

# LaTeX

# Workshop



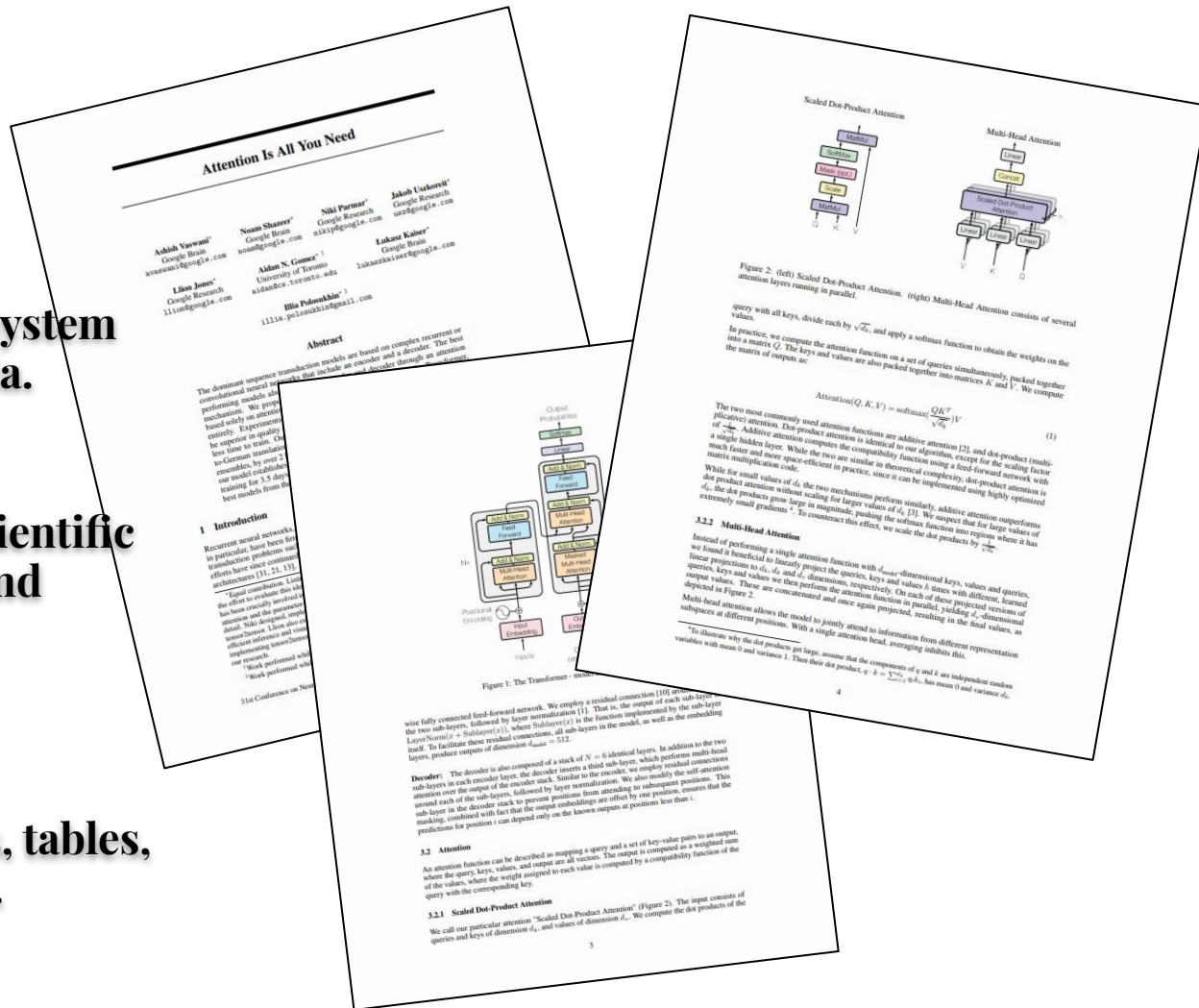
Universiteit Leiden

**By Dalia Kamal Zadeh & Koorosh Komeili Zadeh**

What is LaTeX?

