Play with LaTeX

and have fun!

保安

QSCTech

2021.2

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What is LaTeX

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Bibliography in LaTeX

Summary

LaTeX is a document preparation system for the TeX typesetting program.

What is LaTeX

LaTeX is a document preparation system for the TeX typesetting program.

So, what are the differences between TeX, LaTeX, XeTeX, LuaTeX...?

What is LaTeX

LaTeX is a document preparation system for the TeX typesetting program.

So, what are the differences between TeX, LaTeX, XeTeX, LuaTeX...?

- TeX is a typesetting system (or a formatting system).
- LaTeX uses the TeX for formatting its output, and is itself written in the TeX macro language.
- XeTeX is a TeX typesetting engine using Unicode and supporting modern font technologies.
- LuaTeX is embedded with a Lua scripting engine.

What can LaTeX do

What can LaTeX do

- Excellent typesetting of mathematical formulae

What can LaTeX do

- Excellent typesetting of mathematical formulae
- Accurate document formatting

What can LaTeX do

- Excellent typesetting of mathematical formulae
- Accurate document formatting
- Intelligent hyphenation and justification

What can LaTeX do

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- Excellent typesetting of mathematical formulae
- Accurate document formatting
- Intelligent hyphenation and justification
- and much more intersting applications!

What can LaTeX do

- Excellent typesetting of mathematical formulae
- Accurate document formatting
- Intelligent hyphenation and justification
- and much more intersting applications!

A story about TeX

Knuth(TeX's father) offers monetary awards to people who find and report a bug in TeX. The award per bug started at US$2.56 and doubled as each bug found until it was frozen at its current value of $327.68.

Reduce workload

Imagine: I want to display a formula like this:

$$F[A] = \mathrm{Merge}\left(\hat{F}[A_1] - \hat{F}[A_0], \hat{F}[A_1] + \hat{F}[A_0]\right)$$

$$G[A'] = \mathrm{Merge}\left(\frac{\hat{F}[A'_1] - \hat{F}[A'_0]}{2}, \frac{\hat{F}[A'_1] + \hat{F}[A'_0]}{2}\right)$$

Reduce workload

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$$F[A] = \mathrm{Merge}\left(\hat{F}[A_1] - \hat{F}[A_0], \hat{F}[A_1] + \hat{F}[A_0]\right)$$

$$G[A'] = \mathrm{Merge}\left(\frac{\hat{F}[A'_1] - \hat{F}[A'_0]}{2}, \frac{\hat{F}[A'_1] + \hat{F}[A'_0]}{2}\right)$$

```
F [A] = \mathrm{Merge} \left(
    \hat{F} [A_1] - \hat{F} [A_0],
    \hat{F} [A_1] + \hat{F} [A_0]
\right)
G [A'] = \mathrm{Merge} \left(
    {\hat{F} [A'_1] - \hat{F} [A'_0] \over 2},
    {\hat{F} [A'_1] + \hat{F} [A'_0] \over 2}
\right)
```

Reduce workload

Too many `\hat{F}` ?

Reduce workload

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Too many `\hat{F}` ?

Try to replace `\hat{F}` with `\fh`!

Reduce workload

Too many `\hat{F}` ?

Try to replace `\hat{F}` with `\fh`!

Previously declare:

```
\newcommand{\fh}{\hat{F}}
```

Reduce workload

Too many \hat{F} ?

Try to replace \hat{F} with \fh!

Previously declare:

```
\newcommand{\fh}{\hat{F}}
```

And you can just code:

```
F [A] = \mathrm{Merge} \left(
    \hf [A_1] - \hf [A_0],
    \hf [A_1] + \hf [A_0]
\right)
G [A'] = \mathrm{Merge} \left(
    {\hf [A'_1] - \hf [A'_0] \over 2},
    {\hf [A'_1] + \hf [A'_0] \over 2}
\right)
```

To be flexible

Again, I want to display this formula:

$$\sum_{i=1}^{n}\sum_{j=1}^{m}\gcd(i,j)^k = \sum_{d=1}^{n} d^k \sum_{i=1}^{n}\sum_{j=1}^{m}[\gcd(i,j)=d]$$

$$= \sum_{d=1}^{n} d^k \sum_{x=1}^{\lfloor \frac{n}{d} \rfloor} \mu(x) \left\lfloor \frac{n}{dx} \right\rfloor \left\lfloor \frac{m}{dx} \right\rfloor$$

To be flexible

Again, I want to display this formula:

$$\begin{aligned}\sum_{i=1}^{n}\sum_{j=1}^{m}\gcd(i,j)^k &= \sum_{d=1}^{n} d^k \sum_{i=1}^{n}\sum_{j=1}^{m}[\gcd(i,j)=d] \\ &= \sum_{d=1}^{n} d^k \sum_{x=1}^{\lfloor \frac{n}{d} \rfloor} \mu(x) \left\lfloor \frac{n}{dx} \right\rfloor \left\lfloor \frac{m}{dx} \right\rfloor\end{aligned}$$

```
\sum_{i=1}^{n}\sum_{j=1}^{m}\gcd(i,j)^k&=
\sum_{d=1}^{n}d^k\sum_{i=1}^{n}\sum_{j=1}^{m}
[\gcd(i,j)=d]\\ &=\sum_{d=1}^{n}d^k\sum_{x=1}^
{\lfloor{n\over d}\rfloor}\mu(x)\lfloor
{n\over dx}\rfloor\lfloor{m\over dx}\rfloor
```

To be flexible

For $\sum_{i=1}^{n}$:

```
\newcommand{\st}[2]{\sum_{#1=1}^{#2}}
```

To be flexible

For $\sum_{i=1}^{n}$:

```
\newcommand{\st}[2]{\sum_{#1=1}^{#2}}
```

For $\gcd(i, j)$:

```
\newcommand{\gc}[1]{\gcd\left(#1\right)}
```

To be flexible

For $\sum_{i=1}^{n}$:

```
\newcommand{\st}[2]{\sum_{#1=1}^{#2}}
```

For $\gcd(i,j)$:

```
\newcommand{\gc}[1]{\gcd\left(#1\right)}
```

For $\left\lfloor \frac{n}{d} \right\rfloor$:

```
\newcommand{\fl}[2]{\left\lfloor
    {#1 \over #2}
\right\rfloor}
```

To be flexible

And the tex code becomes:

```
\st{i}{n}\st{j}{m}\gc{i, j}^k &= \st{d}{n}d^k
\st{i}{n}\st{j}{m}[\gc{i, j}=d] \\
&= \st{d}{n} d^k \st{x}{\fl{n}{d}}\mu(x)
\fl{n}{dx}\fl{m}{dx}
```

RE-define commands

We also have `\renewcommand`

RE-define commands

We also have \renewcommand

```
\renewcommand{\phi}{\varphi}
\renewcommand{\gcd}[1]{\gcd\left(#1\right)}
\renewcommand{\songti}{\CJKfontspec{STSong}}
\renewcommand{\refname}{参考文献}
\renewcommand{\colsep}{0.2em}
\renewcommand{\frac}[3][\over]{{#3 #1 #2}}
```

RE-define commands

We also have \renewcommand

```
\renewcommand{\phi}{\varphi}
\renewcommand{\gcd}[1]{\gcd\left(#1\right)}
\renewcommand{\songti}{\CJKfontspec{STSong}}
\renewcommand{\refname}{参考文献}
\renewcommand{\colsep}{0.2em}
\renewcommand{\frac}[3][\over]{{#3 #1 #2}}
```

For example:

```
\frac{\varphi}{3}
\frac[\choose]{\phi}{3}
```

$$\frac{3}{\varphi} \qquad \binom{3}{\varphi}$$

Interesting packages

Users around the world have been creating lots of packages for more functions and convenience.

Interesting packages

Users around the world have been creating lots of packages for more functions and convenience.

