

SIG Proceedings Paper in LaTeX Format*

Extended Abstract[†]

J. McFadden[‡]

Institute of Technology
Univ. of Washington: Tacoma
Tacoma, WA 98402
mcfaddja@uw.edu

Y. Tamta[§]

Institute of Technology
Univ. of Washington: Tacoma
Tacoma, WA 98402
yashaswitamta@gmail.com

J. N. Gandhi[¶]

Institute of Technology
Univ. of Washington: Tacoma
Tacoma, WA 98402
jugalg.uw.edu

ABSTRACT

Two different No-SQL database software packages will be implemented in and/or installed on several different types of systems. In turn, these systems will be deployed using several different types of platforms. This variety in software, systems, and platforms will allow different combinations of these to be compared based on metrics chosen in advance. In general, the metrics will include performance, setup, maintenance, and costs. These metrics will also be sufficiently detailed, precise, and consistent to provide reliable assessment, as well as having sufficient scope to provide a viable comparison. and

CCS CONCEPTS

•Computer systems organization →Cloud based systems; *Software as a Service*; *Containers Service*; *Virtualization*; •Database systems →NoSQL; •Virtualization methods →Containers; •Cloud Systems →Performance; Cost;

KEYWORDS

ACM proceedings, L^AT_EX, text tagging

ACM Reference format:

J. McFadden, Y. Tamta, and J. N. Gandhi. 1997. SIG Proceedings Paper in LaTeX Format. In *Proceedings of TCSS 562: Cloud Computing Term Project, Tacoma, WA USA, April 2017 (TCSS 562: Spring 2017)*, 5 pages.
DOI: 10.475/123_4

1 INTRODUCTION

The software/systems chosen for comparison in this project are two different NoSQL database system. These systems will be deployed/run/operated in several different ways. These include *SaaS*¹ implementations, *containerized* implementations, and *native installations*. The goal of the project is to understand the performance

characteristics of each deployment method *and* to quantify the costs of each deployment method. These costs will be calculated based on the hourly cost to operate, the initial time & costs required for setup, and the maintenance requirement of a deployment. Additionally, performance of the systems and deployments will be measured using the time required to carry out various database operations, under a set of several different conditions, as well as the CPU, memory, and network loads imposed by the various deployments under the same set of conditions.

2 SYSTEMS AND PLATFORMS

We will be using two NoSQL database software packages. The first software package is **DynamoDB** from Amazon Web Services (AWS), while the second software package will be **Cassandra**, an open-source NoSQL database software package. These software packages will be deployed using several different systems and platforms, as described below.

2.1 Systems

This project will run the software packages on three different systems (*or types of systems*). We have chosen systems which range from hosted *SaaS* through various degrees of virtualization and then all the way to non-virtualized machines. These systems are as follows

A): *SaaS*

B): *Running inside a Docker container*

C): *Running on a dedicated machine*

These four systems will be deployed using several different platforms which we will describe in the next part of this section; however, before proceeding to that, we will give a through description of each system listed above.

2.1.1 SaaS (code: A). In this system paradigm, a particular software package is developed and maintained with the intent of being used by a provider as selling *Software as a Service*. As far as system configuration on our end (*the system-administrator/developer*), paradigm only requires that we select a platform provider and collected the database data so that it can eventually be prepared for deployment.

2.1.2 Running inside a Docker container (code: B). For the purposes for this paper and the ensuing project, we will only use **containers** which are created using and for use in *Docker*. This choice was made because of *Docker*'s ubiquity, wide availability,

*Produces the permission block, and copyright information

[†]The full version of the author's guide is available as `acmart.pdf` document

[‡]

[§]

[¶]

¹**SaaS** : Software as a service.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

TCSS 562: Spring 2017, Tacoma, WA USA

© 2016 Copyright held by the owner/author(s). 123-4567-24-567/08/06...\$15.00

DOI: 10.475/123_4

and the ease of access to cloud services designed for and solely dedicated to the deployment of *Docker* containers. This implementation paradigm requires that a *Docker* container be created after which, the software package in question be installed into the container so that it can be run on the operating system employed in the container (*the OS² was chosen at the time of container creation*). Additionally, as far as this paper and project are concerned, the use of a *Docker* container as a means of implementation does not imply the use of any particular platform for running the containers, or even a deployment of the *Docker* software/system itself.

