LSU INFORMATION TECHNOLOGY SERVICES

Introduction to LaTeX

Xiaoxu Guan

High Performance Computing, LSU

June 21, 2017

LSU INFORMATION TECHNOLOGY SERVICES

Overview

- What are TEX and LATEX?
- What can LATEX do for us?
- Document structure
- Text formatting
- Compile a LaTeX file
- Special characters in LaTeX file
- Font types, accents, and colors
- Paragraph formatting
- Mathematics and equations
- Tables
- Including figures
- Further reading

What are TEX and LATEX?

- TEX and LATEX are **typesetting** systems;
- TEX was designed and created by **Donald Knuth** in 1978; The goal was to "produce high-quality books using a reasonably minimal amount of effort" (if you're willing to learn);
- TEX and LATEX are de facto standards for publications in academia, and have widely accepted in math, computer science, physics, and even in social sciences;
- They are **programming** macro languages. What you type is **NOT** what you see; they require the "**compilers**" to process the source TEX or LATEX code;
- LATEX means **Leslie Lamport** TEX; it contains a large collection of TEX macros and processing engines; output files in **PostScript** or **PDF**; the latest version is LATEX2ϵ;

What are TEX and LATEX?

```
\begin{equation}
\bigoint_{\partial \Omega}
{\bm D}\cdot d {\bm S } =
\bigint \mkern-10mu \bigint
\mkern-10mu
\bigint_{\Omega} \rho_{\rm f} dV,
\end{equation}

\begin{equation}
\bigoint_{C}{\bm}E \cdot d\bm{\ell}
= - \frac{d}{dt}\bigint\mkern-10mu
\bigint_{\Sigma}\bm{B }
\cdot d\bm{S}. \end{equation}

\textbf{7.3.6 Boundary Conditions}
In general, the fields, $\bm E$, $\bm
B$, $\bm D$, and $\bm H$ will be
discontinuous at a boundary between
$\ldots$
```

$$\oint_{\partial\Omega} \boldsymbol{D} \cdot d\boldsymbol{S} = \iiint_{\Omega} \rho_{\mathrm{f}} dV, \quad (1)$$

$$\oint_{C} \boldsymbol{E} \cdot d\boldsymbol{\ell} = -\frac{d}{dt} \iint_{\Sigma} \boldsymbol{B} \cdot d\boldsymbol{S}. \quad (2)$$

7.3.6 Boundary Conditions

In general, the fields, $\boldsymbol{E}$, $\boldsymbol{B}$, $\boldsymbol{D}$, and $\boldsymbol{H}$ will be discontinuous at a boundary between . . .

What can LaTeX do for us?

- Almost everything we can do on paper: book, paper, letter, report, slides, poster, and figure, etc;

What can LaTeX do for us?

- Almost everything we can do on paper: book, paper, letter, report, slides, poster, and figure, etc;

CHAPTER FIVE

A book chapter

Time Propagation of Partial Differential Equations Using the Short Iterative Lanczos Method and Finite-Element Discrete Variable Representation

Barry I. Schneider*,[1], Xiaoxu Guan[†], Klaus Bartschat[‡]

*Applied and Computational Mathematics Division, Information Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, Maryland, USA
[†]High Performance Computing, Louisiana State University, Baton Rouge, Louisiana, USA
[‡]Department of Physics and Astronomy, Drake University, Des Moines, Iowa, USA
[1]Corresponding author: e-mail address: barry.schneider@nist.gov

Contents

What can LaTeX do for us?

- Almost everything we can do on paper: book, paper, letter, report, slides, poster, and figure, etc;

PRL **103,** 213201 (2009) PHYSICAL REVIEW LETTERS week ending 20 NOVEMBER 2009

Complete Breakup of the Helium Atom by Proton and Antiproton Impact

Xiaoxu Guan* and Klaus Bartschat†

Department of Physics and Astronomy, Drake University, Des Moines, Iowa 50311, USA

(Received 5 June 2009; published 17 November 2009)

We present a fully *ab initio*, nonperturbative, time-dependent approach to describe single and double ionization of helium by proton and antiproton impact. The problem is discretized by a flexible finite-element discrete-variable representation on the radial grid. Good agreement with the most recent experimental data for absolute angle-integrated cross sections is obtained for projectile energies between 3 keV and 6 MeV. Also, angle-differential cross sections for two-electron ejection are predicted for a proton impact energy of 6 MeV. The time evaluation of the ionization process is portrayed by displaying the electron density as a function of the projectile location.

