

## L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> Homework Class Documentation & Testing

**Question 1.** What is this document?

This is a demonstration of my homework class aiming to ease a few of the *hassles* of L<sup>A</sup>T<sub>E</sub>X. It is an extension of the *American Mathematical Society (AMS) Journal Article* (`amsart`) class and should have all of its functionality.

**Question 2.** What preamble commands does the class have?

We have all that AMS article has, the preamble for this document had:

---

```

1  ...
2  \author{Musa Al'Khwarizmi}
3  \class{CS 3141: Prof. Kamil's Algorithm Analysis}
4  \date{\today}
5  \title{Homework Class Test}
6  \address{Bayt El-Hikmah}
7  ...

```

---

**Question 3.** What symbol shortcuts does it have?

It has the symbols shown in table 1,

Macro	Symbol	Macro	Symbol
<code>\C</code>	$\mathbb{C}$	<code>\floor{\frac{x}{2}}</code>	$\left\lfloor \frac{x}{2} \right\rfloor$
<code>\R</code>	$\mathbb{R}$	<code>\ceil{\frac{x}{2}}</code>	$\left\lceil \frac{x}{2} \right\rceil$
<code>\Q</code>	$\mathbb{Q}$	<code>\near{\frac{x}{2}}</code>	$\nearrow \frac{x}{2}$
<code>\Z</code>	$\mathbb{Z}$	<code>\arr{\frac{x}{2}}</code>	$\langle \frac{x}{2} \rangle$
<code>\N</code>	$\mathbb{N}$	<code>\paren{\frac{x}{2}}</code>	$\left( \frac{x}{2} \right)$
<code>\P</code>	$\mathbb{P}$	<code>\brk{\frac{x}{2}}</code>	$\left[ \frac{x}{2} \right]$
<code>\F</code>	$\mathbb{F}$	<code>\curl{\frac{x}{2}}</code>	$\left\{ \frac{x}{2} \right\}$
<code>\GF, \GF[7]</code>	$\mathbb{F}_2, \mathbb{F}_7$	<code>\abs{\frac{x}{2}}</code>	$\left  \frac{x}{2} \right $
<code>\O</code>	$\emptyset$	<code>\modulo[7]</code>	$\mathbb{Z}/7\mathbb{Z}$
<code>\O(n)</code>	$\mathcal{O}(n)$	<code>\vec{v}</code>	$\vec{v}$
<code>\?</code>	$\stackrel{?}{=}$	<code>\bijective</code>	$\hookrightarrow$
<code>\is</code>	$\equiv$	<code>\surjective</code>	$\twoheadrightarrow$
<code>\al</code>	$\alpha$	<code>\injective</code>	$\hookleftarrow$
<code>\ep</code>	$\varepsilon$	<code>\Ra</code>	$\Rightarrow$
<code>\phi</code>	$\varphi$	<code>\ra</code>	$\rightarrow$
<code>\p</code>	$\partial$	<code>\derivative[g]{f}</code>	$\frac{df}{dg}$
<code>\D</code>	$d$	<code>\derivative{\zeta}</code>	$\frac{d\zeta}{dx}$

Table 1. Symbols table.

The commands that have twin delimiters expand according to their input,

$$[x], [y], [z], \langle x, y, z \rangle, \left\lfloor \frac{x}{2} \right\rfloor < \frac{x}{2} < \left\lceil \frac{x}{2} \right\rceil, \left\lfloor \frac{x}{2} \right\rfloor, \left\langle \frac{x}{2}, \frac{x}{3}, \frac{x}{4} \right\rangle, \left( \frac{x}{2}, \frac{x}{3}, \frac{x}{4} \right), \left[ \frac{x}{2}, \frac{x}{3}, \frac{x}{4} \right], \left\{ \frac{x}{2}, \frac{x}{3}, \frac{x}{4} \right\}, \left| \frac{x}{2} \right|$$

**Question 4.** Are pictures still a pain though?

No! we have,

```
\img<label>[width]{caption}{path/f0, path/f1, ... , path/fn}
```

Or, you can set the path to all the images once with `\graphicspath{{path}}` in the preamble and then you can do,

```
\img<label>[width]{caption}{f0, f1, ... , fn}.
```

We did `\graphicspath{{../media/}}` with,

```
\img<trio>[0.2]{Al'Khwarizmi}{khwarizmi, kitab, page}
```

to get the figure 1.

