <i>In Progress</i> )		Content Notes		
EE M16	Digital Systems		Verilog Lab		
EE M116C	Computer Systems Architecture				
CS M152A	Digital Design Lab		Verilog Team Project		
CS 251A	Advanced Computer Architecture		gem5 Hardware Sim Project, Graduate Course		
CS 35L	Software Construction Lab		POSIX basics (e.g. pthreads, bash)		
CS 111	Operating Systems Principles		Focus on POSIX		
CS 118	Computer Network Fundamentals				
CS 130	Software Engineering		Java Team Project		
CS 131	Programming Languages				
CS 133	Parallel & Distributed Computing		OpenMP, OpenCL, MPI, GPGPU, FPGA		
CS M146	Machine Learning				
CS 161	Fundamentals of Artificial Intelligence				
CS 174A	Intro to Computer Graphics		See WebGL Jelly Cube Project		
CS 180	Algorithms & Complexity				
CS 181	Formal Languages & Automata		Regex, CFG, Turing Machines, Decidability		
Engr 185EW	Art of Engineering Endeavors		Writing Intensive Team Project		
Math 110A	Algebra		Ring Theory		
Math 110AH	Algebra Honors		Group Theory		
Math 110BH	Algebra Honors		Ring Theory, Module Theory		
Math 110C	Algebra		Field Theory, Galois Theory		
Math 111	Theory of Numbers		Overview of p-adic Numbers		
Math 115A	Linear Algebra				
Math 115B	Linear Algebra				
Math 120A	Differential Geometry				
Math 131AH	Analysis Honors		Metric Spaces		
Math 131BH	Analysis Honors		Derivation, Riemann Integration		
Math 132H	Complex Analysis Honors				
Math 134	Systems of Differential Equations				
Math 142	Mathematical Modeling				
Math 167	Game Theory				
Math 170A	Probability Theory				

*Note: There is no honors equivalent to the Field Theory Course.*

## West Valley College Education – 2015-2017

**GPA** 4.0 (upon transferring to UCLA)

### Select Courses

	Title	Content Notes
Math 4B	Differential Equations	
Math 19	Discrete Mathematics	
Psych 2	Experimental Psychophysiology	Experiment Design & Paper
Phys 4D	Modern Physics	Relativity