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Topics

1. Data Portability, Consistency, and Management
2. Programming Models for the Cloud

Current Research

Our current research activities are focused on developing a methodology for cloud application development and management at an abstract level by incorporating semantic enrichments at each phase of the applications lifecycle. This objective is intended to be achieved by using semantically enhanced, domain specific languages (DSL) for developing and configuring applications and introducing a middleware layer as a facade for core cloud services. Two major research activities in the Services Research Lab in the Kno.e.sis center are pertinent to this objective.

1. Mobicloud : A DSL and the associated machinery to generate Cloud mobile hybrid applications, i.e. applications that span over a Cloud based back-end and a mobile device front-end. Mobicloud has been made available publicly and has been published at 2nd IEEE International Conference on Cloud Computing Technology and Science (Cloudcom) 2010¹.
2. DSL for Nuclear Magnetic Resonance (NMR) data processing: A collaborative effort with bioinformatics scientists in the Air Force Research Lab (AFRL), the focus of this research is to identify a set of fundamental operators for NMR data and enable the use of Clouds to process this data via a DSL. A compute intensive scientific workflow is supported by executing different tasks on a cloud.

¹ <http://knoesis.org/library/resource.php?id=936>

Vision: Cloud_S: semantics empowered portable, easy to use and federated Clouds

The research focus of Cloud so far has been primarily on the *provider perspective*, i.e. the Cloud in terms that matter to a provider. The *user perspective* has received lesser attention. Given that many cloud related technologies have matured and cloud-based application deployment and services are rapidly increasing, it is time to focus significant research attention to the user perspective of the Cloud. Similar thoughts have been expressed by Ian Foster in his keynote at IEEE Cloudcom 2010, themed 'What the Cloud really means for science'².

Our broad vision for Cloud computing is based on the belief that convenient, ubiquitous and technology agnostic access to Clouds should be the future. Our research agenda is outlined by the Cirrocumulus project³ where the key objective is to remove the *hindrance to the adoption of the cloud caused by vendor lock-in, in terms of development, deployment and management of application artifacts in computing clouds*. This covers three important aspects.

1. A strategy to write programs and specify data for Cloud in platform agnostic way.
2. A strategy to interact with a Cloud in an interface agnostic way.
3. A strategy to migrate code and data across Cloud platforms.

These strategies leverage the know-how of the Semantic Web, an effort that helped to create a large set of technologies for generic modeling/representation and data integration. Some of our ideas in incorporating semantics in above strategies are envisioned in a two part column in IEEE Internet Computing⁴.

There are many research issues in realizing this vision. When this vision is achieved, we should be able to realize applications that address unmet computing needs. One important outcome would be cloud federation, i.e. Use of applications and data that span over multiple, heterogeneous Clouds. Such federation brings up issues on when and where to move data and code, requiring strategies to model Cloud capabilities. Once these modeling strategies mature, reasoning and matching capabilities pioneered in Semantic Web research may be applied for automated/semi-automated Cloud selection. This not only simplifies the Cloud user interaction pattern, but also gives opportunities to totally new automated applications.

In summary, we call for an increased attention on modeling and interfacing Clouds, focusing on interoperability and portability of data and applications. Given that computing is moving towards ubiquity, the simplified use of Cloud would be a welcome advancement. Just as Web 2.0 opened up the Web to all, we envision use of Clouds that requires little or no specialized training for its users.

² <http://www.slideshare.net/ianfoster/cloud-com-foster-december-2010>

³ <http://knoesis.wright.edu/research/srl/projects/cirrocumulus/>

⁴ http://wiki.knoesis.org/index.php/Modeling_for_cloud