# What is LaTeX?

1. **LaTeX is a typesetting system widely used in academia.**
2. **Essential for writing scientific papers, assignments, and reports.**
3. **Supports complex mathematical formulas, tables, citations, and graphics.**



# Why Use LaTeX?

## 1. Professional Quality:

Documents look polished, standardized.

## 2. Powerful for Math:

Handles formulas and equations easily.

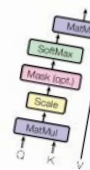
## 3. Efficient:

Automates numbering, references, and layouts.

## 4. Widely Used:

Academic fields require LaTeX for papers.

Scaled Dot-Product Attention



Multi-Head Attention

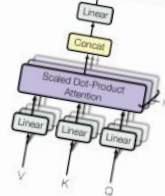


Figure 2: (left) Scaled Dot-Product Attention. (right) Multi-Head Attention consists of several attention layers running in parallel.

query with all keys, divide each by  $\sqrt{d_k}$ , and apply a softmax function to obtain the weights on the values. In practice, we compute the attention function on a set of queries simultaneously, packed together into a matrix  $Q$ . The keys and values are also packed together into matrices  $K$  and  $V$ . We compute the matrix of outputs as:

$$\text{Attention}(Q, K, V) = \text{softmax}\left(\frac{QK^T}{\sqrt{d_k}}\right)V \quad (1)$$

The two most commonly used attention functions are additive attention [2], and dot-product (multiplicative) attention. Dot-product attention is identical to our algorithm, except for the scaling factor of  $\frac{1}{\sqrt{d_k}}$ . Additive attention computes the compatibility function using a feed-forward network with a single hidden layer. While the two are similar in theoretical complexity, dot-product attention is much faster and more space-efficient in practice, since it can be implemented using highly optimized matrix multiplication code.

While for small values of  $d_k$  the two mechanisms perform similarly, additive attention outperforms dot product attention without scaling for larger values of  $d_k$  [3]. We suspect that for large values of  $d_k$ , the dot products grow large in magnitude, pushing the softmax function into regions where it has extremely small gradients\*. To counteract this effect, we scale the dot products by  $\frac{1}{\sqrt{d_k}}$ .

### 3.2.2 Multi-Head Attention

Instead of performing a single attention function with  $d_{\text{model}}$ -dimensional keys, values and queries, we found it beneficial to linearly project the queries, keys and values  $h$  times with different, learned linear projections to  $d_k$ ,  $d_k$  and  $d_v$  dimensions, respectively. On each of these projected versions of queries, keys and values we then perform the attention function in parallel, yielding  $d_v$ -dimensional output values. These are concatenated and once again projected, resulting in the final values, as depicted in Figure 2.

Multi-head attention allows the model to jointly attend to information from different representation subspaces at different positions. With a single attention head, averaging inhibits this.

\*To illustrate why the dot products get large, assume that the components of  $q$  and  $k$  are independent random variables with mean 0 and variance 1. Then their dot product,  $q \cdot k = \sum_{i=1}^{d_k} q_i k_i$ , has mean 0 and variance  $d_k$ .

## **Today's Topics:**

**1- File structure**

**2- Start Coding**

**3- Installing Python**

**4- Installing Start**

**5- Installing IDE**

**6- Lab exercise 1**

---

# Getting Started with LaTeX

Well...! Overleaf



## Step-by-Step Guide:

- Go to [overleaf.com](https://overleaf.com)
- Create an account or log in with university credentials.
- Start a new project and choose a template (e.g., article or report).