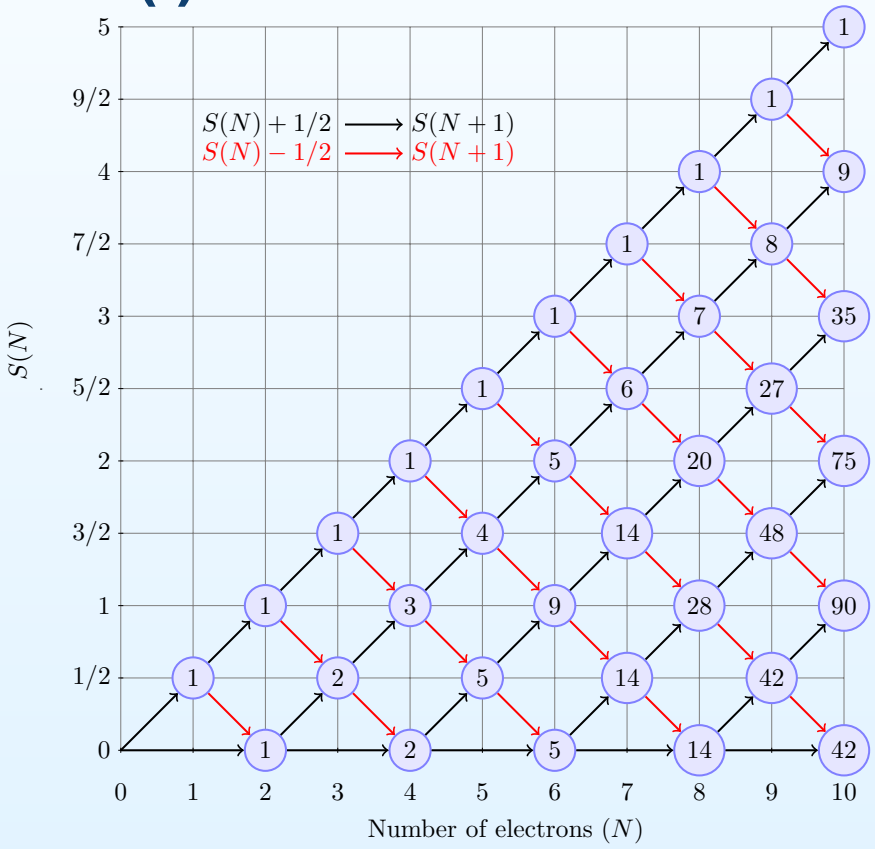
DOI: 10.1103/PhysRevLett.103.213201 PACS numbers: 34.50.Fa, 25.40.Ep, 25.43.+t, 36.10.−k

A journal paper

What can LaTeX do for us?

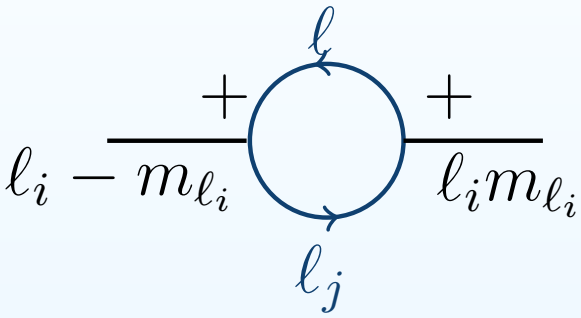
- Almost everything we can do on paper: book, paper, letter, report, slides, poster, and figure, etc;

(I)



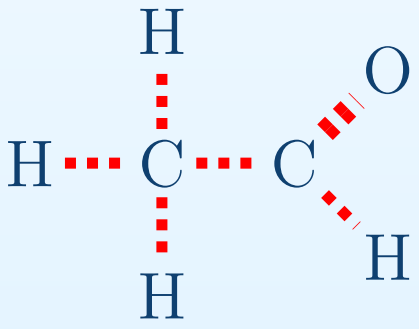
(II)

$$(-1)^{m_{\ell_i}+\ell_j+\ell}$$



$$= (-1)^{\ell_i+\ell_j+\ell}$$

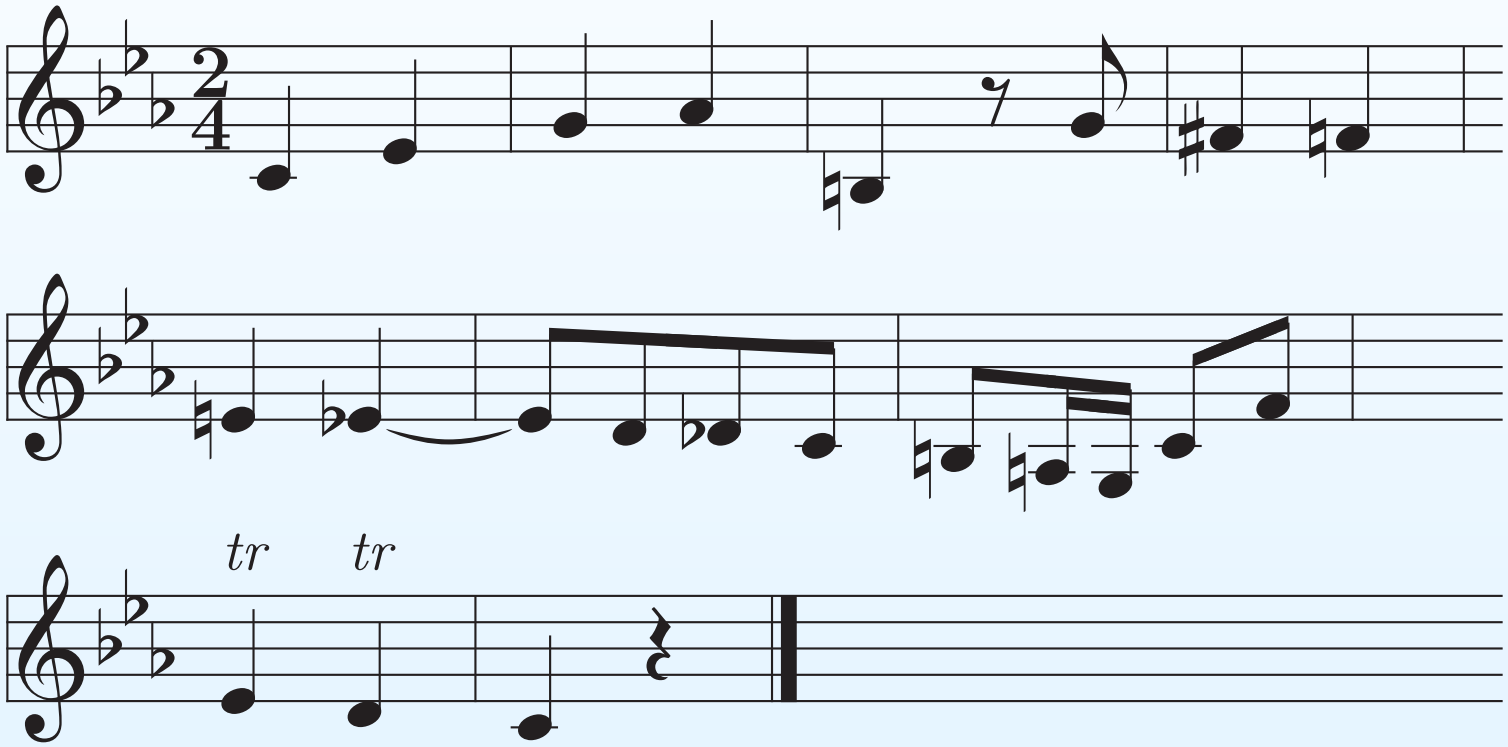
(III)