We can import a package as

```
\usepackage[options]{package_name}
```

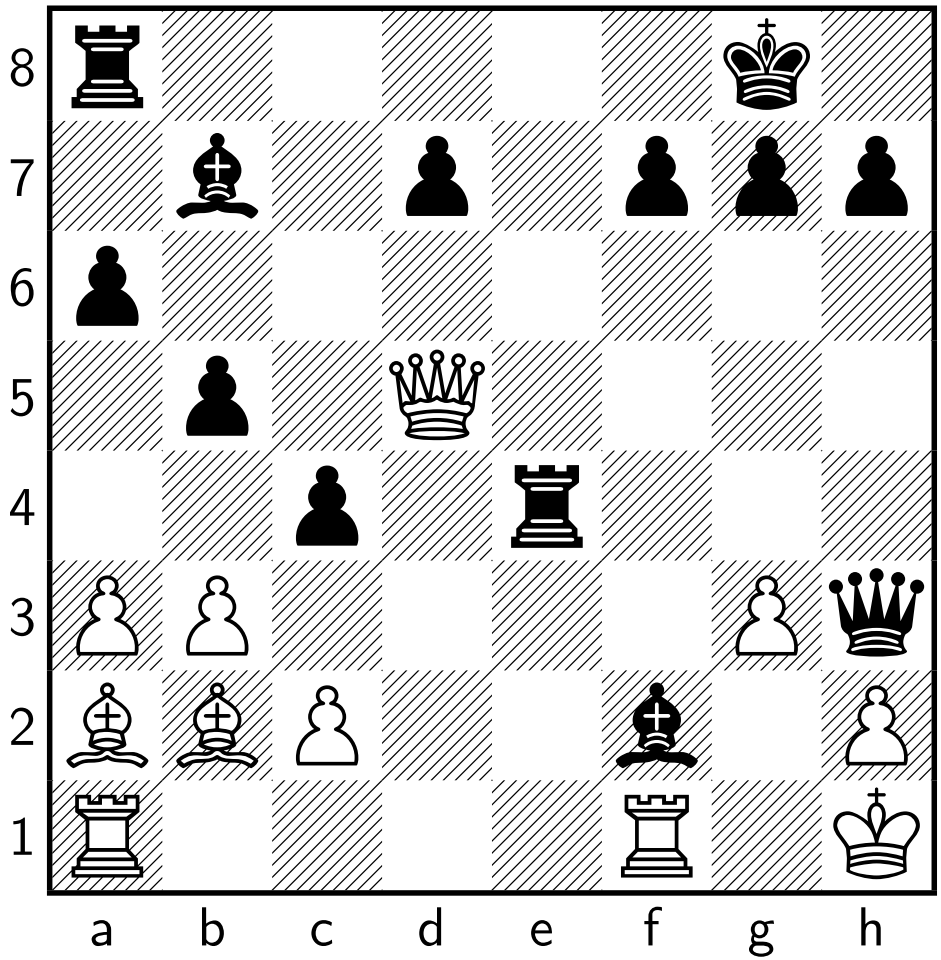
Interesting packages / skak

Package skak enables us to display a chess board conveniently.

Interesting packages / skak

Package skak enables us to display a chess board conveniently. For example:

```
\fenboard{%
r5k1/%
1b1p1ppp/%
p7/%
1p1Q4/%
2p1r3/%
PP4Pq/%
BBP2b1P/%
R4R1K w - - 0 20}
\mbox{}
\showboard
```

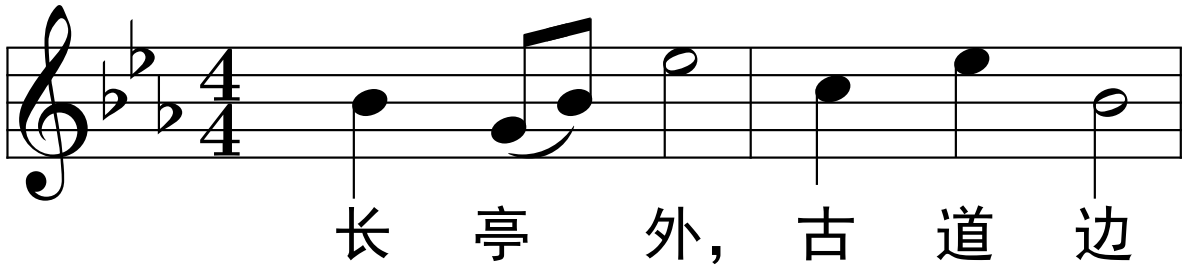


Interesting packages / `musixtex`

Package `musixtex` enables us to display musical notation.

Interesting packages / musixtex

Package musixtex enables us to display musical notation. For example:



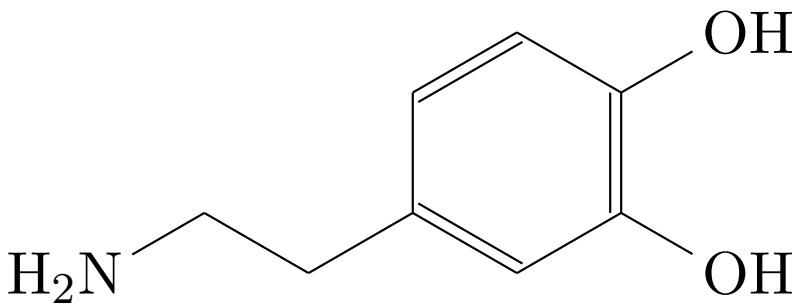

```
\begin{music}
\generalsignature{-3}\generalmeter{\meterfrac44}
\nobarnumbers\startextract
\Notes\zsong{长}\ql i \en
\notes\zsong{亭}\islurd0g\ibu0g5\qb0g\tslur0i\tbu0\qb0i \en
\notes\zsong{外, }\hl l \en\bar
\Notes\zsong{古}\ql j \zsong{道} \ql l \en
\notes\zsong{边}\hl i \en
\endextract\end{music}
```

Interesting packages / chemfig

Package chemfig enables us to draw chemical structure formulae.

Interesting packages / chemfig

Package chemfig enables us to draw chemical structure formulae.
For example:



(Dopamine)

```
\chemfig{
    H_2N-[:30,,2]-[:330]-[:30]=^[:330]-[:30]
    (-[:330,,,1]OH)=^[:90](-[:30,,,1]OH)
    -[:150]=^[:210](-[:270])
}
```

Useful packages / geometry

Package geometry provides an easy and flexible user interface to customize page layout, implementing auto-centering and auto-balancing mechanisms so that the users have only to give the least description for the page layout.

Useful packages / geometry

Package geometry provides an easy and flexible user interface to customize page layout, implementing auto-centering and auto-balancing mechanisms so that the users have only to give the least description for the page layout.

For example:

```
\usepackage[a4paper, hmargin=2cm]{geometry}
\geometry{top=1.1in}
```

Useful packages / geometry

Package geometry provides an easy and flexible user interface to customize page layout, implementing auto-centering and auto-balancing mechanisms so that the users have only to give the least description for the page layout.

For example:

```
\usepackage[a4paper, hmargin=2cm]{geometry}
\geometry{top=1.1in}
```

Besides hmargin, top, you can also set much more parameters to customize your layout.

Useful packages / geometry

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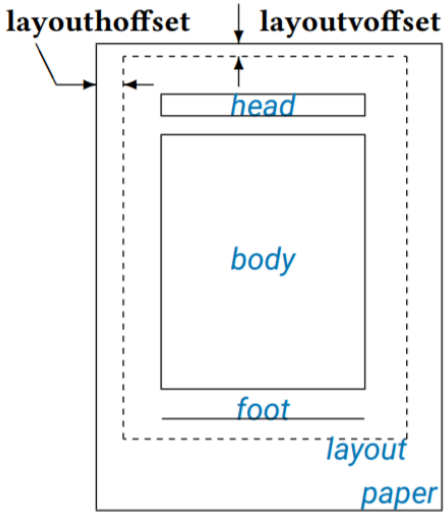
Summary

Size of paper:

- `paper`: a3paper, a4paper, a5paper, b5paper, letterpaper...
- `paperwidth` / `paperheight` = <length>
- `landscape` / `portrait`

Size of layout:

- `layout` = <papername>
- `layoutwidth` / `layoutheight` = <length>
- `layouthoffset` / `layoutvoffset` = <length>



Useful packages / geometry

Size of body:

- `hscale / vscale` = <decimal>
- `width / height` = <length>

Size of margins:

- `left / right / top / bottom` = <length>
- `hmargin / vmargin` = <length>
- `hmarginratio / vmarginratio` = <decimal> or <margin1, margin2>
- `hcentering / vcentering` = <true/false>
- `twoside`
- `bindingoffset` = <length>
- `headheight` = <length>
- `headsep` = <length>
- `footskip` = <length>
- `nohead / nofoot`

Useful packages / lastpage

Reference the number of pages in your document.

Useful packages / lastpage

Reference the number of pages in your document.

Usage:

```
\usepackage{lastpage}
Page \thepage of \pageref{LastPage}
```

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Useful packages / fancyhdr

This package provides extensive control of page headers and footers.

Useful packages / fancyhdr

This package provides extensive control of page headers and footers.

For instance:

```
\usepackage{fancyhdr}
\pagestyle{fancy}
\fancyhead[L,R]{}
\fancyhead[C]{\@title}
\fancyfoot[L]{Dr.Knuth}
\fancyfoot[C]{}
\fancyfoot[R]{\thepage / \pageref{LastPage}}
```

Useful packages / `fancyhdr`

What if I want to make the first page no head/foot?

Useful packages / fancyhdr

What if I want to make the first page no head/foot?

```
\thispagestyle{empty}
```

Useful packages / fancyhdr

What if I want to make the first page no head/foot?

```
\thispagestyle{empty}
```

What if I want to set different head/foot style for even/odd pages?

Useful packages / fancyhdr

What if I want to make the first page no head/foot?

```
\thispagestyle{empty}
```

What if I want to set different head/foot style for even/odd pages?

```
\fancyhead[LE, RO]{...}
\fancyhead[CO]{...}
\fancyfoot[LE, RO]{...}
\fancyfoot[LO, RE]{...}
\fancyfoot[CO, CE]{...}

\fancyhf[CO]{...}
```

Useful packages / fancyhdr

What if I want to change the style of the line under the header / above the footer?

Useful packages / fancyhdr

What if I want to change the style of the line under the header / above the footer?

```
\renewcommand{\headrulewidth}{2pt}
\renewcommand{\footrulewidth}{0pt}
\renewcommand{\headruleskip}{1em}
\renewcommand{\footruleskip}{0.8pt}
```

Useful packages / `fancyhdr`

Am I able to define my own page styles?

Useful packages / fancyhdr

Am I able to define my own page styles?

```
\fancypagestyle{mystyle}{
    \fancyhead[CO]{...}
    \fancyfoot[L, R]{...}
    \renewcommand{\headrulewidth}{0.1pt}
}
\fancypagestyle{yourstyle}[mystyle]{
    \fancyhead[LE, CE]{...}
    \fancyfoot[L]{...}
}

\pagestyle{mystyle}
\thispagestyle{yourstyle}
```

Useful packages / fancyhdr

How to self-change the text according to current chapter / section?