Source Rich Text

Recompile



```

1 \section{Introduction} \label{sec:intro}
2
3 \latex\ \footnote{\url{http://www.latex-project.org/}} is a
4 document markup
5 language that is particularly well suited for the publication
6 of
7 mathematical and scientific articles \citep[lamport94]. \latex\
8 was written
9 in 1985 by Leslie Lamport who based it on the \TeX\ typesetting
10 language
11 which itself was created by Donald E. Knuth in 1978. In 1988 a
12 suite of
13 \latex\ macros were developed to investigate electronic
14 submission and
15 publication of AAS Journal articles
16 \citep{1989BAAS...21..780H}. Shortly
17 afterwards, Chris Biemesderfer merged these macros and more into
18 a \latex\
19 2.08 style file called \aastex. These early \aastex\ versions
20 introduced
21 many common commands and practices that authors take for
22 granted today.
23 Substantial revisions
24 were made by Lee Brotzman and Pierre Landau when the package
25 was updated to
26 v4.0. AASTeX v5.0, written in 1995 by Arthur Ogawa, upgraded
27 to \latex\ 2e
28 which uses the document class in lieu of a style file. Other
29 improvements
30 to version 5 included hypertext support, landscape deluxetables
31 and
32 improved figure support to facilitate electronic submission.
33 \aastex\ v5.2 was released in 2005 and introduced additional
34 graphics
35 support plus new mark up to identifier astronomical objects,

```

DRAFT VERSION SEPTEMBER 1, 2022  
Typeset using L<sup>A</sup>T<sub>E</sub>X default style in AASTeXv5.2

# Template AASTeX PASP Article with Examples: v6.3.1\*

JEFFREY G. MANGUM<sup>1</sup>

(PASP EDITOR-IN-CHIEF)

DANIEL FABRICANT<sup>2,3</sup>

<sup>1</sup>National Radio Astronomy Observatory

North American ALMA Science Center

580 Edgemont Road

Charlottesville, VA 22903, USA

<sup>2</sup>Southwestern Astrophysical Observatory

<sup>3</sup>PASP Associate Editor

## ABSTRACT

This example manuscript is intended to serve as a tutorial and template for authors to use when writing their own PASP Journal articles. This template is a modified version of the AASTeX Template for submissions to AAS Journals: <https://www.overleaf.com/latex/templates/aastex-template-for-submissions-to-aas-journals-apj-a-j-apjs-apjl-paj-rnaas/vwygggqvhcgg>. The manuscript includes a history of AASTeX and includes figure and table examples to illustrate these features. Information on features not explicitly mentioned in the article can be viewed in the manuscript comments or more extensive online documentation. Authors are welcome to replace the text, tables, figures, and bibliography with their own and submit the resulting manuscript to the PASP peer review system. The first lesson in the tutorial is to remind authors that PASP has a 300 word limit for the abstract<sup>1</sup>. If you exceed this length we may rescind the manuscript and ask you to re-write it. This abstract has 144 words.

**Keywords:** Classical Novae (251) — Ultraviolet astronomy(1736) — History of astronomy(1868) — Interdisciplinary astronomy(804)

## 1. INTRODUCTION

L<sup>A</sup>T<sub>E</sub>X<sup>1</sup> is a document markup language that is particularly well suited for the publication of mathematical and scientific articles (Lamport 1994). L<sup>A</sup>T<sub>E</sub>X was written in 1985 by Leslie Lamport who based it on the T<sub>E</sub>X typesetting language which itself was created by Donald E. Knuth in 1978. In 1988 a suite of L<sup>A</sup>T<sub>E</sub>X macros were developed to investigate electronic submission and publication of AAS Journal articles (Hanisch & Biemesderfer 1989). Shortly afterwards, Chris Biemesderfer merged these macros and more into a L<sup>A</sup>T<sub>E</sub>X 2.08 style file called AASTeX. These early AASTeX versions introduced many common commands and practices that authors take for granted today. Substantial revisions were made by Lee Brotzman and Pierre Landau when the package was updated to v4.0. AASTeX v5.0, written in 1995 by Arthur Ogawa, upgraded to L<sup>A</sup>T<sub>E</sub>X 2e which uses the document class in lieu of a style file. Other improvements to version 5 included hypertext support, landscape deluxetables and improved figure support to facilitate electronic submission. AASTeX v5.2 was released in 2005 and introduced additional graphics support plus new mark up to identifier astronomical objects, datasets and facilities. In 1996 Maxim Markevich modified the AAS preprint style file, aaspp4sty, to closely emulate the very tight, two column style of a typeset Astrophysical Journal article. The result was emulateapj.sty. A year later Alexey Vikhlinin

