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Notional View of Cloud Computing on Higher Education in Virtual Learning Environment

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Abstract

The new technologies enable individuals to personalise the environment in which they work or learn, utilising a range of tools to meet their interests and needs. In this fairly short theoretical paper, we explore the salient features of digital scholarship (DS), and the nature and educational potential of 'cloud computing' (CC) in order to exploit the affordance of CC in advancing the scholarship of teaching and learning in a higher education context. In the manuscript we argue that the cloud computing has a significant place in the higher education landscape both as a ubiquitous computing tool and a powerful platform that can enhance engagement among educators to understand and improve practice, and thus, increase productivity. Specific cloud tools considered in this paper are the Google Docs and Microsoft's Skydive. By critically examining the utility of these two tools, we find that they are user friendly media which can be used as a personal digital workspace as well as for storage for digital artefacts. Such artefacts stored in the "cloud" can be accessed from anywhere at anytime, and can be easily shared with others. It is worth trying its use by academics for sharing tested and tried teaching materials, artefacts, portfolios, strategies, and research outcomes. As a result, the purpose is to raise awareness among those educators who are not familiar with the potential of CC in providing a platform for active collaboration which is critical to promote the ideals of DS for one's professional development and be successful in their profession.

Keywords: Cloud Computing, Advanced Education and Virtual Learning Environments

Introduction

Higher Education of landscape around the world is in a constant state of flux and evolution, mainly as a result of significant challenges arising from efforts in adopting new and emerging technologies and pedagogies in their teaching and learning environments. This is mainly as a result of a new genre of students with learning needs vastly different from their predecessors, and it is increasingly recognised that using technology effectively in higher education is essential to providing high quality education and preparing students for the challenges of the 21st century [1]. However, an unresolved challenge to the effective use of technology in education is the continued dominance of traditional didactic pedagogy despite the critical need for a paradigm shift from the passive teacher centred approach (transmission of information and skills) to student centred

constructivists' approaches whereby students construct knowledge through interaction and collaboration with peers as well as teachers. The bulk of today's e-learning systems still consist of simple conversion of classroom-based content to an electronic format while still retaining its traditional distinctive knowledge centric nature [6]. Although the new technologies have the potential to play an important role in the development and emergence of new pedagogies, where control can shift from the teacher to an increasingly more autonomous learner, and to rescue the HE from this appalling situation, the change is very slow or not forthcoming at all for various reasons.

This is mainly because both teachers and learners require a number of specific skills for technology supported constructivist approaches that is, online tutor skills, and online learning skills; learners get limited support to develop such skills from their teachers who often lack these same skills themselves. This scenario is not only in developing countries, but also widespread in developed countries. Based on a UK-based study, [7] reports, "Unfortunately, the likelihood that their adoption of new technologies would foster innovative pedagogy is slim [7]. After analysing the state of technology use in HE at Stanford University in USA, Cuban [2] concluded, "Dominant teaching practices remained largely constant in the years of greatest penetration of new technologies". As a result, teaching is more a private interaction between the teacher and his/her own students, and is seldom evaluated by peers or any other reviewers for effectiveness. It is becoming clear to many people, including students, that traditional methods are unable to address the needs of HE where the emphasis is on higher order learning experiences and outcomes demanded of a changing knowledge- and communication-based society. The rapid advances in technology in the last few decades have had a significant impact on work, leisure, culture and social interaction. The kind of skills students need to develop to be prepared for the jobs of the 21st century is different from what they needed 20 years ago. Therefore, it is not an option but is a necessity the move beyond our comfort zones towards adopting constructivist approaches that can better equip our student for the needs of the 21st century. It is hoped that this move can be effectively facilitated by adopting the ideals of the SoTL through innovative research approaches that befit the digital age in ways it is conducted, conveyed, and shared among colleagues and the public, and how it is integrated into one's own teaching to achieve a new level of efficiency and effectiveness.

What is cloud computing?

