

Tanimodori 的 L^AT_EX 备忘录

v 1.0.0

Tanimodori

2020 年 7 月 10 日

0 约定

-  表示内容属于由 Plain T_EX
-  表示内容属于 L^AT_EX
-  表示内容属于宏包
-  表示内容属于本文中的宏

1 基本

1.1 L^AT_EX 文档基本格式

```
% !TEX TS-program = xelatex
% !TEX encoding = UTF-8
\XeTeXlinebreaklocale "zh"
\XeTeXlinebreakskip = 0pt plus 1pt      % 编译引擎选项、编码
\documentclass[12pt]{article}           % 全局选项、文档属性
\usepackage{xCJK,fontspec}              % 宏包及其选项
\usepackage{graphicx}
\usepackage{amsmath,amssymb,amsthm}
\title{\LaTeX\ Test}                   % 标题
\author{\LaTeX\ User}                  % 作者
\date{yyyy.mm.dd}                      % 日期
\begin{document}                        % 导言区结束，进入正文
\maketitle
\section{Foo}                           % 节
\subsection{Bar}                        % 小节
The quick fox jumps over the lazy dog. % 正文
\end{document}                          % 正文结束
```

1.2 空格

一次 L^AT_EX 源文件编译过程中的主要步骤包括：

1. 前端编辑器（例如 TeXWorks）根据源文件和用户设置交给对应的引擎（例如 X_YL_AT_EX）
2. 引擎将源文件令牌化
3. 引擎根据令牌序列输出结果。

在令牌化过程中，单个空格、多个空格或者单个换行符会被看作一个空格令牌，多个换行符会被看做换行令牌。但是控制字¹末尾的空格字符会被忽略，不会作为空格令牌。还需加上 “\ ” 来插入一个控制空格。控制换行符可以通过 “\\ ” 插入

L^AT_EXwithout space
L^AT_EX with space!

\LaTeX\ without space\\
\LaTeX\ with space!

我们用尺度（*dimension*）一词来描述空格的长度。尺度由“实数 + 单位”构成，例如“5pt”、“-1.1 em”、“+,6cm”都是合法的尺度。在 T_EX 中，可以通过 \hskip <dimen> 、\vskip <dimen> 插入水平和垂直空格。L^AT_EX 的对应命令为 \hspace{<dimen>} 和 \vspace{<dimen>}。一般来说，由于历史遗留问题，我们应尽量使用 L^AT_EX 包装好的命令，避免使用 T_EX 命令。

能够产生水平空格的常见指令见下表。

¹Control Word，由反斜杠和字母序列组成，例如 “\LaTeX”，是控制序列的一种。

空格宽度	文本模式		数学模式	
	代码	示例	代码	示例
.16667em 或 3mu	a\,b	a b	$\$a\,,b\$$	$a\,b$
	a\thinspace b	a b	$\$a\,\thinspace b\$$	$a\,b$
-3mu			$\$a\,!b\$$	ab
			$\$a\mkern-\thinmuskip b\$$	ab
4.0mu plus 2.0mu minus 4.0mu			$\$a\>b\$$	$a\,b$
			$\$a\!:b\$$	$a\,b$
			$\$a\mkern\medmuskip b\$$	$a\,b$
5.0mu plus 5.0mu			$\$a\;;b\$$	$a\,b$
			$\$a\mkern\thickmuskip b\$$	$a\,b$
.5em	a\enspace b	a b	$\$a\,\enspace b\$$	$a\,b$
1em	a\quad b	a b	$\$a\,\quad b\$$	$a\,b$
2em	a\qquad b	a b	$\$a\,\qquad b\$$	$a\,b$
<len>	a\hskip 1em b	a b	$\$a\,\hskip 1em b\$$	$a\,b$
	a\kern 1pc b	a b	$\$a\,\kern 1pc b\$$	$a\,b$
	a\hspace{25pt} b	a b	$\$a\,\hspace{25pt} b\$$	$a\,b$
<stuff>	axyzb	axyzb	$\$axyzb\$$	$axyzb$
	a\hphantom{xyz}b	a b	$\$a\,\hphantom{xyz}b\$$	$a\,b$
inter-word	a{ }b	a b	$\$a\{ \}b\$$	ab
	a\space b	a b	$\$a\,\space b\$$	ab
control	a\ b	a b	$\$a\,\,b\$$	$a\,b$
unbreakable	a~b	a b	$\$a\sim b\$$	$a\,b$
rubber	a\hfill b	a b	$\$a\,\hfill b\$$	$a\,b$
	a\hspace{\fill} b	a b	$\$a\,\hspace{\fill} b\$$	$a\,b$

其中mu是数学模式下的单位长度。<dimen> plus <dimen> minus <dimen> 除了定义空格的长度以外,还定义了空格的伸缩量。\\hphantom会提供与参数水平尺寸相同的空格。“~”、\\hspace*和\\vspace*产生的空格是不换行空格,也就是说L^AT_EX不会在此处换行。\\hfill、\\vfill (T_EX)、\\hspace{\\fill}、\\vspace{\\fill} (L^AT_EX) 将产生填满剩余空间的空格,若有多个,则按照比例分配,例如:

左对齐	右对齐	左对齐 <code>\\hspace*{\\fill}\\</code>
		<code>\\hspace*{\\fill}</code> 右对齐 <code>\\</code>
	居中	<code>\\hspace*{\\fill}</code> 居中 <code>\\hspace*{\\fill}</code>

1.3 字体

1.3.1 指定字体

我们首先需要导入xeCJK和fontspec宏包，然后才能指定中英文字体。

```
% 导言区
\usepackage{xeCJK,fontspec}
% 设置英文宋体、黑体、等宽字体
\setmainfont{Source Han Serif SC}
\setsansfont{Source Han Sans SC}
\setmonofont{Sarasa Mono SC}
% 设置中文宋体、黑体、等宽字体
\setCJKmainfont{Source Han Serif SC}
\setCJKsansfont{Source Han Sans SC}
\setCJKmonofont{Sarasa Mono SC}
```

我们还可以给字体指定伪斜体与伪粗体

```
\setmainfont[AutoFakeSlant=0.2, AutoFakeBold=1.5]{Source Han Serif SC}
```

以及设置小型大写字母替代字体

```
\setmainfont[
  SmallCapsFont=TeX Gyre Termes,
  SmallCapsFeatures={Letters=SmallCaps}
]{Source Han Serif SC}
```

1.3.2 指定字形

命令	等价命令	效果
<code>\textnormal{...}</code>	<code>{\normalfont ...}</code>	Sample Text 示例文本
<code>\emph{...}</code>	<code>{\em ...}</code>	<i>Sample Text</i> 示例文本
<code>\textrm{...}</code>	<code>{\rmfamily ...}</code>	Sample Text 示例文本
<code>\textsf{...}</code>	<code>{\sffamily ...}</code>	Sample Text 示例文本
<code>\texttt{...}</code>	<code>{\ttfamily ...}</code>	Sample Text 示例文本
<code>\textup{...}</code>	<code>{\upshape ...}</code>	Sample Text 示例文本
<code>\textit{...}</code>	<code>{\itshape ...}</code>	<i>Sample Text</i> 示例文本
<code>\textsl{...}</code>	<code>{\slshape ...}</code>	<i>Sample Text</i> 示例文本
<code>\textsc{...}</code>	<code>{\scshape ...}</code>	SAMPLE TEXT
<code>\textbf{...}</code>	<code>{\bfseries ...}</code>	Sample Text 示例文本
<code>\textmd{...}</code>	<code>{\mdseries ...}</code>	Sample Text 示例文本
<code>\textl{...}</code>	<code>{\lfseries ...}</code>	不支持

1.3.3 指定字体大小

命令	效果
<code>\tiny</code>	Sample Text 示例文本
<code>\scriptsize</code>	Sample Text 示例文本
<code>\footnotesize</code>	Sample Text 示例文本
<code>\small</code>	Sample Text 示例文本
<code>\normalsize</code>	Sample Text 示例文本
<code>\large</code>	Sample Text 示例文本
<code>\Large</code>	Sample Text 示例文本
<code>\LARGE</code>	Sample Text 示例文本
<code>\huge</code>	Sample Text 示例文本
<code>\Huge</code>	Sample Text 示例文本

1.3.4 指定字体颜色 PKG

red text
blue text

```
\usepackage{xcolor} % 导言区
{\color{red} red text}\\
\textcolor{blue}{blue text}
```

2 版式与结构 PKG

2.1 页边距

```
% 引言区
\usepackage{geometry}
\geometry{left=1.5cm,right=1.5cm,top=1.5cm,bottom=2cm,a4paper}
```

2.2 日期

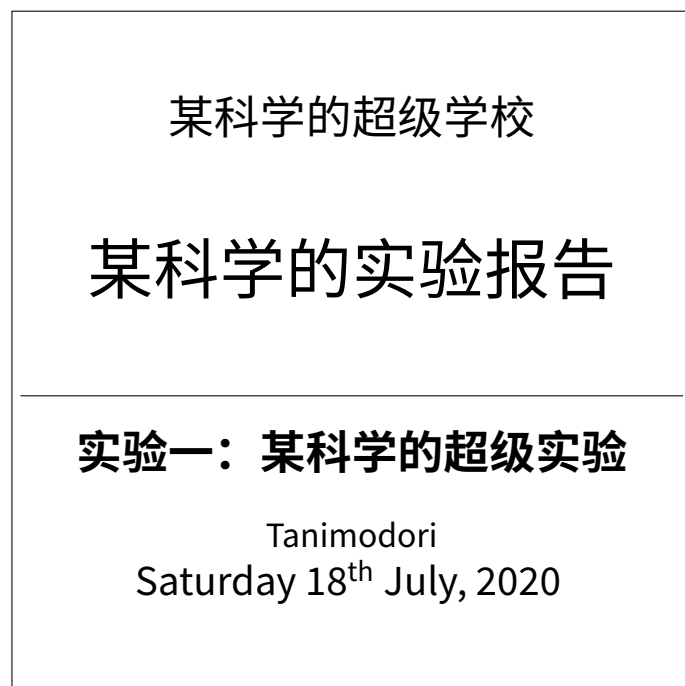
2020.07.18 2020 年 7 月 18 日

```
\usepackage{datetime} % 导言区
\renewcommand{\dateseparator}{.}
\yyyymmdddate
\today % yyyy.mm.dd
\newdateformat{cndate}{\THEYEAR 年\THEMONTH 月
↪ \THEDAY 日}
\cndate\today % yyyy年mm月dd日
```

2.3 分割线

```
\noindent\rule{\textwidth}{0.4pt}
```

2.4 自定义封面



```
\begin{document}
  \begin{titlepage}
    \sffamily
    \centering
    \vspace{1cm}
    {\Large 某科学的超级学校\par}
    \vspace{0.8cm}
    {\Huge 某科学的实验报告\par}
    \vspace{0.4cm}
    \noindent\rule{\textwidth}{0.4pt}
    {\bfseries\Large
      实验一：某科学的超级实验\par}
    \vspace{0.4cm}
    {Tanimodori}
    \vfill
    {\large \today}
    \vspace{1.2cm}
  \end{titlepage}
\end{document}
```

