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Velocity 9: Fast and Usable Serverless Computing

Serverless computing platforms are a type of cloud platform designed for the easy deployment of software. Over the past decade, software developers have realized that large monolithic applications are hard to maintain and scale over time. Instead, companies have learned to prefer “microservices,” which can be scaled and updated independently from one another. The natural extension of this progression is a system where every API endpoint is its own service. However, this leads to an explosion in the number of servers and services that must be managed. This is where serverless can step in. By separating writing code from deploying it to a specific physical server, or set of servers, serverless enables highly scalable applications without requiring users to babysit massive fleets of computers. However, many developers are resistant to using serverless platforms (like AWS Lambda or Google Cloud Functions). Why is that?

Well, there are a number of reasons. For one, many of these platforms are difficult to use, especially if you want continuous integration (your code to be immediately deployed as soon as it is fully tested). Developers are not used to this new paradigm of software development. When existing services add layers of complexity on top of that unfamiliarity, then users are turned away. Additionally, existing serverless solutions suffer from the “cold-start” problem. In order for serverless providers to maintain their low-cost platforms, they need to shutdown serverless components that are not in use. But then, when a call comes in for that component, the service has to quickly reactivate it. Even state of the art serverless platforms, like AWS Lambda and Google Cloud Functions, have cold start times on the order of half a second or slower. This is simply not workable for many use cases. Consider a shopping website backed by serverless code. It is unacceptable for the website to hang occasionally for a few seconds when a user tries to interact with it.

Velocity 9 is our serverless platform that attempts to solve these problems. Simply implementing a usable open-source serverless framework would already be an achievement. Open source and modifiable is a killer feature for many developers. And there are numerous industries that want or need to self host their infrastructure. For example, military and healthcare systems almost inevitably need to be kept on-premises. (This requirement is codified in law -- it is not a technological question.) And even everyday users may want the option to self-host since existing solutions force you to stick with a specific provider even if they raise their prices. While open-source and self-hostable options do already exist, they are extremely complex to set up and maintain. You do not get the benefits of serverless if you still have a bunch of hard-to-manage servers. Our vision is to create a serverless platform that is easy to use. But our goals go beyond that. We also aim to provide a better quality of service than AWS or Google Cloud. By using software fault isolation technologies from GWU’s Systems lab, we believe we can reduce cold start times by an order of magnitude. And by integrating with Github continuous integration, we can make it incredibly easy to deploy code. These factors combine into a “speed equation,” improving developer velocity and user reactivity.

While we face a number of challenges surrounding our innovative core isolation technology, we have the skills to address them. We are seeking funding to make the serverless dream possible for everyone.

Velocity 9: Serverless Computing for the Masses

Velocity 9 is a new upcoming solution in the realm of serverless computing. It aims to address speed and complexity issues present with current solutions from companies such as Amazon and Google. Serverless computing allows developers to not worry about the “how” in deploying their code, as the serverless computing provider handles all of the infrastructure required to make the code accessible to the web. In turn, developers can spend all of their time developing their code, and do not need to spend any time maintaining infrastructure like web servers. To be clear, “serverless” computing still means that there are servers in use, just none that a developer needs to access or maintain. While this new paradigm brings advantages for the developer, there are still problems with existing solutions that have prevented serverless from becoming a serious alternative to traditional computing. One of these issues is the complete reliance on proprietary technology. For example, in order to use Amazon’s serverless option, AWS Lambda, all code must either be uploaded directly to Lambda or hosted in a different Amazon service. Amazon does not offer any interoperability with services from other companies. While Amazon has a reputation for being secure with their data, developers who utilize Lambda must place all of their trust in the company. Companies offer these walled-garden ecosystems that lock you into using only their products under the guise of convenience, but this requirement is not actually so convenient- Amazon, in particular, requires a large amount of complex configuration to fully deploy a serverless app, making it difficult for more casual developers to develop one. Serverless computing could be the future of web technology, but only if it becomes more accessible to developers.