\* Released on March, 1st, 2021

<sup>1</sup> Abstracts for Publications of the Astronomical Society of the Pacific are limited to 300 words

<sup>2</sup> <http://www.latex-project.org/>



Template

IEEEtran

imag

appendix.tex

biblio.bib

dataset\_and\_featu...

intro.tex

model.tex

File outline

Introduction

```

1 % !TEX root = template.tex
2
3 \section{Introduction}
4 \label{sec:introduction}
5
6 Artificial Neural Networks (ANN) are powerful learning
  algorithms inspired by the brain to store information
  \cite{hl}. Similar to the human brain, ANN is based on
  a collection of neurons with many connections between
  them. Neural networks have been used to find unknown
  relationships between various parameters based on large
  numbers of examples. Examples of successful
  applications of neural networks are object detection,
  image classification, computer vision, speech
  recognition. Moreover, neural networks are more and
  more used in medical applications. There are many types
  of neural networks architectures. Examples of various
  types of neural networks are the Hopfield network, the
  multilayer perceptron, the Boltzmann machine, and the
  Kohonen network.
7
8 In this homework, the focus is on two different neural
  networks for solving two kinds of supervised learning
  problems. For this reason, the analysis will be divided
  into two building blocks:
9
10 \begin{enumerate}
11 \item Regression Task

```

Homework 1: Supervised Deep Learning

Eugenia Anello<sup>1</sup>

1. INTRODUCTION

Artificial Neural Networks (ANN) are powerful learning algorithms inspired by the brain to store information [1]. Similar to the human brain, ANN is based on a collection of neurons with many connections between them. Neural networks have been used to find unknown relationships between various parameters based on large numbers of examples. Examples of successful applications of neural networks are object detection, image classification, computer vision, speech recognition. Moreover, neural networks are more and more used in medical applications. There are many types of neural networks architectures. Examples of various types of neural networks are the Hopfield network, the multilayer perceptron, the Boltzmann machine, and the Kohonen network. In this homework, the focus is on two different neural networks for solving two kinds of supervised learning problems. For this reason, the analysis will be divided into two building blocks:

- Regression Task
- Classification Task

The first architecture proposed is a simple neural network to solve a regression problem. In this regression task, the goal is to train a neural network that approximates an unknown function. As training point, there are only noisy measures from the target function.

The second and last explored model is the convolutional neural network to classify MNIST handwritten digits into one of 10 classes representing integer values from 0 to 9, inclusively. This last dataset, called MNIST, consists of 70,000 images of handwritten digits. To find the best architectures in both problems, the hyperparameters were tuned using Optuna, an automatic hyperparameter optimization software framework. The advantage of Optuna is that it allows to define search spaces for the hyperparameters dynamically and uses pruning to discard low-quality trials easily. Through this approach, different optimizers and regularization methods were considered. In both tasks, k fold cross validation was implemented to evaluate the final performance of the models. The report is structured as follows. In Section 2, there are details about the methodology applied. In Section 3, there are the results. An appendix is

one model for each SL problem to solve. Google Colab was the environment used to train and evaluate the models.

*A. Regression task*

Before building the neural network, the training dataset was splitted into 80 samples for the training set and 20 samples for the validation set, while the test set remains composed by 100 samples. The structure of the neural network proposed includes three fully connected layers, in which each of them have respectively 26, 88, 38 hidden units and ELU as activation, and an output layer, that returns an output value corresponding to the prediction of the response variable.