Ethanal

What can LaTeX do for us?

- Almost everything we can do on paper: book, paper, letter, report, slides, poster, and figure, etc;



(IV) A music note

Document structure

- **Global structure**:

```
1  \documentclass[...]{...}
2  ...     % preamble
3  \begin{document}
4  ...
5  \end{document}
```

- The **preamble** area is used to define new commands, load external packages, and other settings, etc; it controls the entire document;
- General form: `\documentclass[options]{class}`
- All the contexts after `\end{document}` are ignored;
- All TEX and LATEX control commands and keywords start with an `\`;

LSU INFORMATION TECHNOLOGY SERVICES

Document structure

- `class` defines what kind of document needs to be created;
- `class` needs to be one of the following `article`, `report`, `book`, `letter`, `beamer`, `proc`, `slides`, ...;
- `options` specifies the paper size, font size, orientation, number of columns, ...;
- `options` can be the combination of `10pt, 11pt, 12pt`, `a4paper`, `twocolumn`, `landscape`, ...;
- Examples:

```
\documentclass[a4paper,11pt,twoside]{article}
\documentclass[12pt,twocolumn,a4paper]{article}
\documentclass[varwidth, border=10pt]{standalone}
\documentclass[pdf,slideColor,colorBG,accumulate]
                    {prosper}
```

Document structure

- The power of LaTeX relies on the packages;

```
\usepackage[options]{graphicx}
\usepackage[options]{tikz}
\usepackage[options]{xcolor}
\usepackage[options]{amsmath}
```

- These packages allow you to include a graph, draw a figure, use color, and special AMS math fonts, etc;

```
\begin{document}
    \title{"Hello World" from LaTeX!}
    \author{John Cox}
    \date{May 27, 2004}
    \maketitle                    % Document Environment
\end{document}
```

Document structure

- The other useful environments:

```
\begin{abstract}
        ...
\end{abstract}
```

```
\begin{center}
        ...
\end{center}
```

```
\begin{minipage}{6.5cm}
        ...
\end{minipage}
```

- Sectioning commands:

```
\section{Introduction to \rm{\LaTeX}}
    ...
\section{Document structure of a \rm{\LaTeX} file }
```

```
\chapter{Introduction to \rm{\LaTeX} }
    ...
\chapter{Document structure of a \rm{\LaTeX} file}
```

How to compile a TeX file?

- Run `latex` or `tex` on the source file to generate a `dvi` file; `DVI` stands for the device independent file format (`xdvi` to view it). Other files (`.log`, `.aux`, etc) are also generated. DVI can be converted to PostScript (PS), PDF, SVG formats;
- Run `dvips -o mypaper.ps mypaper.dvi` to create the PostScript (PS) file;
- Run `ps2pdf mypaper.ps` to create the PDF file;

$$\text{mypaper.tex} \xrightarrow{\text{latex}} \text{mypaper.dvi} \xrightarrow{\text{dvips}} \text{mypaper.ps} \xrightarrow{\text{ps2pdf}} \text{mypaper.pdf}$$

- Generate the PDF directly from the tex source: `pdflatex`

$$\text{mypaper.tex} \xrightarrow{\text{pdflatex}} \text{mypaper.pdf}$$

Special characters in LaTeX

- There are 10 characters reserved by LaTeX and are only used on commands: `$ & % # ~ _ \ { }`
- Except for the **new lines**, most **white spaces** in the source file are ignored, so focus on **logical** concepts;
- **Dashes**: three different lengths of dash: - (-), - - (–), - - - (—)
- **White space** after a period: in some cases, a period doesn't mean to end a sentence: **et al.**, **etc.**, and **cont.**
- **Quotation markers**: “ ”(‘ ‘ double quotes’ ’), ‘ ’ (‘ single quotes’)
- Preventing line breaks: add a glue or put it in a box. Dr. Cox (this should be avoided, `Dr.~Cox`), `Section~5`, `12~seconds`, or `\mbox{Dr.\ Cox}`.
- Emphasizing text: use `\emph{Hello, World!}` to create *Hello, World!*

