xparse: 효율적인 Ti*k*Z coding

In-Sung Cho

2020/5/30

공주대학교 문서작성워크숍 2020 Spring

한국텍학회 · 한국텍사용자그룹 (http://ktug.org)

Table of Contents

1 Introduction

Why macro?

그림 그리기

한두번 그리기
어쨌든 그리면 된다
많은 그림 그리기
필수적인 반복

lshort-ko.pdf

6.1 마음대로 바꾸기

6.1.1 새로운 명령

효율적인 매크로 사용

반복 사용시 유용

나중에 전체 바꾸기 용이

2 매크로 정의하기: 기초

2.1 명령 정의하기: 단순 대체

정의: `\def\hisnameA{홍길동}`
입력: `남자 친구 \hisnameA\가 떠나갔다. 나빴다.`

출력 남자 친구 홍길동이 떠나갔다. 나빴다.

정의: `\def\hisnameA{공유}`
입력: `새로운 남자 친구 \hisnameA\가 내게로 왔다. 설렌다.`

출력 새로운 남자 친구 공유가 내게로 왔다. 설렌다.

정의: `\newcommand\hisnameB{홍길동}`
입력: `어제, 남자 친구 \hisnameB\가 떠나갔다. 나빴다.`

출력 어제, 남자 친구 홍길동이 떠나갔다. 나빴다.

정의: `\renewcommand\hisnameB{공유}`
입력: `새로운 남자 친구 \hisnameB\가 내게로 왔다. 설렌다.`

출력 새로운 남자 친구 공유가 내게로 왔다. 설렌다.

2.2 명령 정의하기: 필수 인자, 옵션 인자

```
\def\myinv#1{\frac{1}{#1}}

$\displaystyle \myinv{123}$ \quad
$\displaystyle \myinv{x^2+1}$
```

$$\frac{1}{123} \quad \frac{1}{x^2+1}$$

```
\def\mypfrac#1#2{\frac{\partial #1}{\partial #2}}

$\displaystyle \mypfrac{f(x,y)}{x}$
```

$$\frac{\partial f(x,y)}{\partial x}$$

```
\newcommand\mypfrac[2]{\frac{\partial #1}{\partial #2}}

$\displaystyle \mypfrac{f(x,y)}{x}$
```

$$\frac{\partial f(x,y)}{\partial x}$$

```
\newcommand\mypfrac[3][1]{%
\frac{\partial^{#1} #2}{\partial #3^{#1}}%
}

$\displaystyle \mypfrac{f(x,y)}{x}$ \par\vskip1em
$\displaystyle \mypfrac[2]{f(x,y)}{x}$
```

$$\frac{\partial^1 f(x,y)}{\partial x^1}$$

$$\frac{\partial^2 f(x,y)}{\partial x^2}$$

3 xparse

```
\usepackage{xparse}
```

```
\documentclass{oblivoir}
% \usepackage{xparse}
```

3.1 getting started: \NewDocumentCommand

3.1.1 단순 대체

```
%\def\hisname{`Gongyu'}
%\newcommand\hisname{`Gongyu'}
\NewDocumentCommand\hisname{}{`Gongyu'}

Does \hisname\ really like me?
```

Does ‘Gongyu’ really like me?

3.1.2 필수 인자: 하나

```
\def\myinv#1{\frac{1}{#1}}
$\displaystyle \myinv{x^2+1}$
```

$$\frac{1}{x^2+1}$$

```
\newcommand\myinv[1]{\frac{1}{#1}}
$\displaystyle \myinv{x^2+1}$
```

$$\frac{1}{x^2+1}$$

```
\NewDocumentCommand\myinv{m}{\frac{1}{#1}}
$\displaystyle \myinv{x^2+1}$
```

$$\frac{1}{x^2+1}$$

3.1.3 필수 인자: 둘

```
\def\mypfrac#1#2{\frac{\partial #1}{\partial #2}}
$\displaystyle \mypfrac{f(x,y)}{x}$
```

$$\frac{\partial f(x,y)}{\partial x}$$

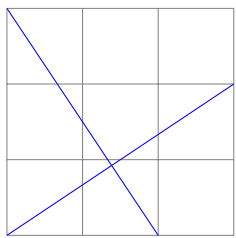
```
\newcommand\mypfrac[2]{\frac{\partial #1}{\partial
    #2}}
$\displaystyle \mypfrac{f(x,y)}{x}$
```

$$\frac{\partial f(x,y)}{\partial x}$$

```
\NewDocumentCommand\mypfrac{mm}{%
\frac{\partial #1}{\partial #2}
}
$\displaystyle \mypfrac{f(x,y)}{x}$
```

$$\frac{\partial f(x,y)}{\partial x}$$

```
\NewDocumentCommand\myline{mm}
{\draw [blue] #1 -- #2;
}

\begin{tikzpicture}
\draw [help lines] (0,0) grid (3,3);
\myline{(0,0)}{(3,2)}
\myline{(0,3)}{(2,0)}
\end{tikzpicture}
```