2.5 目录

通常结构

```
\renewcommand{\contentsname}{\centering 目录}
\begin{document}
\tableofcontents
\thispagestyle{empty} % 禁用页码
\newpage
\setcounter{page}{1}
\end{document}
```

带超链接的目录

```
\usepackage[CJKbookmarks]{hyperref}
\hypersetup{
  colorlinks=true,
  linktoc=page,
  linkcolor=blue
}
\begin{document}
\tableofcontents
\end{document}
```

2.6 参考文献

通常结构

```
\usepackage{hyperref}
\usepackage[hyperref=true,backend=biber,sorting=none,backref=false,doi=false,isbn=false,url=false]{
  ↪ biblatex}
\addbibresource{example.bib}
% 引言区
\begin{document}
Foo\parencite{Foo_Bar_2020}
\printbibliography[heading=none]
\end{document}
```

上标方括号参考

```
% 引言区
\DeclareCiteCommand{\supercite}[\mkbibsuperscript]
  {\iffieldundef{prenote}
    {}
    {\BibliographyWarning{Ignoring prenote argument}}}%
  {\iffieldundef{postnote}
    {}
    {\BibliographyWarning{Ignoring postnote argument}}}%
  {\usebibmacro{citeindex}}%
  {\bibopenbracket\usebibmacro{cite}\bibclosebracket}
  {\supercitedelim}
  {}
```

3 数学模式

下花括号

$$1 \underbrace{0 \cdots 0}_{10 \text{ zeros}}$$

```
\[1\underbrace{0\cdots0}_{\text{10 zeros}}\]
```

分类

$$x = \begin{cases} 1, & y = 1 \\ 2, & y = 2 \\ 0, & \text{otherwise.} \end{cases}$$

```
\[x=\begin{cases}
  1,&y=1\\
  2,&y=2\\
  0,&\text{otherwise.}
\end{cases}\]
```

矩阵

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

```
\[A=\begin{bmatrix}
1&2\\
3&4
\end{bmatrix}\]
```

等式

$$T_0(k) = \frac{1}{2}T_0(k-1) \quad (1)$$

```
\begin{equation}
T_{\{0\}}(k)=\frac{1}{2} T_{\{0\}}(k-1)
\end{equation}
```

连等式

$$\begin{aligned} y &= (x+1)(x-1) \\ &= x^2 - 1 \end{aligned}$$

```
\[\begin{aligned}
y&=(x+1)(x-1)\\
&=x^2-1
\end{aligned}\]
```

微积分

$$\begin{aligned} \iiint_{\Omega_2} \sqrt{z} dv &= \iiint_{\Omega_2} \sqrt{r \cos \varphi} \cdot r^2 \sin \varphi dr d\theta d\varphi \\ &= \int_0^{\frac{\pi}{4}} d\varphi \int_0^{2\pi} d\theta \int_0^1 r^{\frac{5}{2}} \sin \varphi \sqrt{\cos \varphi} dr \\ &= - \int_0^{\frac{\pi}{4}} \sqrt{\cos \varphi} d \cos \varphi \cdot 2\pi \cdot \frac{2}{7} \\ &= -\frac{2}{3} (\cos \varphi)^{\frac{3}{2}} \bigg|_0^{\frac{\pi}{4}} \cdot \frac{4\pi}{7} \\ &= \frac{4\pi}{21} (2 - \sqrt[4]{2}) \end{aligned}$$

```
\newcommand{\dr}{\mathrm{d}r}
\newcommand{\dth}{\mathrm{d}\theta}
\newcommand{\dph}{\mathrm{d}\varphi}
\newcommand{\dzz}{\mathrm{d}z}
\[\begin{aligned}
\iiint_{\Omega_2}\sqrt{z}\mathrm{d}v&=\iiint_{\Omega_2} \sqrt{r\cos\varphi}\cdot r^2\sin\varphi\dr\dth
\Rightarrow \dph\\
&=\int_0^{\frac{\pi}{4}}\frac{\pi}{4}\dph\int_0^{2\pi}\dth\int_0^1r^{\frac{5}{2}}\sin\varphi\sqrt{\cos\varphi}\dr\\
&=-\int_0^{\frac{\pi}{4}}\frac{\pi}{4}\sqrt{\cos\varphi}\mathrm{d}\cos\varphi\cdot 2\pi\cdot \frac{2}{7}\\
&=-\frac{2\pi}{3}(\cos\varphi)^{\frac{3}{2}}\Big|_0^{\frac{\pi}{4}}\cdot \frac{4\pi}{7}\\
&=\frac{4\pi}{21}(2-\sqrt[4]{2})\\
\end{aligned}\]
```


行列式

$$\left| \begin{array}{ccccc} a+x_1 & a & a & \cdots & a \\ -x_1 & x_2 & 0 & \cdots & 0 \\ -x_1 & 0 & x_3 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ -x_1 & 0 & 0 & \cdots & x_n \end{array} \right| \begin{array}{l} r_1 + (-\frac{a}{x_2})r_2 \\ r_1 + (-\frac{a}{x_3})r_3 \\ \vdots \\ r_1 + (-\frac{a}{x_n})r_n \end{array} \rightarrow \left| \begin{array}{cccc} a+x_1 \left(1 + \frac{a}{x_2} + \frac{a}{x_3} + \cdots + \frac{a}{x_n}\right) & 0 & 0 & \cdots & 0 \\ -x_1 & x_2 & 0 & \cdots & 0 \\ -x_1 & 0 & x_3 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ -x_1 & 0 & 0 & \cdots & x_n \end{array} \right|$$

```
\[ \begin{vmatrix}
a+x_1 & a & a & \cdots & a \\
-x_1 & x_2 & 0 & \cdots & 0 \\
-x_1 & 0 & x_3 & \cdots & 0 \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
-x_1 & 0 & 0 & \cdots & x_n
\end{vmatrix}
\begin{array}{l}
r_1 + (-\frac{a}{x_2})r_2 \\
r_1 + (-\frac{a}{x_3})r_3 \\
\vdots \\
r_1 + (-\frac{a}{x_n})r_n
\end{array}
\rightarrow \\
\begin{vmatrix}
a+x_1 \left(1 + \frac{a}{x_2} + \frac{a}{x_3} + \cdots + \frac{a}{x_n}\right) & 0 & 0 & \cdots & 0 \\
-x_1 & x_2 & 0 & \cdots & 0 \\
-x_1 & 0 & x_3 & \cdots & 0 \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
-x_1 & 0 & 0 & \cdots & x_n
\end{vmatrix}
\]
```

4 图片

4.1 嵌入位图、矢量图、PDF

```
\usepackage{graphicx}
\includegraphics[width=1\linewidth]{example.png}
\includegraphics[width=1\linewidth]{example.svg}
\includegraphics[width=1\linewidth]{example.pdf}
```

4.2 图表标题

```
% 引言区
\usepackage{caption}
\captionsetup[figure]{name=图}
\captionsetup[table]{name=表}
\renewcommand{\contentsname}{\centering 目录}
\begin{figure}[]
  \centering
  \includegraphics[width=1\linewidth]{example.png}
  \caption{Foo}
  \label{fig:foo}
```

5 表格

列表

• item 1
• item 2

```
\begin{itemize} % 无序列表
\item item 1
\item item 2
\end{itemize}
```

1. item 1
(a) Nested item 1
(b) Nested item 2
2. item 2

```
\begin{enumerate} % 有序列表
\item item 1
\begin{enumerate} % 嵌套列表
\item Nested item 1
\item Nested item 2
\end{enumerate}
\item item 2
\end{enumerate}
```

Apple item 1
Butter item 2
Charlie item 3

```
\begin{description} % 描述列表
\item [Apple] item 1
\item [Butter] item 2
\item [Charlie] item 3
\end{description}
```

tabular

十进制数	4-3-2-1 编码
0	0000
1	0001
2	0010
3	0100
4	1000
5	1001
6	1010
7	1100
8	1101
9	1110

```
\begin{tabular}{|1|1|1|1|}\hline
十进制数& 4-3-2-1编码 \\\hline
0      & 0000 \\\hline
1      & 0001 \\\hline
2      & 0010 \\\hline
3      & 0100 \\\hline
4      & 1000 \\\hline
5      & 1001 \\\hline
6      & 1010 \\\hline
7      & 1100 \\\hline
8      & 1101 \\\hline
9      & 1110 \\\hline
\end{tabular}
```

现态	次态		当前输出
	$X = 0$	$X = 1$	
a	c	c	1
c	d	f	0
d	f	a	1
f	c	d	0

```

\usepackage{multirow} % 导言区
\begin{tabular}{c|cc|c}\hline
\multirow{2}{*}{现态}&\multicolumn{2}{|c|}{次态}
↪ &\multirow{2}{*}{当前输出}\\ccline{2-3}
~&\$X=0\$&\$X=1\$&~\\\hline
a&c&c&1\\
c&d&f&0\\
d&f&a&1\\
f&c&d&0\\\hline
\end{tabular}

```

6 代码 PKG

Matlab

```

function xbar=mymean(x)
    t=0;
    n=length(x);
    for i=1:n
        t=t+x(i);
    end
    xbar=t/n;
end

```

```

\usepackage{listings}
\usepackage{matlab-prettifier} % 导言区
\begin{lstlisting}[style=Matlab-editor]
function xbar=mymean(x)
    t=0;
    n=length(x);
    for i=1:n
        t=t+x(i);
    end
    xbar=t/n;
end
\end{lstlisting}

```

x86 汇编

```
data segment
s db 'Hello World!$'
data ends

code segment
assume cs:code, ds:data
start: mov ax, data
mov ds, ax

lea dx, s
mov ah, 09H
int 21H

mov ax, 4C00H
int 21H

code ends
end start
```

```
\usepackage{listings} % 导言区
\lstdefinestyle{customasm}{
language=[x86masm]Assembler,
basicstyle=\linespread{1.0}\small\ttfamily,
commentstyle=\color{Brown},
keywordstyle=\color{blue}\bfseries,
stringstyle=\color{Green}\bfseries,
keepspaces=true,
columns=fixed,
basewidth=0.5em,
}
\lstinputlisting[style=customasm]{examples/x86asm_example.asm}
```

C

```
int main(int argv, char* argc[]) {
    for (int j = 0; j < 200; ++j) {
        int t, p, found;
        fscanf(input, "(%d,%d) ", &t, &
↪ p);
        found = mem_find(p);
        if (found != -1) {
            ++hit;
            fprintf(output, "%c", mem[
↪ found].data[t]);
        } else {
            found = mem_find_empty();
            mem_load(&mem[found], disk,
↪ p);
            fprintf(output, "%c", mem[
↪ found].data[t]);
        }
    }
    return 0;
}
```

```
\usepackage{listings} % 导言区
\lstdefinestyle{customc}{
language=C,%
keepspaces=true,%
columns=fixed,%
basewidth=0.5em,%
basicstyle=\ttfamily,%
breaklines=true,%
commentstyle=\color{Green},%
keywordstyle=\color{blue}\bfseries,%
stringstyle=\color{Brown}\bfseries,%
numberstyle=\ttfamily\color{Gray},%
showstringspaces=false%
}
\lstinputlisting[style=customc]{examples/c_example.c
↪ }
```