Useful packages / fancyhdr

How to self-change the text according to current chapter / section?

```
\fancyhead[L]{\leftmark} % higher-level
\fancyhead[R]{\rightmark} % lower-level
```

Useful packages / fancyhdr

How to self-change the text according to current chapter / section?

```
\fancyhead[L]{\leftmark} % higher-level
\fancyhead[R]{\rightmark} % lower-level

\makeboth{leftmark}{rightmark}
\makeright{rightmark}
```

The `\leftmark` contains the **L**eft argument of the **L**ast `\markboth` on the page, the `\rightmark` contains the **R**ight argument of the fi**R**st `\markboth` or the only argument of the fi**R**st `\markright` on the page. If no marks are present on a page they are "inherited" from the previous page.

Useful packages / `fancyhdr`

You can influence how chapter, section, and subsection information (only two of them!) is displayed by redefining the `\chaptermark`, `\sectionmark`, and `\subsectionmark` commands.

Useful packages / fancyhdr

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- `\thechapter` is the chapter number.
- `\chaptername` is the name "chapter".
- `\chapter` is the title of chapter.

Useful packages / fancyhdr

You can influence how chapter, section, and subsection information (only two of them!) is displayed by redefining the `\chaptermark`, `\sectionmark`, and `\subsectionmark` commands.

- `\thechapter` is the chapter number.
- `\chaptername` is the name "chapter".
- `\chapter` is the title of chapter.

For example:

```
\renewcommand{\chaptermark}[1]{
    \markboth{\chaptername\ \thechapter.\ #1}{}
} % Chapter 2. Plan
\renewcommand{\sectionmark}[1]{
    \markright{\thesection.\ #1}
} % 2.1. Preparations
```

Useful packages / hyperref

This package is used to handle cross-referencing commands to produce hypertext links in the document.

Useful packages / hyperref

This package is used to handle cross-referencing commands to produce hypertext links in the document.
Usage:

```
\usepackage{hyperref}
\hypersetup{
    CJKbookmarks=true,
    colorlinks=true,
    linkcolor=orange,
    anchorcolor=red,
    urlcolor=blue,
    citecolor=cyan,
}
\url{https://www.baidu.com}
```

Useful packages / hyperref

This package is used to handle cross-referencing commands to produce hypertext links in the document.
Usage:

```
\usepackage{hyperref}
\hypersetup{
    CJKbookmarks=true,
    colorlinks=true,
    linkcolor=orange,
    anchorcolor=red,
    urlcolor=blue,
    citecolor=cyan,
}
\url{https://www.baidu.com}
```

https://www.baidu.com

Useful packages / hyperref


```
\url{https://www.baidu.com}
\href{https://www.google.com}{Google}
```

https://www.baidu.com
Google

Useful packages / hyperref


```
\url{https://www.baidu.com}
\href{https://www.google.com}{Google}
```

https://www.baidu.com
Google

```
\hypertarget{sampletarget}{[HYPERREF]}
```

[HYPERREF]

Useful packages / hyperref


```
\hyperlink{sampletarget}{> HIT ME ! <}
```

> HIT ME ! <

Useful packages / graphicx

This package builds upon the graphics package, providing a key-value interface for optional arguments to the \includegraphics command.

```
\usepackage{graphicx}
\includegraphics[width=3cm]{xxx.png}
\includegraphics[height=0.7in]{xxx.jpg}
\includegraphics[width=\textwidth]{xxx.eps}
```

Useful packages / graphicx

- `width` = <length>
- `height` = <length>
- `scale` = <decimal>
- `angle` = <decimal>
- `viewport` = four arguments separated by space, indicating the LB & the RT points of viewable area.
- `clip` = <**T**/F>

Useful packages / `xcolor`

This package starts from the basic facilities of the `color` package, and provides easy driver-independent access to several kinds of color tints, shades, tones, and mixes of arbitrary colors.

Useful packages / xcolor

This package starts from the basic facilities of the color package, and provides easy driver-independent access to several kinds of color tints, shades, tones, and mixes of arbitrary colors.

```
\usepackage[dvipsnames*,svgnames,x11names]{xcolor}
\color{NavyBlue}{NavyBlue}
\color{Crimson}{Crimson}
\color{Plum}{Plum}
\color{Teal}{Teal}
\color{LimeGreen}{LimeGreen}
```

NavyBlue Crimson Plum Teal LimeGreen

Useful packages / xcolor


```
\colorbox{PeachPuff}{PeachPuff}
\fcolorbox{SlateBlue}{Coral}{SlateBlue + Coral}
```

PeachPuff SlateBlue + Coral

Useful packages / xcolor


```
\colorbox{PeachPuff}{PeachPuff}
\fcolorbox{SlateBlue}{Coral}{SlateBlue + Coral}
```

PeachPuff SlateBlue + Coral

```
\definecolor{myblue}{rgb}{0.12, 0.23, 0.89}
\definecolor{myred}{RGB}{188, 21, 24}
\definecolor{mycyan}{cmyk}{0.99, 0.1, 0.11, 0}
\definecolor{mygreen}{HTML}{79A245}
```

myblue myred mycyan mygreen

Useful packages / xcolor

Color blending:

```
\color{red!50!green}{red+green}
\color{red!25!blue}{red+blue}
\color{cyan!70!black}{cyan+black}
\color{cyan}{\textbf{cyan}}
\color{cyan!70!white}{cyan+white}
\color{orange!30!Crimson!40!white}{OWC}
```

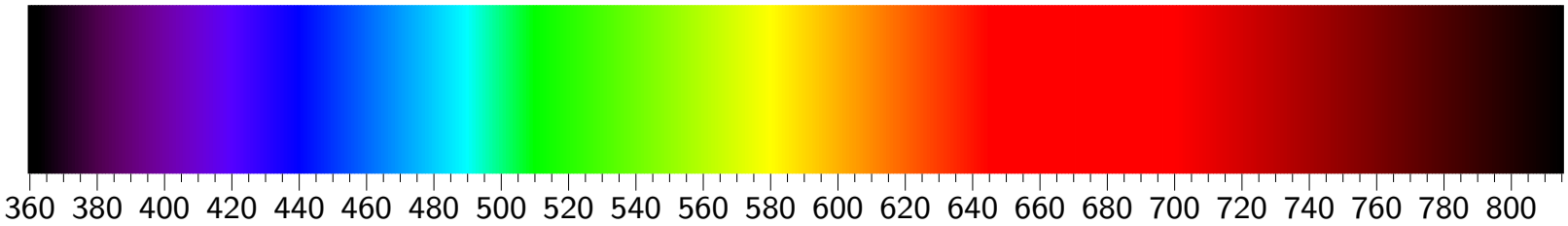
Useful packages / xcolor

Color blending:

```
\color{red!50!green}{red+green}
\color{red!25!blue}{red+blue}
\color{cyan!70!black}{cyan+black}
\color{cyan}{\textbf{cyan}}
\color{cyan!70!white}{cyan+white}
\color{orange!30!Crimson!40!white}{OWC}
```

red+green red+blue cyan+black **cyan** cyan+white OWC

Useful packages / xcolor



Useful packages / `listings`

This package enables the user to typeset programming code in document.

Useful packages / listings

This package enables the user to typeset programming code in document.

```
\usepackage{listings}
\lstset{language=c++,
        basicstyle=\fontspec{Consolas},
        tabsize=4}
\begin{lstlisting}
inline int gcd(int a, int b) {
    return b==0 ? a : gcd(b, a % b)
}
\end{lstlisting}
```

```
inline int gcd(int a, int b) {
    return b==0 ? a : gcd(b, a % b)
}
```

Useful packages / `minted`

This package facilitates expressive syntax highlighting using the powerful Pygments library.

Useful packages / minted

This package facilitates expressive syntax highlighting using the powerful Pygments library.

```
\begin{minted}{python}
def sum(n):
    p = range(1, n + 1)
    return sum(p)
\end{minted}
```

```python
def sum(n):
    p = range(1, n + 1)
    return sum(p)
```

Useful packages / minted

More options:

```
\begin{minted}[linenos=true,bgcolor=Cornsilk]{c++}
void add_value(int x, int v) {
    for(; x <= n; x += x & (-x)) {
        f[x] += v;
    }
}
int get_value(int x) {
    int v = 0;
    for(; x; x -= x & (-x)) {
        v += f[x];
    }
    return v;
}
\end{minted}
```

Useful packages / minted


```
1  void add_value(int x, int v) {
2      for(; x <= n; x += x & (-x)) {
3          f[x] += v;
4      }
5  }
6  int get_value(int x) {
7      int v = 0;
8      for(; x; x -= x & (-x)) {
9          v += f[x];
10     }
11     return v;
12 }
```

Useful packages / minted

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```
\begin{minted}[mathescape, autogobble,
    style=autumn]{lisp}
    (setq a 10)
    (setq b 20)
    (format t "~% A + B = ~d" (+ a b))
    ; Calc $a + b$
    (format t "~% A - B = ~d" (- a b))
    ; Calc $a - b$
    (format t "~% a BAND b = ~a" (logand a b))
    ; Calc $a \land b$
\end{minted}
```

Useful packages / minted


```
(setq a 10)
(setq b 20)
(format t "~% A + B = ~d" (+ a b))
; Calc a + b
(format t "~% A - B = ~d" (- a b))
; Calc a - b
(format t "~% a BAND b = ~a" (logand a b))
; Calc a ∧ b
```

Useful packages / fontspec

This package allows users of either XeLaTeXor LuaLaTeXto load OpenType fonts in a document.

Useful packages / fontspec

This package allows users of either XeLaTeXor LuaLaTeXto load OpenType fonts in a document.