2.1.3 Running on a dedicated machine (code: C). The third system paradigm involves acquiring and configuring a dedicated machine which can be either an actual, physical machine or a virtual machine. In either case, the machine will have performance specifications and run an OS appropriate for our planned use. When setting up one of these machines, after configuration and setup of physical/virtual system, the selected OS will be installed and configured for use. Once it has been verified that the OS has been properly installed and configured (*i.e. running stably*) we will install the software selected for testing on that instance, along with any other software or system components required to run that software. After configuring the installed software, the machine will be prepared and configured for use as a server running said software. The final step of this paradigm is preparing the software and system combination for final deployment to the selected platform.

2.2 Platforms

We have chosen four different platforms on which to deploy our systems. The chosen platforms span the range of cloud service paradigms from *SaaS* to *PaaS*³ to *IaaS*⁴. We list the three platforms, along with two variations on one of the platforms, below

- 1): (An) AWS Software Service (*SaaS*)
- 2): Containers (using *Docker*) running on
 - i): AWS's Container Service (*PaaS*)
 - ii): AWS EC2 Machines running the *Docker* run-time in Linux (hybrid *Pass/IaaS*)
- 3): AWS EC2 Machines running native installations of the software in Linux (*IaaS*)
- 4): A dedicated, non-virtualized server (*server*)

In the next section, we list which systems will run each software package, along with an explanation why each software-system pairing was chosen. Additionally, we will describe which platforms will be used to deploy each system and why those deployment choices were made. Before proceeding to that, and as with our list of system, we will describe each platform thoroughly.

2.2.1 AWS Software Service (code: 1). Our first platform we will use for the deployment of some systems is AWS's Software Service platform which provides various software packages which run as a

service. This means that Administrator do not have to configure and secure a server and OS on which to run the software, nor do they have to install and manage the running of the software on said server. Instead, all a System Administrator must do is create an instance of the desired Software Service, with the configuration required for the application at hand. Once the instance has been created, it is loaded with any information required and/or data to be used, after which it is immediately available for use by users and other clients.

2.2.2 Containers (code: 2-).⁵

The next platform we have chosen involves the deployment of the previously described *Docker* containers. We will use two different platforms that implement the *Docker* engine which is actually responsible for running the containers. These "Docker Platforms" are

- [AWS's Container Service (code: 2i)]

3 DEPLOYMENT

The deployment strategy will be described in two parts which can be briefly described as "what systems will be used to run and/or implement each software package" and "which platforms will be used to deploy each of these systems". Specifically, the first part of the description for our deployment strategy details which systems will be used to run each software package (*DynamoDB or Cassandra*), along with how the each system will implement and run the software. This will be complemented by the second part of the description, which will detail what platforms will be used for deploying each of the systems, along with why each platform was chosen to deploy are particular software/system combination.

²OS: Operating System

³PaaS : Platform as a service.

⁴IaaS : Infrastructure as a service.

⁵The "-" after the 2 is a place-holder for an additional code-letter, as there are two different versions of this platform being used.

3.1 Math Equations

You may want to display math equations in three distinct styles: inline, numbered or non-numbered display. Each of the three are discussed in the next sections.

3.1.1 Inline (In-text) Equations. A formula that appears in the running text is called an inline or in-text formula. It is produced by the `math` environment, which can be invoked with the usual `\begin . . . \end` construction or with the short form `$. . . $`. You can use any of the symbols and structures, from α to ω , available in \LaTeX [?]; this section will simply show a few examples of in-text equations in context. Notice how this equation: $\lim_{n \rightarrow \infty} x = 0$, set here in in-line math style, looks slightly different when set in display style. (See next section).

3.1.2 Display Equations. A numbered display equation—one set off by vertical space from the text and centered horizontally—is produced by the `equation` environment. An unnumbered display equation is produced by the `displaymath` environment.

