

# LaTeX Example Doc

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CS 800

*Current draft: 2/8/26 at 3:53pm EST*

Look at the source main.tex to see how this is done.

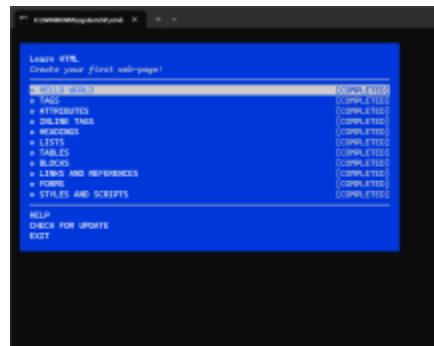
## 1 URIs

- **Webpage:** [https://www.cs.odu.edu/~cs\\_aacha003/](https://www.cs.odu.edu/~cs_aacha003/)
- **LinkedIn:** <https://www.linkedin.com/in/acharya-ashish>
- **Google Scholar:** <https://scholar.google.com/citations?user=x0WXuPwAAAAJ&hl=en>
- **ORCID:** <https://orcid.org/0009-0000-7571-6802>

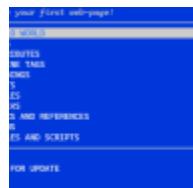
## 2 Images

All figures must have a caption and must be referenced in the text. See the example below.

Figure 1 shows an original PNG with no scaling or cropping. Figure 2 shows an example of cropping the image using the `trim`, `clip` options to `includegraphics`.

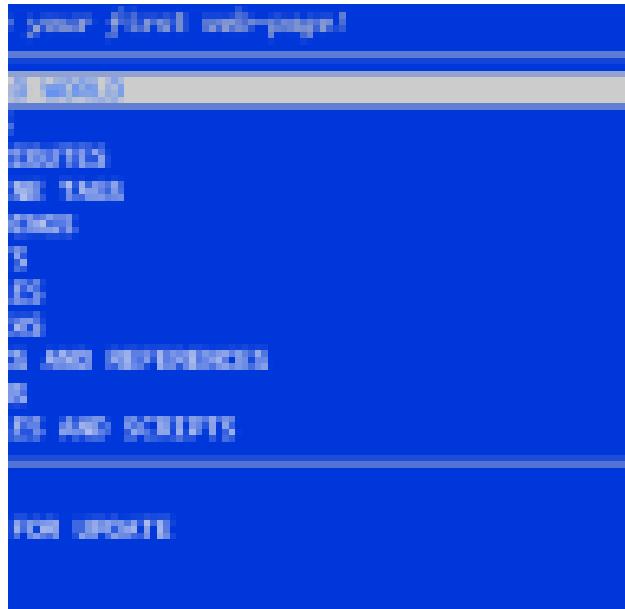


**Figure 1:** Original PNG



**Figure 2:** Cropped PNG - 0.25in from left, 0.5in from bottom, 1in from right, 0.3in from top

Figure 3 shows the same cropping as Figure 2 but scaled up. It's blurry because the original image (Figure 1 was a low resolution.)

**Figure 3:** Cropped and scaled PNG

We can insert PDFs into the document in the same way as images. Figure 4 is the first page of an academic paper. I've added the `\frame` command to show where the boundaries are. Figure 5 shows the margins trimmed off so that the text can be larger (scaled up).

### 3 Quotation Marks

Quotation marks are weird in LaTeX. Here's using "double quotes". *Not quite right.* Here's the "proper way". It's two backticks and two single quotes: ‘‘proper way’’

### 4 Tables

Table 1 shows a simple example table. Table 2 shows an example confusion matrix from [https://en.wikipedia.org/wiki/Confusion\\_matrix](https://en.wikipedia.org/wiki/Confusion_matrix). This employs rows that span multiple columns (multicol) and columns that span multiple rows (multirow).

**Table 1:** Simple Table

Week	Date	Topic
1	Sep 1, 3	Introduction, What's Vis and Why Do It?
2	Sep 8, 10	Data and Data Cleaning
3	Sep 15, 17	Marks and Channels

**Table 2:** Example Confusion Matrix from Wikipedia

		Actual	
		Cat	Dog
Predicted	Cat	5 (TP)	3 (FP)
	Dog	2 (FN)	3 (TN)

## 1 Introduction

Recurrent neural networks, long short-term memory [13] and gated recurrent [7] neural networks in particular, have been firmly established as state of the art approaches in sequence modeling and transduction problems such as language modeling and machine translation [35, 2, 5]. Numerous efforts have since continued to push the boundaries of recurrent language models and encoder-decoder architectures [38, 24, 15].

Recurrent models typically factor computation along the symbol positions of the input and output sequences. Aligning the positions to steps in computation time, they generate a sequence of hidden states  $h_t$ , as a function of the previous hidden state  $h_{t-1}$  and the input for position  $t$ . This inherently sequential nature precludes parallelization within training examples, which becomes critical at longer sequence lengths, as memory constraints limit batching across examples. Recent work has achieved significant improvements in computational efficiency through factorization tricks [21] and conditional computation [32], while also improving model performance in case of the latter. The fundamental constraint of sequential computation, however, remains.

Attention mechanisms have become an integral part of compelling sequence modeling and transduction models in various tasks, allowing modeling of dependencies without regard to their distance in the input or output sequences [2, 19]. In all but a few cases [27], however, such attention mechanisms are used in conjunction with a recurrent network.

In this work we propose the Transformer, a model architecture eschewing recurrence and instead relying entirely on an attention mechanism to draw global dependencies between input and output. The Transformer allows for significantly more parallelization and can reach a new state of the art in translation quality after being trained for as little as twelve hours on eight P100 GPUs.

## 2 Background

The goal of reducing sequential computation also forms the foundation of the Extended Neural GPU [16], ByteNet [18] and ConvS2S [9], all of which use convolutional neural networks as basic building block, computing hidden representations in parallel for all input and output positions. In these models, the number of operations required to relate signals from two arbitrary input or output positions grows in the distance between positions, linearly for ConvS2S and logarithmically for ByteNet. This makes it more difficult to learn dependencies between distant positions [12]. In the Transformer this is reduced to a constant number of operations, albeit at the cost of reduced effective resolution due to averaging attention-weighted positions, an effect we counteract with Multi-Head Attention as described in section 3.2.

Self-attention, sometimes called intra-attention is an attention mechanism relating different positions of a single sequence in order to compute a representation of the sequence. Self-attention has been used successfully in a variety of tasks including reading comprehension, abstractive summarization, textual entailment and learning task-independent sentence representations [4, 27, 28, 22].

End-to-end memory networks are based on a recurrent attention mechanism instead of sequence-aligned recurrence and have been shown to perform well on simple-language question answering and language modeling tasks [34].

To the best of our knowledge, however, the Transformer is the first transduction model relying entirely on self-attention to compute representations of its input and output without using sequence-aligned RNNs or convolution. In the following sections, we will describe the Transformer, motivate self-attention and discuss its advantages over models such as [17, 18] and [9].

## 3 Model Architecture

Most competitive neural sequence transduction models have an encoder-decoder structure [5, 2, 35]. Here, the encoder maps an input sequence of symbol representations  $(x_1, \dots, x_n)$  to a sequence of continuous representations  $\mathbf{z} = (z_1, \dots, z_n)$ . Given  $\mathbf{z}$ , the decoder then generates an output sequence  $(y_1, \dots, y_n)$  of symbols one element at a time. At each step the model is auto-regressive [10], consuming the previously generated symbols as additional input when generating the next.

**Figure 4:** Inserted PDF

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**Figure 5:** Trimmed PDF