```
\usepackage{fontspec}
\setmainfont{Times New Roman}
\setsansfont{Arial}
\setmainfont{Courier New}
\setCJKmainfont{simsun}
```

Useful packages / fontspec


```
\usepackage{fontspec}
\newCJKfontfamily\kyoukasho{
    A-OTF-KyokaICAPro-Regular.otf
}
\newCJKfontfamily\lyra{FOT-LyraStd-DB.otf}
\newfontfamily\JBMono{JetBrainsMono-Regular.ttf}
{\kyoukasho 何光年でも この歌を口ずさみながら}
{\CJKfamily{lyra}\fontsize{18pt}{24pt}\selectfont
    季節は次々生き返る}
{\JBMono 1<=2>-3!=4==5 procedure (<->|-+-|?=</>)}
```

Useful packages / fontspec

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```
\usepackage{fontspec}
\newCJKfontfamily\kyoukasho{
    A-OTF-KyokaICAPro-Regular.otf
}
\newCJKfontfamily\lyra{FOT-LyraStd-DB.otf}
\newfontfamily\JBMono{JetBrainsMono-Regular.ttf}
{\kyoukasho 何光年でも この歌を口ずさみながら}
{\CJKfamily{lyra}\fontsize{18pt}{24pt}\selectfont
    季節は次々生き返る}
{\JBMono 1<=2>-3!=4==5 procedure (<->|-+-|?=</>)}
```

何光年でもこの歌を口ずさみながら
季節は次々生き返る
1⩽2≻−3≠4⩵5 procedure (⟷⊢+⊣?=</>)

Useful packages / beamer

beamer is a LaTeX class for producing presentations and slides.

Useful packages / beamer

beamer is a LaTeX class for producing presentations and slides.

Usage:

```
\documentclass{beamer}
\usetheme{California}

\begin{frame}{Title}
    First sentence...

    \pause

    Second sentence...
\end{frame}
```

Useful packages / beamer

To use `minted` enviroment in a `beamer` frame, a `[fragile]` option is necessary for successful compilation.

Useful packages / beamer

To use `minted` enviroment in a `beamer` frame, a `[fragile]` option is necessary for successful compilation.

Take this frame as an example:

```
\begin{frame}[fragile]{Useful packages / \texttt{beamer}}
    To use \texttt{minted} enviroment in a \texttt{beamer}
  frame, a \texttt{[fragile]} option is necessary for
  successful compilation.
  \vskip 0.7em
  \pause

  Take this frame as an example:
  \footnotesize
  \inputminted{tex}{beamer_2.tex}
\end{frame}
```

Useful packages / makecell

This package supports common layouts for tabular column heads in documents.

Useful packages / makecell

This package supports common layouts for tabular column heads in documents.

For example:

```
\begin{tabular}{|c|c|c|}
    \hline
    A & B & \makecell[{{p{3cm}}}]{C} \\
    \hline
    \makecell[l]{2333 \\ 344444 \\ 455} & D & E \\
    \hline
\end{tabular}
```

Useful packages / makecell

This package supports common layouts for tabular column heads in documents.

For example:

```
\begin{tabular}{|c|c|c|}
    \hline
    A & B & \makecell[{{p{3cm}}}]{C} \\
    \hline
    \makecell[l]{2333 \\ 344444 \\ 455} & D & E \\
    \hline
\end{tabular}
```

A	B	C
2333 344444 455	D	E

Useful packages / makecell


```
\begin{tabular}{|c|c|}                                    \hline
    \makecell[l]{Left aligned \\ cell text} &
    Cell text \\                                          \hline
    \makecell*{Multilined \\ cell text} &
    \makecell*{Cell text} \\                              \hline
    \makecell*[r]{Right aligned \\ cell text} &
    \makecell[b]{Bottom aligned \\ cell text}\\
                                                          \hline
    \makecell*[{{p{3cm}}}]
        {Cell long text with predefined width} &
    \makecell[{{>{\parindent1em}p{3cm}}}]
        {Cell long...} \\                                 \hline
\end{tabular}
```

Useful packages / makecell

Left aligned cell text	Cell text
Multilined cell text	Cell text
Right aligned cell text	Bottom aligned cell text
Cell long text with predefined width	Cell long...

Useful packages / multirow

This package which provides a construction for table cells that span more than one row of the table.

Useful packages / multirow

This package which provides a construction for table cells that span more than one row of the table.

Usage:

```
\multirow[vpos]{nrows}{width}[vmove]{text}
```

- `vpos` defines the vertical positioning of the text in the multirow block.
- `nrows` is the number of rows to span.
- `width` is the width to which the text is to be set. `*` indicates the natural width.
- `vmove` is a length used for fine-tuning: the text will be raised by that length above wherever it would otherwise have gone.
- `text` is the actual text of the construct. Use `\\` to force linebreaks.

Useful packages / multirow

Example:

```
\begin{tabular}{|p{3cm}|c|}
    \hline
    \multirow[b]{4}*{Common text}
    & Column g2a \\ & Column g2b \\
    & Column g2c \\ & Column g2d \\
    \hline
    \multirow{3}[3cm]{\makecell[c]{Common \\ text}}
    & Column g2a \\ \cline{2-2}
    & Column g2b \\ \cline{2-2}
    & Column g2c \\
    \hline
\end{tabular}
```

Useful packages / multirow

Common text	Column g2a Column g2b Column g2c Column g2d
Common text	Column g2a
	Column g2b
	Column g2c

Useful packages / multirow


```
\usepackage{diagbox}
\begin{tabular}{|p{1em}|p{2cm}|p{2cm}|p{2cm}|}
    \hline
    \multicolumn{2}{|c|}{\multirow{2}*{Action}}
    & \multicolumn{2}{|c|}{A} \\
    \cline{3-4}
    \multicolumn{2}{|c|}{}
    & keeps slient
    & betrays \\
    \hline
    \multirow{2}*{B}
    & keeps silent
    & \diagbox[innerwidth=2cm]{-1}{-1}
    & \diagbox[innerwidth=2cm]{-3}{0} \\
    \cline{2-4}
    & betrays
    & \diagbox[innerwidth=2cm]{0}{-3}
    & \diagbox[innerwidth=2cm]{-2}{-2} \\
    \hline
\end{tabular}
```

Useful packages / multirow

Action		A	
		keeps slient	betrays
B	keeps silent	-1 / -1	0 / -3
	betrays	-3 / 0	-2 / -2

Useful packages / multicol

This package defines a multicols environment which typesets text in multiple columns, and balances the end of each column at the end of the environment.

Useful packages / multicol

This package defines a multicols environment which typesets text in multiple columns, and balances the end of each column at the end of the environment.

Usage:

```
\begin{multicols}{3}
    ...
\end{multicols}
```

Lorem ipsum doloamet, ajsbhjassgg jkhdjf dhfsjs, Lorem ipsum dolorsit amet, Lorem ipsum dolorsit ametametamet, Lorem ipsum dolorsit amet, Lorem ipsum dolorsit amet, LOOOOsjd dolorsit amet,

Useful packages / amsmath

This package adapts for use in LaTeX most of the mathematical features found in AMS-TeX;

Useful packages / amsmath

This package adapts for use in LaTeX most of the mathematical features found in AMS-TeX;

`equation`, `equation*`, `align`, `align*`, `gather`, `gather*`, `alignat`, `alignat*`, `multline`, `multline*`, `flalign`, `flalign*`, `split`

Useful packages / amsmath

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```
\begin{equation}
    -\frac{\hbar^2}{2\mu}\nabla^2\Psi+U\Psi=E\Psi
\end{equation}

\begin{equation*}
    i\hbar\frac{d}{dt}\ket{\psi}=\hat{H}\ket{\psi}
\end{equation*}
```

Useful packages / amsmath

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Summary

```
\begin{equation}
    -\frac{\hbar^2}{2\mu}\nabla^2\Psi+U\Psi=E\Psi
\end{equation}

\begin{equation*}
    i\hbar\frac{d}{dt}\ket{\psi}=\hat{H}\ket{\psi}
\end{equation*}
```

$$-\frac{\hbar^2}{2\mu}\nabla^2\Psi + U\Psi = E\Psi \tag{1}$$

$$i\hbar\frac{\mathrm{d}}{\mathrm{d}t}\left|\psi\right\rangle = \hat{H}\left|\psi\right\rangle$$

Useful packages / amsmath

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Summary

```
\begin{equation}
  \begin{split}
    \oint_L H \cdot dl & = I_0 +
    \iint_S \frac{\partial D}{\partial t}\cdot dS \\
    \oint_L E \cdot dl = -\iint_S &
    \frac{\partial B}{\partial t}\cdot dS
  \end{split}
\end{equation}
```

Useful packages / amsmath