Again, in either environment, you can use any of the symbols and structures available in \LaTeX ; this section will just give a couple of examples of display equations in context. First, consider the equation, shown as an inline equation above:

$$\lim_{n \rightarrow \infty} x = 0$$

(1)

Notice how it is formatted somewhat differently in the `displaymath` environment. Now, we'll enter an unnumbered equation:

$$\sum_{i=0}^{\infty} x + 1$$

and follow it with another numbered equation:

$$\sum_{i=0}^{\infty} x_i = \int_0^{\pi+2} f$$

(2)

just to demonstrate \LaTeX 's able handling of numbering.

3.2 Citations

Citations to articles [? ? ? ?], conference proceedings [?] or maybe books [? ?] listed in the Bibliography section of your article will occur throughout the text of your article. You should use BibTeX to automatically produce this bibliography; you simply need to insert one of several citation commands with a key of the item cited in the proper location in the `.tex` file [?]. The key is a short reference you invent to uniquely identify each work; in this sample document, the key is the first author's surname and a word from the title. This identifying key is included with each item in the `.bib` file for your article.

The details of the construction of the `.bib` file are beyond the scope of this sample document, but more information can be found in the *Author's Guide*, and exhaustive details in the *LaTeX User's Guide* by Lamport [?].

This article shows only the plainest form of the citation command, using `\cite`.

3.3 Tables

Because tables cannot be split across pages, the best placement for them is typically the top of the page nearest their initial cite. To

Table 1: Frequency of Special Characters

Non-English or Math	Frequency	Comments
Ø	1 in 1,000	For Swedish names
π	1 in 5	Common in math
\$	4 in 5	Used in business
Ψ ₁ ²	1 in 40,000	Unexplained usage



Figure 1: A sample black and white graphic.

ensure this proper “floating” placement of tables, use the environment `table` to enclose the table's contents and the table caption. The contents of the table itself must go in the `tabular` environment, to be aligned properly in rows and columns, with the desired horizontal and vertical rules. Again, detailed instructions on `tabular` material are found in the *LaTeX User's Guide*.

Immediately following this sentence is the point at which Table 1 is included in the input file; compare the placement of the table here with the table in the printed output of this document.

To set a wider table, which takes up the whole width of the page's live area, use the environment `table*` to enclose the table's contents and the table caption. As with a single-column table, this wide table will “float” to a location deemed more desirable. Immediately following this sentence is the point at which Table 2 is included in the input file; again, it is instructive to compare the placement of the table here with the table in the printed output of this document.

It is strongly recommended to use the package `booktabs` [?] and follow its main principles of typography with respect to tables:

- (1) Never, ever use vertical rules.
- (2) Never use double rules.

It is also a good idea not to overuse horizontal rules.

3.4 Figures

Like tables, figures cannot be split across pages; the best placement for them is typically the top or the bottom of the page nearest their initial cite. To ensure this proper “floating” placement of figures, use the environment `figure` to enclose the figure and its caption.

This sample document contains examples of `.eps` files to be displayable with \LaTeX . If you work with `pdfLaTeX`, use files in the `.pdf` format. Note that most modern \TeX systems will convert `.eps` to `.pdf` for you on the fly. More details on each of these are found in the *Author's Guide*.

As was the case with tables, you may want a figure that spans two columns. To do this, and still to ensure proper “floating” placement of tables, use the environment `figure*` to enclose the figure and its caption. And don't forget to end the environment with `figure*`, not `figure`!

Table 2: Some Typical Commands

Command	A Number	Comments
<code>\author</code>	100	Author
<code>\table</code>	300	For tables
<code>\table*</code>	400	For wider tables

Figure 2: A sample black and white graphic that has been resized with the `includegraphics` command.

3.5 Theorem-like Constructs

Other common constructs that may occur in your article are the forms for logical constructs like theorems, axioms, corollaries and proofs. ACM uses two types of these constructs: theorem-like and definition-like.