Font types, accents, and colors

Italic fonts	`\textit{Italic fonts}`
Medium series	`\textmd{Medium series}`
Default Roman family	`\textrm{Default Roman family}`
SMALL CAPS	`\textsc{Small caps}`
Sans serif family	`\textsf{Sans serif family}`
Text in boldface	`\textbf{Text in boldface}`

ò	`\‘{o}`	õ	`\~{o}`	ô	`\^{o}`	ö	`\{"o}`
ō	`\=o}`	o̲	`\b{o}`	ȯ	`\.{o}`	ọ	`\d{o}`
o͡o	`\t{oo}`						

†	`\dag`	‡	`\ddag`	©	`\copyright`	£	`\pounds`
§	`\S`	¶	`\P`	Å	`\AA`	å	`\aa`
æ	`\ae`						

#	`\#`	%	`\%`	$	`\$`	&	`\&`	{	`\{`	}	`\}`

Font sizes and colors

```
Hello {\tiny Hello} Hello {\scriptsize Hello}
Hello {\footnotesize Hello} Hello {\small Hello}
Hello {\normalsize Hello} Hello {\large Hello}
Hello {\Large Hello} Hello {\LARGE Hello}
Hello {\huge Hello} Hello {\Huge Hello}
```

- \usepackage{color} or \usepackage{xcolor};

```
Hello World!  Hello \textcolor{red}{World!}
Hello World!  \textcolor{blue}{Hello} World!
```

- Define our own colors:

```
\definecolor{mycolor}{rgb}{0.122, 0.435, 0.698}
Hello World!  \textcolor{mycolor}{Hello World!}
Hello World!  \textcolor{green!70!black}{Hello
                                World!}
```

Paragraph formatting

- By default, paragraphs in LaTeX are fully justified;
- Use the environments to control alignment:

```
\begin{flushright}...\end{flushright}
\begin{flushleft}...\end{flushleft}
\begin{center}...\end{center}
```

- Start a new line: `\\` (double backslash), `\newline`, or `\hfill \break`
- Start a new paragraph: `\par` or a **blank line**;
- Horizontal space: `\hspace{1cm}`, or `\hfill`
- Vertical space: `\vspace{2in}`, or `\vfill`
- In addition, use `\smallskip`, `\medskip`, or `\bigskip` to control vertical space: `+3pt` or `-1pt` (`\smallskip`), `6pt` or `-2pt` (`\medskip`), `+12pt` or `-4pt` (`\bigskip`);

`1 in≃72 pt`
`1 mm≃2.84 pt`
`ex`, or `em`

Paragraph formatting

- By default in a given section, the first paragraph does not indent; but the indention of other paragraphs can be controlled by `\parindent`;

```
\setlength{\parindent}{0ex}  % zero indent.
\setlength{\parskip}{10pt} % space bet. para.
```

```
\noindent This is the second paragraph ...
```

- Global setting for text alignment:

```
\usepackage[document]{ragged2e}
```

- The above package also supports `\RaggedRight`, `\RaggedLeft`, `\Centering`, and `\justify`;
- Sometimes, we need to indent to the whole block of a paragraph: `{\addtolength{\leftskip}{5mm} ...}`

Math symbols and equations

- In a sentence, use either `$ ... $`, or `\( ... \)`, for instance,

In this work we demonstrate that $\alpha^2 + \beta^2 \gg \pi/4$ is only correct if the Euler condition $\boldsymbol{\nabla x = 0}$ is satisfied.

```
In this work we demonstrate that $\alpha^2 +
\beta^2 \gg \pi/4 $ is only correct if the Euler
condition $\bm{\nabla x=0}$ is satisfied.
```

- (automatically) Assign number to an equation:

We propose a new numerical approach to solve the time-dependent Schrödinger equation

$$i\hbar\frac{\partial\Psi(t)}{\partial t} = H(t)\Psi(t) \qquad (4)$$

for a multi-electron atom in intense laser pulses.

Math symbols and equations

- In a sentence, use either `$ ... $`, or `\( ... \)`, for instance,

In this work we demonstrate that $\alpha^2 + \beta^2 \gg \pi/4$ is only correct if the Euler condition $\nabla x = 0$ is satisfied.

```
In this work we demonstrate that $\alpha^2 +
\beta^2 \gg \pi/4 $ is only correct if the Euler
condition $\bm{\nabla x=0}$ is satisfied.
```

- (automatically) Assign number to an equation:

We propose a new numerical approach to solve the time-dependent Schr\"odinger equation \begin{equation} i\hbar \frac{\partial \Psi(t)}{\partial t} = H(t) \Psi(t) \end{equation} for a multi-electron atom in intense laser pulses.

```
We propose a new numerical approach to solve
the time-dependent Schr\"odinger equation
\begin{equation} i\hbar \frac{\partial
\Psi(t)}{\partial t} = H(t) \Psi(t)
\end{equation} for a multi-electron atom in
intense laser pulses.
```

Math symbols and equations

- Greek letters:

