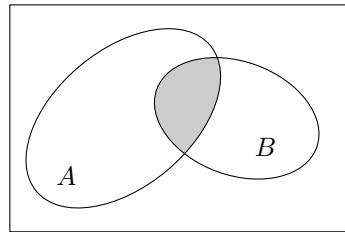
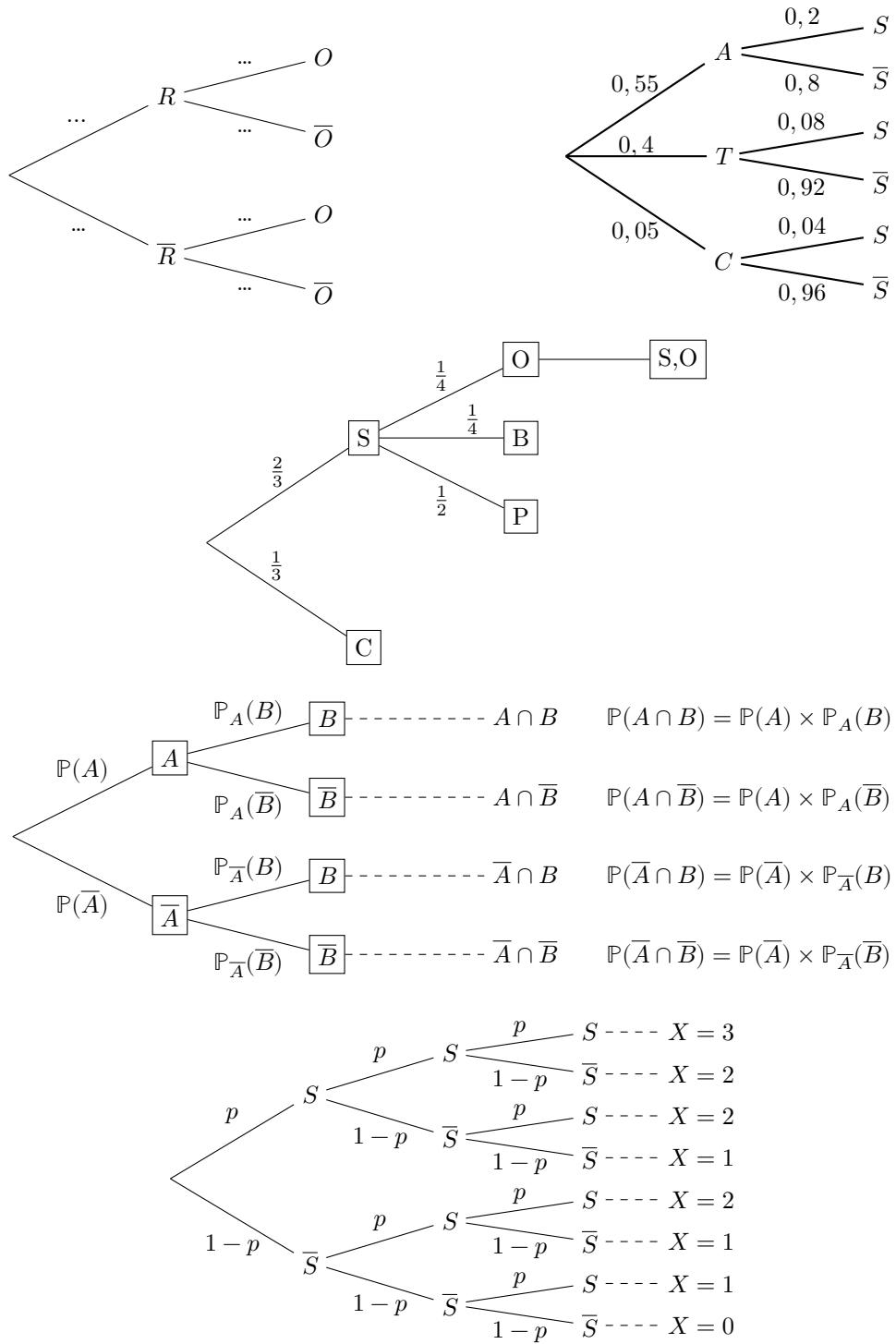