Velocity 9 recognizes the complexities with available commercial serverless options and aims to create a platform that anyone can use and develop on, without needing to waste time with complicated configuration. We will integrate our platform with existing tools like Github so that developers do not need to change their workflow or become reliant on a particular ecosystem, such as Amazon’s AWS services. In doing so, we hope to lower the barrier for entry for developing web applications, so that newer developers can more easily create and test web apps without becoming an expert in AWS. Furthermore, this project is open source and self-hostable, meaning that anyone who wants to host their own serverless infrastructure could do so. This would enable a company who cares about protecting their data and does not feel comfortable uploading it to services from Amazon or Google to still promote serverless technology its developers. This would also allow a university to host its own serverless platform for students to develop on, as a way to promote learning how to build web applications without needing to learn all of the tools required for traditional computing.

While our project would simplify the process of deploying with serverless infrastructure, there are a number of technical challenges that we have to solve for the project to succeed. Arguably one of the most important is developing a system that requires as little additional work from developers as possible to work with our infrastructure. As previously stated, AWS has complexity issues that we are trying to solve, and for our system to be able to compete with an offering like that we need to offer a compelling developer experience. At the same time, we cannot sacrifice ease-of-use for speed. If we want companies to use our project, then it needs to offer comparable speeds to Google Cloud or AWS Lambda at minimum, and ideally be faster. If we solve these problems, then Velocity 9 will alter the nature of web application development by offering an accessible platform to encourage the use of serverless computing and provide a safe way for large scale companies to integrate serverless computing into their infrastructure. Therefore, we are reaching out to you to request funding for our project, so that we can see this new solution come to fruition. We believe serverless is the future, and we hope you can be a part of it.

Velocity 9: The future of fast

The goal of this project is to make serverless development fast, easy to use, and secure. The term 'serverless' does not mean 'no' servers, 'serverless' is a way for a person to develop an application without having to purchase or rent servers. This takes the hassle of managing and maintaining hardware out of application development. Serverless allows the developer to focus on making their application the best it can be. Over the past five years companies large and small have begun to adopt a microservices approach to application design. 'Microservices' means that each part of the application is developed and exists independent from the other parts. This separation of large complex application into smaller 'micro' services allows for isolated development and more fine-tuned scaling. In the past if one part of an application was causing a bottleneck, the application would have to be redesigned or more servers would need to be provisioned. Now, using a microservices architecture companies can scale specific parts of their applications as needed with little overhead. Velocity 9 will provide an easy to use, open source solution for companies that is faster than existing options.

While many companies consider transitioning to microservices, this new way of architecting applications introduces complexity into the way applications are hosted. A single application can be hosted on one server, but now that this large application has been broken up into many smaller microservices, one server isn't good enough. This is where serverless can help. A company that is unable to devote the resources to manage a set of microservices can have them hosted on a serverless product. Right now, the largest provider of serverless is Amazon in their AWS product Amazon Lambda. Unfortunately Amazon Lambda is built primarily to support other Amazon services. Lambda requires integration with other complicated Amazon services that make it difficult to use, unless the developer is willing to host their entire application on AWS. For many companies this just is not an option. Amazon provides a serverless option but it comes with many very expensive strings attached. For monetary and security reasons Amazon Lambda might not be the right serverless provider for many companies. While other serverless offerings exist and are self hostable, they are extremely cumbersome to use and require a lot of overhead to set up.