3.1.4 옵션 인자

```
\newcommand\mypfrac[3][1]{%
\frac{\partial^{#1} #2}{\partial #3^{#1}}%
}
```

```
\NewDocumentCommand\mypfrac{ O{1} m m}{%
\frac{\partial^{#1} #2}{\partial #3^{#1}}%
}
$\displaystyle \mypfrac{f(x,y)}{x}$ \par\vskip1em
$\displaystyle \mypfrac[2]{f(x,y)}{x}$
```

$$\frac{\partial^1 f(x,y)}{\partial x^1}$$

$$\frac{\partial^2 f(x,y)}{\partial x^2}$$

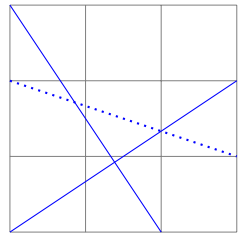
어깨의 1을 없애고 싶다.

```
%% \IfNoValueTF                                %
\NewDocumentCommand\mypfrac{ o m m }{%
\IfNoValueTF {#1}
  {\frac{\partial #2}{\partial #3}%
  }
  {\frac{\partial^{#1} #2}{\partial #3^{#1}}%
  }
}
$\displaystyle \mypfrac{f(x,y)}{x}$ \par\vskip1em
$\displaystyle \mypfrac[2]{f(x,y)}{x}$
```

$$\frac{\partial f(x,y)}{\partial x}$$

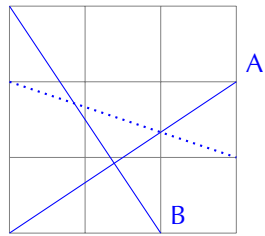
$$\frac{\partial^2 f(x,y)}{\partial x^2}$$

```
\NewDocumentCommand\myline{ O {blue} m m }
{\draw [blue,#1] #2 -- #3;
}

\begin{tikzpicture}
\draw [help lines] (0,0) grid (3,3);
\myline{(0,0)}{(3,2)}
\myline{(0,3)}{(2,0)}
\myline[thick,dotted]{(0,2)}{(3,1)}
\end{tikzpicture}
```



Question: label도 붙일 수 있을까?

```
%% labels
\NewDocumentCommand\myline{ O{blue} m m O{} }
{\draw [blue,#1] #2 -- #3 node [above right] {#4};  %
}

\begin{tikzpicture}
\draw [help lines] (0,0) grid (3,3);
\myline{(0,0)}{(3,2)}[A]
\myline{(0,3)}{(2,0)}[B]
\myline[thick,dotted]{(0,2)}{(3,1)}
\end{tikzpicture}
```



Question: `\myline(0,0)(3,2){A}` 이런 식으로 쓸 수 있을까?

3.2 xparse: basics

- 기본형
  - `\NewDocumentCommand`
  - `\RenewDocumentCommand`
  - `\ProvideDocumentCommand`
  - `\DeclareDocumentCommand`
- 확장형
  - `\...ExpandableDocumentCommand`
- True/False 검사
  - `\IfNoValueTF` `\IfNoValueT` `\IfNoValueF`
  - `\IfValueTF` `\IfValueT` `\IfValueF`
  - `\IfBooleanTF` `\IfBooleanT` `\IfBooleanF`
- more...
  - xparse 매뉴얼 `texdoc xparse`
  - xparse: high-level document command parser[1]

[1] 공주대학교 문서작성워크숍 2016

3.3 argument specifiers

```
%% syntax:
\NewDocumentCommand{<command>}{<arg. spec.>}{<definition>}
```

3.3.1 mandatory argument specifiers

- `m: {#1}` (mandatory)
  - `+m`
- `r(): (#1)` (required)
  - `r<>: <#1>`
  - `r||: |#1|`

```
\NewDocumentCommand\mypfrac{ r|| r+= }{%
\frac{\partial #1}{\partial #2}
}
$\displaystyle \mypfrac|f(x,y)|+x=$ % working but bad example
```

$$\frac{\partial f(x,y)}{\partial x}$$

- more
  - `R(){<default>}`, `v`, `b` (Required,verbatim,body)
  - `l`, `u` (not recommended by the team)

3.3.2 optional argument specifiers

- `o` : `[#1]` (optional)
  - `+o` : `\par` 허용
  - `!o` : no space trimming (after mandatory argument)
- `O{<default>}` : `[#1]` or `[<deftault>]`
- `d()` : `(#1)` (delimitered)
  - `d<>` : `<#1>`
  - `d||` : `|#1|`
- `D(){<default>}` : `(#1)` or `(<deftault>)`
- `s` : either `\mymacro` or `\mymacro*` (starred)

```
\NewDocumentCommand\mymacro{sm}
{ \IfBooleanTF {#1} {<\mymacro*>} {<\mymacro>} }
```

- `t<token>` : `\mymacro` or `\mymacro<token>` (token)
  - generalized `t`
- more
  - `e`, `E(){<default>}` (experimental) (embellishments)
  - `g`, `G{<default>}` (not recommended by the team)

3.3.3 구박 받는 argument specifiers

- `l: #1{...` (left group token)
- `u<token>: #1<token>` (until)
- `g: {#1}` (group tokens)
- `G{<default>}: {#1}` or `{<deftault>}`

Why?

In the `xparse` manual...

The **simplest syntax** is often best,
with argument specifications such as `mmmm` or `ommmm`,
namely an optional argument followed by some **standard mandatory ones**.
The **optional argument** can be made
to support **key–value syntax** using tools from l3keys.

Really?

```
\NewDocumentCommand\mytest{ m O{} G{blue} }
{\textcolor{#3}{#2 #1}}

\mytest{Once}[\LARGE] you stop leaning,
you start dying.\par
\mytest{Once}[\LARGE] {orange} you stop leaning,
you start dying.\par
\mytest{Once}[\LARGE] {green} {\bfseries you stop leaning},
you start dying.\par
%\mytest{Once}[\LARGE]        {\bfseries you stop leaning},
%you start dying.     % ERROR
```

Once you stop leaning, you start dying.