Python

```
#!/usr/local/bin/python
# -*- coding: utf-8 -*-
"""
This is an example module
"""

class Example():
    """
    This is an example class
    """

    def __init__(self, arg):
        # This is an example class
        self.data = arg
        if arg == 'foo':
            print('foo')
        else:
            print('bar')
```

```
\usepackage{listings} % 导言区
\lstdefinestyle{custompython}{
    language=Python,
    keepspaces=true,
    columns=fixed,
    basewidth=0.5em,
    basicstyle=\ttfamily,
    breaklines=true,
    commentstyle=\color{Green},
    keywordstyle=\color{blue}\bfseries,
    stringstyle=\color{Brown}\bfseries,
    showstringspaces=false
}
\lstinputlisting[style=custompython]{examples/
    ↪ python_example.py}
```

diff

```
12 -   int i;
13 -   for (i = 0; i < N; i++)
14 -       pthread_create(&tid[i], NULL,
    ↪ thread, &i);
12 +   int i, args[N];
13 +   for (i = 0; i < N; i++) {
14 +       args[i] = i;
15 +       pthread_create(&tid[i], NULL,
    ↪ thread, args + i);
16 +   }
```

```
\usepackage{xcolor}
\definecolor{diffstart}{named}{gray}
\definecolor{diffincl}{named}{Green}
\definecolor{diffrem}{named}{Red}
\usepackage{listings}
\lstdefinestyle{customdiff}{
    language=C,
    keepspaces=true,
    columns=fixed,
    basewidth=0.5em,
    basicstyle=\ttfamily,
    breaklines=true,
    commentstyle=\color{Green},
    keywordstyle=\color{blue}\bfseries,
    stringstyle=\color{Brown}\bfseries,
    numberstyle=\ttfamily\color{Gray},
    showstringspaces=false,
    morecomment=[f][\color{diffstart}]{@@},
    morecomment=[f][\color{diffincl}]{+\ },
    morecomment=[f][\color{diffrem}]{-\ },
    numbers=left,
    stepnumber=1
}
% LISTINGS linenumber hack
\makeatletter
\let\orig@lstnumber=\the\lstnumber
\newcommand\lstsetnumber[1]{\gdef\the\lstnumber
    ↪ {#1}}
\newcommand\lstresetnumber{\global\let
    ↪ \the\lstnumber=\orig@lstnumber}
\makeatother
% 导言区
\begin{lstlisting}[style=customdiff,firstnumber
    ↪ =12, mathescape=true]
-   int i;
-   for (i = 0; i < N; i++)
-       pthread_create(&tid[i], NULL, thread, &i)
    ↪ ;$\lstresetnumber\setcounter{lstnumber
    ↪ }{11}$
+   int i, args[N];
+   for (i = 0; i < N; i++) {
+       args[i] = i;
+       pthread_create(&tid[i], NULL, thread,
    ↪ args + i);
+   }
\end{lstlisting}
```

终端



```
\usepackage{listings}
\lstdefinestyle{terminal}{
  backgroundColor=\color{black},
  basicstyle=\ttfamily\color{white},
  numbers=none,
  columns=fixed,
  basewidth=0.5em
} % 导言区
\begin{lstlisting}[style=terminal]
C:\>
\end{lstlisting}
```

伪代码

procedure SELECT TASK

for all client i in Q **do**

if s_i is False **then**

for all task $t(t_1, t_2, \dots, t_k)$ in Q_i **do**

if All $a_{t_{k_0}}$ is True **then**

$s_i \leftarrow$ True

 All $a_{t_{k_0}} \leftarrow$ False

$Q_i.\text{pop}(t)$

 Tell client i that these k re-

sources are available

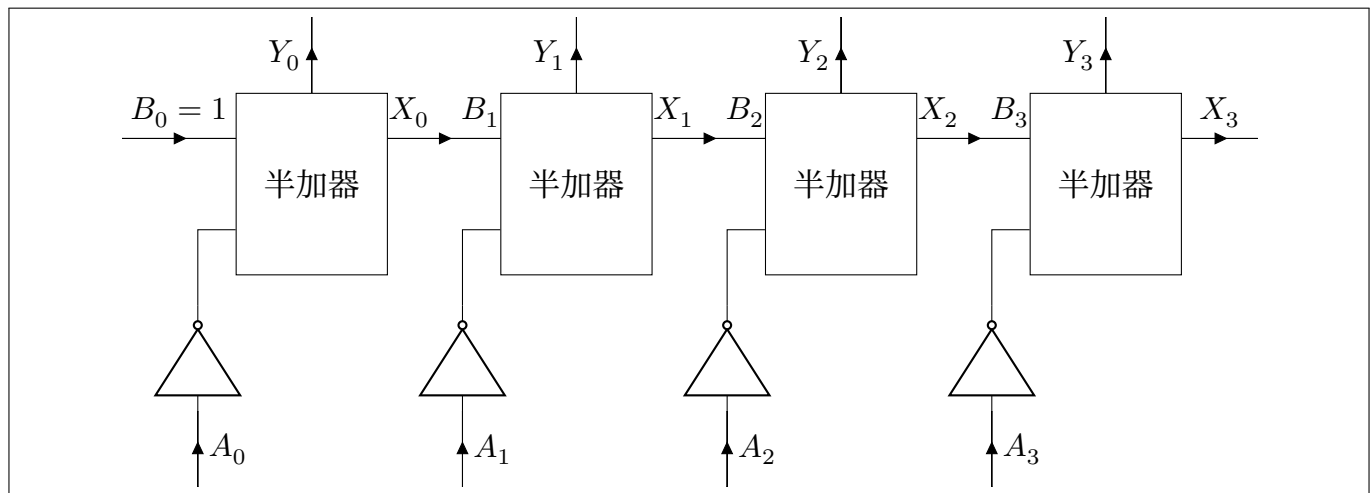
 Delay for a while

```
\usepackage{algorithm}
\usepackage[noend]{algpseudocode} % 导言区
% \begin{algorithm}
\begin{algorithmic}
\Procedure{Select Task}{}
\State \ForAll{client  $i$  in  $Q$ }
\If{ $s_i$  is False}
\ForAll{task  $t(t_1, t_2, \dots, t_k)$  in  $Q_i$ }
\If{All  $a_{t_{k_0}}$  is True}
\State  $s_i$  \gets True
\State {All  $a_{t_{k_0}}$ } \gets False
\State  $Q_i.\text{pop}(t)$ 
\State {Tell client  $i$  that these  $k$  resources
  ↪ are available}
\EndIf
\EndFor
\EndIf
\EndFor
\State Delay for a while
\EndProcedure
\end{algorithmic}
% \end{algorithm}
```

7 Tikz PKG

7.1 命令示例

`\foreach`



```

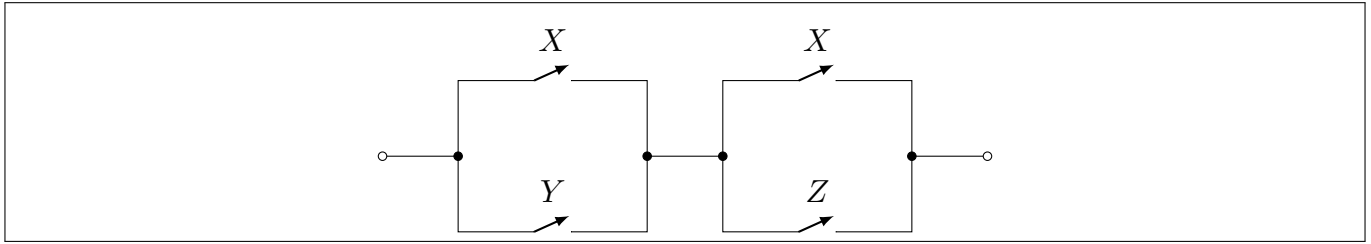
\begin{tikzpicture}[>=latex]
\foreach \x in {1, 2, 3, 4} {
  \pgfmathtruncatemacro{\xminus}{\x-1}
  \draw
    (\xminus*3.5,0) node[draw,minimum width=2cm,minimum height=2.4cm] (ha\x) {半加器}
    ($ (ha\x.west)!0.5!(ha\x.south west)$) coordinate (ha\x-a)
    ($ (ha\x.west)!0.5!(ha\x.north west)$) coordinate (ha\x-b)
    ($ (ha\x.east)!0.5!(ha\x.north east)$) coordinate (ha\x-x)
    ($ (ha\x.north)$) coordinate (ha\x-y)
    (ha\x-a) -| ++ (-0.5,-1) node[not port, anchor=out, rotate=90] (ha\x-an) {}
    (ha\x-an.in) to[short,i^<=${A_{\xminus}}$] ++ (0,-1)
    (ha\x-y) to[short,i^>=${Y_{\xminus}}$] ++ (0,1);
}
\foreach \x in {1, 2, 3} {
  \pgfmathtruncatemacro{\xminus}{\x-1}
  \pgfmathtruncatemacro{\xplus}{\x+1}
  \draw
    (ha\x-x) to[short,i^>=${X_{\xminus}\quad B_{\x}}$] (ha\xplus-b);
}
\draw
  (ha1-b) to[short,i^<=${B_0=1}$] ++ (-1.5,0)
  (ha4-x) to[short,i^>=${X_3}$] ++ (1,0);
\end{tikzpicture}

```


7.2 内容示例

7.2.1 数字逻辑设计

开关电路



```
\usepackage{tikz}
\usetikzlibrary{arrows,shapes}
\usepackage[american,RPvoltages]{circuitikz}
% 导言区
\begin{circuitikz}[>=latex]
\draw
(0,0) to [short,o-*] (1,0) coordinate (left_in) ---+ (0,1)
---+ (1,0) to[nos,->,l=$X$] ++ (0.5,0) ---+ (1,0)
---+ (0,-1) coordinate (left_out) to [short,*-*] ++ (1,0) coordinate (right_start)

(left_in) ---+ (0,-1)
---+ (1,0) to[nos,->,l=$Y$] ++ (0.5,0) ---+ (1,0)
-- (left_out)

(right_start) ---+ (0,1)
---+ (1,0) to[nos,->,l=$X$] ++ (0.5,0) ---+ (1,0)
---+ (0,-1) coordinate (right_end) to [short,*-o] ++ (1,0) coordinate(end)

(right_start) ---+ (0,-1)
---+ (1,0) to[nos,->,l=$Z$] ++ (0.5,0) ---+ (1,0)
-- (right_end);
\end{circuitikz}
```

门电路 MACRO

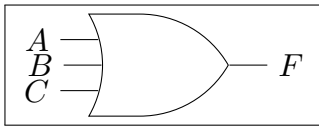
首先导入 xparse 宏包

```
\usepackage{xparse} % 导言区
```

with input labels、**with output label**、**with select labels** 选项可以为门电路标记输入标签、输出标签和选择标签，其用法如下：

```
with input labels={comma-seperated-list}
with output label=output-label
with select labels={comma-seperated-list}
```