```
\begin{equation}
  \begin{split}
    \oint_L H \cdot dl & = I_0 +
    \iint_S \frac{\partial D}{\partial t}\cdot dS \\
    \oint_L E \cdot dl = -\iint_S &
    \frac{\partial B}{\partial t}\cdot dS
  \end{split}
\end{equation}
```

$$\begin{aligned} \oint_L H \cdot \mathrm{d}l &= I_0 + \iint_S \frac{\partial D}{\partial t} \cdot \mathrm{d}S \\ \oint_L E \cdot \mathrm{d}l &= -\iint_S \frac{\partial B}{\partial t} \cdot \mathrm{d}S \end{aligned} \tag{2}$$

Useful packages / amsmath

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Summary

```
\begin{align}
  \phii &= \prod_{i=1}^s \phii(p_i^{k_i})     & 1 \\
  &=\prod_{i=1}^s (p_i-1) \times p_i^{k_i-1} & 2 \\
  &=n\prod_{i=1}^s (1-\frac{1}{p_i})          & 3
\end{align}
```

Useful packages / amsmath

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Summary

```
\begin{align}
  \phii &= \prod_{i=1}^s \phii(p_i^{k_i})     & 1 \\
  &=\prod_{i=1}^s (p_i-1) \times p_i^{k_i-1} & 2 \\
  &=n\prod_{i=1}^s (1-\frac{1}{p_i})          & 3
\end{align}
```

$$\begin{aligned}
\varphi(n) &= \prod_{i=1}^{s} \varphi\left(p_i^{k_i}\right) && 1 && (3)\\
&= \prod_{i=1}^{s} (p_i - 1) \times p_i^{k_i - 1} && 2 && (4)\\
&= n \prod_{i=1}^{s} \left(1 - \frac{1}{p_i}\right) && 3 && (5)
\end{aligned}$$

Useful packages / amsmath

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Summary

```
$$ \left(\frac{n}{p}\right) =
\begin{cases}
  1, & p \nmid n \text{ and }
       \exists x>0, x^2 \equiv n \pmod{p} \\
  -1, & p \nmid n \text{ and }
       \forall x>0, x^2 \not\equiv n \pmod{p} \\
  0, & p \mid n
\end{cases} $$
```

Useful packages / amsmath


```
$$ \left(\frac{n}{p}\right) =
\begin{cases}
  1, & p \nmid n \text{ and }
       \exists x>0, x^2 \equiv n \pmod{p} \\
  -1, & p \nmid n \text{ and }
       \forall x>0, x^2 \not\equiv n \pmod{p} \\
  0, & p \mid n
\end{cases} $$
```

$$\left(\frac{n}{p}\right) = \begin{cases} 1, & p \nmid n \text{ and } \exists x > 0, x^2 \equiv n \pmod{p} \\ -1, & p \nmid n \text{ and } \forall x > 0, x^2 \not\equiv n \pmod{p} \\ 0, & p \mid n \end{cases}$$

Useful packages / `algorithmicx`

This package provides a flexible, yet easy to use, way for inserting good looking pseudocode or source code in your papers.

Useful packages / algorithmicx

This package provides a flexible, yet easy to use, way for inserting good looking pseudocode or source code in your papers.

For example:

Algorithm 2 Euclid′ s algorithm

```
1: procedure EUCLID(a, b)                    ▷ The gcd of a and b
2:     r ← a mod b
3:     while r ≠ 0 do                        ▷ We have the answer if r is 0
4:         a ← b
5:         b ← r
6:         r ← a mod b
7:     end while
8:     return b                              ▷ The gcd is b
9: end procedure
```

Useful packages / algorithmicx


```
\usepackage{algorithm}
\usepackage{algorithmicx}
\usepackage{algpseudocode}

\begin{algorithmic}[1]
\State $s \gets 0$

\For{$i \gets 1, n$}
    \State $s \gets s + i$
\EndFor

\While{$j \le n$}
    \State $p \gets p \times i$
\EndWhile
\end{algorithmic}
```

1: $s \leftarrow 0$
2: **for** $i \leftarrow 1, n$ **do**
3: $\quad s \leftarrow s + i$
4: **end for**
5: **while** $j \leq n$ **do**
6: $\quad p \leftarrow p \times i$
7: **end while**

Useful packages / algorithmicx


```
\Repeat
  \State $k \gets k + 1$
  \State $t \gets t - 1$
\Until{$k \ge t$}

\If{$a > b$}
  \State\Call{Print}$(a)$
\ElsIf{$a < b$}
  \State\Call{Print}$(b)$
\Else
  \State\Call{Print}$(0)$
\EndIf
```

repeat
    $k \leftarrow k + 1$
    $t \leftarrow t - 1$
until $k \geq t$
if $a > b$ **then**
    $\textsc{Print}(a)$
else if $a < b$ **then**
    $\textsc{Print}(b)$
else
    $\textsc{Print}(0)$
end if

Useful packages / algorithmicx


```
\Procedure{DepthFirstSearch}{$u$}
    \State $u$ get visited
    \ForAll{$v \in \text{Neighbors of }u$}
        \If{$v$ is visited}
            \State\Call{DepthFirstSearch}$(v)$
        \EndIf
    \EndFor
\EndProcedure
```

1: **procedure** DepthFirstSearch(u)
2: u get visited
3: **for all** $v \in$ Neighbors of u **do**
4: **if** v is visited **then**
5: DepthFirstSearch(v)
6: **end if**
7: **end for**
8: **end procedure**

Useful packages / algorithmicx


