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Guide to Cloud Computing

Principles and Practice

Springer

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ISSN 1617-7975
ISBN 978-1-4471-4602-5 ISBN 978-1-4471-4603-2 (eBook)
DOI 10.1007/978-1-4471-4603-2
Springer London Heidelberg New York Dordrecht

Library of Congress Control Number: 2012953098

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To Dad

Richard Hill

To Andy McEwan

Laurie Hirsch

To my Dad and Julia

Peter Lake

To my wonderful family

Siavash Moshiri

Foreword

More so than most IT trends we have seen come and go over the past couple of decades, cloud computing has infiltrated the IT mainstream as a collection of innovations, technology advances and intelligent new applications of not-so-new IT models and technologies. The proliferation of cloud computing is a double-edged sword, readily swung by both professionals and amateurs alike. The broad commercialisation and attractive price points of public cloud computing platforms make cloud-based IT resources accessible to pretty much any organisation with interest and a sufficient credit rating. Methodology, governance and even a project plan are not prerequisites, leaving the door wide open for those who want to create (or recreate) convoluted and ineffective technology architectures that are distinguished from past failed on-premise environments only with the 'cloud' label.

In other words, cloud computing provides us with technology innovation that we must choose to apply based on how and to what extent it helps us fulfil our business requirements. It can improve scalability and reliability and provide cost-effective access to vast pools of resources—but it does not automatically help us improve how we align our business with IT automation, nor does it automatically improve our IT automation (even if it is already aligned). In fact, it can make things significantly worse, especially for those entering the nebulous cloud industry with tunnel vision.

Understanding and making the most of what cloud computing has to offer all comes down to education. This book provides clear guidance in the most essential areas of cloud computing, ranging from its technologies and models to its applications for real-world business. When it comes to considering or planning for cloud adoption, we must make educated decisions or not even attempt that path. Clarity amongst the clouds is critical to determining not just how cloud technologies can solve business problems, but what distinct problems introduced by cloud computing can be addressed and, hopefully, avoided.

Arcitura Education Inc. & CloudSchool.com — Thomas Erl

About Thomas Erl

Thomas Erl is a renown IT author, a speaker of international fame and founder of SOASchool.com® and CloudSchool.com™. Thomas is also the editor of the *SOA Magazine*. With over 140,000 copies in print world-wide, his seven published books in SOA related areas have become international bestsellers. As CEO of Arcitura Education Inc. and SOA Systems Inc. Thomas has led the development of curricula for the internationally recognized SOA Certified Professional (SOACP) and Cloud Certified Professional (CCP) accreditation programs.

Preface

Overview and Goals

Although the term cloud computing is relatively new, some of the concepts that underpin this rapidly expanding area of computing have been with us for a while. IT professionals need to be able to separate the hype from the facts and understand how the new platforms can help organisations become more efficient and more responsive to internal and external systems users.

A Guide to Cloud Computing: Principles and Practice addresses the need for a single text to describe the cloud computing landscape from first principles. It considers both the technologies involved in designing and creating cloud computing platforms and the business models and frameworks that result from the real-world implementation of those platforms.

Key objectives for this book include:

- Present an understanding of the key technologies involved in cloud computing
- Explore the potential use of cloud computing in a business environment
- Demonstrate the technologies and approaches utilised to build cloud computing infrastructure
- Understand the social, economic and political aspects of the ongoing growth in cloud computing use
- Consider the legal and security concerns of cloud computing, which may act as barriers to its success
- Identify areas for further research in a fast-moving domain

Organisation and Features

This book is organised into three parts:

- Part I introduces cloud computing concepts and principles.
- Part II discusses the technological aspects of cloud computing.
- Part III is devoted to issues and challenges with business aspects of cloud computing architecture, both now and in the future.

Target Audiences

A topic as disruptive as cloud computing immediately draws interest from a wide body of individuals. We have written this book to specifically support the following audiences:

Advanced undergraduate students and *postgraduate students* will find the combination of theoretical and practical examples of cloud computing, of particular relevance to a modern computer science, software engineering, computer networking, distributed systems or any course that makes reference to the latest developments in computing as a utility. As such, *university instructors* may adopt this book as a core text. Similarly, *researchers* will find the direct application of theory to practice of use, especially when using clouds for research projects.

Since this book adopts a learning-by-doing approach, the extensive worked examples that explain how to construct a cloud platform will no doubt be relevant to *IT infrastructure technicians*, as well as *application developers* who will also be able to understand the issues faced when developing upon a cloud platform.

Business leaders, IT infrastructure managers and *technical consultants* will have a need to understand how cloud computing can positively affect their organisations and will find the chapters on adoption strategies, financial appraisal, security and governance of particular interest, when they are faced with making critical strategic and operational decisions.