Once you stop leaning, you start dying.

Once **you stop leaning**, you start dying.

What's going on?

- 모든 인자의 값이 있는지 찾는다.
- !를 사용하면, 필수 인자 뒤에 스페이스가 오면 찾는 것을 중지한다.

```
\NewDocumentCommand\mytest{ m O{} !G{blue} }
{\textcolor{#3}{#2 #1}}

\mytest{Once}[\LARGE] {green} {\bfseries you stop leaning},
you start dying.\par
\mytest{Once}[\LARGE]         {\bfseries you stop leaning},
you start dying.      % SUCCESS
```

Once green **you stop leaning**, you start dying.

Once **you stop leaning**, you start dying.

4 tikz coding using `xparse`

```
\usepackage{xparse}
```

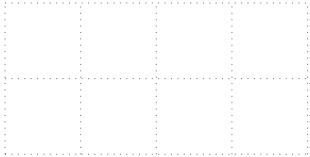
```
%\usepackage{xparse}
\usepackage{tikz-workshop}
```

KTUG wiki LaTeXWorhop 2020 Spring

4.1 help lines

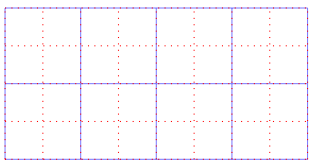
4.1.1 help lines: step by step

```
\begin{tikzpicture}
\draw [black!50,dotted] (0,0) grid (4,2);
\end{tikzpicture}
```



```
\NewDocumentCommand\myhelplines{ O{} r() r() }
{ \draw [black!50,dotted,#1] (#2) grid (#3); }

\begin{tikzpicture}
\myhelplines(0,0)(4,2)
\end{tikzpicture}
```

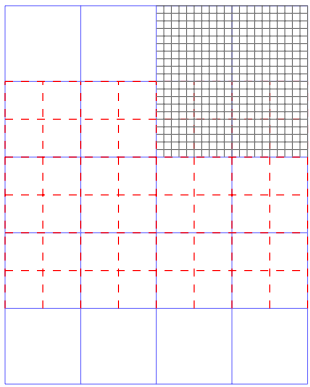
```
\NewDocumentCommand\myhelplines{ O{} r() d() }
{\IfNoValueTF {#3}
  { \draw [black!50,dotted,#1] (0,0) grid (#2); }
  { \draw [black!50,dotted,#1] (#2)  grid (#3); }
}
\begin{tikzpicture}
\myhelplines[blue!50,solid](0,0)(4,2)
\myhelplines[red,step=5mm](4,2)
\end{tikzpicture}
```



4.1.2 save to tkz-workshop.sty: \usepackage{tikz-workshop}

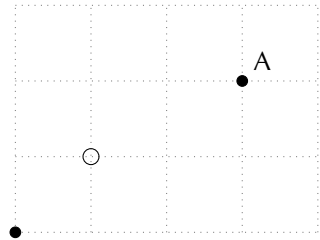
```
%% tikz-workshop.sty
%% \wkhelplines
\NewDocumentCommand\wkhelplines{O{}r()d()}
{\IfNoValueTF {#3}
  {\draw [black!50,dotted,#1] (0,0) grid (#2);}
  {\draw [black!50,dotted,#1] (#2) grid (#3);}
}
```

```
%% \usepackage{tikz-workshop}
\begin{tikzpicture}
\wkhelplines[blue!50,solid](4,5)
\wkhelplines[dashed,red,step=5mm](0,1)(4,4)
\wkhelplines[thin,solid,step=1mm](2,3)(4,5)
\end{tikzpicture}
```

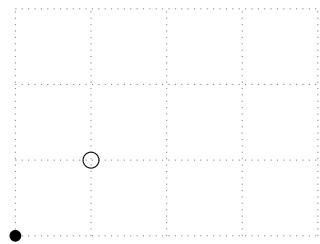


4.2 dot: step by step

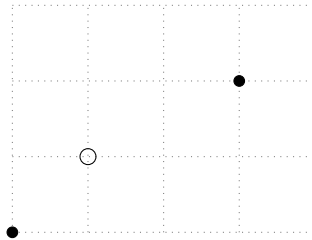
```
%% to draw
\begin{tikzpicture}
\wkhelplines(4,3)
\draw [fill] (0,0) circle (2pt);
\draw        (1,1) circle (3pt);
\draw [fill] (3,2) circle (2pt)
      node [inner sep=0pt,{label={45:A}}] {};
\end{tikzpicture}
```




```
%% define macro to use
\NewDocumentCommand\mydot{ O{} r() D(){2pt} }
{ \draw [#1] (#2) circle (#3); }
\NewDocumentCommand\mydotfill{ O{} r() D(){2pt} }
{ \draw [fill,#1] (#2) circle (#3); }

\begin{tikzpicture}
\wkhelplines(4,3)
\mydotfill(0,0)
\mydot(1,1)(3pt)
\end{tikzpicture}
```



```
%% starred version
\NewDocumentCommand\mydot{ s O{} r() D(){2pt} }
{\IfBooleanTF {#1}
  { \draw [fill,#2] (#3) circle (#4); }
  { \draw [#2]      (#3) circle (#4); }
}

\begin{tikzpicture}
\wkhelplines(4,3)
\mydot*(0,0)
\mydot(1,1)(3pt)
\mydot*(3,2)
\end{tikzpicture}
```

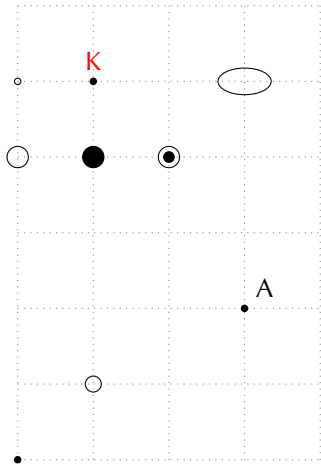


이제, label을 넣을 차례다.