注意：该命令只能处理输入在左侧，输出在右侧的门。使用示例如下。



```
\begin{tikzpicture}
\node (or) [
    draw, or gate US, scale=2,
    logic gate inputs=nnn,
    with input labels={$A$, $B$, $C$},
    with output label=$F$
] {};
\end{tikzpicture}
```

该命令的定义如下：

```
% \fixname from https://tex.stackexchange.com/a/213815/220363
\tikzset{
  keep name/.style={prefix after command={\pgfextra{\let\fixname\tikzlastnode}}},
  pics/input labels/.initial={},
  pics/output label/.initial={},
  pics/select labels/.initial={},
  with input labels/.pic={
    \edef\ilabels{\pgfkeysvalueof{/tikz/pics/input labels}}%
    \foreach \ilabel [count=\li] in \ilabels {
      \draw (\fixname.input \li) ++ (-0.5,0) node (\fixname_i_\li) [left] {\ilabel} -- (\fixname
    ↪ .input \li);
    }
  },
  with input labels/.style={
    keep name,
    append after command = {
      pic {input labels={#1}, with input labels}
    }
  },
  with output label/.pic={
    \edef\olabel{\pgfkeysvalueof{/tikz/pics/output label}}%
    \draw (\fixname.output) -- ++(0.5,0) node (\fixname_o) [right] {\olabel};
  },
  with output label/.style={
    keep name,
    append after command = {
      pic {output label={#1}, with output label}
    }
  },
  with select labels/.pic={
    \edef\slabels{\pgfkeysvalueof{/tikz/pics/select labels}}%
    \foreach \slabel [count=\li] in \slabels {%
      \draw let \p1=(\fixname.bottom right corner), \p2=(\fixname.select \li) in (\p2) -- (\x2,\y
    ↪ 1-10) node[below] {\slabel};%
    };
  },
  with select labels/.style={
    keep name,

```

```

    append after command = {
      pic {select labels={#1}, with select labels}
    }
  }
}

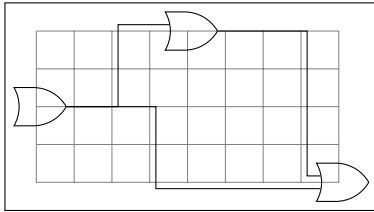
```

hlink、**vlink** 选项可以为连接两个门之间的输入输出，其用法如下

```

\path (anchor1) to [hlink] (anchor2);
\path (anchor1) to [hlink=offset] (anchor2);
\path (anchor1) to [vlink] (anchor2);
\path (anchor1) to [vlink=offset] (anchor2);

```



```

\begin{tikzpicture}[every node/.style={or gate US, draw}]
\draw [help lines, step=0.5cm] (0,0) grid (4,2);
\node (or1) at (0,1) {};
\node (or2) at (2,2) {};
\node (or3) at (4,0) {};
\draw (or1.output) to [hlink] (or2.input 1);
\draw (or2.output) to [hlink=0.5] (or3.input 1);
\draw (or1.output) to [hlink=-0.5] (or3.input 2);
\end{tikzpicture}

```

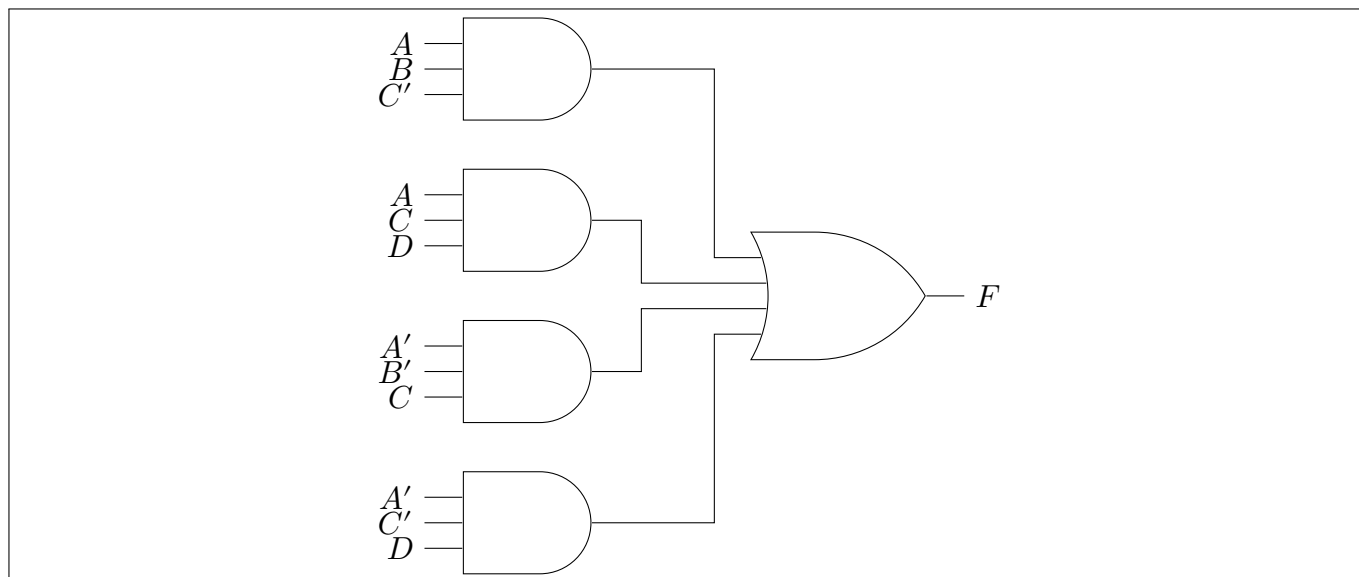
该命令的定义如下：

```

\tikzset{
  hlink/.code = {
    \ifx#1\pgfkeysnovalue%
      \pgfkeysalso{to path={-- ($(\tikztostart)!0.5!(\tikztostart-|\tikztotarget)$) |- (
        ↪ \tikztotarget) \tikztonodes}}
    \else%
      \pgfkeysalso{to path={-- ($(\tikztostart)!0.5!(\tikztostart-|\tikztotarget)+(\#1,0)$) |- (
        ↪ \tikztotarget) \tikztonodes}}
    \fi%
  },
  vlink/.code = {
    \ifx#1\pgfkeysnovalue%
      \pgfkeysalso{to path={-- ($(\tikztostart)!0.5!(\tikztostart|-|\tikztotarget)$) -| (
        ↪ \tikztotarget) \tikztonodes}}
    \else%
      \pgfkeysalso{to path={-- ($(\tikztostart)!0.5!(\tikztostart|-|\tikztotarget)+(0,\#1)$) -| (
        ↪ \tikztotarget) \tikztonodes}}
    \fi%
  }
}

```

使用以上两个命令的基本门电路用例如下：



```

\usepackage{tikz}
\usetikzlibrary{arrows,shapes,shapes.gates.logic.US,shapes.gates.logic.IEC}
% 导言区
\begin{tikzpicture}[>=latex]
\node (or) [
    or gate US, draw, scale=2,
    logic gate inputs=nnnn,
    with output label=$F$
] at (4,-5) {};
\foreach \i/\list/\offset in
{1/{A$,B$,C'$/0.5,2/{A$,C$,D$/-0.5,3/{A'$,B'$,C$/-0.5,4/{A'$,C'$,D$/0.5}
{
\node (and\i) [
    and gate US, draw, scale=2,
    logic gate inputs=nnn,
    with input labels=\list
] at (0,-\i*2) {};
\draw (and\i.output) to [hlink=\offset] (or.input \i);
}
\end{tikzpicture}

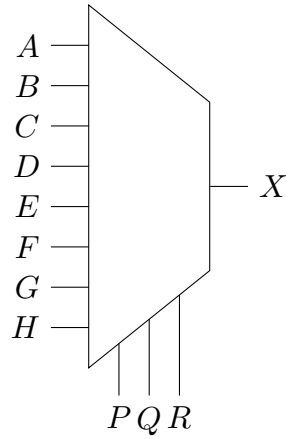
```

MUX MACRO

mux 样式的用法如下

```
\node [mux=in-ports-numbers] {};
```

示例代码如下



```

\begin{center}
\begin{tikzpicture}
\node (mux) [
    mux=8,
    with input labels={A$,B$,C$,D$,E$,F$,G$,H$},
    with output label=X$,
    with select labels={P$,Q$,R$}
] {};
\end{tikzpicture}
\end{center}

```

mux 样式的定义如下

```

% see https://stackoverflow.com/questions/61729168/
\pgfkeys{
    /tikz/mux ports/.initial=1
}

\makeatletter
\pgfdeclareshape{muxshape}{
\inheritsavedanchors[from=trapezium]
\inheritanchorborder[from=trapezium]
\inheritbackgroundpath[from=trapezium]
\foreach \anchor in {bottom left corner, top right corner, top left corner, bottom right corner,
    ↪ bottom side, left side, right side, top side, center, text, mid, base, mid west, base west, mid
    ↪ east, base east, west, east, north, south, north west, north east, south west, south east}{
    ↪ \inheritanchor[from=trapezium]{\anchor} }
\savedmacro\numports{%
    \edef\numports{\pgfkeysvalueof{/tikz/mux ports}}%
}
\savedmacro\numselports{%
    \pgfmathtruncatemacro{\selports}{ceil(log2(\pgfkeysvalueof{/tikz/mux ports}))}
    \edef\numselports{\selports}%
}
\anchor{output}{\csname pgf@anchor@muxshape@top side\endcsname}
% input ports and select ports
\pgfutil@g@addto@macro\pgf@sh@s@muxshape{%
    % input ports
    \c@pgf@counta\numports\relax%

```

```

\pgfmathloop%\n
\ifnum\pgfmathcounter>\c@pgf@counta%
\else%
\expandafter\xdef\csname pgf@anchor@muxshape@input\space\pgfmathcounter\endcsname{%
  \noexpand\pgf@sh@m@muxshapeinputanchor{\pgfmathcounter}%
}
\repeatpgfmathloop%
% select ports
\c@pgf@counta\numselectports\relax
\pgfmathloop%\n
\ifnum\pgfmathcounter>\c@pgf@counta%
\else%
\expandafter\xdef\csname pgf@anchor@muxshape@select\space\pgfmathcounter\endcsname{%
  \noexpand\pgf@sh@m@muxshapeselectanchor{\pgfmathcounter}%
}
\repeatpgfmathloop%
}
}

\def\pgf@sh@m@muxshapeinputanchor#1{%
  \installtrapeziumparameters
  \lowerleftpoint
  \pgf@xa=\pgf@x \pgf@ya=\pgf@y
  \lowerrightpoint
  \pgf@xb=\pgf@x \pgf@yb=\pgf@y
  \pgfmathsetlength{\pgf@x}{\pgf@xa+(\pgf@xb-\pgf@xa)*#1/(\numports+1)}%
  \pgfmathsetlength{\pgf@y}{\pgf@ya+(\pgf@yb-\pgf@ya)*#1/(\numports+1)}%
}

\def\pgf@sh@m@muxshapeselectanchor#1{%
  \installtrapeziumparameters
  \lowerrightpoint
  \pgf@xa=\pgf@x \pgf@ya=\pgf@y
  \upperrightpoint
  \pgf@xb=\pgf@x \pgf@yb=\pgf@y
  \pgfmathsetlength{\pgf@x}{\pgf@xa+(\pgf@xb-\pgf@xa)*#1/(\numselectports+1)}%
  \pgfmathsetlength{\pgf@y}{\pgf@ya+(\pgf@yb-\pgf@ya)*#1/(\numselectports+1)}%
}

\tikzset{
mux/.code={
  \pgfmathtruncatemacro{\si}{ceil(log2(#1))}%
  \pgfkeys{/tikz/mux ports=#1}
  \pgfkeys{
    /tikz/shape=muxshape,
    /tikz/draw,
    /tikz/trapezium stretches,
    /tikz/shape border rotate = 270,
    /tikz/minimum height=(\si+1)*0.4cm,
    /tikz/minimum width=\si*1.6cm
  }
}

