Cloud computing has recently emerged as a buzz word in the distributed computing community. Many believe that Cloud is going to reshape the IT industry as a revolution. So, what is Cloud Computing? How is it different from service-oriented computing and Grid computing? What are those general challenges and issues for both cloud providers and consumers?

In answering these questions, we aim to define key research issues and articulate future research challenges and directions for cloud computing. To do this, we take an outside-in approach to organize this paper. We first examine a number of cloud applications that exhibit several key characteristics. We then discuss the relationship between Cloud computing and Service-Oriented Computing (SOC) and the relationship between Cloud and Grid computing (i.e. High-Performance Computing). We compare these three computing paradigms and draw attention to how they will benefit each other in a co-existent manner. Next, we discuss service models and deployment models of cloud computing. We elaborate service model and deployment model of a cloud, which leads to the discussion of several data-related issues and challenges such as multi-tenancy, security, and so forth. Finally, we discuss interoperability and standardization issues.