

# introduction to latex

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Jeffrey E. Boyd



# sources

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- L. Lamport, *Latex a document preparation system user's guide and reference manual*, Addison-Wesley, Reading MA, 1985.
- D. F. Griffiths and D. J. Higham, *Learning latex*, SIAM, Philadelphia PA, 1997.



# why not us M\$ Word?

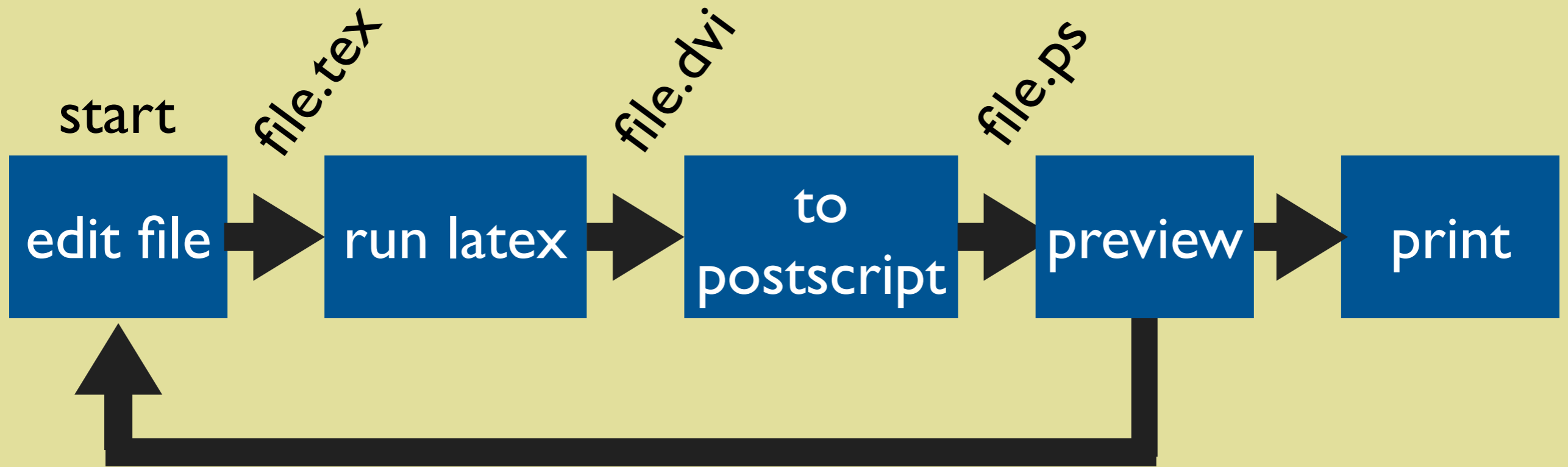
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- Latex is superior for large documents
  - e.g. an MSc thesis
- superior presentation of technical matter
  - especially mathematics
- widely used in academic publication
- free
  - Bill Gates has enough money.



# running latex

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# sample document

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```
% example1.tex - from Griffiths and Higham, "Learning Latex", SIAM, 1997.

\documentclass{article}

\begin{document}

This is a short document to illustrate the basic use of
\LaTeX.

Simply leave a blank line to get a new paragraph;
indentation is automatic.

Mathematical expressions such as  $y = 3 \sin x$ 
are obtained with dollar signs. Equations can be displayed,
as in
\[
y = 3 \sin x.
\]
Numbered equations are also possible:
\begin{equation}
\label{eq:example}
y = 3 \sin x.
\end{equation}
Because we have labeled this equation we can refer to it without
having to know its number. Thus, the preceding equation was
number~(\ref{eq:example}).

Powers (superscripts), as in  $x^2$ , are obtained with \verb"^;
more complicated powers must live in curly braces:  $x^{2+\alpha}$ .

Likewise, subscripts are obtained with the underscore:  $y_3$  or
 $y_{n+1}$ .

We can get both with  $x_{n+1}^{2+\alpha}$ .