```
\begin{algorithm}
  \caption{冒泡排序}
  \begin{algorithmic}[1]
  \Require 一个长度为 $n$ 的排列 $P$
  \Ensure $P$ 排序后的结果。
  \Function{Sort}{$n, F$}
    \While{$P$ 无序}
      \State $x \gets $ \Call{Rand}{$1, n$}
      \State $y \gets $ \Call{Rand}{$1, n$}
      \State \Call{Swap}{$P[x], P[y]$}
    \EndWhile
    \State \Return $P$
  \EndFunction
  \end{algorithmic}
\end{algorithm}
```

Useful packages / algorithmicx

Algorithm 3 冒泡排序

Require: 一个长度为 n 的排列 P

Ensure: P 排序后的结果。

1: **function** $\textsc{Sort}(n, F)$
2: **while** P 无序 **do**
3: $x \leftarrow \textsc{Rand}(1, n)$
4: $y \leftarrow \textsc{Rand}(1, n)$
5: $\textsc{Swap}(P[x], P[y])$
6: **end while**
7: **return** P
8: **end function**

Powerful packages / tikz

Wanna draw pics with LaTeX?

Powerful packages / tikz

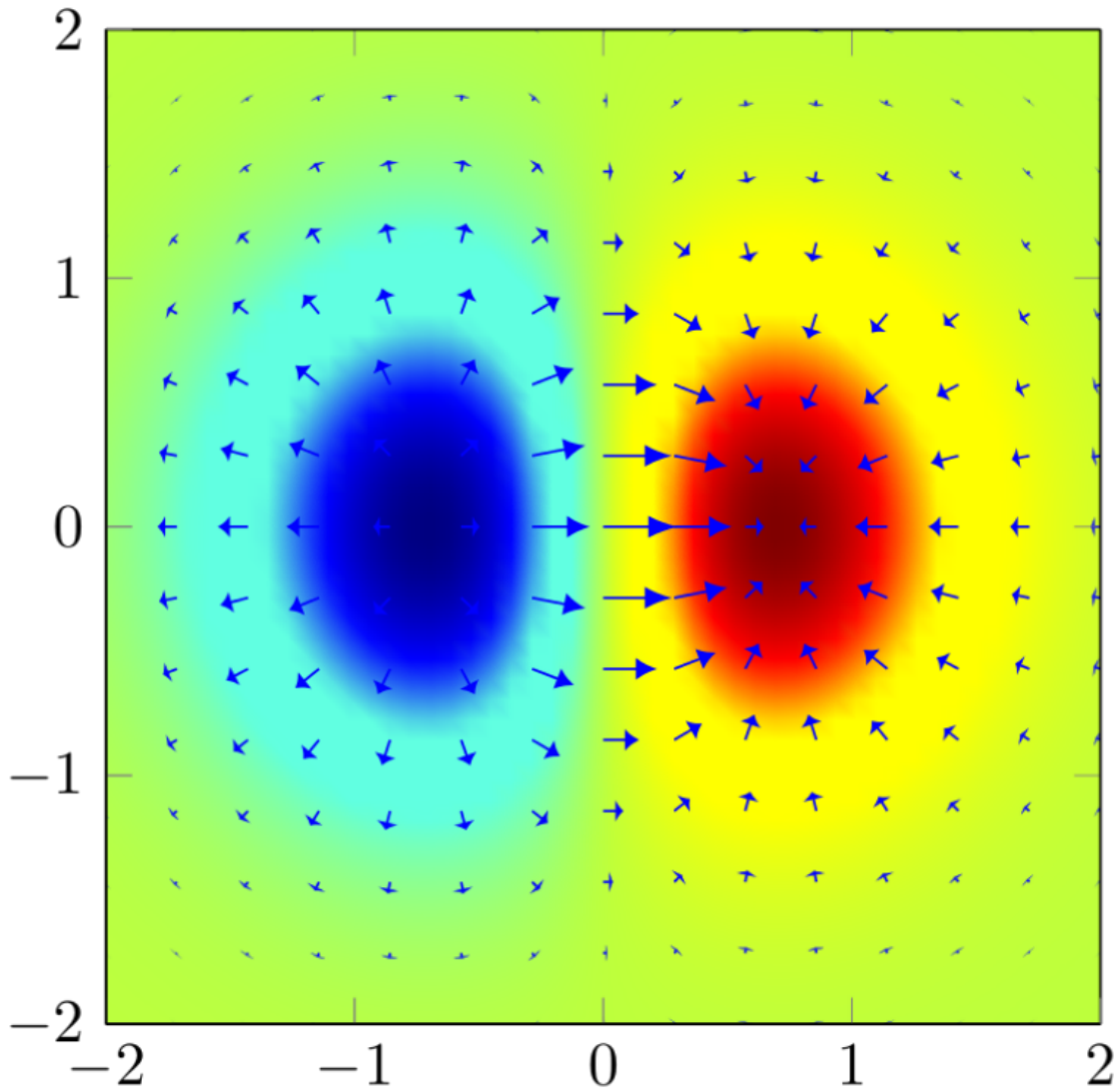
Wanna draw pics with LaTeX?
Use Ti*k*Z!

Powerful packages / tikz

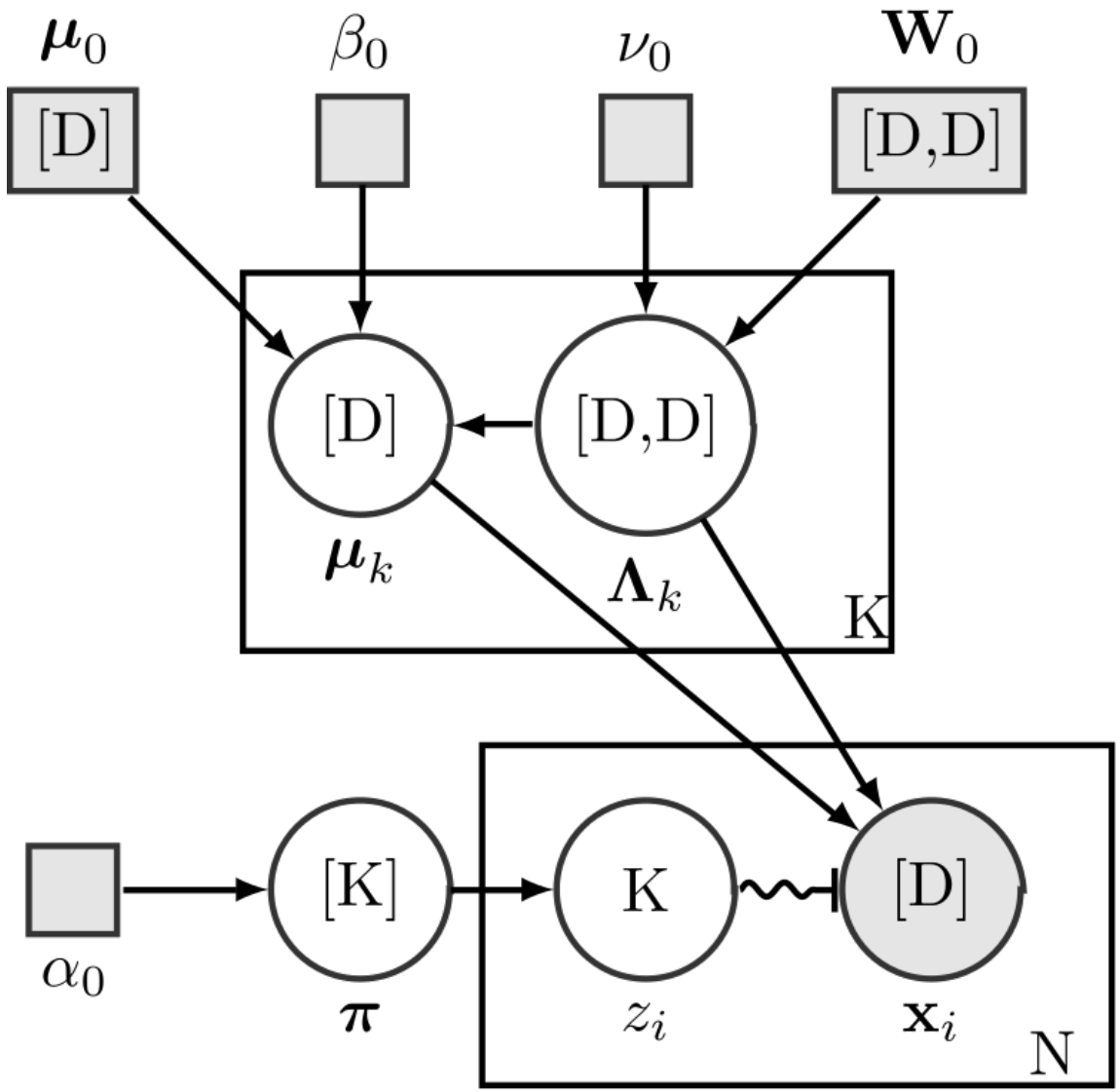
Wanna draw pics with LaTeX?
Use Ti*k*Z!
You can draw:

- 3D drawing
- Finite automata and turing machines
- Coordinate system
- Calendars
- Logic circuit and electrical circuit diagrams
- Matrices
- Mind maps
- Trees
- Special shapes and symbols
- ...

Powerful packages / tikz



Powerful packages / tikz



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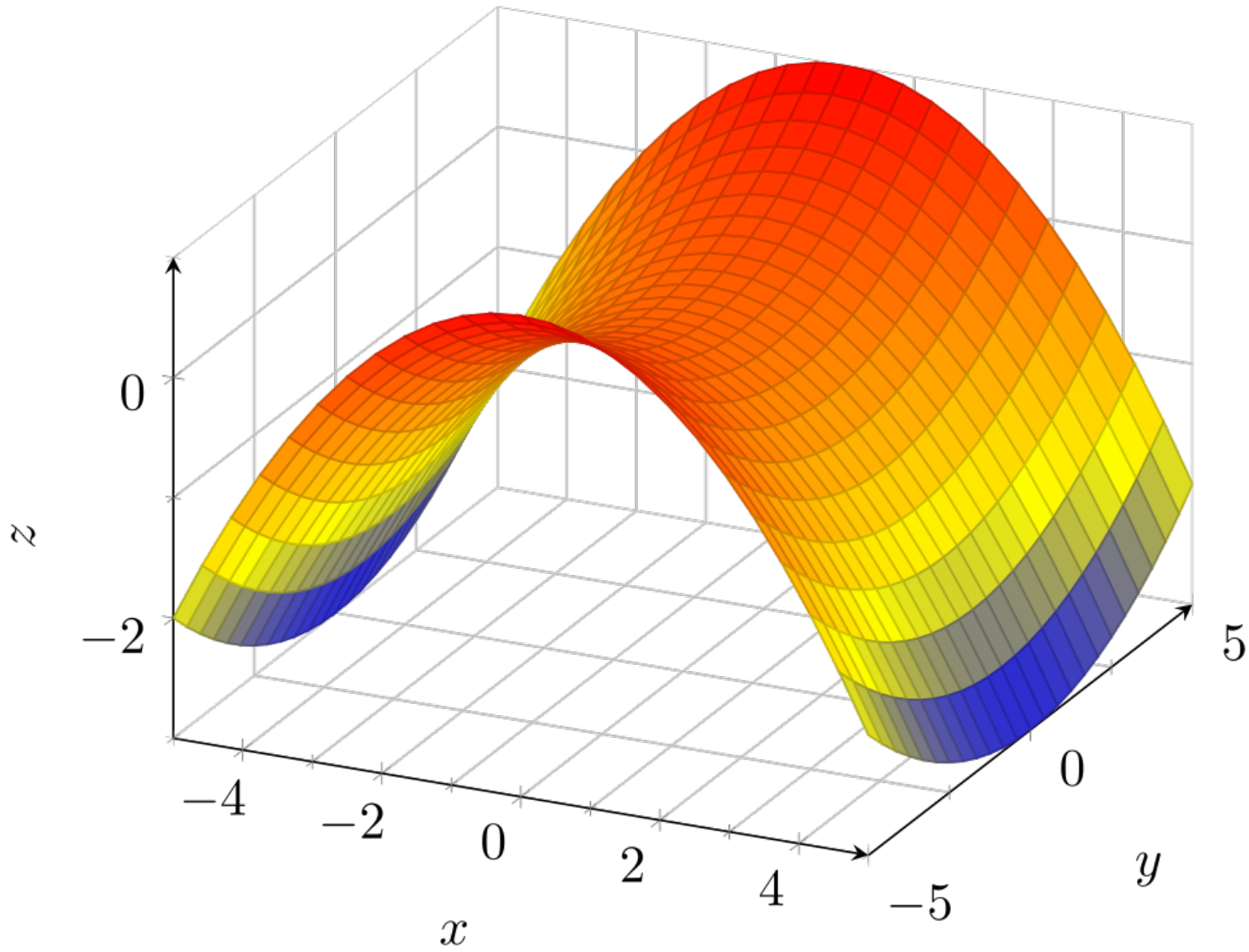

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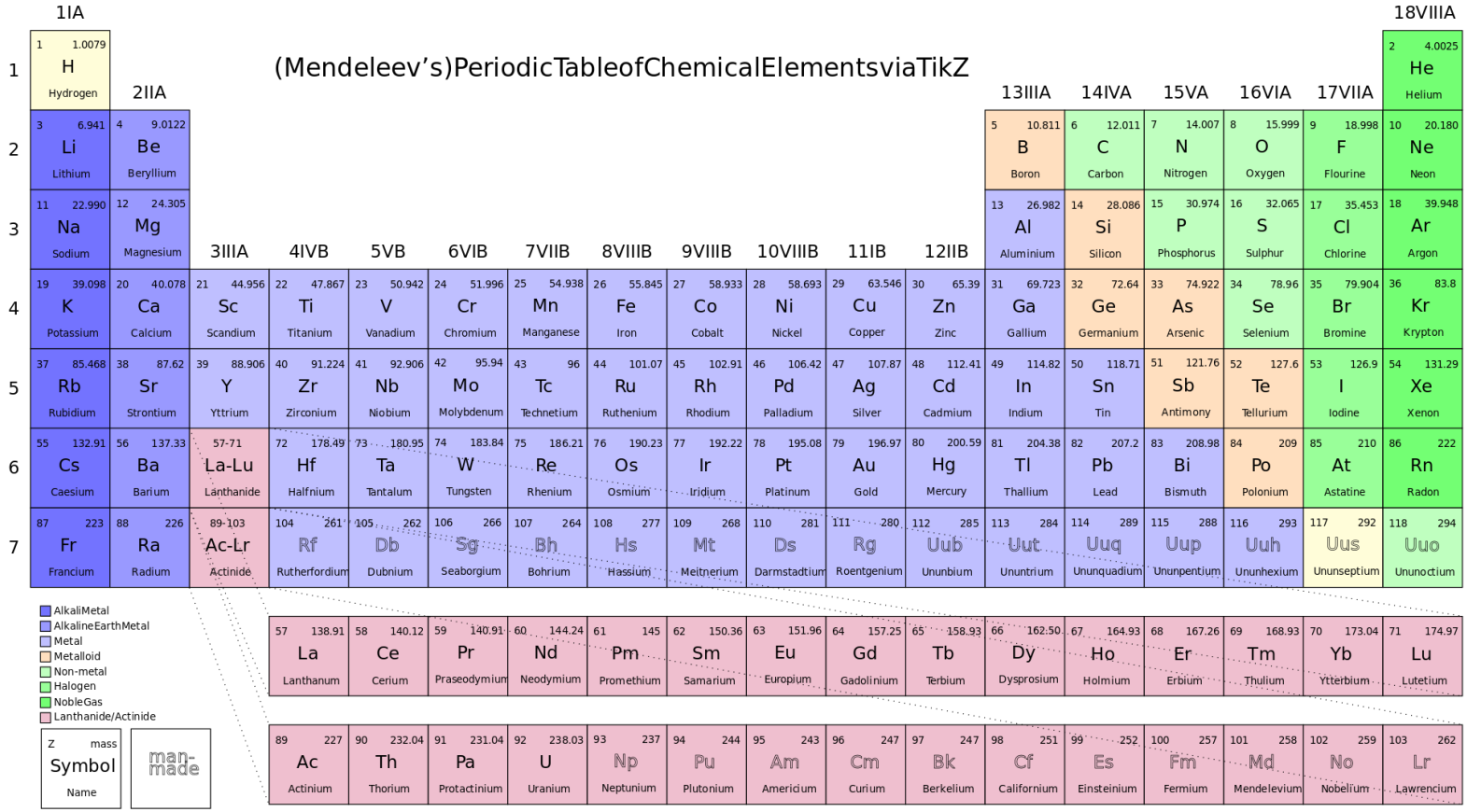

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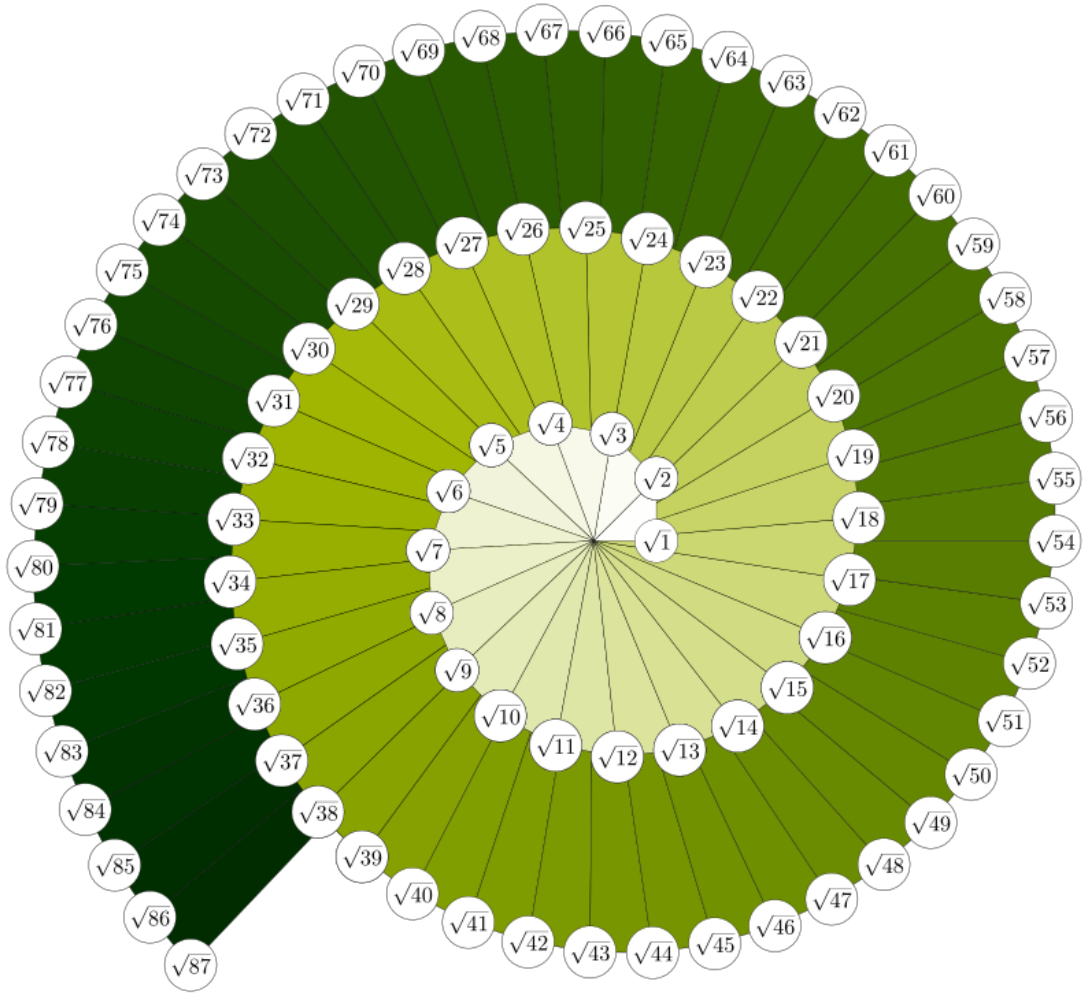

Powerful packages / `tikz`

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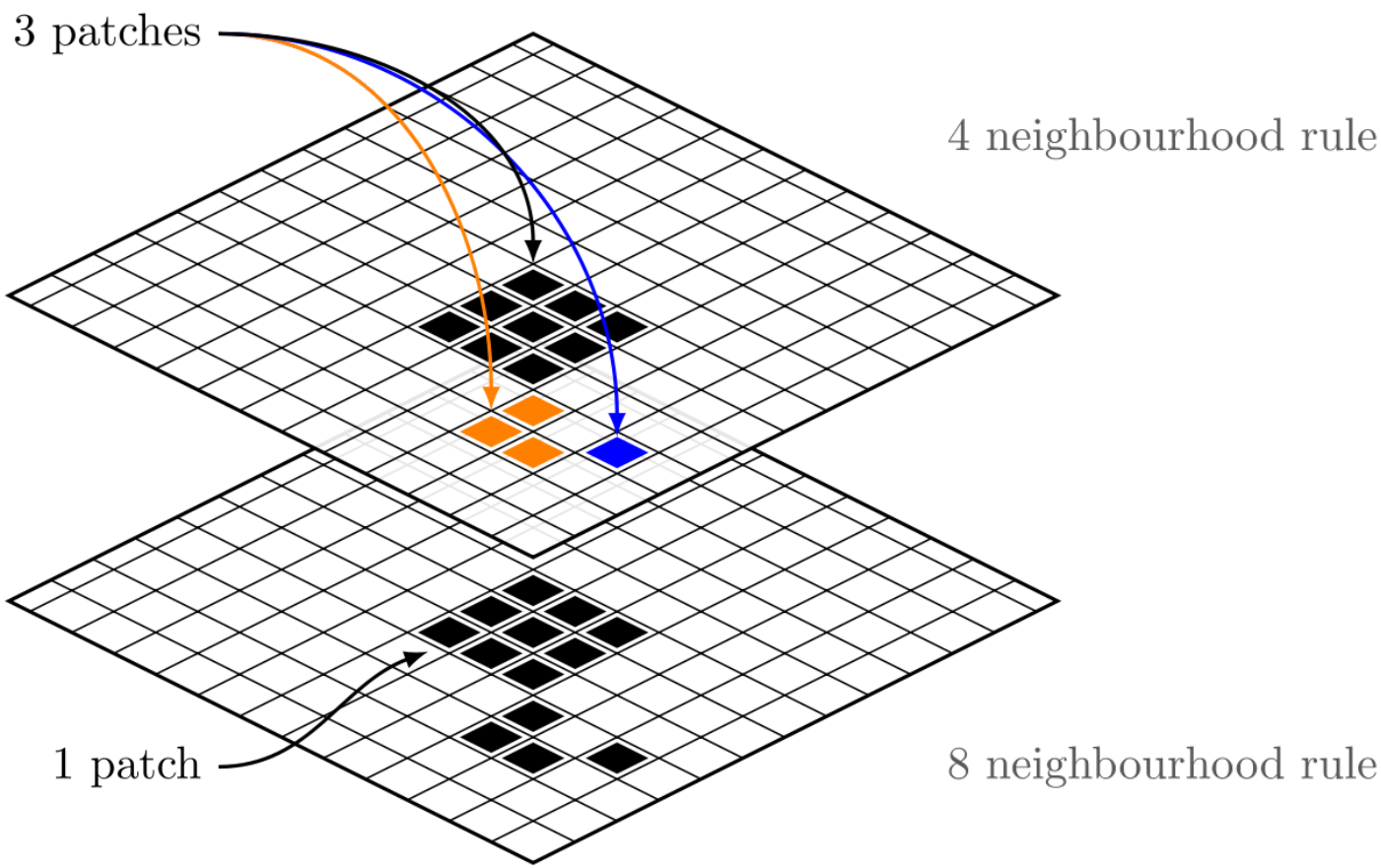
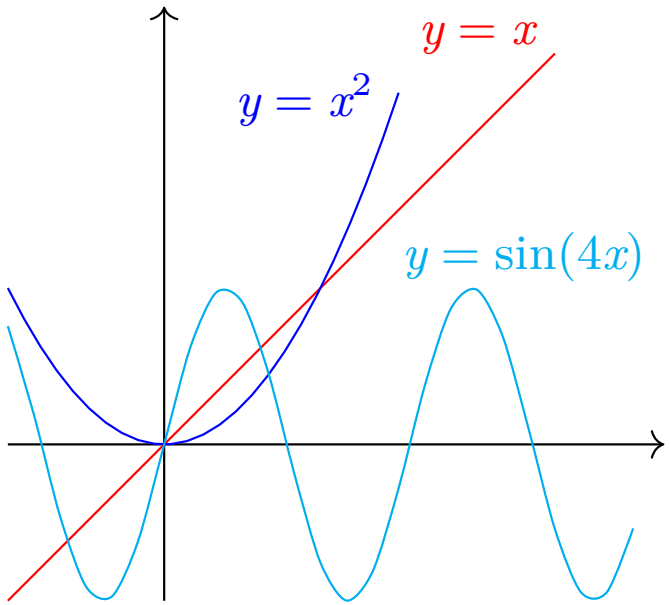


Powerful packages / tikz

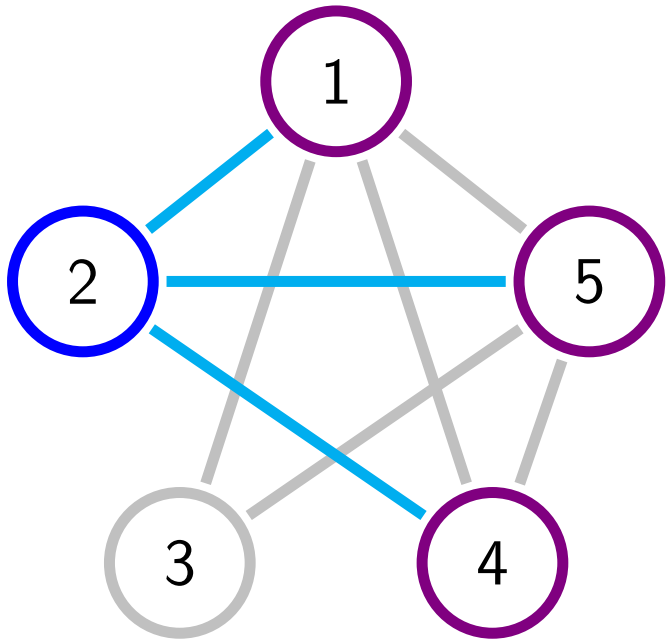

