University of San Diego

CS355

Modeling Cloud-Service Costs

Author:
Nicholas Otto

Professor:
Dr. Simon Koo

April 21, 2013

Contents

1 Overview

1.1 Background

A Cloud computing service is both very simple and very complex. Cloud computing done correctly should be extremely simple for end Users. Cloud Users should find that the service simply works, and have no concerns about the implementation of the cloud. Integration between the Cloud and the User's current access device must be seamless. Dropbox is an excellent illustration of this point: I have a Dropbox folder on my computer that functions just like any other folder. However, anything I save inside the Dropbox folder is almost immediately available to any other device that can access my Dropbox account. The integration with the cloud is seamless, and for me - a User - simple.

Providing Cloud services, on the other hand, is very complex. For each User, the Cloud must receive requests over a network, route those requests to the appropriate webserver, process the request - possibly using a database or other persistant storage - and finally return a response (if required). Since a single Cloud service must be able to handle many Users, appropriate resource management (webserver, storage, database) is very important.

The safest approach to resource management is to assign fixed portions of the Cloud's resources to each User when the User buys into the service. Once the Cloud has assigned as much resources as it has, no more Users are put onto that Cloud service. In this way, the Cloud is able to process every User request, even if every User is using their maximum allowed resources at the same time. Although safe, this one-to-one approach is very inefficient. For example, a User could provision (buy) a certain amount of database capacity, but never actually use it. The Cloud now has unused resources that it must maintain for a User who will never actually use the resource.

Instead, Cloud services will over-sell their resources in an attempt to maximize utilization of the available resources. Over-selling is, naturally, far more profitable, but also much more risky. The Cloud provider must be able to model how much of a User's provisioned resources will actually be used at any given time. Then, the Cloud is able to predict an optimal provisioned/resource ratio that will maximize profits, and minimize service unavailability.

1.2 Problem Definition

The problem this report attempts to solve is as follows:

> Given a basic model of User behavior, what is the greatest provisioned/resource ratio with less than 5% service unavailability?

The "model of User behavior" is defined as how much of a given resource a User will provision, and how much of that provisioned capacity will the User actually consume, given a certain time interval.

2 Webserver

The webserver is the backbone of a Cloud computing platform, containing both the processing power and memory. We make the simplifying assumption that the User will provision a certain percentage of a "core." A core is simply an arbitrary amount of processing power and memory. The Cloud service, then, has a fixed number of cores from which to distribute resources to the Users.

2.1 User Model

Users are assumed to generally provision small percentages of a core. The density function of user provisioning is

$$m(x,n) = \begin{cases} 0 & \text{if } x < 0, \\ (n+1)(1-x)^n & \text{if } 0 \leq x \leq 1, \\ 0 & \text{if } x > 1. \end{cases}.$$

This gives a distribution function of

$$F(x,n) = \begin{cases} 0 & \text{if } x < 0, \\ 1-(1-x)^{n+1} & \text{if } 0 \leq x \leq 1, \\ 1 & \text{if } x > 1. \end{cases}$$

2.2 Cloud Service Model

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

3 Storage

3.1 User Model

3.2 Cloud Service Model

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

4 Database

4.1 User Model

4.2 Cloud Service Model

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

5 Input / Output

5.1 User Model

5.2 Cloud Service Model

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

6 Conclusion

Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetuer tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci, scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.