```

```

}
}
}

```

线网图

MACRO

paramlines 环境可以用于绘制线网图，其定义和示例如下：

```

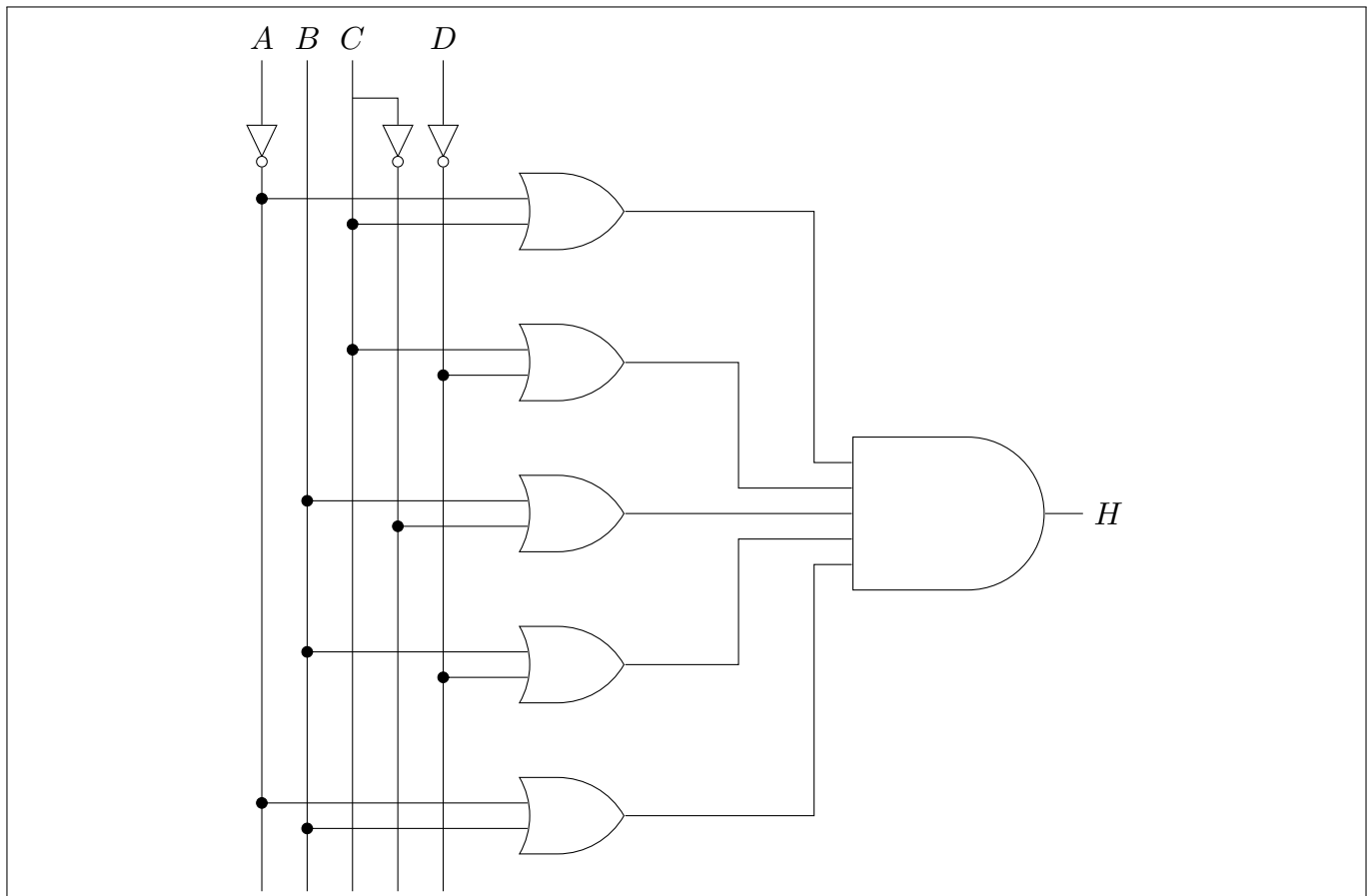
\newcounter{pl@netcount}
\newcounter{pl@linecount}[pl@netcount]
\NewDocumentEnvironment{paramlines}{0{5} 0{1}}{
  \stepcounter{pl@netcount}%
  \newcommand\plparamdef[1]{%%
    \expandafter\edef\csname pl@##1\endcsname{\arabic{pl@linecount}}%%
    \stepcounter{pl@linecount}%
  }
  \newcommand\plsetbasex[1]{%%
    \pgfmathsetmacro{\basex}{\csname pl@##1\endcsname*#2}
  }
  \newcommand\plparambase[1]{%%
    \plparamdef{##1}%
    \plsetbasex{##1}%
  }
  \newcommand\pldrawbaselabel[1]{%%
    \node at (\basex,0.3) {##1};%%
  }
  \newcommand\plparamlabel[2]{%%
    \plparambase{##1}%
    \pldrawbaselabel{##2}%
    \draw (\basex,0) --+ (0,{-(#1)});%%
  }
  \newcommand\plparam[1]{%%
    \plparamlabel{##1}{$##1$}%
  }
  \newcommand\plparaminvlabel[2]{%%
    \plparambase{##1'}%%
    \pldrawbaselabel{##2}%
    \node [not gate US,draw,rotate=270] at (\basex,-1) (not##1'){};%%
    \draw (\basex,0) -- (not##1'.input);%%
    \draw (not##1'.output) -- (\basex,{-(#1)});%%
  }
  \newcommand\plparaminv[1]{%%
    \plparaminvlabel{##1}{$##1$}%
  }
  \newcommand\plparambothlabel[2]{%%

```

```

\plparambase{##1}%%
\pldrawbaselabel{##2}%%
\draw (\basex,0) --+ (0,{-(#1)});%%
\node [not gate US,draw,rotate=270] at ({\basex+#2},-1) (not##1){};%%
\draw (\basex,-0.5)-|(not##1.input);%%
\draw (not##1.output)--({\basex+#2},{-(#1)});%%
\plparamdef{##1'}%%
}
\newcommand\plparamboth[1]{%%
  \plparambothlabel{##1}{$##1$}%%
}
\newcommand\pllink[2]{%%
  \plsetbasex{##1}%%
  \filldraw let \p1=(##2) in (\p1)--(\basex,\y1) circle (2pt);%%
}
}
{}

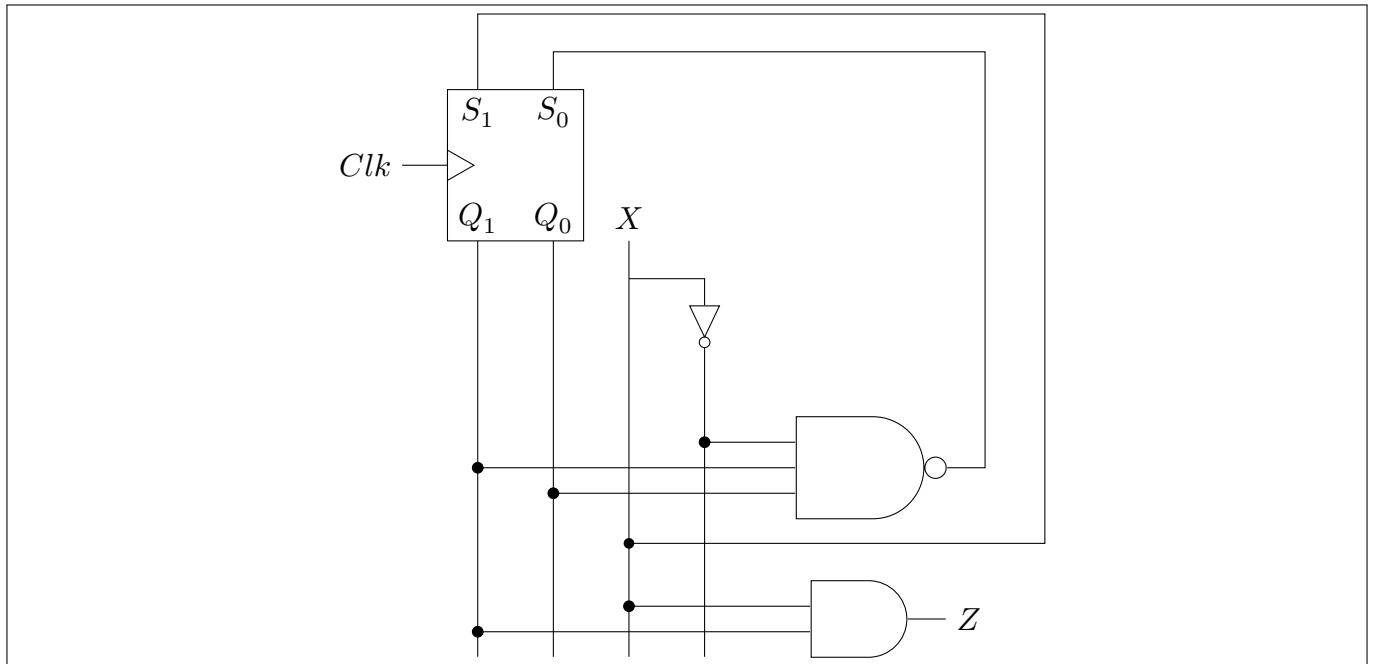
```

```

\begin{center}
\begin{tikzpicture}
\begin{paramlines}[11][0.6]
\plparaminv{A}\plparam{B}\plparamboth{C}\plparaminv{D}
\foreach \x in {1,...,5} {\node [or gate US,draw,scale=2] at (4,-\x*2) (or\x) {};}
\node (and) [
    and gate US, draw, scale=2,
    anchor=input 3, logic gate inputs=nnnnn,
    with output label=$H$
] at ($(or3.output)+(3,0)$) {};
\pllink{A'}{or1.input 1} \pllink{C} {or1.input 2}
\pllink{C} {or2.input 1} \pllink{D'}{or2.input 2}
\pllink{B} {or3.input 1} \pllink{C'}{or3.input 2}
\pllink{B} {or4.input 1} \pllink{D'}{or4.input 2}
\pllink{A'}{or5.input 1} \pllink{B} {or5.input 2}
\draw (or1.output) to [hlink=1] (and.input 1);
\draw (or2.output) to [hlink] (and.input 2);
\draw (or3.output) to [hlink=-1] (and.input 3);
\draw (or4.output) to [hlink] (and.input 4);
\draw (or5.output) to [hlink=1] (and.input 5);
\end{paramlines}
\end{tikzpicture}
\end{center}