Although the concept of "cloud computing" has been around for over a decade, the terminology is only lately gaining popular traction. Technical aspects of cloud computing is certainly out of the scope of this paper. However, it is essential to provide certain salient features that are relevant to academics. The concept of "computing in the cloud" is about the delivery of IT services that run in a web browser; the type of services range from adaptations of familiar tools such as email and personal finance to new offerings such as virtual worlds and social networks. Storage of digital data is an important service among these. Cloud computing is a computing platform that resides in a service provider's large data centre and is able to dynamically provide servers the ability to address a wide range of needs of clients. The cloud is a metaphor for the internet. Some people call it the World Wide Computer. Technically, it is a computing paradigm in which tasks are assigned to a combination of connections, software and services accessed over a network. This network of servers and connections is collectively known as the cloud. Physically, the resource may sit on a bunch of servers at different data centres or even span across continents. Actually, it is designed to work like a whole computer in the cloud and aimed at a wider audience, including those who can't afford their own computer. Computing at the scale of the cloud allows users to access supercomputer level power [4, 5]. Instead of operating their own data centres, firms might rent computing power and storage capacity from a service provider, paying only for what they use, as they do with electricity or water. This paradigm has also been referred to as "utility computing," in which computing capacity is treated like any other metered utility service one pays

only for what one uses. Users can reach into the cloud for resources as they need from anywhere at any time. For this reason, cloud computing has also been described as "on demand computing." Some of the providers of cloud computing service are the Google, Amazon, Sales force, and Microsoft. Microsoft's Windows Live software suite includes an updated electronic mail program, a photo sharing application, a writing tool designed for people who keep Web logs and Skydive for online data storage and Folder Share services. Google took cloud computing a step further by offering a suite of free word-processing and spreadsheet software over a browser. Google Apps, Maps and Gmail are all based in the cloud. Screenshots to demonstrate the affordances of Google Docs and Windows Live are included [10]. As academics, what we are most interested in is its networked data storage capability. This paper explores its potential for storage and dissemination of intellectual work in the form of digital scholarship to other members of the professional community such that they can, in turn, peer-review, critique, and further, build up on it.

The typical uses of cloud computing to academics are:

1. It can be used as a personal workspace;
2. A convenient tool to engage in the scholarship of teaching and learning;
3. Personal Learning Environments (PLEs) used by many people as an alternative to institutionally controlled Virtual Learning Environments (VLEs)/LMS with different personalised tools to meet their own personal needs and preferences; as teachers we are always learning;
4. Provides opportunity for ubiquitous computing;
5. No need for backing up everything to a thumb drive and transferring it from one device to another;
6. No need to copy all stuff from one PC to another when buying a new one. It also means you can create a repository of information that stays with you and keeps growing as long as you want them;
7. Provides large amounts of processing power comparable to supercomputer level.
8. However, the cloud raises some thorny issues about who controls clients' data. Besides, it raises a range of important policy issues, which include issues of privacy, security, anonymity, telecommunications capacity, government surveillance, reliability, and liability, among others. These will have to be worked out for the cloud to gain popularity and wide acceptance.

Theoretical prospective

Architectural layers of cloud computing

A cloud computing platform dynamically provisions, configures, reconfigures, the servers as needed. Servers in the cloud can be physical machines or virtual machines. Advanced clouds typically include other computing resources such as storage area networks (SANs), network equipment, firewall and other security devices. In general, cloud service providers tend to offer services that can be grouped mostly into three categories [10]:

1. Infrastructure as a service
2. Platform as a service
3. Software as a service

Infrastructure as a Service (IaaS)

IaaS is the delivery of computer infrastructure as a service. Infrastructure as a service offers computing capabilities and basic storage as standardized services over the network. Servers, storage systems, switches, routers, and other systems are reserved and made available to handle workloads. IaaS clouds make it very affordable way to provision resources such as servers, connections, storage, and related tools necessary to build an application environment from scratch on-demand [9]. The benefits of IaaS include rapid provisioning, ability to scale and pay only for what you use.

For a start up or small business, one of the most difficult things is to keep capital expenditures under control. By moving your infrastructure to the cloud, you have the provision to scale as if you owned your own hardware and data centre (which is not realistic with a traditional hosting provider) but you keep the upfront costs to a minimum. VCL delivers different infrastructure at one place. It provides a platform (internally no physical infrastructure) virtualization environment in the Universities. Using this, student need not to set up any specific physical infrastructure for their project assignment.VCL provides following services for infrastructure.

