Mizzou Engineering team building cloud computing ‘blueprints’

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Think of a cloud computing provider as a land developer. In many neighborhoods, the blueprints are fairly similar, save for some minor tweaks and remodels. Many of the houses will be built similarly with a common set of functionalities and cost roughly the same.

Many companies and researchers need cloud computing resources with various levels of computing power and security capabilities. But in several situations, the needs of similar companies or researchers mirror each other. So instead of taking the time and energy to build from scratch, how can cloud providers help their users build from “blueprints?”

Mizzou Engineers have taken a new innovative and massive step toward that goal.

MU Electrical Engineering and Computer Science Assistant Teaching Professor and Ph.D. student Ronny Bazan Antequera, Associate Professor Prasad Calyam, graduate student Arjun Ankathatti Chandrashekara and postdoctoral fellow Reshmi Mitra recently published “Recommending heterogeneous resources for science gateway applications based on custom templates composition,” in the Elsevier Future Generation Computer Systems, a top-tier journal.

Their work focused on investigating a method to prescribe blueprints, or templates, to marry the needs of cloud computing consumers with the capabilities of providers. Their test case in cloud user/provider studies involved a common scenario in small manufacturing companies such as TotalSim seeking resources to digitally model and design...
parts for clients in the automotive industry such as Honda.

“What we’re trying to do is link two different worlds together,” Calyam explained. “One world is making access and management of computation and storage easier for computing nonexperts in bioinformatics, health science, neuroscience, manufacturing, etc.

“From the cloud provider prospective, how can they understand how to intelligently prescribe template solutions that address what users really need in terms of software, hardware and other requirements; and how can they build reusable or repurposeable expert knowledge — in this case, templates — that are successful when applied. It takes weeks or months for a cloud user to set up a well-architected and successful system, and they don’t want to do it again. Also, it is overwhelming for a cloud user to really understand what capabilities of a cloud provider are ideally suited for their needs, while also being high-performance, secure and cost-effective.

“So if we can find a method where what has been well-architected and successfully done is stored as a technical element that can be stored in the cloud for reuse or repurpose, it saves a lot of money, time and energy for repeat users or even new users.”

This project uniquely utilized machine learning and artificial intelligence techniques related to building ‘expert systems’ to note the needs and requirements of cloud users and match them with expert knowledge on the right infrastructure and system requirements previously stored by the cloud provider. The template system takes into account both computing benchmarks — how fast it achieves results, how much energy it uses, etc. — and functionality — storage space, for instance.

“Users are essentially presented with three choices of blueprints that let the user either go for a cheapest solution (red option), or an expensive solution that is high-performance/secure and fully managed by the cloud provider (green option), or a solution that has a balance (gold option),” Calyam said of the process where a user requests cloud resources and is given an opportunity to decide which template they want to use based on the auto-generated provider prescriptions. “What we’re trying to do is change the cloud computing field in terms of how we think about architectures, looking at them more like how civil engineers do when constructing tall and robust buildings that fit within a budget. We’re automating the architect’s role here.”

Having shown how successful cloud template automation can be for the manufacturing industry, Calyam and his team are already exploring the potential that exists for this template system to be utilized for scientific research that is data-intensive or computation-intensive, particularly in fields of neuroscience, health science and bioinformatics. Their research also has attracted attention from industry partners such as Aquila Clouds (https://aquilaclouds.com), who are developing technologies to help users to manage their cloud services in an intelligent and cost-effective manner.

“There is clearly a growing importance of machine learning as well as artificial intelligence research and technology development efforts in enabling collaborations between cloud users and providers around the idea of using prescriptive template systems”, Calyam said.

The future of cloud computing is limitless for academia and industry, and its construction just became much simpler thanks to a team of Mizzou Engineers.