

# SIG Proceedings Paper in LaTeX Format\*

Extended Abstract<sup>†</sup>

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## 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<sup>A</sup>T<sub>E</sub>X, text tagging

### ACM Reference format:

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## 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*<sup>1</sup> implementations, *containerized* implementations, and *native installations*. The goal of the project is to understand the performance

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<sup>1</sup>**SaaS** : Software as a service.

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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 four 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

- (1) **AWS *SaaS* system(s)**
- (2) **Virtualization using Docker containers**
- (3) **Virtualization on AWS’s EC2 VMs**
- (4) **Dedicated, non-virtualized machines**

These four systems will be deployed using several different platforms which we will describe in the next part of this section.

### 2.2 Platforms

We have chosen three different platforms on which to deploy our systems. The chosen platforms span the range of cloud service paradigms from *SaaS* to *PaaS*<sup>2</sup> to *IaaS*<sup>3</sup>. We list the three platforms, along with two variations on one of the platforms, below

- **AWS’s DynamoDB Service (*SaaS*)**
- **Containerized implementations (using *Docker*) running on**
  - **AWS’s Container Service (*PaaS*)**

<sup>2</sup>**PaaS** : Platform as a service.

<sup>3</sup>**IaaS** : Infrastructure as a service.

– *AWS EC2 Machines running the docker run-time in Linux* (hybrid *Pass/IaaS*)

- **AWS EC2 Machines running native installations of the software in Linux** (*IaaS*)

In the next section, we list which systems will run each software package, along with a 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.

### 3 DEPLOYMENT

#### 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  $\begin{math} \dots \end{math}$  construction or with the short form  $\$ \dots \$$ . You can use any of the symbols and structures, from  $\alpha$  to  $\omega$ , 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:

$$\lim_{n \rightarrow \infty} x = 0 \quad (1)$$

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:

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

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

**Table 1: Frequency of Special Characters**

Non-English or Math	Frequency	Comments
Ø	1 in 1,000	For Swedish names
$\pi$	1 in 5	Common in math
\$	4 in 5	Used in business
$\Psi_1^2$	1 in 40,000	Unexplained usage

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 Lammport [? ].

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 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 pdf $\LaTeX$ , 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*.

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 1: A sample black and white graphic.

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

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`!

### 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  $\text{\LaTeX}$  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 $\text{\TeX}$ Expert.

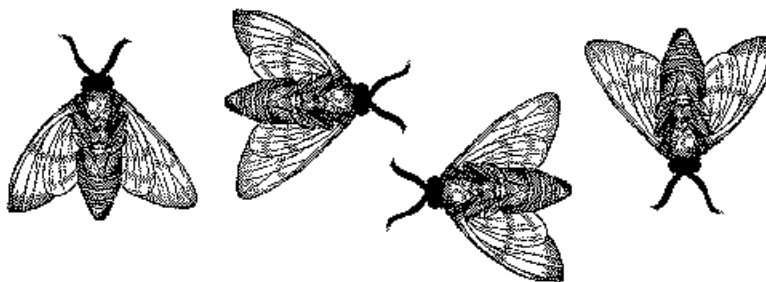


Figure 3: A sample black and white graphic that needs to span two columns of text.

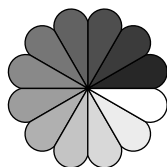


Figure 4: A sample black and white graphic that has been resized with the `includegraphics` command.

### 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

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