- label과 추가 기능을 넣어 `\wkline`으로 이름 붙이고
- `tikz-workshop.sty`에 추가하자.

```
%% tikz-workshop.sty
%% \wkdot
\NewDocumentCommand\wkdot{sO{}r()D<>{above}G{}O{circle}D(){\wkdefaultradius}}
{\IfBooleanTF {#1}
  {\draw [fill,#2] (#3) #6 (#7) node [inner sep=0pt,{label={#4:{#5}}}]{};}
  {\draw [#2] (#3) #6 (#7) node [inner sep=0pt,{label={#4:{#5}}}]{};}
}
```

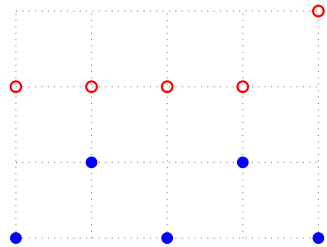
```
%% \usepackage{tikz-workshop}
\begin{tikzpicture}
%% to draw
\wkhelplines(4,6)
\wkdot*(0,0)
\wkdot(1,1)(3pt)
\wkdot*(3,2)<45>{A}
%% more
\wkdot(0,5) \wkdot*(1,5)<[red]90>{K}
\wkdot(3,5)[ellipse](10pt and 5pt)
\setwkcircleradius{4pt} %
\wkdot(0,4) \wkdot*(1,4) \wkdot(2,4) \wkdot*(2,4)(2pt)
\end{tikzpicture}
```



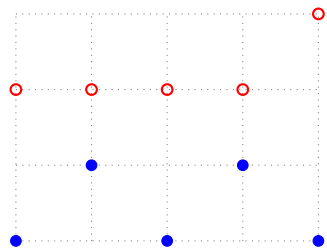
4.3 dots

4.3.1 dots: step by step

```
\begin{tikzpicture}
\wkhelplines(4,3)
\foreach \xx in {(0,0),(1,1),(2,0),(3,1),(4,0)}
  \draw [fill,blue] \xx circle (2pt);
\foreach \xx in {(0,2),(1,2),(2,2),(3,2),(4,3)}
  \draw [red,thick] \xx circle (2pt);
\end{tikzpicture}
```



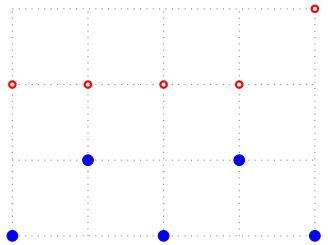
```
\NewDocumentCommand\mydotsfill{ O{} m D(){2pt} }
{ \foreach \xx in {#2} \draw [fill,#1] \xx circle
    (#3); }
\NewDocumentCommand\mydots    { O{} m D(){2pt} }
{ \foreach \xx in {#2} \draw [#1]      \xx circle
    (#3); }
\begin{tikzpicture}
\wkhelplines(4,3)
\mydotsfill[blue]{(0,0),(1,1),(2,0),(3,1),(4,0)}
\mydots[red,thick]{(0,2),(1,2),(2,2),(3,2),(4,3)}
\end{tikzpicture}
```



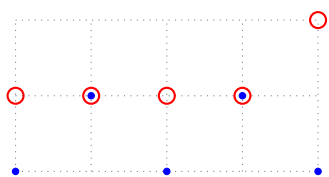
이제, `\IfBooleanTF`를 사용하여 starred (*) version을 갖는 하나의 매크로 `\wkdots`로 정의하자.

```
%% tikz-workshop.sty
% \def\wkdefaultradius{1.2pt}
% \NewDocumentCommand\setwkcircleradius{m}{\renewcommand\wkdefaultradius{#1}}
%% wkdots
\NewDocumentCommand\wkdots{ s O{} m D(){\wkdefaultradius} }{%
\IfBooleanTF {#1}
  {\foreach \xx in {#3} \draw [fill,#2] \xx circle (#4);}
  {\foreach \xx in {#3} \draw [#2] \xx circle (#4);}
}
```

```
%% \usepackage{tikz-workshop}
\begin{tikzpicture}
\wkhelplines(4,3)
\wkdots*[blue]{(0,0),(1,1),(2,0),(3,1),(4,0)}(2pt)
\wkdots[red,thick]{(0,2),(1,2),(2,2),(3,2),(4,3)}
\end{tikzpicture}
```



```
%% \usepackage{tikz-workshop}
\begin{tikzpicture}
\wkhelplines(4,2)
\wkdots*[blue]{(0,0),(1,1),(2,0),(3,1),(4,0)}
\setwkcircleradius{3pt}
\wkdots[red,thick]{(0,1),(1,1),(2,1),(3,1),(4,2)}
\end{tikzpicture}
```



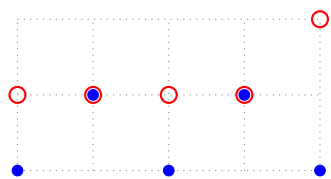
4.3.2 dots: another way

그냥 좌표만 나열하면 안될까?