1 Probabilités

1.1 Un Diagramme de Venn



1.2 Arbres horizontaux pondérés



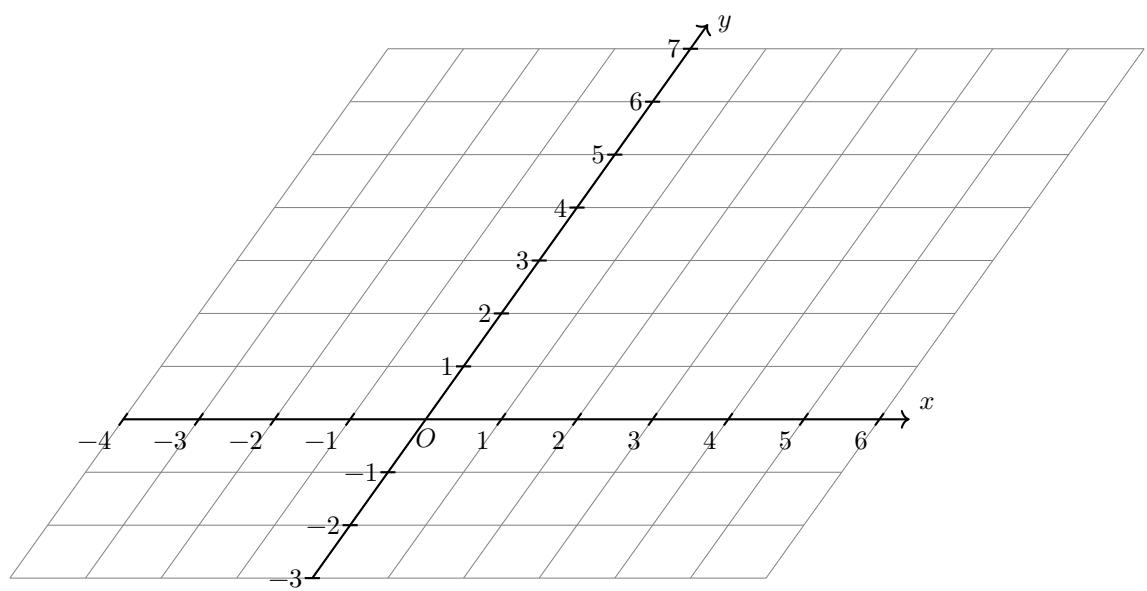
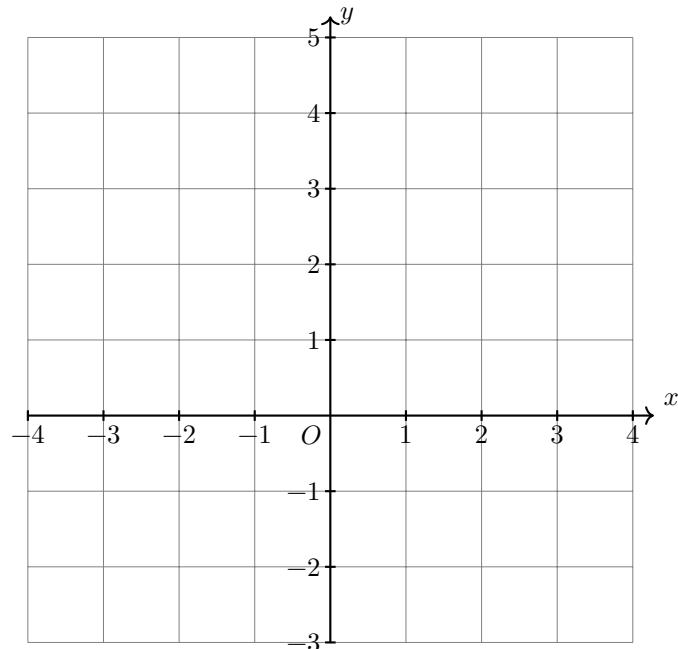
2 Analyse