Here is a theorem:

THEOREM 3.1. *Let f be continuous on $[a, b]$. If G is an antiderivative for f on $[a, b]$, then*

$$\int_a^b f(t) dt = G(b) - G(a).$$

Here is a definition:

Definition 3.2. If z is irrational, then by e^z we mean the unique number that has logarithm z :

$$\log e^z = z.$$

The pre-defined theorem-like constructs are **theorem**, **conjecture**, **proposition**, **lemma** and **corollary**. The pre-defined definition-like constructs are **example** and **definition**. You can add your own constructs using the `amsthm` interface [?]. The styles used in the `\theoremstyle` command are `acmplain` and `acmdefinition`.

Another construct is **proof**, for example,

PROOF. Suppose on the contrary there exists a real number L such that

$$\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)} = L.$$

Then

$$l = \lim_{x \rightarrow c} f(x) = \lim_{x \rightarrow c} \left[g(x) \cdot \frac{f(x)}{g(x)} \right] = \lim_{x \rightarrow c} g(x) \cdot \lim_{x \rightarrow c} \frac{f(x)}{g(x)} = 0 \cdot L = 0,$$

which contradicts our assumption that $l \neq 0$. \square

4 CONCLUSIONS

This paragraph will end the body of this sample document. Remember that you might still have Acknowledgments or Appendices; brief samples of these follow. There is still the Bibliography to

deal with; and we will make a disclaimer about that here: with the exception of the reference to the \LaTeX book, the citations in this paper are to articles which have nothing to do with the present subject and are used as examples only.

A HEADINGS IN APPENDICES

The rules about hierarchical headings discussed above for the body of the article are different in the appendices. In the **appendix** environment, the command `section` is used to indicate the start of each Appendix, with alphabetic order designation (i.e., the first is A, the second B, etc.) and a title (if you include one). So, if you need hierarchical structure *within* an Appendix, start with **subsection** as the highest level. Here is an outline of the body of this document in Appendix-appropriate form:

A.1 Introduction

A.2 The Body of the Paper

A.2.1 Type Changes and Special Characters.

A.2.2 Math Equations.

Inline (In-text) Equations.

Display Equations.

A.2.3 Citations.

A.2.4 Tables.

A.2.5 Figures.

A.2.6 Theorem-like Constructs.

A Caveat for the \TeX Expert.

A.3 Conclusions

A.4 References

Generated by bibtex from your `.bib` file. Run latex, then bibtex, then latex twice (to resolve references) to create the `.bbl` file. Insert that `.bbl` file into the `.tex` source file and comment out the command `\thebibliography`.

B MORE HELP FOR THE HARDY

Of course, reading the source code is always useful. The file `acmart.pdf` contains both the user guide and the commented code.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Yuhua Li for providing the matlab code of the *BEPS* method.

The authors would also like to thank the anonymous referees for their valuable comments and helpful suggestions. The work is

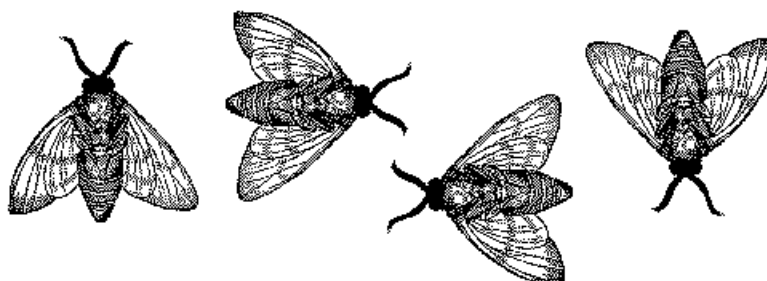


Figure 3: A sample black and white graphic that needs to span two columns of text.

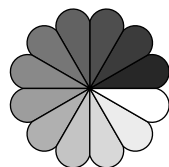


Figure 4: A sample black and white graphic that has been resized with the `includegraphics` command.

supported by the National Natural Science Foundation of China under Grant No.: 61273304 and Young Scientists' Support Program (<http://www.nnsf.cn/youngscientists>).