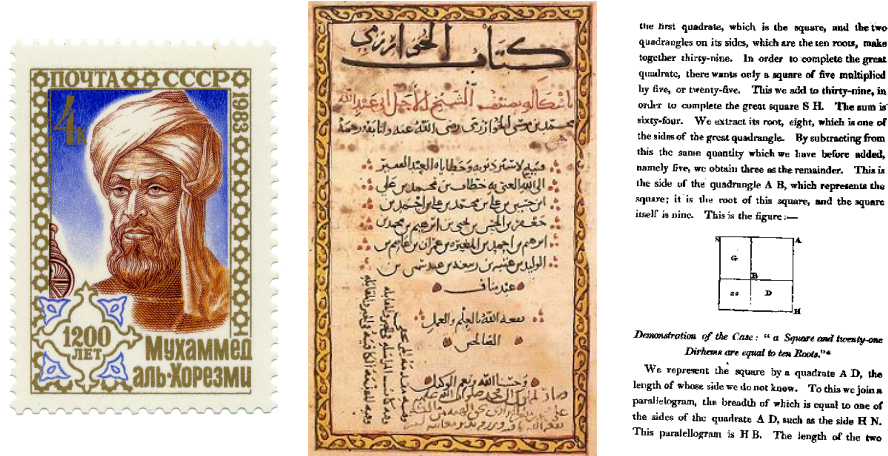


FIGURE 1. Al'Khwarizmi

**Question 5.** What about tables?

The following code to the left gets you the table 2.

```
\tbl<smptb>{Sample table.} {
  Linear & Polynomial & Exponential \\
  $x$ & $x^2$ & $2^x$ \\
  1 & 1 & 2 \\
  2 & 4 & 4 \\
  3 & 9 & 8 \\
  4 & 16 & 16 \\
  5 & 25 & 32 \\
  6 & 36 & 64 \\
  7 & 49 & 127 \\
}
```

Linear	Polynomial	Exponential
$x$	$x^2$	$2^x$
1	1	2
2	4	4
3	9	8
4	16	16
5	25	32
6	36	64
7	49	127

TABLE 2. Sample table.

**Question 6.** Do we have all AMS article environments?

Yes! E. g., the proof environment. Note the fancy *Q.E.D* symbol.

```
\begin{proof}
  Four is the sum of two integers.
```

```
  $1,3 \in \mathbb{Z}$ and $1+3=4$.
```

```
\end{proof}
```

*Proof.* Four is the sum of two integers.

$1, 3 \in \mathbb{Z}$  and  $1 + 3 = 4$ .

**Question 7.** To show citations and references to custom labels: What is the cardinality of  $\mathbb{N}$ ?

It is  $\aleph_0$  [1] (`\cite{arlinghaus1996part}`). See also question IX (`\ref{custom-index}`).

**Question 8.** What headlines does this class have?

We have the following hierarchy of headlines:

- 1) `\question[custom-ind]`
- 2) `\section{name}`
- 3) `\subsection{name}`
- 4) `\subsubsection{name}`.

Since we inherited all the section commands from AMS article, we can also use their starred variants. We demonstrate these bellow,

## 8.1. SECTION

### 8.1.1. Subsection.

### 8.1.2. Subsection.

## 8.2. ANOTHER SECTION

### 8.2.1. Subsection.

*Subsubsection.* This is a started section.

8.2.1.1. *Subsubsection.* We end here.

**Question 9.** Are all headlines preceded by the question number they are under?

Yes, they are preceded by the index of question they are under.

## 9.1. SECTION

### 9.1.1. Subsection.

## 9.2. ANOTHER SECTION

### 9.2.1. Subsection.

9.2.1.1. *Subsubsection.*

9.2.1.2. *Subsubsection.* We end here.