```



```

\usepackage{tikz}
\usetikzlibrary{arrows.meta,shapes} % 导言区
\begin{tikzpicture}
\begin{paramlines}[5.5][1]
\plparamlabel{Q1}{{Q_1}}
\plparamlabel{Q0}{{Q_0}}
\plparamboth{X}
\node [draw, shape=rectangle, minimum height=2cm, minimum width=1.8cm] at (0.5,1){};
\node at (0,1.7) {{S_1}};
\node at (1,1.7) {{S_0}};
\node (clk) [left] at (-1,1) {{Clk}};
\draw (clk) -- (-0.4,1) --+ (0,0.2) --+ (0.35,0) --+(0,-0.2);
% gates
\def\andbasex{5}
\def\orbasex{5}
\node [nand gate US,logic gate inputs=nnn,draw,scale=2] at (\orbasex,-3) (nand1) {};
\node [and gate US,draw,scale=2, with output label=$Z$] at (\andbasex,-5) (and1) {};
\pllink{X}{{and1.input 1}}
\pllink{Q1}{{and1.input 2}}
\pllink{X'}{{nand1.input 1}}
\pllink{Q1}{{nand1.input 2}}
\pllink{Q0}{{nand1.input 3}}
\plsetbasex{X}
\draw (nand1.output) --+(0.5,0) |- (1,2.5) -- (1,2);
\draw (\basex,-4) --+(5.5,0) |- (0,3) -- (0,2);
\fill (\basex,-4) circle (2pt);
\end{paramlines}
\end{tikzpicture}

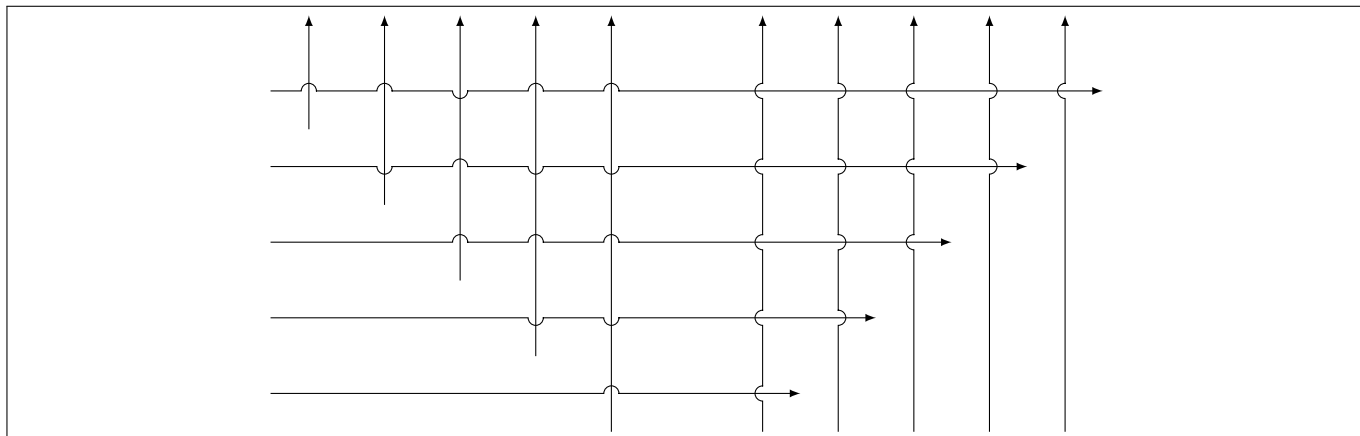
```

交错连线

`\SegAcross` 命令可以绘制绕过连线的线条，其用法如下

<code>\SegRef{from}{to}{line}</code>	% name path
<code>\SegAcross{from}{options}{to}{line}</code>	% single, normal
<code>\SegAcross[]{from}{options}{to}{line}</code>	% single, inverted
<code>\SegAcross*{from}{options}{to}{comma-sep-lines}</code>	% multiple, normal
<code>\SegAcross[]{from}{options}{to}{comma-sep-lines}</code>	% multiple, inverted

使用示例如下。



```

\usetikzlibrary{intersections} % 导言区
\begin{tikzpicture}[>=latex,line cap=rect]
\gdef\reflista{}%
\gdef\reflistb{}%
\foreach \x in {1,...,5} {
  \coordinate (W-\x) at (-5.5,\x);
  \coordinate (E-\x) at (\x+0.5,\x);
  \coordinate (S1-\x) at (-6+\x, 5.5-\x);
  \coordinate (N1-\x) at (-6+\x, 6);
  \coordinate (S2-\x) at (\x, 0.5);
  \coordinate (N2-\x) at (\x, 6);
  \draw [->] (S1-\x) -- (N1-\x);
  \SegRef{S1-\x}{N1-\x}{refa-\x}
  \SegRef{W-\x}{E-\x}{refb-\x}
  \ifnum\x>1%
    \xdef\reflista{\reflista,}%
    \xdef\reflistb{\reflistb,}%
  \fi%
  \xdef\reflista{\reflista refa-\x}%
  \xdef\reflistb{\reflistb refb-\x}%
}
\foreach \x in {1,...,5} {
  \ifodd\x%
    \SegAcross*{W-\x}{->}{E-\x}{\reflista}
    \SegAcross*{S2-\x}{->}{N2-\x}{\reflistb}
  \else%
    \SegAcross*[]{W-\x}{->}{E-\x}{\reflista}
  \fi
}

```

```

\SegAcross*[] {S2-\x}{->}{N2-\x}{\reflistb}
\fi
}
\end{tikzpicture}

```

该命令的定义如下:

```

\makeatletter
\tikzset{%
  startend/.code={%
    \def\@Seg@tmp{#1}%
    \ifx\@Seg@tmp\@nnil%
      \tikzset{%
        start angle=\@Seg@StartAngle,%
        end angle=\@Seg@EndAngle,%
        radius=\@Seg@radius%
      }
    \else%
      \ifdim\@Seg@StartAngle pt<\@Seg@EndAngle pt%
        \tikzset{
          start angle=\@Seg@StartAngle+360,%
          end angle=\@Seg@EndAngle,%
          radius=\@Seg@radius%
        }
      \else
        \tikzset{
          start angle=\@Seg@StartAngle,%
          end angle=\@Seg@EndAngle+360,%
          radius=\@Seg@radius%
        }
      \fi%
    \fi%
  }
}
\def\@Seg@radius{1.mm}
\newcommand*{\ComputeIntersection[4]}{%
  \path [name intersections={of = #1 and #2, total=\t}]
  \pgfextra{\xdef\@Seg@intcount{\t}};
  \ifnum\@Seg@intcount>0%
    \coordinate (SegCenter) at (intersection-1);
    \path [name path=circle] (SegCenter) circle (\@Seg@radius);
    \path [name intersections={of = circle and #2, sort by=#2}];
    \coordinate (#3) at (intersection-1);
    \coordinate (#4) at (intersection-2);
    \pgfmathanglebetweenpoints{\pgfpointanchor{SegCenter}{center}}{\pgfpointanchor{#3}{center}}%
    \let\@Seg@StartAngle\pgfmathresult%
    \pgfmathanglebetweenpoints{\pgfpointanchor{SegCenter}{center}}{\pgfpointanchor{#4}{center}}%
    \let\@Seg@EndAngle\pgfmathresult%
  \fi
}

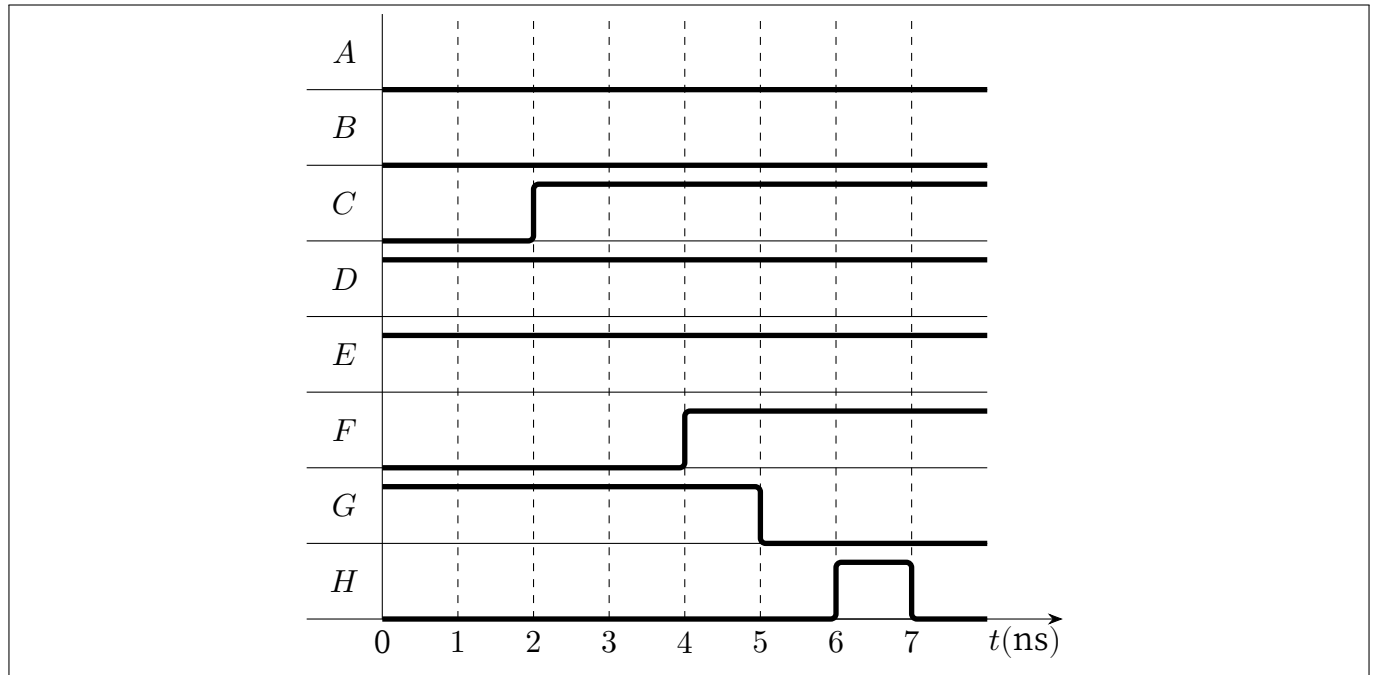
```

```

\newcommand*\SegRef[3] {
  \path [name path=#3] (#1) -- (#2);%
}
\newcommand*\SegAcrossSingle[5][\@nil]{%
  \path [name path=overlay] (#2) -- (#4);%
  \ComputeIntersection{#5}{overlay}{I1}{I2}%
  \ifnum\@Seg@intcount>0%
    \draw [#3] (#2) -- (I1) arc [startend={#1}] (I2) -- (#4);%
  \else
    \draw [#3] (#2) -- (#4);%
  \fi
}
\newcounter{\@Seg@intcounttotal}
\newcommand*\SegAcrossMultiple[5][\@nil]{%
  \def\@Seg@tmp{#1}%
  \path [name path=overlay] (#2) -- (#4);%
  \gdef\@Seg@StartEnd{}%
  \setcounter{\@Seg@intcounttotal}{1}%
  % Compute intersections
  \foreach \line in #5 {%
    \ComputeIntersection{\line}{overlay}{I1-\the\@Seg@intcounttotal}{I2-\the\@Seg@intcounttotal}%
    \ifnum\@Seg@intcount>0%
      \ifnum\the\@Seg@intcounttotal>1%
        \xdef\@Seg@StartEnd{\@Seg@StartEnd,}%
      \fi
      \xdef\@Seg@StartEnd{\@Seg@StartEnd\@Seg@StartAngle/\@Seg@EndAngle}%
      \stepcounter{\@Seg@intcounttotal}%
    \fi
  }
  % Draw path
  \addtocounter{\@Seg@intcounttotal}{-1}%
  \ifnum\the\@Seg@intcounttotal>0%
    \draw [#3] (#2)%
    foreach \@Seg@StartAngle/\@Seg@EndAngle [count=\i] in \@Seg@StartEnd {%
      -- (I1-\i) arc [startend={#1}] (I2-\i)%
    } -- (#4);%
  \else%
    \draw [#3] (#2)-- (#4);%
  \fi%
}
\newcommand*\SegAcross{%
  \ifstar{\SegAcrossMultiple}{\SegAcrossSingle}%
}
\makeatother