2.1 Tableaux de signes et de variations

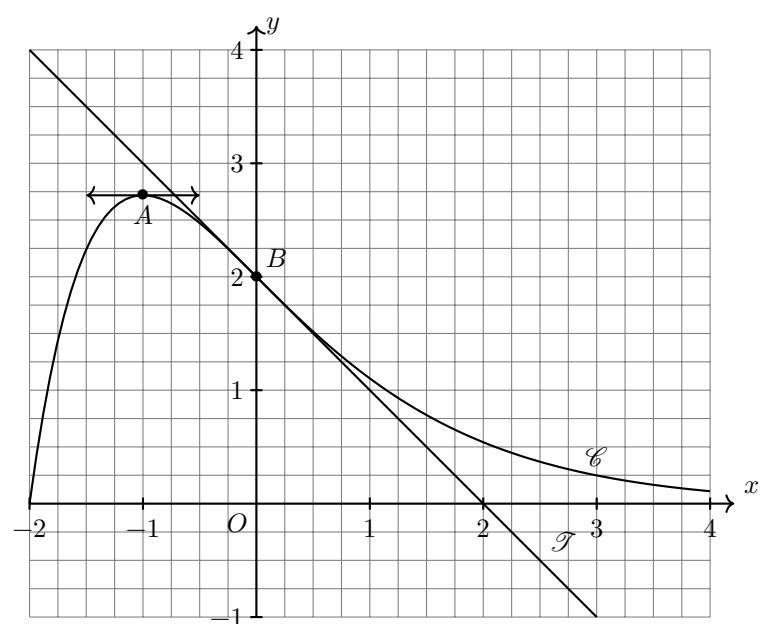
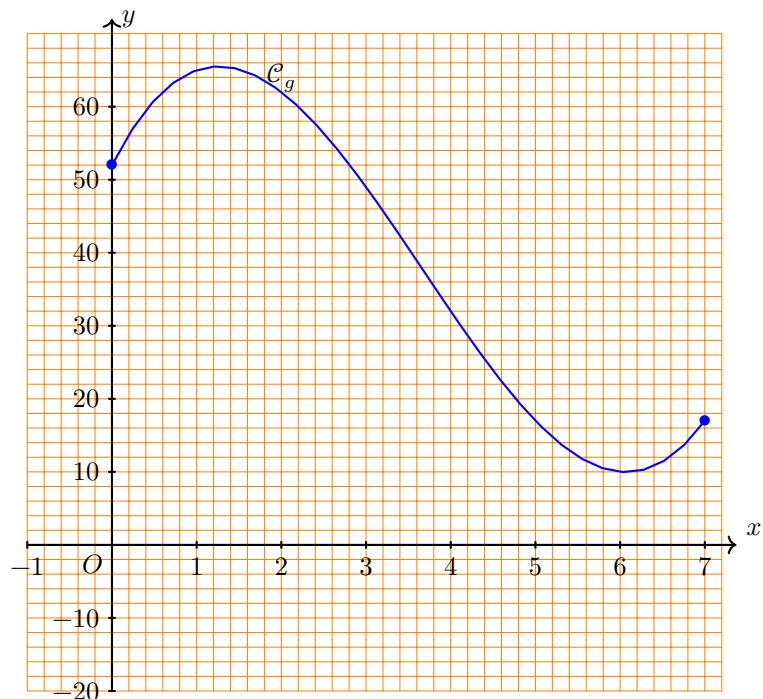
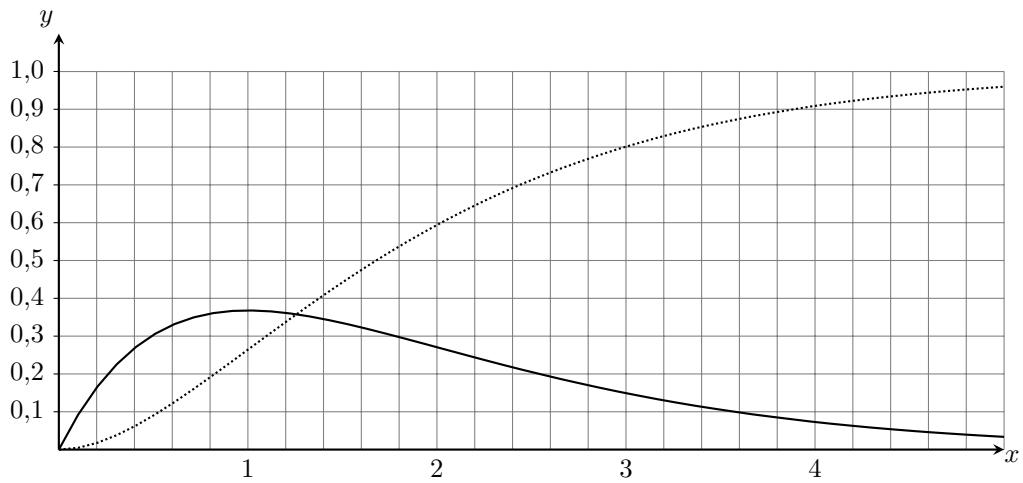
x	-1	$1 - \sqrt{3}$	0	α_1	$1 + \sqrt{3}$	α_2	$+\infty$
$-x^2 + 2x + 2$	+	-	0	+	+	0	-
$x(x+1)$	0	-	-	0	+	-	+
$h'(x)$		+	0	-	+	0	-
variations de h	$h(1 - \sqrt{3})$						
	$-\infty$	$-\infty$	$-\infty$	0	$h(1 + \sqrt{3})$	0	$-\infty$

