

The Single Open Intermediate Language Initiative

<http://soil-initiative.org/>

The information age has seen an explosion in both data and computation, but the two sides to the current technological revolution have not advanced hand in hand. We have infrastructure that enables an application to share a single data store across all its instances, yet we have no such infrastructure that would enable that application to share a single code base across all its instances. Instead an application needs a code base for the desktop, a code base for each mobile platform, and a code base for the web at the least, if not also a code base for the server, for the cloud, or for the device.

One major societal challenge to developing such an infrastructure is standardization and adoption. Thankfully, WebAssembly is a new standard that is already supported by all major browsers, and it is being developed by a vibrant community looking to grow beyond the web—after all, a browser already exists for every general-purpose machine, so the means for directly executing WebAssembly is already available. This young aspiring standard makes *now* the time to make computation as accessible and distributable as data.

Yet many research challenges currently obstruct these aspirations. For one, computation can be harmful, so one should independently audit programs before blindly executing them. At present such auditing is limited in its capabilities, and as such WebAssembly programs must be executed in a sandbox, making them second-class citizens blocked from properly interoperating with the rest of the infrastructure they are a part of. For another, computation is written by people in many languages—not just Java, not just C#, and not just C/C++—and an infrastructure needs to be open to many languages both to serve principles of freedom and to evolve with the inevitable changes in trends.

We created the Single Open Intermediate Language Initiative to coordinate and support research towards developing a single infrastructure that can support all major languages on all major platforms. Our goal is to make computation as easy to generate, share, and consume as data, and to reimagine our existing technologies and invent new technologies given such a revolutionary infrastructure.

Scope. The initiative will require a multi-year effort involving a collaborative team of academic researchers working alongside industry developers, with WebAssembly being the primary vehicle of transfer from research into practice. The initiative will be considering problems on three different timelines: understanding WebAssembly as it is now and exploring the impacts even a sandboxed form of conveyable efficient computation can have; extending WebAssembly to support all major languages on all major platforms fairly; and enriching WebAssembly with specialized technologies so that it can serve purposes beyond simply general-purpose computation.

Expertise. The initiative must develop new language and implementation technology while simultaneously investigating the impact such technology could have on other areas so that its solutions are designed to address not only the needs of today but also the needs of tomorrow. As such, the research expertise of the initiative spans many areas, such as virtual machines, garbage collection, low-level type systems, high-level programming languages, compiler optimization, browser technologies, side-channel attacks, information flow, operating systems, distributed systems, mechanical formalization, and more as we continue to expand to cover new avenues of impact for this technology. Furthermore, members of the initiative have significant experience collaborating with industry development teams to develop and deploy solutions that successfully balance and align the demands and principles of both academia and industry.

Activities. To facilitate close collaborations amongst initiative researchers and with industry developers, the initiative will organize and maintain an online community comprised of both initiative researchers and many invited industry practitioners. This community will be used to determine which challenges to tackle when, identify important practical and theoretical constraints on those challenges, and debate amongst strategies and solutions for those challenges, all while regularly discussing decision points and intermediate results—in many ways this online community can be seen as the research complement to the WebAssembly Community Group. The initiative will host monthly online presentations on current major milestones. The initiative will also organize an annual retreat for the whole community that will highlight recent research successes, discuss critical current issues, and identify key directions for the upcoming year. As solutions solidify, the initiative will then work to incorporate the design into the relevant standards, working with the relevant communities whose representatives in the initiative will have regularly kept informed of the upcoming suggestions.

Partners. The initiative has a formal corporate partners program with a membership fee to help fund our activities. The primary benefits of partner membership include invitations to the online community, monthly online presentations, yearly retreat, and other events as appropriate. These benefits will keep partners informed of upcoming standards proposals, help researchers understand which problems are more pressing, and provide partners opportunities to inform researchers of important constraints to take into consideration. Partners will have access to published research papers, although the expectation is that all research papers will be published under open access, as in alignment with the mission of the initiative.

Personnel. The initiative is comprised of an international team of world-class researchers coordinating their efforts with each other and with industry to develop a single open intermediate language for all languages on all platforms.

- Amal Ahmed — *Northeastern University*
- Steve Blackburn — *Australian National University*
- Stephen Chong — *Harvard University*
- Arjun Guha — *University of Massachusetts, Amherst*
- Adrian Sampson — *Cornell University*
- Deian Stefan — *University of California, San Diego*
- Ross Tate — *Cornell University*
- Zachary Tatlock — *University of Washington*