α \alpha	β \beta	γ \gamma	δ \delta
ϵ \epsilon	ε \varepsilon	ζ \zeta	η \eta
θ \theta	ϑ \vartheta	ι \iota	κ \kappa
λ \lambda	μ \mu	ν \nu	ξ \xi
o o	π \pi	ϖ \varpi	ρ \rho
ϱ \varrho	σ \sigma	ς \varpsigma	τ \tau
υ \upsilon	ϕ \phi	φ \varphi	χ \chi
ψ \psi	φ \varphi	ω \omega	

Γ \Gamma	Λ \Lambda	Σ \Sigma	Ψ \Psi
Δ \Delta	Ξ \Xi	Υ \Upsilon	Ω \Omega
Θ \Thelta	Π \Pi	Φ \Phi	

Math symbols and equations

- Subscripts (_) and superscripts (^):
  a^b `$a^b$` A_2^3 `$A_2^{3}$` $d_{11,24}$ `$d_{11,24}$`
- Fractions (`\frac{}{}`): $y = \frac{a-b}{a+b}$ `$y=\frac{a-b}{a+b}$`
- Roots: $\sqrt{z^2+1}$ `$\sqrt{z^2+1}$` $\sqrt[k]{3}$ `$\sqrt[k]{3}$`
- Calligraphic fonts: $\mathcal{C}+\mathcal{F}>\mathcal{Q}$ `$\mathcal{C+F>Q}$`
- Integrals: $\iint F(\mu,\nu)d\mu d\nu$ `$\iint F(\mu,\nu)d\mu d\nu$`
- Summations: $\sum_{i=0}^{n} a_i$ `$\sum_{i=0}^{n}a_{i}$`
- Limits: $\lim_{x\rightarrow+\infty} f(x)$ `$\lim_{x\rightarrow+\infty}f(x)$`

$\leftarrow$ `\leftarrow`	$\longleftarrow$ `\longleftarrow`	$\uparrow$ `\uparrow`
$\Leftarrow$ `\Leftarrow`	$\Longleftarrow$ `\Longleftarrow`	$\Uparrow$ `\Uparrow`
$\rightarrow$ `\rightarrow`	$\Longrightarrow$ `\Longrightarrow`	$\mapsto$ `\mapsto`
$\updownarrow$ `\updownarrow`	$\nwarrow$ `\nwarrow`	$\nearrow$ `\nearrow`

Math symbols and equations

- Relation symbols:

$\leq$ \leq	$\geq$ \geq	$\equiv$ \equiv	$\models$ \models	$\parallel$ \parallel
$\prec$ \prec	$\succ$ \succ	$\sim$ \sim	$\perp$ \perp	$\bowtie$ \bowtie
$\ll$ \ll	$\gg$ \gg	$\simeq$ \simeq	$\mid$ \mid	$\approx$ \approx
$\subset$ \subset	$\supset$ \supset	$\cong$ \cong	$\neq$ \neq	$\doteq$ \doteq
$\in$ \in	$\ni$ \ni	$\notin$ \notin	$\propto$ \propto	$\vdash$ \vdash

- Other useful math symbols:

$\aleph$ \aleph	$\prime$ \prime	$\forall$ \forall	∞ \infty	$\hbar$ \hbar
∂ \partial	$\exists$ \exists	$\imath$ \imath	∇ \nabla	$\neg$ \neg
$\jmath$ \jmath	$\surd$ \surd	$\flat$ \flat	$\triangle$ \triangle	ℓ \ell
$\wp$ \wp	$\top$ \top	$\natural$ \natural	$\Re$ \Re	$\Im$ \Im
$\bot$ \bot	$\sharp$ \sharp	$\|$ |	$\angle$ \angle	

Math symbols and equations

- Binary symbols:

$\pm$ \pm	$\mp$ \mp	$\cap$ \cup	$\diamond$ \diamond	$\oplus$ \oplus
$\times$ \times	$\uplus$ \uplus	$\ominus$ \ominus	$\div$ \div	$\sqcap$ \seqcap
$\sqcup$ \sqcup	$\otimes$ \otimes	$*$ \ast	$\oslash$ \oslash	$\star$ \star
$\vee$ \vee	$\odot$ \odot	$\circ$ \circ	$\wedge$ \wedge	$\dagger$ \dagger
$\bullet$ \bullet	$\setminus$ \setminus	$\ddagger$ \ddagger	$\cdot$ \cdot	$\wr$ \wr

- Predefined math functions:

$\arccos$ \arccos	$\arcsin$ \arcsin	$\arctan$ \arctan	$\arg$ \arg
$\cosh$ \cosh	$\cot$ \cot	$\coth$ \coth	$\csc$ \csc
$\det$ \det	$\dim$ \dim	$\exp$ \exp	$\lg$ \lg
$\inf$ \inf	$\ln$ \ln	$\log$ \log	$\max$ \max
$\Pr$ \Pr	$\sec$ \sec	$\sin$ \sin	$\tan$ \tan

The array environment for math equations

- How shall we represent a **matrix** or a **multiline** equation?

$$\left(\begin{array}{ccc} a+b & b & c-d \\ \mu & 0 & a-b \\ a^2 & 1 & \mu\nu \end{array} \right) \quad (6)$$

```
\begin{equation}
\left(
\begin{array}{ccc}
   a+b & b & c-d \\
   \mu & 0 & a-b \\
   a^2 & 1 & \mu\nu
\end{array} \right)
\end{equation}
```

$$\begin{aligned} 3x + 5y &= 10 \\ -2x - y &= 4x \end{aligned}$$

```
\begin{eqnarray*}
3x + 5y = 10 \\
-2x - y = 4x
\end{eqnarray*}
```

- Use the environment `eqnarray` and `eqnarray*`;

One above another & accent in math mode

- Use `\overline{}^{}` , `\underbrace{}_{}`, `\overbrace^{}`;

$\overline{xy}^{k}$

The conclusion is $\underline{A \neq B}$.

