

Introduction to L^AT_EX

Scott Harper

16th October 2017

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- Typsetting mathematical expressions is easy.
- Content is kept separate from appearance.

3 Examples of Normal Subgroups

Find an example of $K \leq H \leq G$ such that $K \triangleleft H$ and $H \triangleleft G$ but $K \not\triangleleft G$.

SOLUTION If $G = D_8 = \langle a, b \rangle$, then $H = \langle a^2, b \rangle \triangleleft G$ since $|G : H| = 2$ and $K = \langle b \rangle \triangleleft H$ since $|H : K| = 2$, but $K \not\triangleleft G$ since $aba^{-1} = a^3b \notin \langle b \rangle$. (There are many examples; this is the smallest.)

EXTENSION A subgroup $H \leq G$ is a *characteristic subgroup* of G if $\varphi(H) = H$, for all automorphisms $\varphi \in \text{Aut}(G)$. We write $H \text{ char } G$. Prove that every characteristic subgroup of G is normal. Find an example of a normal subgroup which is not characteristic. Prove that if $K \text{ char } H$ and $H \text{ char } G$ then $K \text{ char } G$. Prove that if $K \text{ char } H$ and $H \triangleleft G$ then $K \triangleleft G$. Prove that $Z(G) \text{ char } G$. (See Sheet 2 Q6(c).)

4 Examples of Quotients

Let $N \triangleleft G$.

(i) Prove that if G is abelian, then N and G/N are abelian.

SOLUTION Let G be an abelian group. Let $x, y \in N$. Then $x, y \in G$ so $xy = yx$. Therefore, N is abelian. Now let $aN, bN \in G/N$. Then $(aN)(bN) = (ab)N = (ba)N = (bN)(aN)$ since G is abelian. Therefore, G/N is abelian.

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$\xrightarrow{\text{compilation}}$

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People used to use ---, which gives —, for parenthesis and pauses, but now people use --, which gives –

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Tip Symbols usually **gobble** all spaces after them, so L^AT_EX is fantastic! is typeset as `\LaTeX\` is fantastic!

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This is better than `\textit{maths}` because it separates the content from the appearance: you can change the definition of `\emph` later.

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2. Explain things
3. Do *not* forget lists

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I advise you always load the following packages.

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\usepackage{amsmath, amssymb, amsfonts, amsthm}
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`\[f \colon \mathbb{R} \setminus \{ 0 \} \to \mathbb{R} \]`
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⋮

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It is easy to automatically create a contents page based on the parts, sections and subsections.

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- `\cite[Theorem~2.4]{ref:Wilson09}` gives [Theorem 2.4, 1]

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`TikZ` allows you to create a huge variety of mathematical images.

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- [L^AT_EX](#) wikibook
- [Detexify](#) app
- [Manual: The BEAMER class](#)
- [Manual: The TikZ and PGF Packages](#)

Where should I look for help?

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StackExchange