Suggested Uses

Guide to Cloud Computing: Principles and Practice can be used as a solid introduction to the concept of computing resource as a utility, and as such it is suggested that readers acquaint themselves with Part I of this book to start with.

This book is suitable as both a comprehensive introduction to cloud computing, as well as a reference text, as the reader develops their skills and abilities through practical application of the ideas. For *university instructors*, we suggest the following programme of study for a 12-week semester format:

- Weeks 1–2: Part I
- Weeks 3–7: Part II
- Weeks 8–11: Part III
- Week 12: Assessment

Part I defines what cloud computing is and places it in context by comparing it with its underlying technologies. It also examines some of the typical cloud models from a business perspective. Themes such as cloud types, cloud deployment models and sustainability are covered.

Part II elaborates upon cloud technologies, service models and data storage within the cloud environment. It also introduces knowledge discovery through intelligent analysis of structured and unstructured data, a rapidly emerging area of cloud development. It introduces topics such as virtualisation, scaling beyond traditional relational models, collective intelligence and visualisation.

Part III examines the business context of cloud. It addresses the strategic context of the cloud option and the mechanisms used to extract business value from cloud investments. These chapters introduce topics such as cloud economics, investment appraisal for cloud, strategic planning, cloud security and Enterprise Cloud Computing.

Review Questions

Each chapter concludes with a set of review questions that make specific reference to the content presented in the chapter, plus an additional set of further questions that will require further research. The review questions are designed in such a way that the reader will be able to answer them based on the chapter contents. They are followed by discussion questions that often require research, extended reading of other material or discussion and collaboration. These can be used as classroom discussion topics by tutors and prompts for extended self-study research or used as the basis of summative assignments.

Hands-On Exercises

The technology chapters include extended hands-on exercises, commencing with the installation of a virtual machine (VM). Readers will then use the VM to practice cloud environment configuration, before progressively engaging in more complex activities, building skills and knowledge along the way. Such an approach ensures that a solid foundation is built before more advanced topics are undertaken. To facilitate the maximum uptake of this learning experience, only open source technologies that are freely available for download have been utilised.

Chapter Summary

A brief summary of each of the twelve chapters is as follows.

Chapter 1 is an introduction to cloud computing, and we define what is meant by the cloud. The cloud is placed in its historical context and some of the key concepts such as service orientation, virtualisation and utility computing are described.

In Chap. 2, we examine the different approaches that can be taken when implementing cloud-based solutions and discuss how an organisation can begin to evaluate which approach is right for them. We then go on to look at the legal implications of this fundamental shift in business practice.

In Chap. 3, we examine the impact of the cloud on society, economy and politics. We look at how people around the globe are beginning to use cloud as a way to provide them with more influence than traditional decision-making approaches. We go on to critically review the claims that cloud computing offers a ‘greener’, more sustainable approach to IT.

Chapter 4 reviews the current state of web, virtualisation and distributed computing technology. We examine how the underlying technologies support key cloud features such as elasticity and scalability. At the end of the chapter, you will build a simple system using MapReduce.

Chapter 5 examines the architecture of cloud systems focusing on the layered model often referred to as the 'cloud stack'. In particular we examine infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) using examples. At the end of the chapter, readers build a cloud application using Google App Engine.

In Chap. 6, we begin by examining the myriad types of data that are found in organisations. We then go on to look at different ways of storing that data, many of which have sprung to prominence because of the cloud. We also look at cloud-based solutions to a typical database administrator's tasks, such as backup and disaster recovery.

In Chap. 7, we discuss various approaches to extracting useful information from data stored in the cloud. In particular, we examine approaches to utilising user-generated content in an intelligent way, to produce practical functionality such as recommendation engines.

In Chap. 8, we consider the strategic context of business investment into cloud computing by discussing key economic drivers. Approaches to investment appraisal are also considered, illustrating how common financial techniques can be used to assemble a business case for cloud adoption (or rejection).

Chapter 9 considers the topic of Enterprise Cloud Computing; how can the business potential of cloud computing be utilised to develop enhanced customer-centric systems? This chapter explores cloud services, as a fundamental building block of the service-oriented enterprise, and introduces enterprise architecture as a proactive means of managing emergent IT infrastructure.

Chapter 10 examines the impact of cloud computing upon security and governance, in particular the use of public cloud services. Approaches to mitigate security risks are described in terms of processes, methods and applicable technologies for protection against accidental and malicious threats.

In Chap. 11, we take the reader through the process of developing a strategic roadmap for cloud adoption, including the selection of appropriate tools and techniques to assist strategic decision-making, as well as understanding the importance of demonstrating business and technological alignment.

Finally, in Chap. 12, we note that the future of cloud computing, like much in the IT arena, is unpredictable. We attempt to highlight drivers and barriers that can help anticipate cloud trends, and report what some experts have said, that might help us make sense of the uncertainty.

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