```

时序图



```
\begin{tikzpicture}[>={Stealth[length=2mm]}]
\def\lshift{-0.3}    % yshift of label on axes
\def\rlimit{8}       % max x can time line reach
\def\hlevel{0.75}    % yshift of high level signal
% variables
\foreach \label [count=\cnt] in {H,...,A} {%
\node at (-0.5,\cnt-0.5) {$\label$}; \draw (-1,\cnt-1) ---- (\rlimit+1,0);
};
% axes
\draw (0,0)--(0,8); \draw[>] (0,0)--(\rlimit+1,0);
\node at (0,\lshift) {0}; \node at (\rlimit+0.5,\lshift) {$t(\mathrm{ns})$};
% verticle lines
\foreach \x in {1,...,7} {%
\pgfmathtruncatemacro{\label}{\x}
\node at (\x,\lshift) {$\label$};
\draw[dashed] (\x,0) -- ++ (0,\rlimit);
};
% time line
\begin{scope}[line width=2pt,rounded corners=2pt]
\draw (0,7)--(\rlimit,7); % A
\draw (0,6)--(\rlimit,6); % B
\draw (0,5)----(2,0)|-(\rlimit,5+\hlevel); % C
\draw (0,4+\hlevel)--(\rlimit,4+\hlevel); % D
\draw (0,3+\hlevel)--(\rlimit,3+\hlevel); % E
\draw (0,2)----(4,0)|-(\rlimit,2+\hlevel); % F
\draw (0,1+\hlevel)----(5,0)|-(\rlimit,1); % G
\draw (0,0)----(6,0)|++(1,\hlevel)|-(\rlimit,0); % H
\end{scope}
\end{tikzpicture}
```

卡诺图

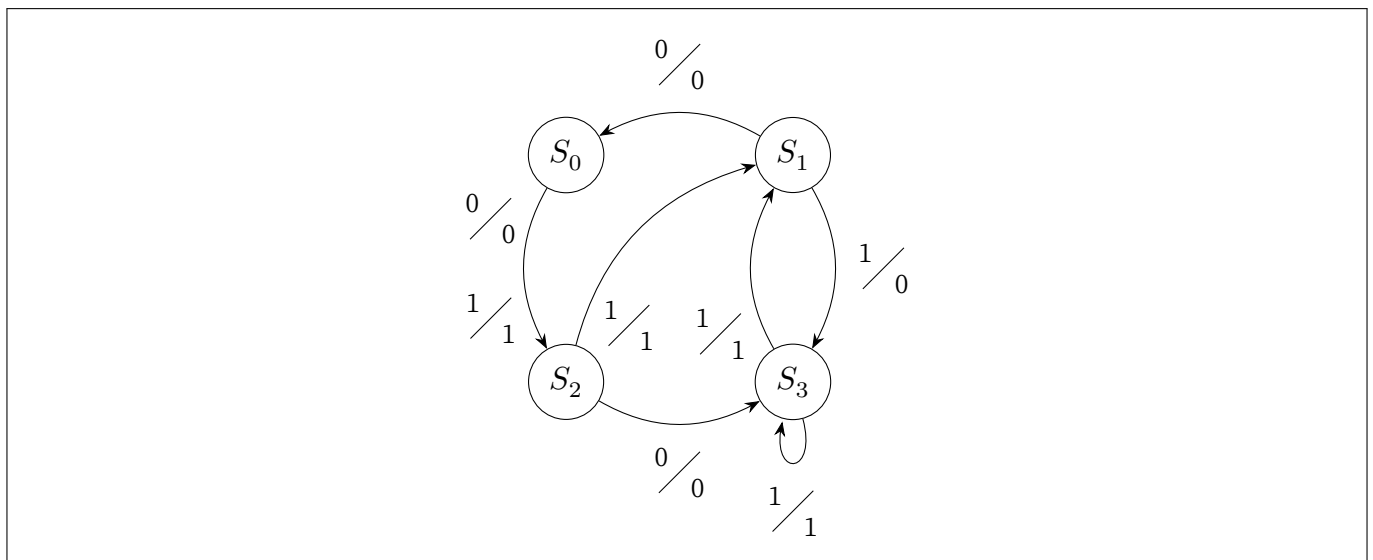
		AB			
		00	01	11	10
CD	00	1	X		
	01	1	1	1	
	11	1			1
	10	1		1	1

```

\usepackage{karnaugh-map} % 导言区
\begin{karnaugh-map}[4][4][1][$AB][$CD$]
  \minterms{0,4,5,7,8,10,11,12,14}
  \terms{1}{{X}}
  \implicant{0}{8}
  \implicant{5}{7}
  \implicant{11}{10}
  \implicantedge{12}{8}{14}{10}
\end{karnaugh-map}

```

自动机



```

\usepackage{tikz}
\usetikzlibrary{arrows.meta,calc,graphs,positioning,quotes,shapes} % 导言区
\begin{tikzpicture}[>={Stealth[length=2mm]}]
\graph[math nodes, nodes={draw,circle}, edge quotes={auto,circle solidus,scale=0.8}, grow right=3cm,
  <- branch down=3cm] {
  S_0 <- [bend left, "0 \nodepart{lower} 0"] S_1;
  S_2 -> [bend right, "0 \nodepart{lower} 0" swap] S_3;
  S_0 -> [bend right, "0 \nodepart{lower} 0" {swap,pos=0.4}, "1 \nodepart{lower} 1" {swap,pos=0.6}] S_2;
  S_2 -> [bend left, "1 \nodepart{lower} 1" {swap,pos=0.2}] S_1;
  S_3 -> [bend left, "1 \nodepart{lower} 1" pos=0.3] S_1;
  S_1 -> [bend left, "1 \nodepart{lower} 0"] S_3;
  S_3 -> [loop below, "1 \nodepart{lower} 1"] S_3;
};
\end{tikzpicture}

```

隐含表

MACRO

implication 环境可以用于绘制隐含表，其定义和示例如下：

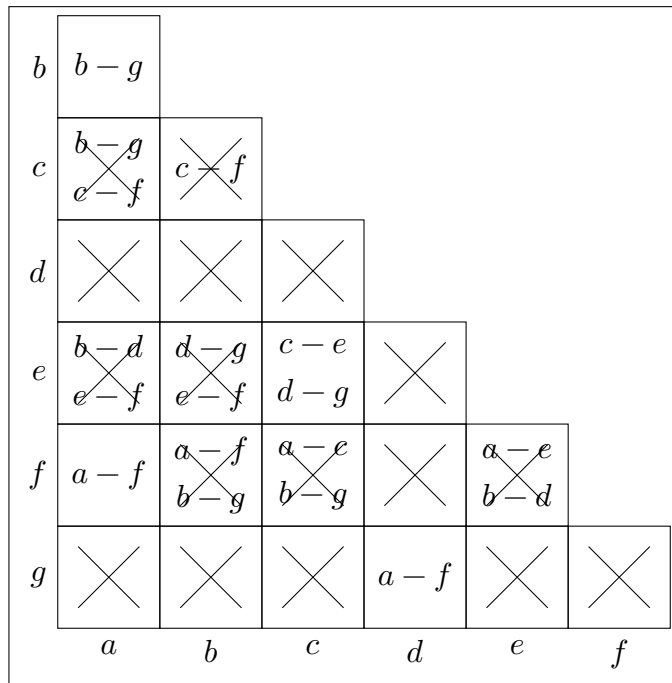
```
% Implication Table environment
% #1 cell size
\makeatletter
\newcounter{impt@netcount}%
\newcounter{impt@linecount}[impt@netcount]%
\newcounter{impt@columncount}[impt@linecount]%
\newenvironment{implication}[1][1.5]{%
  \stepcounter{impt@netcount}%
  \pgfmathsetmacro\cellsize{#1}%
  \pgfmathsetlengthmacro\cellsize\cellsize cm}%
  % \drawcell{label}
  % draw a cell
  \newcommand*\impt@defcxy{%
    \pgfmathsetmacro\cx{\cellsize*\arabic{impt@columncount}}%
    \pgfmathsetmacro\cy{-\cellsize*\arabic{impt@linecount}}%
  }
  \newcommand*\impt@putnode[1]{%
    \node [draw,minimum size=\cellsize\cellsize,align=center] at (\cx,\cy) {##1};%
    \stepcounter{impt@columncount}%
    \ifnum\the\value{impt@columncount}>\the\value{impt@linecount}%
      \stepcounter{impt@linecount}%
    \fi%
  }
  \newcommand*\impt@putx{%
    \draw ({\cx-0.3*\cellsize},{\cy-0.3*\cellsize})---+(0.6*\cellsize,0.6*\cellsize);%
    \draw ({\cx-0.3*\cellsize},{\cy+0.3*\cellsize})---+(0.6*\cellsize,-0.6*\cellsize);
  }
  \newcommand*\drawcell@star[1]{%
    \impt@defcxy%
    \impt@putnode{##1}%
  }
  \newcommand*\drawcell@nostar[1]{%
    \impt@defcxy%
    \impt@putnode{##1}%
    \impt@putx%
  }
  \newcommand*\drawcell{%
    \ifstar{\drawcell@star}{\drawcell@nostar}%
  }
  % \drawlabelv{labels}
  % draw vertical labels
  \newcommand*\drawlabelv[1]{%
    \foreach \label [count=\n from 0] in {##1}{%
      \node [anchor=west] at ({-\cellsize*0.5},{-\cellsize*\n}) {\label};%
    }%
  }
  % \drawlabelh{labels}
  % draw horizontal labels
```



```

\newcommand*\drawlabelh[1]{%
  \foreach \label [count=\n from 0] in {###1}{%
    \node [anchor=north] at ({\cellsize*\n},{-\cellsize*(\arabic{impt@@linecount}-0.5)}) {
      \label};%
    }%
  }
}
\makeatother