**Question IX.** Is the cardinality of Naturals and Reals the same because they are both infinite?

No, the cardinality of  $\mathbb{R}$  is greater because they are also uncountable. See also question 7.

**Question 10.** How much space does a question need at the end of a page?

Starting from the question statement, we need at least 8 lines left on the page or the question moves to next page.

[4]

[5]

[6]

[7]

[8]

### Question 11. What is a complete minimal example?

In listing 1 we show a complete document using `homework.cls`,

---

```

1  \documentclass{homework}
2  \author{Musa Al`Khwarizmi}
3  \class{CS 3141: Prof. Kamil's Algorithm Analysis}
4  \date{\today}
5  \title{Minimal Complete Document}
6  \address{Bayt El-Hikmah}
7
8  % \geometry{a5paper}
9
10 \begin{document} \maketitle
11
12 \question Write down sets in order of containment.
13
14 We pretend that equivalence classes are just numbers.
15 \[
16   \mathbb{C} \supset \mathbb{R} \supset \mathbb{Q} \supset \mathbb{Z} \supset \mathbb{N} \supset
17   \mathbb{P} \not\supset (\mathbb{GF}[7] = \text{modulo}[7]) \supset \{\emptyset\}
18 \]
19
20 \question Give an example element of  $\mathbb{O}(n)$ .
21
22 Take  $11n$  in  $\mathbb{O}(n)$ .
23
24 \question Find roots of  $x^2 - 8x = 9$ .
25
26 We proceed by factoring,
27 \begin{align*}
28   x^2 - 8x - 9 &= 9 - 9 \quad \& \text{\text{Subtract 9 on both sides.}} \quad \backslash\backslash \\
29   x^2 - x + 9x - 9 &= 0 \quad \& \text{\text{Breaking the middle term.}} \quad \backslash\backslash \\
30   x(x - 1) + 9(x - 1) &= 0 \quad \& \text{\text{Pulling out common factors.}} \quad \backslash\backslash \\
31   (x - 1)(x + 9) &= 0 \quad \& \text{\text{Pulling out common } (x - 1).} \quad \backslash\backslash \\
32   x &\in \{1, -9\} \quad \& f(x)g(x) = 0 \text{ \text{Ra } (f(x) \vee g(x)) = 0.} \\
33 \end{align*}
34
35 \question Show  $P \models NP$ .
36
37 Let  $P$  be zero... Sorry.
38 \end{document}

```

---

LISTING 1. Complete L<sup>A</sup>T<sub>E</sub>X Document

This will get you a document looking like the one in figure 2. Note that it appears bigger for illustration purposes only.

### REFERENCES

- [1] Sandra Lach Arlinghaus and SL Arlinghaus. Part ii. elements of spatial planning: Theory. merging maps: Node labeling strategies. *Unknown*, 1996.

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 June 7, 2024

### Minimal Complete Document

**Question 1.** Write down sets in order of containment.

We pretend that equivalence classes are just numbers.

$$\mathbb{C} \supset \mathbb{R} \supset \mathbb{Q} \supset \mathbb{Z} \supset \mathbb{N} \supset \mathbb{P} \not\supset (\mathbb{F}_7 = \mathbb{Z}/7\mathbb{Z}) \supset \{\emptyset\}$$

**Question 2.** Give an example element of  $\mathcal{O}(n)$ .

Take  $11n \in \mathcal{O}(n)$ .

**Question 3.** Find roots of  $x^2 - 8x = 9$ .

We proceed by factoring,

$$x^2 - 8x - 9 = 9 - 9 \quad \text{Subtract 9 on both sides.}$$

$$x^2 - x + 9x - 9 = 0 \quad \text{Breaking the middle term.}$$

$$x(x - 1) + 9(x - 1) = 0 \quad \text{Pulling out common factors.}$$

$$(x - 1)(x + 9) = 0 \quad \text{Pulling out common } (x - 1).$$

$$x \in \{1, -9\} \quad f(x)g(x) = 0 \Rightarrow (f(x) \vee g(x)) = 0.$$

**Question 4.** Show  $P \stackrel{?}{=} NP$ .

Let P be zero... Sorry.

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FIGURE 2. Out document from listing 1.