```
\draw[<->](3.2,0)--(0,0)--(0,6.6);
\draw(0,-1)--(0,0)--(-1,0);
\draw[red,domain=-0.4:3] plot(\x,2*\x)
node at (0.8,3.5){$y=2x$};
\draw[blue,domain=-1:2] plot(\x,2*\x*\x)
node at (1.1,2.2){$y=x^2$};
\draw[cyan,domain=-1:3,smooth] plot(\x,{2*sin(4*\x r)})
node at (2.3,0.6){$y=2sin(4x)$};
```



Powerful packages / tikz

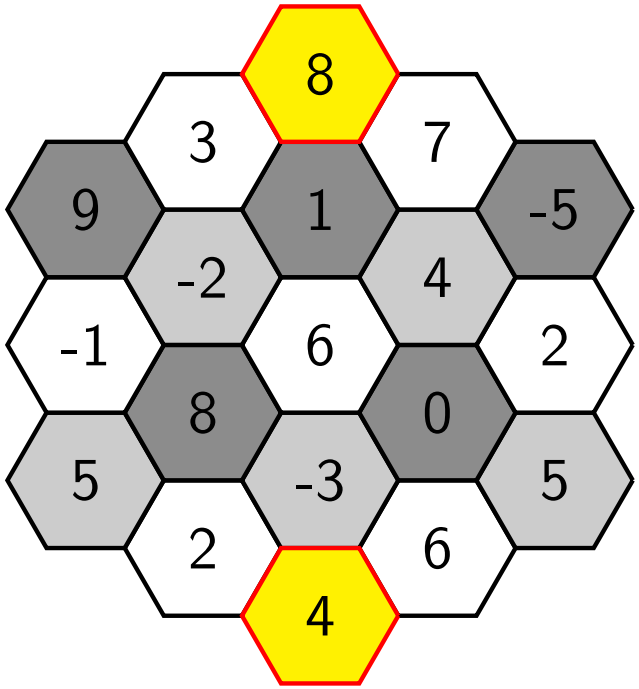