$\overbrace{(a+b)(a-b)}^{\text{the term 1}}$

```
$\overline{xy}^{k}$

The \underline{\tt
conclusion } is
\underline{$A\neq B$}.

$\overbrace{(a+b)(a-b)}^
{\rm the\; term\; 1}$
```

- Accents in math mode:

$\hat{z}$ `$\hat{z}$`	$\check{z}$ `$\check{z}$`	$\breve{z}$ `$\breve{z}$`
$\acute{z}$ `$\acute{z}$`	$\dot{z}$ `$\dot{z}$`	$\tilde{z}$ `$\tilde{z}$`
$\bar{z}$ `$\bar{z}$`	$\ddot{z}$ `$\ddot{z}$`	$\vec{z}$ `$\vec{z}$`
$\underline{z}$ `$\underline{z}$`	$\overline{z}$ `$\overline{z}$`	

Fine-tuned spacing & fonts in math mode

- LaTeX and TeX provide elaborate supports for spacing in math mode: let's consider **horizontal** space;

$\mid\!\mid$	`$\mid\!\mid$ negative thin space`
$\mid\:\mid$	`$\mid\:\mid$ medium space`
$\mid\,\mid$	`$\mid\,\mid$ thin space`
$\mid\;\mid$	`$\mid\;\mid$ thick space`
$\mid\ \mid$	`$\mid\␣\mid$ interword space`

$\mathit{\Sigma+\nabla\Phi}$	`$\mathit{\Sigma+\nabla\Phi}$`
$\mathrm{\Sigma+\nabla\Phi}$	`$\mathrm{\Sigma+\nabla\Phi}$`
$\mathbf{\Sigma+\nabla\Phi}$	`$\mathbf{\Sigma+\nabla\Phi}$`
$\mathtt{\Sigma+\nabla\Phi}$	`$\mathtt{\Sigma+\nabla\Phi}$`
$\mathcal{WORLD}$	`$\mathcal{WORLD}$`

Tables

- Use the `tabular` environment:

```
\begin{tabular}[position]{column alignments}
  ...
\end{tabular}
```

- `[position]` is optional (**vertical** position): `[t]` (top), `[c]` (center, this is default), `[b]` (bottom);
- `{column alignments}`: `l` (left-justified), `c` (center justified), and `r` (right-justified); for instance, `{ lcr }`
- Row and column controls:
- `&  % separate columns,`
- `\\  % separate rows,`
- `\hline  % draw a horizontal line,`
- `\cline{n-m}  % a horizontal line from column` n `to` m`.`

Tables

- Use the `tabular` environment:

a^2	$a-b$	$\sqrt{2}$
1	$-t$	3
μ/ν	0	$f(x)$

```
\begin{tabular}{ lrc }
\hline \hline
$a^2$ & $a-b$ & $\sqrt{2}$ \\
$1$ & $-t$ & $3$ \\
$\mu/\nu$ & $0$ & $f(x)$ \\
\hline \hline
\end{tabular}
```

a^2	$a-b$	$\sqrt{2}$
1	$-t$	3
μ/ν	0	$f(x)$

```
\begin{tabular}{ ||l|r|c|| }
\hline \hline
$a^2$ & $a-b$ & $\sqrt{2}$ \\
$1$ & $-t$ & $3$ \\
$\mu/\nu$ & $0$ & $f(x)$ \\
\hline \hline
\end{tabular}
```

Tables

- Use the `tabular` environment:

0x7C0	hex
115	octal
0.0001100	binary
2016.629	decimal

```
\begin{tabular}{ lr }
\hline \hline
${\rm 0x7C0}$ & \tt hex \\
$115$ & \tt octal \\
\cline{2-2}
$0.0001100$ & \tt binary \\
\hline
$2016.629$ & \tt decimal \\
\hline \hline
\end{tabular}
```

- Here `\cline{2-2}` draws a **shorter** line from column 2 to column 2 underneath the second row;
- Note `&` behaves like a "delimiter" to indicate the **end** of cell;
- What happens to the **last cell?**

Tables

- Use the `tabular` environment:
- `\multicolumn{n}{alignment}{item}`

Numbers			Descriptions
0x7C0	0x11A2B	hex	reset on 01/12/2014
115	1024	octal	reset on 03/10/2015
0.1100		binary	disabled by John
2016.629	1/10	decimal	reset on 06/04/1990

- Here `n` is the number of columns to be spanned and `alignment` is one of `l`, `r`, `c`, while `item` is the content;
- Add more empty cells (`&`), if you need more spaces;
- In the above table, `lrccc` is used in `\begin{tabular}`;

Tables

- Use the `tabular` environment:
- How can we make data align on the **decimal point**?
- Use `@{...}` **construct** as the column separator;

users@gmail.com	2.14159
balice@example.edu	10.12
jobco@power.com	987.654

- How many **columns** do we have here?
- We use `\begin{tabular}{ r@{@}l r@{.}l }`;
- This construct removes the spaces between columns and add the symbol we specified without adding extra spaces;
- Or you might try the package `siunitx`;