1. Compute
    (a) Physical Machines
    (b) Virtual Machines
    (c) OS-level virtualization
2. Network
3. Storage

VCL manager provides appropriate virtualization (aggregation, disaggregation) of the available hardware resources before mapping the requested image onto that hardware. VCL services focus on controlling the resource at the platform level.

Platform as a Service (PaaS)

Platform as a service is a virtualized platform that comprises one or more servers (virtualized over the set of physical servers), operating systems, and specific applications (such as Apache and MySQL for Web-based applications). In some cases, you can provide a VM image that contains all the necessary user-specific applications. Platform as a service comprise a layer of software and provides it as a service that can be used to build higher-level services. There are at least two perspectives on PaaS depending on the perspective of the producer or consumer of the services (a) The person producing (Here VCL) PaaS might produce a platform by integrating an OS, middleware, application software, and even a development environment that is then provided to a customer as a service and (b) the person using (users in Universities) PaaS would see an encapsulated service that is presented to them through an interface. The customer interacts only with the platform through the interface, and the platform does what is necessary to manage and scale it to provide a given level of service. The Virtual appliances can be classified as instances of PaaS. Using VCL, Students need not to physically install any specific services, solution stacks or databases on their machine. It provides the images to students where they can simply select these images and use them on a machine provided in a cloud.

1. Services
2. Solution Stacks
    - Java
    - PHP
    - .NET
3. Storage
    - Databases
    - File Storage

Software as a Service (SaaS)

SaaS is the ability to access software over the Internet as a service. Software as a service has a complete application to offer as a service on demand. A single instance of the software runs on the cloud and services multiple end users or client organizations. Here the best example remote application service is Google Apps, which provides several enterprise applications through a standard Web browser. VCL allows any of the software as a service solutions, virtualization solutions, and terminal services solutions available today. VMWare, XEN, MS Virtual Server, Virtuoso, and Citrix are typical examples. VCL also as allows any of the access/service delivery

options those are suitable from RDP or VNC desktop access, to X-Windows, to a Web service or similar.

Cloud computing infrastructure models

There are three basic service models to consider in a university based cloud computing, such as Public, Private and Hybrid clouds [10].

Public clouds

Public computing clouds are open to anyone who wants to sign up and use them. Public clouds are run by vendors, and applications from different customers are likely to be mixed together on the cloud's servers, storage systems, and networks. One of the benefits of public clouds is that they can be much larger than a company's private cloud and can offer the ability to scale up and down on demand, shifting infrastructure risks from the enterprise to the cloud provider.IBM operates a cloud data centre for its customers. Multiple customers share the same infrastructure, but each others' cloud is secure and separated as though behind its own firewall.

Private clouds

The intention of designing the private cloud is basically an organization that needs more control over their data than they can get by using a vendor hosted service. Private clouds are built for the exclusive use of one organization, providing the utmost control over data, security, and quality of service. Private clouds typically sit behind the firewall of an organization (enterprise or university), and only people within that organization have permission to access the cloud and its resources.

Hybrid clouds

Hybrid clouds combine both public and private cloud models. This model introduces the complexity of determining how to distribute applications across both a public and private cloud. If the data is small, or the application is stateless, a hybrid cloud can be much more successful than if large amounts of data must be transferred into a public cloud for a small amount of processing. VCL can work on Hybrid cloud model. It can provide services and infrastructure to the students and faculties of single university acting as a private cloud. It can also extend this services for inter university using public cloud. This requires more secure network.