- 옵션 인자 u를 사용하여 ;를 만날 때가지를 모두 인자로 취급하게 하는 것도 하나의 시도.

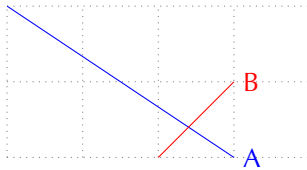
```
%% tikz-workshop.sty
%% \wkDots
\NewDocumentCommand\wkDots{ s O{} u; D(){\wkdefaultradius} }
{\IfBooleanTF #1
  {
  \draw [draw=none,mark=*,mark size=#4,#2] plot coordinates {#3};
  }
  {
  \draw [draw=none,mark=o,mark size=#4,#2] plot coordinates {#3};
  }
}
```

```
%% \usepackage{tikz-workshop}
\begin{tikzpicture}
\wkhelplines(4,2)
\wkDots*[blue](0,0)(1,1)(2,0)(3,1)(4,0);(2pt)
\setwkcircleradius{3pt}
\wkDots[red,thick](0,1)(1,1)(2,1)(3,1)(4,2);
\end{tikzpicture}
```

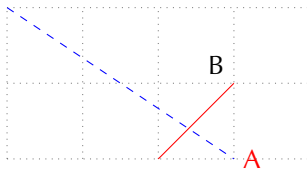


4.4 line: step by step

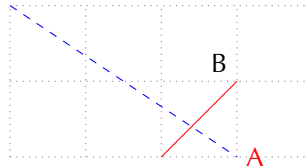
```
\begin{tikzpicture}
\wkhelplines(4,2)
\draw [blue] (0,2) --  (3,0) node [right] {A};
\draw [red]  (2,0) -- +(1,1) node [right] {B};
\end{tikzpicture}
```




```
\NewDocumentCommand\myline{ O{} r() r() O{} G{} }
{\draw [#1] (#2)  --  (#3)
       node [black,right,#4] {#5};
}
\NewDocumentCommand\mylinePlus{ O{} r() r() O{} G{} }
{\draw [#1] (#2)  -- +(#3)
       node [black,right,#4] {#5};
}

\begin{tikzpicture}
\wkhelplines(4,2)   % \usepackage{tikz-workshop}
\myline[blue,dashed](0,2)(3,0)[red]{A}
\mylinePlus[red](2,0)(1,1)[above left]{B}
\end{tikzpicture}
```

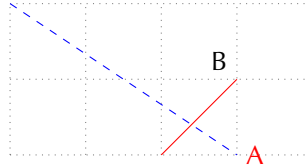


```
\NewDocumentCommand\myline{ O{} d"" r() r() O{} G{} }
{\draw [name path=#2,#1] (#3)  --  (#4)
       node [black,right,#5] {#6};
}
\NewDocumentCommand\mylinePlus{O{} d"" r()r()O{}G{}}
{\draw [name path=#2,#1] (#3)  -- +(#4)
       node [black,right,#5] {#6};
}

\begin{tikzpicture}
\wkhelplines(4,2)   % \usepackage{tikz-workshop}
\myline[blue,dashed]"AA"(0,2)(3,0)[red]{A}
\mylinePlus[red](2,0)(1,1)[above left]{B}
\end{tikzpicture}
```




```
%% tikz-workshop.sty
%% \wkline
\NewDocumentCommand\wkline{ t+ O{} d"" r() d() O{} G{} }
{\IfBooleanTF #1
  {\draw [name path=#3,#2] (#4)  -- +(#5) node [black,right,#6] {#7};}
  {\draw [name path=#3,#2] (#4)  --  (#5) node [black,right,#6] {#7};}
}
```

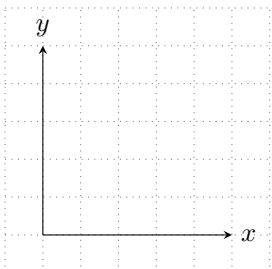
```
%% \usepackage{tikz-workshop}
\begin{tikzpicture}
\wkhelplines(4,2)
\wkline[blue,dashed]"AA"(0,2)(3,0)[red]{A}
\wkline+[red](2,0)(1,1)[above left]{B}
\end{tikzpicture}
```



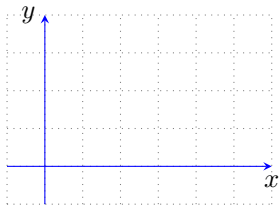
4.5 axes: \wkaxes

```
%% \wkaxes
\NewDocumentCommand\wkaxes{ O{} D<>{0,0} r() d() O{} G{} O{} G{} }
{\IfNoValueTF {#4}
    {\draw [->,>=stealth,#1] ({0,0}|-#2) -- (#3|-#2)
           node (xaxis) [black,right,#5] {$#6$};
     \draw [->,>=stealth,#1] (#2|-{0,0}) -- (#2|-#3)
           node (yaxis) [black,above,#7] {$#8$};
    }
    {\draw [->,>=stealth,#1] (#3|-#2)    -- (#4|-#2)
           node (xaxis) [black,right,#5] {$#6$};
     \draw [->,>=stealth,#1] (#2|-#3)    -- (#2|-#4)
           node (yaxis) [black,above,#7] {$#8$};
    }
}
```

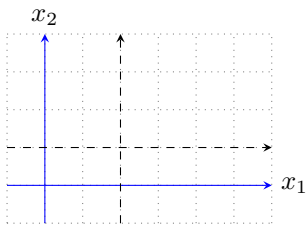
```
\begin{tikzpicture}[scale=.5]
\wkhelplines(-1,-1)(6,6)
\wkaxes(5,5){x}{y}
\end{tikzpicture}
```