Including figures

- Load the package `graphicx`: `\usepackage{graphicx}`
- Use the `\begin{figure}` ... `\end{figure}` environment

Figure 1: LSU Tiger vs. LaTeX Lion

- Note `latex` only supports figures in **PS** and **EPS** formats, and `pdflatex` supports **PDF**, **PNG**, or **JPG** figures;

Including figures

- Load the package `graphicx`: `\usepackage{graphicx}`
- Use the `\begin{figure}` ... `\end{figure}` environment

```
\begin{figure}[!htb]
\centering
\includegraphics[width=0.4\textwidth]{Lsu_logo-6.ps}
\hspace*{9mm}
\includegraphics[width=0.4\textwidth]{ctanlion.eps}
\caption{LSU Tiger vs.~{\rm \LaTeX\ }Lion}
\end{figure}
```

- Use `\caption{...}` for the caption;
- Position control: `[!htb]`: `h` means put it here, `t` top, `b` bottom, while `!` overrides the default setting. However, nothing can be guaranteed, as all **figures** and **tables** are **floating** objects;

Including figures

- Load the package `graphicx`: `\usepackage{graphicx}`
- Use the `\begin{figure}` ... `\end{figure}` environment
- Sometimes, creating a side caption will be a necessity:

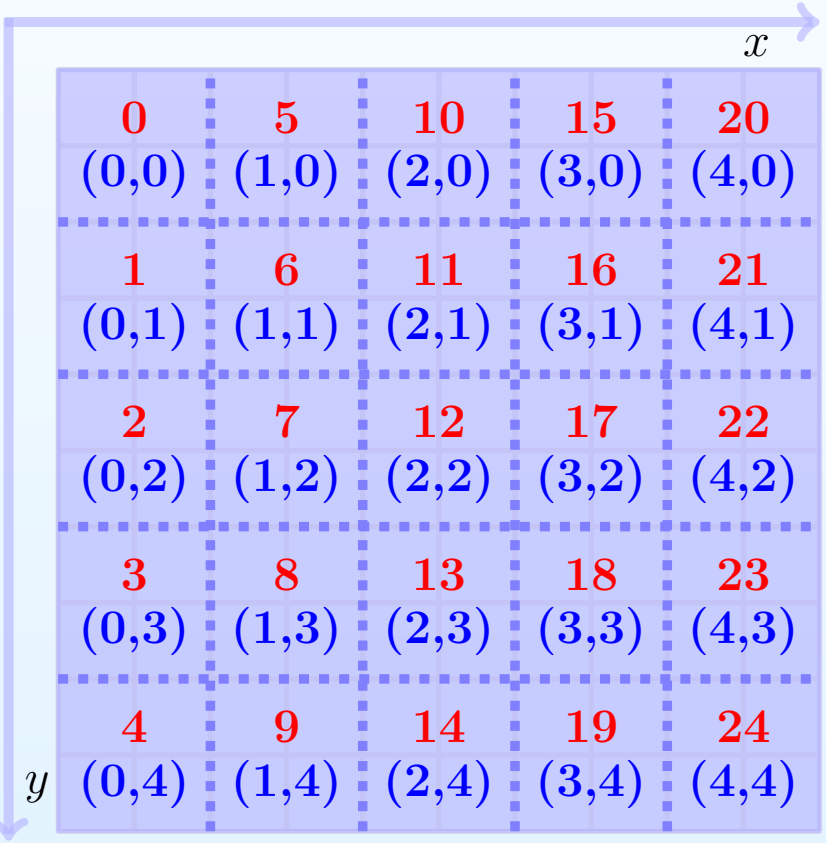


Fig. 2: MPI rank IDs in 2D domain decomposition. Each MPI task is assigned a unique Cartesian coordinate (x, y) starting from 0. This makes possible for further split of the entire communicator in a row- or column-way according to either x or y coordinate.

- The above figure was created by using `minipage` env;

Including figures

- Load the package `graphicx`: `\usepackage{graphicx}`
- Use the `\begin{figure}` ... `\end{figure}` environment
- Sometimes, creating a side caption would be a necessary:
- The above figure was created by using `minipage` env;
- A better way to do it is to use the package `sidecap`:

```
...
\usepackage{sidecap}
...
\begin{SCfigure}
\centering
\caption{... caption here ...}
\includegraphics[width=0.3\textwidth]{mpi-matvec-8.ps}
\end{SCfigure}
```

- Note the `\textwidth` parameter;

Including figures

- More options on `\includegraphics`:
- General syntax:

```
\includegraphics[attr_1=val_1,attr_n=val_n]{fname}
```

- Supports multiple attributes: `width=xy`, `height=xy`, `angle=xy` (in degrees), `scale=x` (this is for scale factor), `clip=true`, `bb=llx lly urx ury` (set up bounding box), . . .