Layers	Input Shape	Output Shape	Activation function
Input Layer	1	26	ELU
Hidden Layer 1	26	88	ELU
Hidden Layer 2	88	38	ELU
Output Layer	30	1	-

TABLE 1: ANN architecture

The hyperparameters of the model are selected using a hyperparameter optimization framework, called Optuna [2]. The range and optimal values of these hyperparameters selected for the model are shown in Table 2.

Hyperparameter	Range	Optimal Value
Learning rate	[0.00001-0.01]	0.07
Train batch size	[2-10]	4
Optimizer	[Adam,Adadelta,Adagrad,RMSprop,SGD]	Adagrad
Number of linear layers	[1,2,3]	3
Number of units for input layer	[4-128]	26
Number of units for first hidden layer	[4-128]	88
Number of units for second hidden layer	[4-128]	38

TABLE 2: The range and optimal values of hyperparameters for NN.

Multiple values were tried for the Learning rate between 0.00001 and 0.01.



LaTeX

Basics

## Document Structure:

- `\documentclass{article}`
- `\begin{document}`
- `\end{document}`

**Packages:** Extend functionality. Example:

`\usepackage{amsmath}` for advanced math.

**Comments:** `%` for inline comments.

## Inline Equations:

`\( a^2 + b^2 = c^2 \)`

## Displayed Equations:

`\begin{equation} E = mc^2`  
`\end{equation}`

## Common Math Symbols:

`\frac`, `\sum`, `\int`, `\alpha`, `\pi`

Examples for Calculus:

derivatives, integrals, limits.

# LaTeX Basics and Writing Math in LaTeX

## Document Structure:

- `\documentclass{article}`
- `\begin{document}`
- `\end{document}`

**Packages:** Extend functionality.

Example: `\usepackage{amsmath}` for advanced math.

**Comments:** `%` for inline comments.

**Inline Equations:** `\( a^2 + b^2 = c^2 \)`

**Displayed Equations:** `\begin{equation} E = mc^2 \\ \end{equation}`

**Common Math Symbols:** `\frac`, `\sum`, `\int`, `\alpha`, `\pi`

Examples for Calculus: derivatives, integrals, limits.

## Writing Math in LaTeX

### Inline Equations

An inline equation example:  $a^2 + b^2 = c^2$ .

### Displayed Equations

Displayed equations are written in their own line, like this:

$$E = mc^2$$

### Common Math Symbols

Some common math symbols in LaTeX:

- Fractions: `\frac{a}{b}` produces  $\frac{a}{b}$
- Summation: `\sum` produces  $\sum$
- Integral: `\int` produces  $\int$
- Greek Letters: `\alpha` produces  $\alpha$ , `\pi` produces  $\pi$

### Examples for Calculus

You can write calculus-related expressions using LaTeX:

1. Derivatives:  $\frac{dy}{dx}$
2. Integrals:  $\int_0^1 x^2 dx$
3. Limits:  $\lim_{x \rightarrow 0} \frac{1}{x}$

# Structuring Your Document

- **Sections and Subsections:**

- `\section{Introduction}`
- `\subsection{Background}`

- **Lists:**

- **Itemized:**

```
\begin{itemize}
    \item Fractions
\end{itemize}
```

- **Numbered:**

```
\begin{enumerate}
    \item Derivatives
\end{enumerate}
```

## Writing Math in LaTeX

## Section

### Inline Equations

An inline equation example:  $a^2 + b^2 = c^2$ .