\end{document}
```



# compile

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- `latex example1`
  - compile latex source to dvi document
- `dvips -o example1.ps example1`
  - convert dvi to postscript
- `gv example1.ps`
  - view the postscript file
- `ps2pdf example1.ps (or dvi2pdf )`
  - convert to pdf if desired

# output

---

This is a short document to illustrate the basic use of  $\text{\LaTeX}$ .  
Simply leave a blank line to get a new paragraph; indentation is automatic.  
Mathematical expressions such as  $y = 3 \sin x$  are obtained with dollar signs.  
Equations can be displayed, as in

$$y = 3 \sin x.$$

Numbered equations are also possible:

$$y = 3 \sin x. \tag{1}$$

Because we have labeled this equation we can refer to it without having to know its number. Thus, the preceding equation was number (1).

Powers (superscripts), as in  $x^2$ , are obtained with  $\wedge$ ; more complicated powers must live in curly braces:  $x^{2+\alpha}$ .

Likewise, subscripts are obtained with the underscore:  $y_3$  or  $y_{n+1}$ .

We can get both with  $x_{n+1}^{2+\alpha}$ .

# output

---

This is a short document to illustrate the basic use of L<sup>A</sup>T<sub>E</sub>X.  
Simply leave a blank line to get a new paragraph; indentation is automatic.  
Mathematical expressions such as  $y = 3 \sin x$  are obtained with dollar signs.  
Equations can be displayed, as in

$$y = 3 \sin x.$$

Numbered equations are also possible:

$$y = 3 \sin x. \tag{1}$$

Because we have labeled this equation we can refer to it without having to know its number. Thus, the preceding equation was number (1).

Powers (superscripts), as in  $x^2$ , are obtained with  $\wedge$ ; more complicated powers must live in curly braces:  $x^{2+\alpha}$ .

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# special characters

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- `\ & $ % ~ _ { } # ^`
- if you need to use these
  - precede with `\`
  - e.g., `\& \% \_ \{ \}`
- `\verb` means verbatim - no translation
  - everything between the first character after `\verb` and the next occurrence of that character

# environments

---

- special treatment for parts of a document
- for example
  - figures
  - equations
  - lists
  - tables
  - verbatim
- consult Lamport for details

```
\begin{itemize}

  \item Every sentence should
        make sense in isolation.
        Like that one.

  \item There is a lot to be
        said for brevity.

  \item Many words can
        ostensibly be deleted.

  \item Eschew the
        highfalutin.

  \item Understatement is a
        mindblowingly effective
        weapon.

\end{itemize}
```



# mathematics

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- enclose in
  - $\$ \$$ 
    - for in-line
  - $\left[ \right]$ 
    - centred equation environment
    - aka  $\begin{equation*} \end{equation*}$
  - $\begin{equation} \end{equation}$ 
    - centred and numbered equation

# Greek math

---

```
\[  
  \alpha + \beta + \gamma  
\]  
  
\[  
  \Gamma + \Delta + \Theta  
\]
```

$$\alpha + \beta + \gamma$$

$$\Gamma + \Delta + \Theta$$

# symbols

---

```
\[
  \pm \odot \otimes \div
\]

\[
  \nabla \Re \exists \forall
\]

\[
  \leq \geq \subset \supseteq \propto \simeq
\]

\[
  \arccos() \cos() \log() \tan()
\]

\[
  \leftarrow \Leftarrow \mapsto
\]
```

$\pm \odot \otimes \div$

$\nabla \Re \exists \forall$

$\leq \geq \subset \supseteq \propto \simeq$

$\arccos() \cos() \log() \tan()$

$\leftarrow \Leftarrow \mapsto$

# examples

---

```
\[  
  x = \frac{1+y}{1+2z^2}  
\]  
  
\[  
  x_3 + y^{n+2} = z\sqrt{b^2-4ac}  
\]  
  
\[  
  S_n = a_1 + a_2 + \cdots + a_n  
\]  
  
\[  
  a_n = 3 + (-1)^n, n = 1,2,\ldots,N  
\]
```

$$x = \frac{1+y}{1+2z^2}$$

$$x_3 + y^{n+2} = z\sqrt{b^2 - 4ac}$$

$$S_n = a_1 + a_2 + \cdots + a_n$$

$$a_n = 3 + (-1)^n, n = 1, 2, \dots, N$$

# examples

---

```
\[
S_N = \sum_{j=1}^N a_j
\]

\[
\int_{x=0}^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2}
\]

\[
\lim_{n \rightarrow \infty} (1 + x/n)^n = e^x
\]

\[
\max_{1 \leq x \leq 2} x + \frac{1}{x} = \frac{5}{2}
\]

\[
G(x) := \prod_{i=1}^n f_i(x)
\]
```

$$S_N = \sum_{j=1}^N a_j$$

$$\int_{x=0}^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$$

$$\lim_{n \rightarrow \infty} (1 + x/n)^n = e^x$$

$$\max_{1 \leq x \leq 2} x + \frac{1}{x} = \frac{5}{2}$$

$$G(x) := \prod_{i=1}^n f_i(x)$$

# examples

---