```
\begin{tikzpicture}
    [Node/.style={circle, draw=Silver, fill=white, line width=2pt,
    minimum size=9mm}, ONode/.style={circle, draw=white, fill=white,
    line width=2pt, minimum size=10mm}, PNode/.style={circle, fill=white,
    draw=Blue, line width=2pt, minimum size=9mm}, QNode/.style={circle,
    draw=Purple, fill=white, line width=2pt, minimum size=9mm}];
    \node[ONode] (b1) at (2, 3.08) {};
    \node[ONode] (b2) at (0.38, 1.8) {};
    \node[ONode] (b3) at (1, 0) {};
    \node[ONode] (b4) at (3, 0) {};
    \node[ONode] (b5) at (3.62, 1.8) {};
    \node[QNode] (a1) at (2, 3.08) {\large\textsf{1}};
    \node[PNode] (a2) at (0.38, 1.8) {\large\textsf{2}};
    \node[Node] (a3) at (1, 0) {\large\textsf{3}};
    \node[QNode] (a4) at (3, 0) {\large\textsf{4}};
    \node[QNode] (a5) at (3.62, 1.8) {\large\textsf{5}};
    \draw [draw = Silver, line width = 2pt] (b1) -- (b3);
    \draw [draw = Silver, line width = 2pt] (b1) -- (b4);
    \draw [draw = Silver, line width = 2pt] (b1) -- (b5);
    \draw [draw = Silver, line width = 2pt] (b3) -- (b5);
    \draw [draw = Silver, line width = 2pt] (b4) -- (b5);
    \draw [draw = cyan, line width = 2pt] (b1) -- (b2);
    \draw [draw = cyan, line width = 2pt] (b2) -- (b4);
    \draw [draw = cyan, line width = 2pt] (b2) -- (b5);
\end{tikzpicture}
```

Powerful packages / tikz



Powerful packages / tikz

从这里开始



到这里结束

BibTeX

BibTeX stands for a tool and a file format which are used to describe and process lists of references, mostly in conjunction with LaTeX documents.

BibTeX

BibTeX stands for a tool and a file format which are used to describe and process lists of references, mostly in conjunction with LaTeX documents.

Put your references information in `ref.bib`:

```
@article{cochran1967fast,
    title={What is the fast Fourier transform?},
    author={Cochran, William T and Cooley, ...},
    journal={Proceedings of the IEEE},
    volume={55},
    number={10},
    pages={1664--1674},
    year={1967},
    publisher={IEEE}
}
```

BibTeX

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Cite your references in `thesis.tex`:

```
    The fast Fourier transform is a computational
tool which facilitates signal analysis such as power
spectrum analysis and filter simulation by means of
digital computers.~\cite{cochran1967fast}
```

BibTeX

Cite your references in `thesis.tex`:

```
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spectrum analysis and filter simulation by means of
digital computers.~\cite{cochran1967fast}
```

Then create bibliography environment in the end of `thesis.tex`:

```
\bibliography{ref}{}
\bibliographystyle{unsrt}
```

BibTeX

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Compile!

BibTeX

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digital computers.~\cite{cochran1967fast}
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\bibliography{ref}{}
\bibliographystyle{unsrt}
```

Compile!

1. `pdflatex thesis.tex`
2. `bibtex thesis.tex`
3. `pdflatex thesis.tex`
4. `pdflatex thesis.tex`

Summary

- `\newcommand` & `\renewcommand`

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- lastpage
- fancyhdr
- hyperref
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- listings & minted
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Wish you have fun playing with LaTeX!