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ACCEPTED MANUSCRIPT

Teaching cloud computing: a software engineering perspective

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When a new area of a discipline emerges, university teachers are faced with the problem of when (and if) this should be introduced into their courses. They have to ask two questions: firstly, is this something that is attracting a lot of publicity but which will have little long-term impact and secondly, what are the essential elements of this topic, which should be part of an enduring course. Cloud computing is no exception here although I think that it is fair to say that the first question has already been answered. Cloud computing is not going to go away and we certainly do have a responsibility to include this in our courses.

We have already seen a number of cloud computing courses being offered and even some Master's degrees. Lee Gillam's course at Surrey University was one of the earliest and he has written some reflections on this course[1]. His course is a general introductory course in cloud computing that starts by introducing the notions of software, platform and infrastructure as a service. It covers relevant cloud protocols such as SOAP and REST and discusses the map-reduce computational model and its instantiation in Hadoop. The course makes comparisons with grid and peer to peer computing and discusses service-level agreements, cloud economics and security.

In this article, I want to avoid simply listing what I think should be included in a cloud computing course. Rather, I want to look at the topic of teaching cloud computing from a more abstract perspective and discuss the issues and problems of teaching this subject. In line with the theme of this issue, I will look at this from a software engineering rather than a business or information systems perspective – teaching cloud computing in these areas would be rather different from what I discuss here.

When considering issues of teaching, I find it helpful to consider topics from three perspectives:

1. *Sensitisation* Telling students about something and how it is used. Essentially, the aim here is to ensure that they are not surprised when they encounter this when they leave university. There is no expectation that students will have practical skills or theoretical knowledge. Typically, sensitization is the first stage of introducing a new topic into the curriculum.
2. *Practice* At this stage, students are given some tuition in the practical elements of a topic – so, in cloud computing, they may be asked to provision some servers on a cloud service such as AWS or Microsoft Azure. Practice is usually the next stage after sensitization.
3. *Principles* At this stage, we are trying to abstract the fundamental principles of a topic and present these to students. An understanding of these principles means that students

[1] Lee Gillam, Bin Li and John O'Loughlin. "Teaching Clouds: Lessons Taught and Lessons Learnt ". In *Cloud Computing for Teaching and Learning: Strategies for Design and Implementation*. Ed. Lee Chao. IGI Global, 2012.

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