```



```

\usepackage{tikz} % 导言区
\begin{tikzpicture}
\begin{implication}[1.35]
%S_1
\drawcell*{$b-g$}
%c
\drawcell*{$b-g$}\{$c-f$}
\drawcell*{$c-f$}
%d
\drawcell{}
\drawcell{}
\drawcell{}
%e
\drawcell*{$b-d$}\{$e-f$}
\drawcell*{$d-g$}\{$e-f$}
\drawcell*{$c-e$}\{$d-g$}
\drawcell{}
%f
\drawcell*{$a-f$}
\drawcell*{$a-f$}\{$b-g$}
\drawcell*{$a-c$}\{$b-g$}
\drawcell{}
\drawcell*{$a-e$}\{$b-d$}
%g
\drawcell{}
\drawcell{}
\drawcell{}
\drawcell*{$a-f$}
\drawcell{}
\drawcell{}
\drawcell{}
%labels
\drawlabelv{$b$, $c$, $d$, $e$, $f$, $g$}
\drawlabelh{$a$, $b$, $c$, $d$, $e$, $f$}
\end{implication}
\end{tikzpicture}

```

register 样式的定义和用例如下

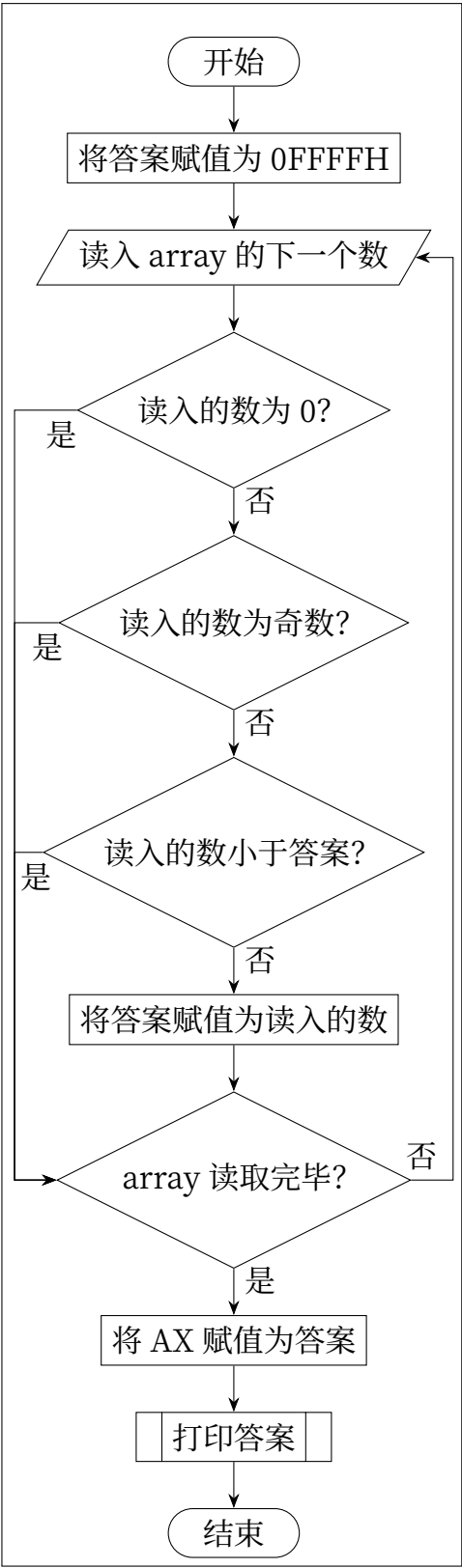
```
\makeatletter
\pgfdeclareshape{register}{
  \inheritsavedanchors[from=rectangle]
  \inheritanchorborder[from=rectangle]
  \foreach \anchor in {north,north west,north east,center,west,east,mid,
    mid west,mid east,base,base west,base east,south,south west,south east}{%
    \inheritanchor[from=rectangle]{\anchor}}%
  \savedanchor\centerpoint{%
    \pgf@x=.5\wd\pgfnodeparttextbox%
    \pgf@y=.5\ht\pgfnodeparttextbox%
    \advance\pgf@y by -.5\dp\pgfnodeparttextbox%
  }
  \backgroundpath{%
    \southwest \pgf@xa=\pgf@x \pgf@ya=\pgf@y%
    \northeast \pgf@xb=\pgf@x \pgf@yb=\pgf@y%
    \centerpoint \pgf@xc=\pgf@x \pgf@yc=\pgf@y%
    \pgfpathmoveto{\pgfpoint{\pgf@xa}{\pgf@ya}}
    \pgfpathlineto{\pgfpoint{\pgf@xa}{\pgf@yb}}
    \pgfpathlineto{\pgfpoint{\pgf@xb}{\pgf@yb}}
    \pgfpathlineto{\pgfpoint{\pgf@xb}{\pgf@ya}}
    \pgfpathclose%
    \pgf@xa=\pgf@xc \advance\pgf@xa by-5pt%
    \pgf@xb=\pgf@xc \advance\pgf@xb by5pt%
    \pgf@yc=\pgf@ya \advance\pgf@yc by8.66pt%
    \pgfpathmoveto{\pgfpoint{\pgf@xa}{\pgf@ya}}
    \pgfpathlineto{\pgfpoint{\pgf@xc}{\pgf@yc}}
    \pgfpathlineto{\pgfpoint{\pgf@xb}{\pgf@ya}}
    \pgfpathclose%
  }
}
\makeatother
```



```
\usepackage{tikz} % 导言区
\tikzset {
  register/.style={draw,fill=white,shape=register,inner ysep=10pt,minimum width=20pt,
    ↪ minimum height=2cm,align=center}
}
\begin{tikzpicture}
\node[register] {ICache\SRAM};
\end{tikzpicture}
```

7.2.2 程序设计

流程图



```
\usepackage{tikz}
\usetikzlibrary{arrows.meta,graphs,quotes}
\usepackage{flowchart}
% 导言区
\begin{tikzpicture}[
>={Stealth[length=2mm]},
io/.style = {draw, trapezium, trapezium left angle=60, trapezium
    right angle=120},
decide/.style={draw, diamond, shape aspect=#1},
decide/.default={2},
term/.style = {draw, terminal},
proc/.style = {draw, process},
preproc/.style = {draw, predproc},
hv path/.style =
{to path={-| (\tikztotarget) \tikztonodes}},
vh path/.style =
{to path={|- (\tikztotarget) \tikztonodes}},
skip loop/.style =
{to path={-- ++(0,#1) \tikztonodes -| (\tikztotarget) }},
vskip loop/.style =
{to path={-- ++(#1,0) \tikztonodes |- (\tikztotarget) }},
every to quotes/.style={auto, near start},
every edge quotes/.style={auto, near start}
]
\graph[grow down sep=1.5em]
{
s [term,as=开始]->
a [proc,as=将答案赋值为0FFFFH]->
b [io,as=读入array的下一个数]->
c [decide,as=读入的数为0? ]->["否"]
d [decide,as=读入的数为奇数? ]->["否"]
e [decide,as=读入的数小于答案? ]->["否"]
f [proc,as=将答案赋值为读入的数]->
g [decide,as=array读取完毕? ]->["是"]
h [proc,as=将AX赋值为答案]->
i [preproc,as=打印答案]->
t [term,as=结束];
c ->["是", vskip loop=-3cm] g;
d ->["是", vskip loop=-3cm] g;
e ->["是", vskip loop=-3cm] g;
g ->["否", vskip loop=3cm] b;
};
\end{tikzpicture}
```

7.2.3 操作系统

调度结果图

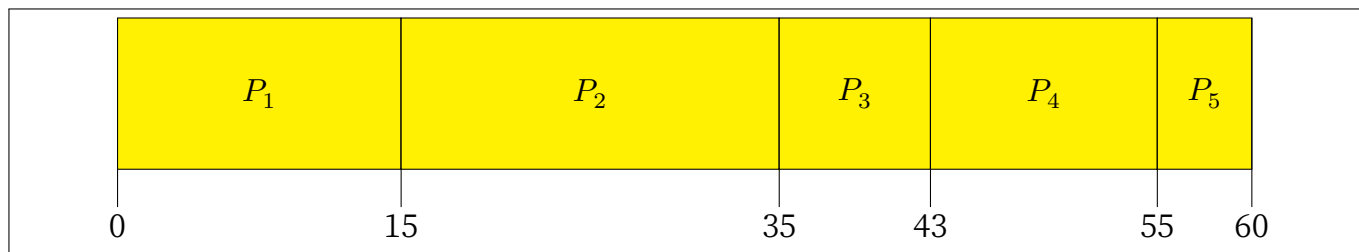


dispatchgraph 环境可以用于绘制隐含表，其定义和示例如下：

```

\newcommand*\dgset[1]{%
\pgfkeys{%
/dispatch graph/.cd,##1%
}}
\dgset{
  xscale/.initial = 1,
  height/.initial = 1,
  fill/.initial = yellow!20
}
\newenvironment{dispatchgraph}
{%
  \newcommand*\dgcalc{%
    \edef\dgheight{\pgfkeysvalueof{/dispatch graph/height}}%
    \edef\dgxscale{\pgfkeysvalueof{/dispatch graph/xscale}}%
  }
  \newcommand*\drawdmark[1][0]{%
    \dgcalc%
    \draw ({##1 * \dgxscale}, -0.5) -- ({##1 * \dgxscale}, \dgheight);%
    \node at ({##1 * \dgxscale}, -0.75) {##1};%
  }
  \newcommand*\drawslice[2]{%
    \dgcalc%
    \filldraw[fill=\pgfkeysvalueof{/dispatch graph/fill}] ({\dgxcu * \dgxscale}, 0) -| ({##1 *
    ↪ \dgxscale}, \dgheight) -| cycle;%
    \node at ({(\dgxcu + ##1) * \dgxscale * 0.5}, {\dgheight * 0.5}) {##2};%
    \drawdmark[##1]
    \pgfmathsetmacro\dgxcu{##1}%
  }
  \begin{tikzpicture}%
    \pgfmathsetmacro\dgxcu{0}%
    \drawdmark[0]%
  }%
  \end{tikzpicture}%
}

```



```

\usepackage{tikz}
\dgset{
  height = 2,
  xscale = 0.25,
  fill = yellow
} % 导言区
\begin{dispatchgraph}
  \drawslice{15}{{P_1}}
  \drawslice{35}{{P_2}}
  \drawslice{43}{{P_3}}
  \drawslice{55}{{P_4}}
  \drawslice{60}{{P_5}}
\end{dispatchgraph}

```