Heterogeneous resource clouds

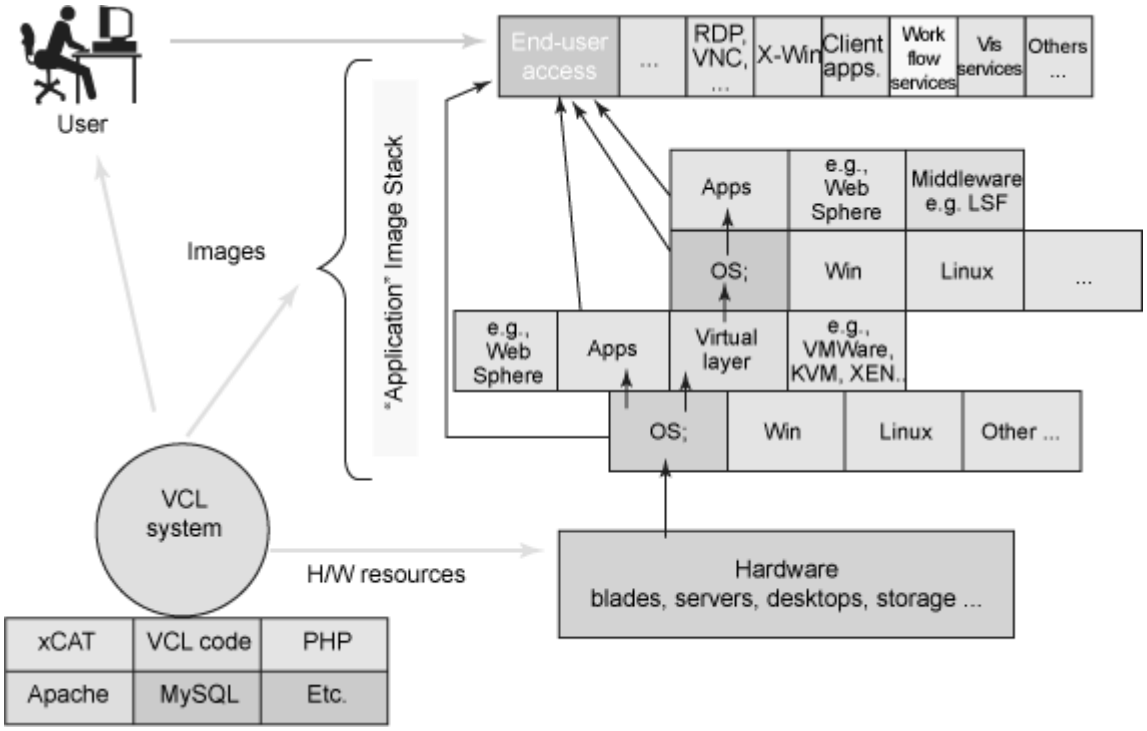
The main intention of designing heterogeneous cloud in universities is to significantly decrease the configuration scale of the cluster system through consolidating heterogeneous workloads, while increasing the number of requests for parallel workload by provisioning enough resources (e.g., based on Globus, Hadoop, or Condor). For large organization, different utilities often maintain dedicated cluster systems for different workloads. Thus the main challenge is to consolidate heterogeneous workloads of the same organization on the cloud computing platform through VCL. From the perspective of a VCL, it can transform and support any type of environment (as heterogeneous) as long as an image with the appropriate environment manager is available.

High-level architecture of VCL

This VCL architecture mainly is intended for designing and configuring a cloud computing system that serve both the educational and research missions of the university in a very economical and cost efficient manner. VCL delivers a range of functionalities and services that map well onto the cloud computing requirements and its expectations. There are few principal components in the VCL architecture as shown in Figure 2.For more information about VCL and its working model, see the Resource section.

- An end-user access interface (web based)
- A resource-manager (or VCL manager) which includes a scheduler, security, performance monitoring, virtual network management, etc
- An image repository (or image)
- Computational, storage, networking hardware and
- Security

Figure 1: VCL physical architecture



User

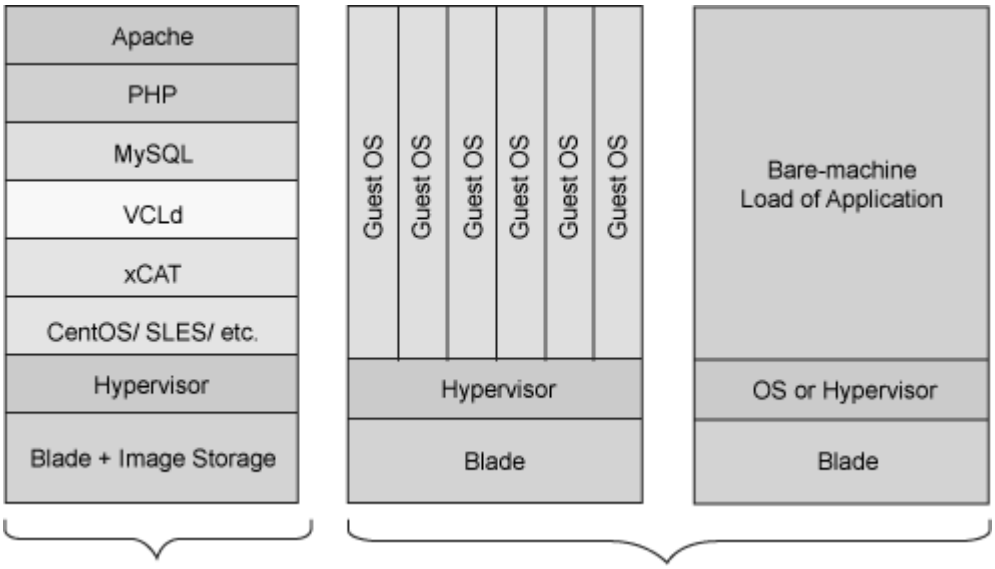
Initially user accesses VCL through a Web interface to select desired combination of application from a menu. See Figure 1. If a user specific image combination is not already available as an image, an authorized user can have the flexibility to construct their own image from the VCL library components. The VCL manager software then maps that user request to available software application images and (possibly heterogeneous) hardware resources, and schedules it for either immediate use (on demand) or for later use.