Our goal is to address many of the issues inherent in Amazon Lambda and other serverless projects by providing an option that is open source, self hostable, and easy to use. Velocity 9 will be open source, this will allow for anyone to use it and contribute to it. By nature of being open source, every part of our system is publicly verifiable and can be easily accessed by any customer who wishes to understand it at a fine-grained level. Our system will also be self hostable. A company that needs to ensure the safety of its data can continue to do so as well as take advantage of serverless computing using Velocity 9. Velocity 9 will also support continuous integration with Git and Github. This means that every time a developer makes a change to their code that change will be automatically propagated throughout the architecture. Along with this continuous integration the configuration process will be extremely simple. All a developer will have to do is visit our website, select some simple options and their Github repo -a place where code is stored- will be setup with a configuration file as well as some boiler plate serverless code. Velocity 9 will also leverage new technologies like web assembly to achieve speeds faster than Amazon Lambda. We expect to achieve this speed advantage through specific design choices that are different than Amazon Lambda. In the Amazon Lambda architecture a significant amount of time is spent copying code from another Amazon service called S3. By foregoing this copying and compiling of the functions, Velocity 9 will gain a speed advantage compared to Amazon Lambda. Implementing this speed improvement over lambda will be technically challenging but with the help of start up funding our team will be capable of providing easy to use, open-source, fast serverless to the masses.

Similar Projects

While Velocity 9 aims to improve the serverless computing experience, serverless computing as a concept is in no way a new idea. As such, there are a number of other projects that all offer “serverless computing”. One of the most prominent offerings is Amazon’s AWS Lambda, a cloud platform that allows developers to upload their serverless code where it will run on Amazon’s massive AWS infrastructure. The primary selling-point for Lambda is its tight integration with other AWS services. Utilizing AWS storage and networking services in conjunction with Lambda is heavily encouraged, and it gives application developers flexibility with how they deploy and configure their application. This flexibility comes with a cost, however, which is that **of** using all of Amazon’s services results in a great deal of complexity for developers. Unless a developer is trying to deploy a production-grade, large-scale application, most of the features AWS provides are unnecessary, meaning that deploying more simple applications will still require a lot of configuration from the developer. Velocity 9 differs **from** _____ because it still offers a robust serverless computing experience, but without the additional configuration steps from a service like AWS Lambda. Of course, this tradeoff means that our service is not as flexible as Lambda, but it also means that Velocity 9 has wider appeal. Any developer can easily deploy their code with our project, instead of just the people willing to learn how to configure AWS Lambda and its associated services.

A second similar project is Apache OpenWhisk, a self-hostable serverless infrastructure. If data privacy is a concern that prohibits use of a service like AWS Lambda, then a company can deploy Apache OpenWhisk to allow its developers to still write code using the serverless computing paradigm. This solves the problem of data privacy, but at the expense of having an easy development environment. OpenWhisk makes it difficult for developers to automatically update code that **they’ve** written and deployed, resulting in additional work that they have to perform. Additionally, the actual process for setting up OpenWhisk is complex, making it difficult for companies to switch to. Velocity 9 solves both of these problems. By providing integration with tools already being used by developers, the code updating process is a seamless experience because developers **don’t** actually need to do anything different. Furthermore, the actual infrastructure installation process has been architected in such a way that it makes it easy to configure, solving the complexity problem present with OpenWhisk.

Google Cloud Functions is a third similar project, and has similarities to AWS Lambda due to it being hosted by a cloud provider. One of the major drawbacks to Google Cloud, however, is the severe performance drawback from the slow cold-start times. The cold-start time, as explained earlier, refers to how long the function takes to execute after being inactive for a long period of time. The longer the cold-start time, the worse experience a user could potentially have. Google Cloud has an average of around three seconds for its cold-start time, which is significantly longer than AWS Lambda. Our project aims to beat the performance of Google Cloud, therefore making a better experience for the end-user. A user does not want to have to wait up to three seconds for a website login to process, which is why speed is paramount to our project.

