

L^AT_EX 2_ε 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^AT_EX. 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>	α	<code>\injective</code>	\hookleftarrow
<code>\ep</code>	ε	<code>\Ra</code>	\Rightarrow
<code>\phi</code>	φ	<code>\ra</code>	\rightarrow
<code>\p</code>	∂	<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.

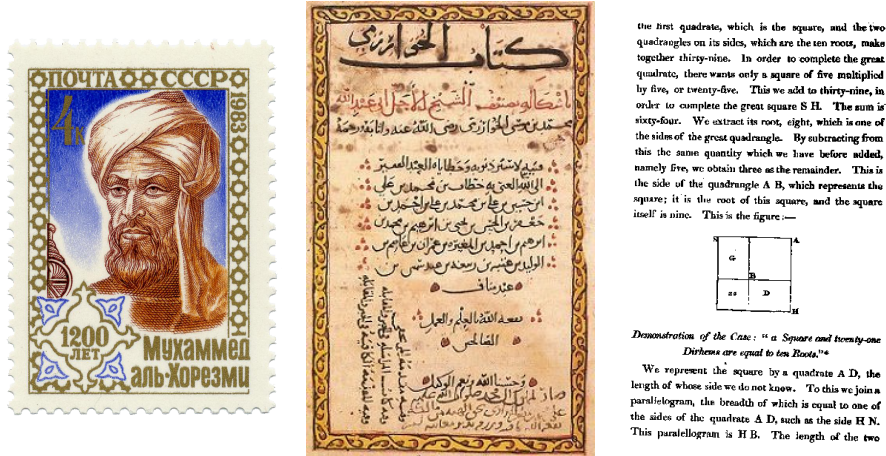


FIGURE 1. Al'Khwarizmi

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^AT_EX 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.

BAYT EL-HIKMAH

FIGURE 2. Out document from listing 1.