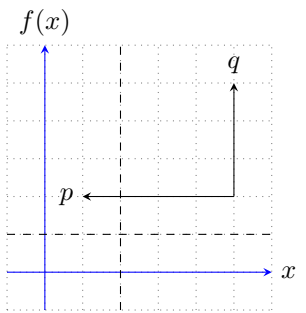
```
\begin{tikzpicture}[scale=.5]
\wkhelplines(-1,-1)(6,4)
\wkaxes[blue](-1,-1)(6,4)[below]{x}[left]{y}
\end{tikzpicture}
```




```
\begin{tikzpicture}[scale=.5]
\wkhelplines(-1,-1)(6,4)
\wkaxes[blue](-1,-1)(6,4){x_1}{x_2}
\wkaxes[dashed]<2,1>(-1,-1)(6,4)
\end{tikzpicture}
```




```
\begin{tikzpicture}[scale=.5]
\wkhelplines(-1,-1)(6,6)
\wkaxes[blue](-1,-1)(6,6){x}{f(x)}
\wkaxes[-,dashed]<2,1>(-1,-1)(6,6)
\wkaxes<5,2>(5,2)(1,5)[left]{p}{q}
\end{tikzpicture}
```

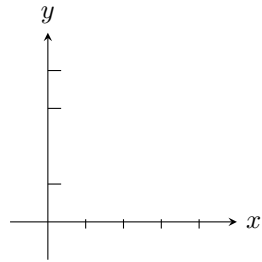


4.6 ticks

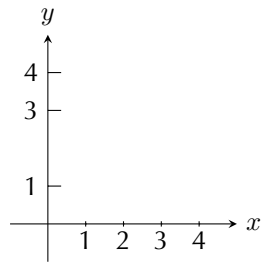
4.6.1 ticks: \wkticks

```
%% wkticks
\NewDocumentCommand\wkticks{ s O{} D(.{0} D.){0} m O{} D(.{0} D.) {0}m }
{\IfBooleanTF {#1}
  { \foreach \xx in {#5}
    \draw [#2] (\xx cm,#3pt) -- (\xx cm,#4pt);
    \foreach \yy in {#9}
    \draw [#6] (#7pt,\yy cm) -- (#8pt,\yy cm);
  }
  { \foreach \xx/\xtext in {#5}
    \draw [#2] (\xx cm,#4pt) -- (\xx cm,#3pt)
       node [black,below,text height=1.25ex,text depth=.25ex] {\xtext};
    \foreach \yy/\ytext in {#9}
    \draw [#6] (#8pt,\yy cm) -- (#7pt,\yy cm) node [black,left] {\ytext};
  }
}
```

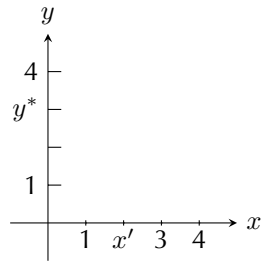
```
\begin{tikzpicture}[scale=.5]
%\wkhelplines(-1,-1)(6,6)
\wkaxes(-1,-1)(5,5){x}{y}
\wkticks*(-5..2){1,...,4}(0..10){1,3,4}
\end{tikzpicture}
```




```
\begin{tikzpicture}[scale=.5]
%\wkhelplines(-1,-1)(6,6)
\wkaxes(-1,-1)(5,5){x}{y}
\wkticks*(-2..2){1,...,4}(0..10){1,3,4}
\wkticks{1,...,4}{1,3,4}
\end{tikzpicture}
```




```
\begin{tikzpicture}[scale=.5]
%\wkhelplines(-1,-1)(6,6)
\wkaxes(-1,-1)(5,5){x}{y}
\wkticks*(-2..2){1,...,4}(0..10){1,...,4}
\wkticks{1,2/$x'$,3,4}{1,3/$y^*$,4}
\end{tikzpicture}
```



4.6.2 ticks: `\wktikcsx` and `\wktikcsy`

```
%% wktikcsx
\NewDocumentCommand\wkticksx{ s O{} D(.{0} D.){2} m O{} }
{\IfBooleanTF {#1}
    { \foreach \xx/\xtext in {#5}
      \draw [#2] (\xx cm,#4pt) -- (\xx cm,#3pt);
    }
    { \foreach \xx/\xtext in {#5}
      \draw [#2] (\xx cm,#4pt) -- (\xx cm,#3pt)
          node [black,below,text height=1.25ex,text depth=.25,#6] {\xtext};
    }
}
```

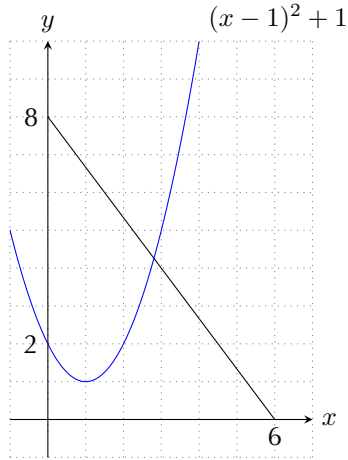
```
%% wktikcsy
\NewDocumentCommand\wkticksy{ s O{} D(.{0} D.){2} m O{} }
{\IfBooleanTF {#1}
    { \foreach \yy/\ytext in {#5}
      \draw [#2] (#4pt,\yy cm) -- (#3pt,\yy cm);
    }
    { \foreach \yy/\ytext in {#5}
      \draw [#2] (#4pt,\yy cm) -- (#3pt,\yy cm) node [black,left,#6] {\ytext};
    }
}
```

