Jad Assaf

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EDUCATION

Youngstown State University 2025 – Present
B.S. in Physics (Minor in Mathematics)
- **Research Engagement**: Collaborated with faculty on binary analysis architectures and compiler data-routing flows.

TECHNICAL SKILLS

- **Languages**: C++23, C, Haskell, Lean 4, Assembly (x86/x64), GLSL, Python, Bash
- **Systems & Graphics**: OpenGL 4.3 Compute Shaders, SPH Dynamics, Memory Management, POSIX API, Concurrency
- **Tooling & Theory**: LLVM/Clang Toolchains, CMake, GDB, Git, Formal Code Verification, Interactive Theorem Proving

TECHNICAL PROJECTS

AQUADESIC 2026
GPU-Accelerated Real-Time Computational Fluid Dynamics Solver (C++23 / OpenGL)
- Engineered a fully GPU-resident Weakly Compressible SPH (WCSPH) solver handling 12,000+ particles at 60+ FPS.
- Implemented an $O(N)$ spatial hashing neighbor search using parallel bitonic sorting across Shader Storage Buffer Objects (SSBOs).
- Developed a screen-space fluid rendering pipeline with bilateral depth smoothing, normal reconstruction, and Fresnel shading.

Phi 2026
Formally Verified Compiler Framework (Lean 4)
- Developed a LISP-style compiler framework and formal verification suite using the Lean 4 interactive theorem prover.
- Mechanized proofs for operational semantics, type safety, and AST transformations to guarantee bug-free compilation paths.

Kerrdesic 2026
General Relativity Orbital Raytracer & Geodesic Integrator (C++)
- Constructed a numerical integrator to calculate photon geodesics in Kerr spacetime around rotating black holes.
- Solved non-linear differential equations of motion to visualize gravitational lensing and accretion disk shadows.

Haskompile 2026
Ahead-of-Time Optimizing LLVM Compiler Frontend (Haskell)
- Built an AOT compiler frontend featuring a custom Megaparsec token extractor and type-aware AST representation.
- Architected a multi-pass semantic analysis layer using Monad transformers to emit optimized LLVM intermediate representation.

ACTIVITIES & INTERESTS

- **Chess**: 2100+ Elo
- **Core Interests**: Low-Level Systems Programming, Computational Physics, & Programming Language Theory