### Displayed Equations

## Subsection

Displayed equations are written in their own line, like this:

$$E = mc^2$$

### Common Math Symbols

Some common math symbols in LaTeX:

- Fractions: `\frac{a}{b}` produces  $\frac{a}{b}$
- Summation: `\sum` produces  $\sum$
- Integral: `\int` produces  $\int$
- Greek Letters: `\alpha` produces  $\alpha$ , `\pi` produces  $\pi$

} **Itemized**

### Examples for Calculus

You can write calculus-related expressions using LaTeX:

1. Derivatives:  $\frac{dy}{dx}$
2. Integrals:  $\int_0^1 x^2 dx$
3. Limits:  $\lim_{x \rightarrow 0} \frac{1}{x}$

} **Enumerated**

# Including Figures and Tables

- Figures:

- `\section{Introduction}`
- `\subsection{Background}`

- Tables:

- Itemized:

```
\begin{tabular}{|c|c|}  
\hline Column 1 & Column 2 \\\hline\end{tabular}
```

## Including Figures and Tables

### Figures

To include a figure in LaTeX, use the `figure` environment:

```
\begin{figure}  
\includegraphics{image.png}  
\caption{A sample figure}  
\end{figure}
```

Example usage in the document:



Figure 1: A sample figure

### Tables

Tables in LaTeX are created using the `tabular` environment. You can create tables with various types of data, including text, numbers, and percentages, and even format them for readability.

```
\begin{tabular}{|c|c|c|c|}  
\hline  
Name & Age & Score & Improvement (\%) \\\hline  
Alice & 21 & 85 & 5.5 \\  
Bob & 22 & 90 & 7.2 \\  
Charlie & 20 & 78 & 4.1 \\  
Diana & 23 & 92 & 6.8 \\  
\hline\end{tabular}
```

Here is how it looks:

Name	Age	Score	Improvement (%)
Alice	21	85	5.5
Bob	22	90	7.2
Charlie	20	78	4.1
Diana	23	92	6.8

Table 1: Sample table with fictional data

Tables can be customized further with more formatting options, colors, and styles.

# Bibliography and Citations

- **Using BibTeX:**

To automatically manage citations:

```
\bibliography{references}
```

- **Citations:**

For in-text citations: `\cite{reference}`

- **References list:**

Manage reference details.

File: `references.bib`

```
@article{exampleReference,  
  author = {Edsger W. Dijkstra},  
  title = {Sample Paper},  
  journal = {Journal of Examples},  
  year = {2002}  
}
```

## Bibliography and Citations

In LaTeX, managing references and citations is streamlined using BibTeX, allowing automatic formatting and management of your bibliography.

### Using BibTeX

To include a bibliography in your document, add the following commands where you want the bibliography to appear:

```
\bibliography{references}  
\bibliographystyle{plain}
```

This will pull references from a separate `references.bib` file, which should be stored in the same directory or properly referenced.

### Citations

Citations are made easily by placing the reference key inside the command like this:

```
\cite{reference}
```

### Sample Citations

Here are some examples of how you can cite notable works:

"Raise your quality standards as high as you can live with, avoid wasting your time on routine problems, and always try to work as closely as possible at the boundary of your abilities. Do this, because it is the only way of discovering how that boundary should be moved forward." [1]

"The dominant sequence transduction models are based on complex recurrent or convolutional neural networks that include an encoder and a decoder. The best performing models also connect the encoder and decoder through an attention mechanism. We propose a new simple network architecture, the Transformer, based solely on attention mechanisms, dispensing with recurrence and convolutions entirely." [2]

### References

[1] Edsger W. Dijkstra. *Selected Writings on Computing: A Personal Perspective*. Springer-Verlag, 1982.

[2] Ashish Vaswani, Noam M. Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Lukasz Kaiser, and Illia Polosukhin. Attention is all you need. In *Neural Information Processing Systems*, 2017.

# Overleaf Advanced Features



## Collaboration:

Work with peers in real-time.

## Version Control:

Track document changes over time.

## Templates:

Find templates for articles,  
assignments, and reports.

---



# Tips for LaTeX

**Practice:** Start with simple documents and take a note via LaTeX.

**Resources:**

- LaTeX Wikibook
- Overleaf documentation.

**Ask for Help:** LaTeX communities or Language Models.

---

# Hands-On Practice

Walk through creating a simple document together on Overleaf.

Write some math equations, insert an image, and create a table.

# Final Questions & Feedback

Q&A Session

Feedback

---

Thanks  
See you soon!