4.7 plotting functions

4.7.1 functions: `\wkfn`

```
\NewDocumentCommand\wkfn{ O{} D""{} m D[.{1.1} D.]{5} O{} G{}}
{
  \draw [samples=200,name path=#2,#1] plot [domain=#4:#5] (\x,{#3})
        node [black,above right,#6] {#7};
}
```

```
\begin{tikzpicture}[scale=.5]
\wkhelplines(-1,-1)(7,10)
\wkaxes(-1,-1)(7,10){x}{y}
\wkfn{8-4/3*\x}[0..6]
\wkticks{6}{2,8}
\def\Fx{(\x-1)^2+1}
\wkfn[blue]{\Fx}[-1..4]{$(x-1)^2+1$}
\end{tikzpicture}
```

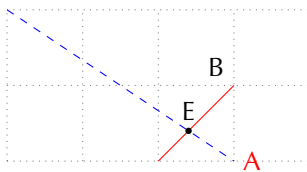


4.8 intersection points

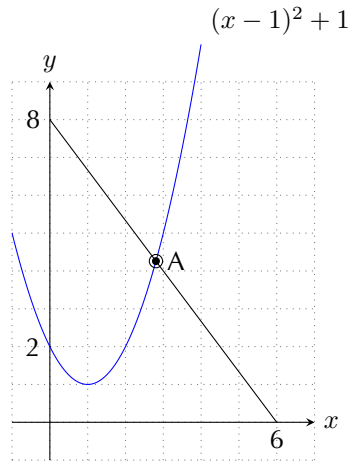
4.8.1 \wkXpoint

```
% definition: \wkXpoint (together with macros with "path name")
\NewDocumentCommand\wkXpoint{sO{}mmD(){}O{1}D<>{45}G{}D(){\wkdefaultradius}}
{\IfBooleanTF {#1}
  {
  \path[fill,name intersections={of=#3 and #4},#2] (intersection-#6)
    coordinate (#5) circle (#9) node [inner sep=0pt,{label={#7:{#8}}}]{};
  }
  {
  \path[name intersections={of=#3 and #4},#2] (intersection-#6)
    coordinate (#5) node [inner sep=0pt,{label={#7:{#8}}}]{};
  }
}
```

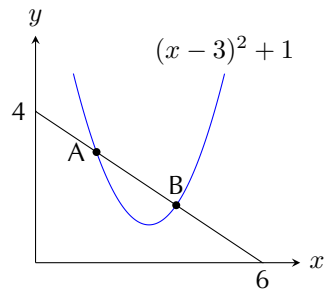
```
%% \usepackage{tikz-workshop}
\begin{tikzpicture}
\wkhelplines(4,2)
\wkline[blue,dashed]"AA"(0,2)(3,0)[red]{A}
\wkline+[red]"BB"(2,0)(1,1)[above left]{B}
\wkXpoint*{AA}{BB}(X)<90>{E}
\end{tikzpicture}
```



```
\begin{tikzpicture}[scale=.5]
\wkhelplines(-1,-1)(7,9)
\wkaxes(-1,-1)(7,9){x}{y}
\wkfn"DD"{8-4/3*\x}[0..6]
\wkticks{6}{2,8}
\def\Fx{(\x-1)^2+1}
\wkfn[blue]"Fx"{\Fx}[-1..4]{$(x-1)^2+1$}
\wkXpoint*{DD}{Fx}(X)(3pt)
\wkdot(X)<0>{A}(5pt)
\end{tikzpicture}
```

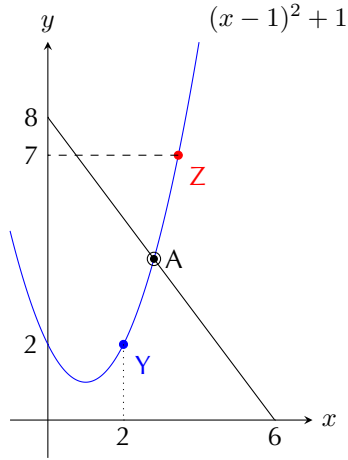



```
\begin{tikzpicture}[scale=.5]
\wkaxes(7,6){x}{y}
\wkfn"Dx"{4-2/3*\x}[0..6]
\wkticks{6}{4}
\def\Gx{(\x-3)^2+1}
\wkfn[blue]"Gx"{\Gx}[1..5][above]{$(x-3)^2+1$}
\wkXpoint*{Dx}{Gx}(X1)<180>{A}(3pt)
\wkXpoint*{Dx}{Gx}(X2)[2]<90>{B}(3pt)
\end{tikzpicture}
```



4.8.2 \wkvXpoint and \wkhXpoint

```
\begin{tikzpicture}[scale=.5]
%\wkhelplines(-1,-1)(7,10)
\wkaxes(-1,-1)(7,10){x}{y}
\wkfn"DD"{8-4/3*\x}[0..6]
\wkticks{2,6}{2,7,8}     %
\def\Fx{(\x-1)^2+1}
\wkfn[blue]"Fx"{\Fx}[-1..4]{$(x-1)^2+1$}
\wkXpoint*{DD}{Fx}(X)(3pt)
\wkdot(X)<0>{A}(5pt)
%-------------------------------------
\wkvXpoint*[blue]{2}{Fx}(Y)<-45>{Y}(3pt)
\wkhXpoint*[red]{7}{Fx}(Z)<-45>{Z}(3pt)
\draw [dotted] (Y) -- (Y|-0,0);
\draw [dashed] (Z) -- (Z-|0,0);
\end{tikzpicture}
```