```
\begin{enumerate}
  \item $ S_N = \sum_{j=1}^N a_j $
  \item $ \int_{x=0}^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2} $
  \item $ \lim_{n \rightarrow \infty} (1 + x/n)^n = e^x $
  \item $ \max_{1 \leq x \leq 2} x + \frac{1}{x} = \frac{5}{2} $
  \item $ G(x) := \prod_{i=1}^n f_i(x) $
\end{enumerate}
```

$$1. S_N = \sum_{j=1}^N a_j$$

$$2. \int_{x=0}^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$$

$$3. \lim_{n \rightarrow \infty} (1 + x/n)^n = e^x$$

$$4. \max_{1 \leq x \leq 2} x + \frac{1}{x} = \frac{5}{2}$$

$$5. G(x) := \prod_{i=1}^n f_i(x)$$

# examples

The system may be written in the matrix--vector form  $A \mathbf{u} = \mathbf{e}$ , where

```
\[
  A = \left[
    \begin{array}{ccc}
      1 & 1 & 1 \\
      x & y & z \\
      x^2 & y^2 & z^2
    \end{array}
  \right], \;
  \mathbf{u} = \left[
    \begin{array}{c}
      x \\
      y \\
      z
    \end{array}
  \right]
\]
```

and  $\mathbf{e} = [1, 1, 1]^T$ . The determinant of  $A$  is given by

```
\[
  \left| \begin{array}{ccc}
    1 & 1 & 1 \\
    x & y & z \\
    x^2 & y^2 & z^2
  \end{array} \right| = (x-y)(y-z)(z-x),
\]
```

so  $A$  is nonsingular precisely when the three values  $x, y, z$  are distinct.

The system may be written in the matrix--vector form  $A\mathbf{u} = \mathbf{e}$ , where

$$A = \begin{bmatrix} 1 & 1 & 1 \\ x & y & z \\ x^2 & y^2 & z^2 \end{bmatrix}, \quad \mathbf{u} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

and  $\mathbf{e} = [1, 1, 1]^T$ . The determinant of  $A$  is given by

$$\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ x^2 & y^2 & z^2 \end{vmatrix} = (x - y)(y - z)(z - x),$$

so  $A$  is nonsingular precisely when the three values  $x, y, z$  are distinct.



# titles

---

```
\title{Learning \LaTeX}

\author{David F. Griffiths\\
  University of Dundee
  \and
  Desmond J. Higham \\
  Strathclyde University}

\date{June 1996}

\maketitle

\begin{abstract}
  The abstract is optional.
\end{abstract}
```

## Learning L<sup>A</sup>T<sub>E</sub>X

David F. Griffiths      Desmond J. Higham  
University of Dundee    Strathclyde University

June 1996

### Abstract

The abstract is optional.



# sections

---

- `\section{Section title}`
- `\label{sec:mysection}`
- `\subsection{}`
- `\subsubsection{}`
- `\section*{}`
- unnumbered section
- `\appendix`



# graphics and figures

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- several packages to choose from
  - `\usepackage{graphics}`
    - `\includegraphics{filename}`
  - `\usepackage{graphicx}`
    - `\includegraphics[height=3in]{filename}`
- `\usepackage{epsfig}`
  - `\epsfig{figure=filename,width=3in}`



# example

```
\documentclass{article}

\usepackage{graphicx}
\usepackage{epsfig}

\begin{document}

Figure~\ref{fig:swarmart} explains everything.

\begin{figure}
\center
\begin{tabular}{cc}
\epsfig{figure=swarm-pic3.eps,width=3in} &
\includegraphics[width=3in]{SwarmArt2.eps} \\
(a) & (b)
\end{tabular}
\caption{This is how SwarmArt 2003 worked.}
\label{fig:swarmart}
\end{figure}

\end{document}
```

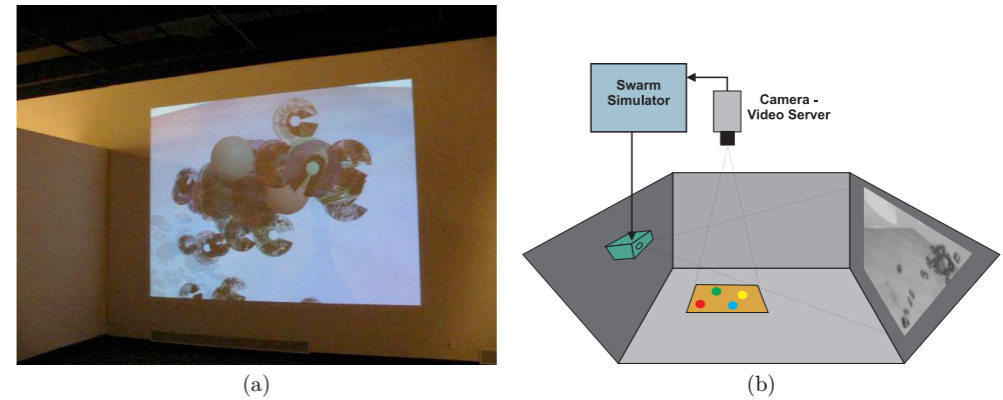


Figure 1: This is how SwarmArt 2003 worked.

Figure 1 explains everything.