Computational hardware/network storage

Virtualization completely abstracts the hardware to the point where software stacks can be deployed and redeployed without being tied to a specific physical server. VCL servers provide a pool of resources that are exploited for the user's needs. The resources are allocated depending on the particular applications that are to be computed. The storage and network resource are dynamic, meeting both the workload and user demands. The term compute clouds are usually complimented by storage clouds that provide virtualized storage through VCL facilitating the storage of virtual machine images. In VCL, computational hardware and storage can be anything from a blade centre, to a collection of diverse desktop units or workstations, to an enterprise server or to a high-performance computing engine. A typical VCL installation will have one or more blade chassis, usually one of the blades being designated as the management node. Each blade has at least two

networking interfaces one for the public network, and the other for a private network that is used to manage the blades and load images. Storage is attached either directly through a network.

Figure 2: VCL Application Storage



Reviews

Scholarship of Teaching and Learning (SoTL)

It is becoming increasing evident that teaching should no more be a private affair (as it used to be traditionally) but a peer-reviewed transparent process that makes it known what makes learning possible and how student learning can be improved generally. An ideal model of the SoTL offers a framework for peer review and making transparent the processes of making learning possible, not only in one's own classroom but even beyond it. Contend that the scholarship of teaching "requires a kind of 'going meta,' in which faculty frame [5] and systemically investigate questions related to student learning the conditions under which it occurs, what it looks like, how to deepen it, and so forth and do so with an eye not only to improving their own classroom but to advancing practice beyond it." The salient attributes of SoTL are (a) Teaching as well as its development is done publicly to invite critical review in order to improve teaching but also with an emphasis on inquiry into student learning (b) Peer review and evaluation of teaching and its development; peer review enhances the dialogue related to teaching effectiveness, course content, pedagogical methods, and assessment strategies (c) Adoption by peers through further development or modification or even as it is in an atmosphere of intellectual openness which is a recognition of the appropriateness of one's approaches and (d) Investigation of questions related to student learning, particularly around issues of student learning the conditions under which it occurs, what it looks like, how to deepen it, and so forth with a view to improving not only their own classroom but also to advancing practice beyond it. I argue that substantial pedagogical innovations in HE will not come unless there is a proper understanding of the processes of SoTL, a positive mindset towards a culture of the SoTL and the adoption of its ideals by teachers in HE. The understanding that should precede adoption should be deep enough to bring about change in teachers' beliefs about what constitutes knowledge and

learning in HE settings, and further, what means to be 'educated' in the 21st century. This is an essential catalyst for educational change to occur. Reports if there is a key to reinventing our educational system, it lies in what our teachers believe about the nature of knowing [4]. Without a re-examination and change in beliefs about the nature of knowing, there will be no substantial change in the enterprise of education; we will stay in a vicious cycle. The new epistemological beliefs constructivism and SoTL must then be incorporated into the teaching practice. By constructivist belief, the emphasis is on learner-centred teaching and learning environments that is nurtured/ supported by the affordances of emerging communication technologies. In this paper the focus is on SoTL. By the principles of SoTL, the success in aligning our classroom practice depends largely on our individual efforts, and our ongoing dialogue with colleagues who may have done it successfully before or who are struggling with the same transformation. Collaborative dialogue and communication within a community connect minds, either directly or indirectly, engenders deep thinking and fosters cross fertilisation of ideas. Hutchings (Carnegie Foundation, 2000) presented the following taxonomy of questions teachers can pose in such collaborative environments for inquiry into student learning.