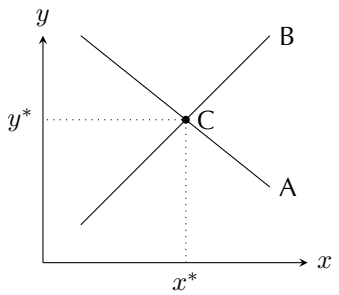


4.9 projections

4.9.1 projections: \wkproj

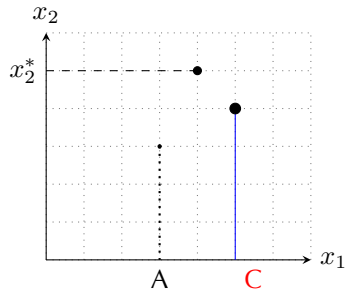
```
%% projection on axes (depending \wkaxes)
%% \wkproj
\NewDocumentCommand\wkproj{sO{}r()O{}G{}O{}G{}D(){\wkdefaultradius}}
{\IfBooleanTF {#1}
  {\draw [dotted,#2] (#3 |- xaxis) node [black,below,#4] {#5}
  -- (#3) -- (yaxis |- #3) node [black,left,#6] {#7};
   \draw [fill] (#3) circle (#8);
  }
  {\draw [dotted,#2] (#3 |- xaxis) node [black,below,#4] {#5}
  -- (#3) -- (yaxis |- #3) node [black,left,#6] {#7};
  }
}
```

```
\begin{tikzpicture}[scale=.5]
\wkaxes(7,6){x}{y}
\wkline"AA"(1,6)(6,2){A}
\wkline"BB"(1,1)(6,6){B}
\wkXpoint*{AA}{BB}(C)<0>{C}(3pt)
\wkproj(C){$x^*$}{$y^*$}       %
\end{tikzpicture}
```

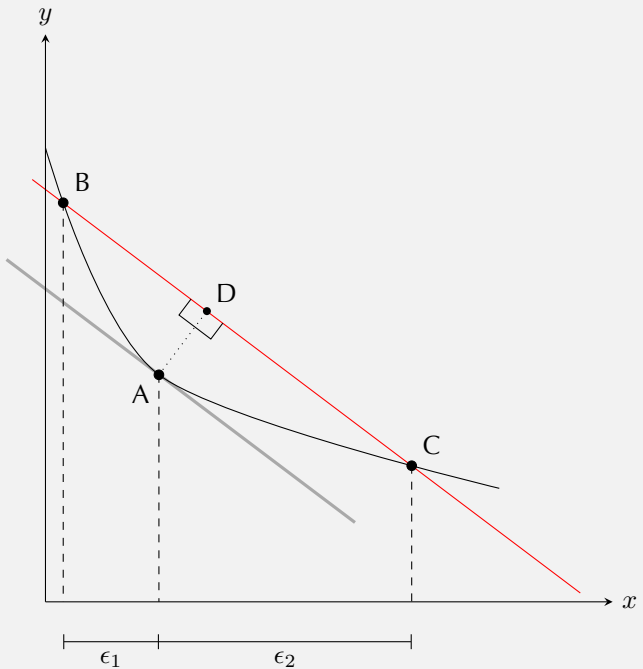


4.9.2 `\wkprojx` and `\wkprojy`

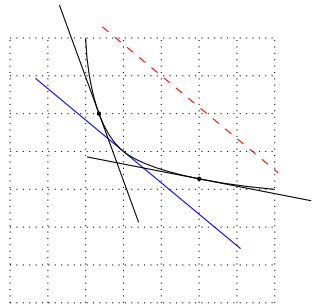
```
\begin{tikzpicture}[scale=.5]
\wkhelplines(7,6)
\wkaxes(7,6){x_1}{x_2}
\wkprojx*[thick](3,3){A}
\coordinate (B) at (4,5);
\wkprojy*[dashed](B){$x_2^*$}(3pt)
\wkprojx*[solid,blue](5,4)[below right,red]{C}(4pt)
\end{tikzpicture}
```



4.10 tangent line



```
\begin{tikzpicture}[scale=.5]
\draw [dotted] (0,0) grid (7,7);
\coordinate (B) at (3,4) ;
\draw [name path=Ux,smooth,tension=.7]
      plot coordinates {(2,7) (B) (7,3)};
\wktangentOn[blue]{Ux}(B)[3cm..4cm]
\wktangentOn[red,dashed]{Ux}(B)(1,2)[2cm..4cm]
\wkvXpoint*{5}{Ux}(K)
\wktangentOn{Ux}(K)[3cm..3cm]
\wkhXpoint*{5}{Ux}(KK)
\wktangentOn{Ux}(KK)[3cm..3cm]
\end{tikzpicture}
```



```
\begin{tikzpicture}[scale=.5]
\draw [dotted] (0,0) grid (7,7);
\coordinate (B) at (3,4) ;
\draw [name path=Ux,smooth,tension=.7]
      plot coordinates {(2,7) (B) (7,3)};
\wktangentOn[blue]{Ux}(B)[3cm..4cm]
\setwktangentdelta{1}{2}  %% set variations
\wktangentOn[red]{Ux}(B)[3cm..4cm]
\end{tikzpicture}
```