More words on spaces and boxes

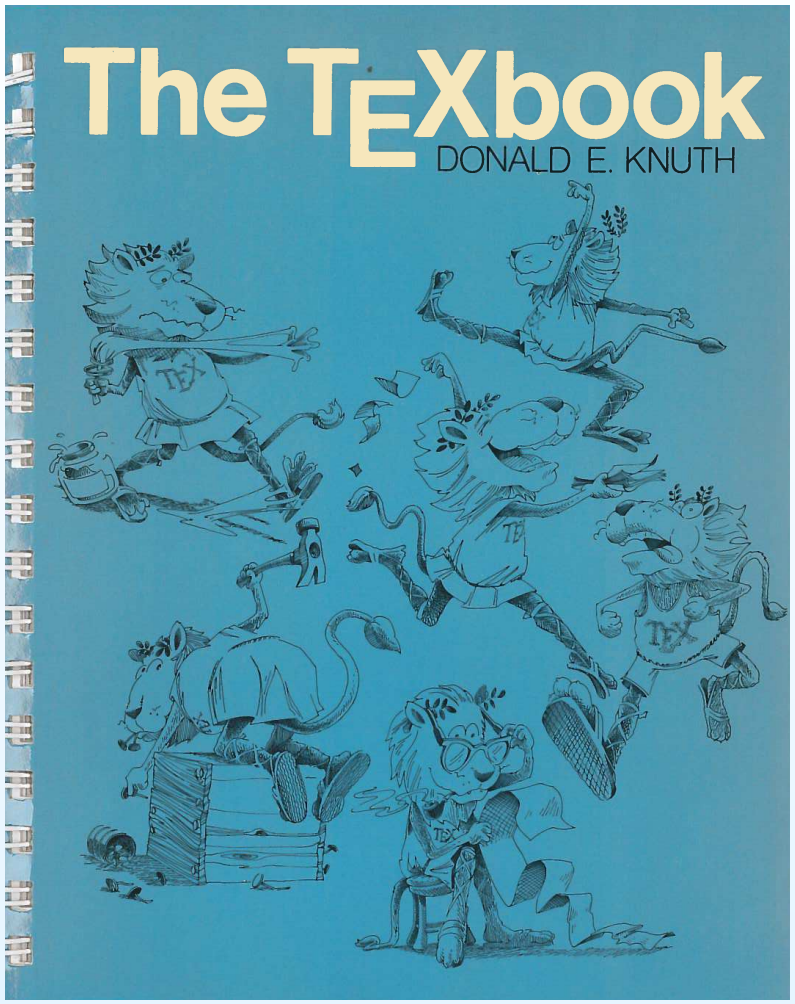
- The horizontal space can be controlled with `\hspace{width}`, while the `\vspace{height}` controls the vertical space;
- A `box` is a whole chunk of space that TEX will never split;
- `\mbox{text}` controls a horizontal box. The text in `\mbox{}` never be split across lines or pages;
- `\makebox[...][l]{...}` is useful: `\makebox[3cm]{liberty}`

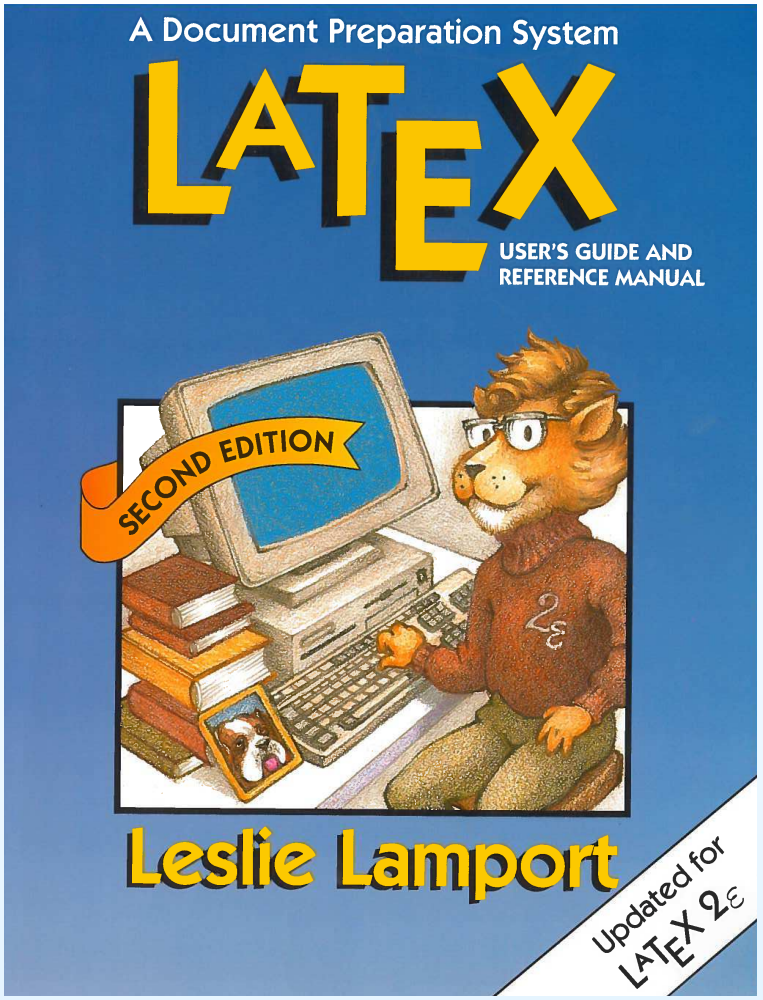
```
Free software is a matter of
liberty      , not price.
```

```
Free software is a matter of
liberty      , not price.
```

- `\framebox[][]{...}` is the same as `\makebox[][]{...}`, but adds a frame;

Further reading





Questions?

sys-help@loni.org