1. "What works?" – These are questions that seek "evidence about the relative effectiveness of different approaches".
2. "What is?" – These are questions that seek to describe how students learn, and accordingly, describe different teaching strategies;
3. "Visions of the possible" – These are questions related to goals for teaching and learning that have yet to be achieved or are new to the teacher asking the questions.
4. "Theory building" questions – These are questions designed to build theoretical frameworks for SoTL.

By and large, the overall SoTL approach is similar to 'development research' as articulated [8] or 'design experiments' [1, 3]

Brown and Collins defined the critical characteristics of design experiments as:

1. addressing complex problems in real contexts in collaboration with practitioners,
2. integrating known and hypothetical design principles with technological affordances to render plausible solutions to these complex problems, and
3. Conducting rigorous and reflective inquiry to test and refine innovative learning environments as well as to define new design principles.

Development research design is appropriate when the intervention is implemented to address a need and clarifies a few steps [9] of development research design: In the search for innovative 'solutions' for educational problems, interaction with practitioners is essential it possible to create a practical and effective intervention for an existing problem or intended change in the real world? Interaction with practitioners is needed to gradually clarify both the problem at stake and the characteristics of its potential solution. An iterative process of 'successive approximation' or 'evolutionary prototyping' of the 'ideal' intervention is desirable. Direct application of theory is not sufficient to solve those complicated problems. For most teachers, SoTL is an uncharted territory; technology can greatly facilitate and advance the SoTL. More than ever before, there is an urgent need for more and better research through increased active collaboration among teachers in order to optimise their roles and expertises. Active collaboration among teachers is no longer an option, but a must for their success as teachers; further, it has a growing positive impact on the intellectual life of their institutions. It is even crucial for the survival of HE institutions when they are ranked based on the extent of its online presence as a provider of quality education.

Practical application of cloud computing in Higher Education

Cloud concept has significant implications as a communication medium. While it may not be highly interactive in a physical sense, it has strong potential for social interactivity. The goal of utilising this type of tool is the achievement of 'virtual communities' of educators, researchers and

practitioners on the Internet working in small collaborative groups which may help to promote a more reflective metacongitive approach in tackling problems and advancing the practices. In order to succeed in research projects and to develop quality work through iterative processes, the role of active collaboration with colleagues and experts in the field at its various stages of development cannot be overemphasised. Stages in research projects are mainly: Setting Research Theme, Discussion and Collaboration, System Development, and Presentation and Publishing. The 'cloud computing' provides an easy user-friendly environment / platform for this type of collaboration. The cloud platform can support teachers to prepare teaching portfolio; presentation on teaching to a local audience; a conference presentation; a manuscript to be submitted for publication, etc. It may also include, for the purpose of critical review and evaluation, self reported e Portfolios that summarise a teacher's major teaching accomplishments and strengths in the form of short descriptions of activities and achievements (e.g., what and how they teach types of instructional methods, materials, and techniques, why they teach that way, and whether or not it works with evidences), feedback from peers based on teaching observation and peer review of related scholarly activities, feedback from students based on their views on instructional activities, and the end-of-course student evaluation instrument.

Conclusion

The paper describes the salient features of the SoTL and discusses how the educational potential of 'cloud computing' may be utilised for advancing the much needed practice of collaboration among educators, and achieving the ideals of SoTL. I argue that the cloud computing has a significant place in the higher education landscape both as a ubiquitous computing tool and a powerful platform that can enhance engagement among educators to understand and improve practice, and thus, increase productivity. Specific cloud tools considered in this paper are the Google Docs and Microsoft's Skydive. By critically examining the features of the Google Docs and Microsoft's Skydive, I find that they are user friendly media which can be used as a personal digital workspace as well as for storage for digital artefacts that can be accessed or easily shared with others anywhere at any time. It is worth trying its use by academics for sharing tested-and-tried teaching strategies and materials, and to promote the ideals of SoTL for one's professional development and be successful in their profession.

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