Target Audience

Velocity 9 is intended to be used by any developer or company that would like to write and deploy serverless applications but does not want the headache or cost of using existing serverless solutions. For example, consider a startup that would like to implement an application that has been designed with a microservices architecture. This startup can pay large sums of money to Amazon and have AWS host its application. This option requires the startup to learn how to use AWS products and develop its application to run on AWS servers. This option has little value for the startup in that it is expensive and limited. Choosing AWS is a commitment for the startup that requires a large amount of funding, this commitment also requires the startup to conform the application to run in the AWS environment. If Amazon prices are too large the other option for serverless is open-source. The current options include Apache and Google projects that are all difficult to setup and manage. If the startup cannot afford Amazon it will have to dedicate large amounts of time to learn and deploy open source alternatives. In either case the onus is on the startup to provide time and/or money to get started. Velocity 9 provides a streamlined path so the startup can begin writing its application as soon as possible. With Velocity 9 all the developer has to do is select a basic serverless application design and link it to their repository. A repository is where developers store their application code. Velocity 9 provides continuous integration with Github repositories, so every time code is saved to the repository the serverless app will be updated without any inconvenience for the developer.

Another important use case for Velocity 9 is found with companies that are already hosting their own large scale application. A company that already has the resources to host a large scale application may want to transition the application to begin utilizing serverless technology or transition the application from monolithic to microservices. This transition from monolithic to microservices means that the application will be split into smaller components that can all be developed and scaled in isolation. Hosting all of these small components can be an inconvenience for the company because the companies servers are configured to host one large application as opposed to many small ones. Velocity 9 is self-hostable, so the company can deploy it on its own servers. Instead of paying Amazon to host this new microservices application, Velocity 9 can be used to repurpose old servers and host each microservice in isolation. With Velocity 9 this company does not have to replace old servers or pay Amazon. This company can also update or modify Velocity 9 code to fit any development or hardware specific needs.

Self-hosting is desirable for companies who already own servers, but it is also extremely attractive for any company with data security considerations. Government contractors or insurance companies storing medical records all need to ensure data security. This requirement should not prevent these companies from leveraging new technologies to become more efficient and scalable. While serverless may seem appealing to a government contractor a large portion of the data they receive must remain on secure servers. Amazon Web Services makes no such guarantees about server security or where specific pieces of data are stored. In order to save server space and achieve low prices AWS hosts multiple instances of client data in the same data center and sometimes on the same server. This opens up the data to potential security vulnerability if the data is sharing a server with a malicious piece of code. Velocity 9 can be used by any company that has security constraints because it can be self-hosted. Companies that want to keep track of their data can be in full control while also gaining the advantages of microservices design and serverless implementation.

Universities and schools looking to educate their students about serverless are forced to pay Amazon and teach the proprietary design of AWS. Serverless is not a proprietary concept and should not be limited to Amazon Lambda. Velocity 9 will provide educators with the ability to teach serverless concepts and ask their students to implement them without any cost to the school. Velocity 9 will allow students to write serverless applications from scratch by providing pre-designed applications that have a

set of functions ready to be implemented. **What is your business model? How do you intend to make profits? How will you create awareness among your target audience?**

Social Good

We see Velocity 9 as an opportunity for the democratization of technology. Imagine a world where a student can write a simple python function, and instantly deploy it so anyone in the world can use it. That is our dream. And our system is so simple to use, that it will be a reality. To this end, we hope to be able to provide credit to students and teachers that would let them innovate for free on our platform. We also want to provide templates and learning tools on our website, so the barrier to entry is minimal. Basically a student could copy and paste some code, write a couple loops, and then have their own unique function up and running. While a lot of students find tangible website and frontend more satisfying, we think if we make the backend as easy, then people will discover a passion for that as well.

While the focus will initially be on scalable serverless, we want people to think of Velocity 9 as a library of internet accessible functions for everyone. By creating a widget on our website that has easy access to all public functions, we can create a master website for web functionality. This will be our users home on the web for their programming dreams.

By creating an easy to use platform that scales massively, we can address the needs of enterprise users without compromising the experience of new programmers. **Does your project need regulation? Can it be put to bad use?**