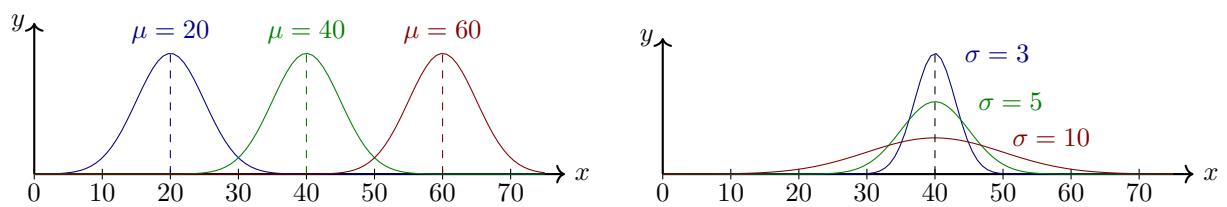
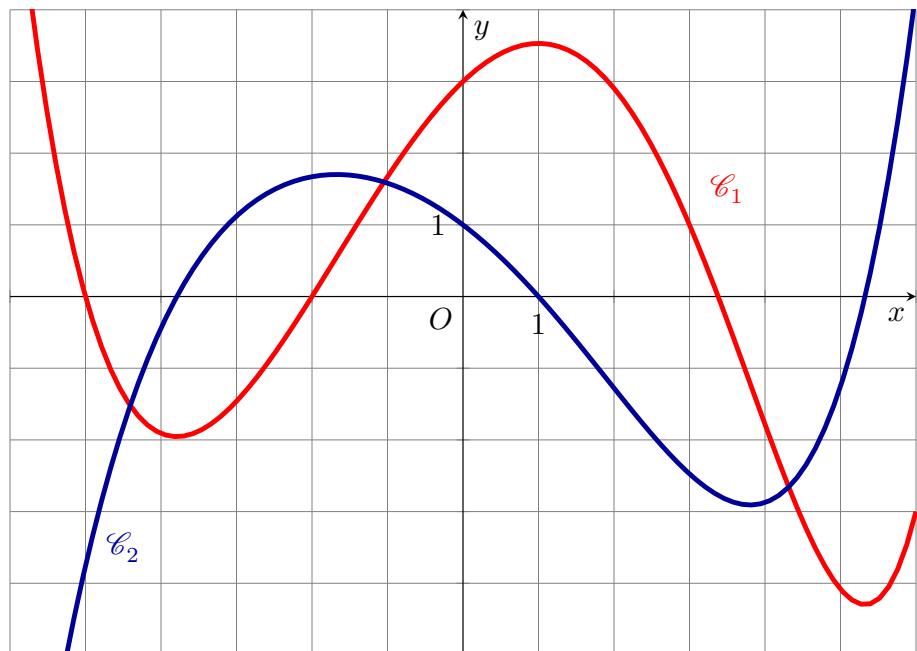
x	-10	-5	1	2	4	5
$f(x)$	3	0	-2	0	2	1

2.2 Repères

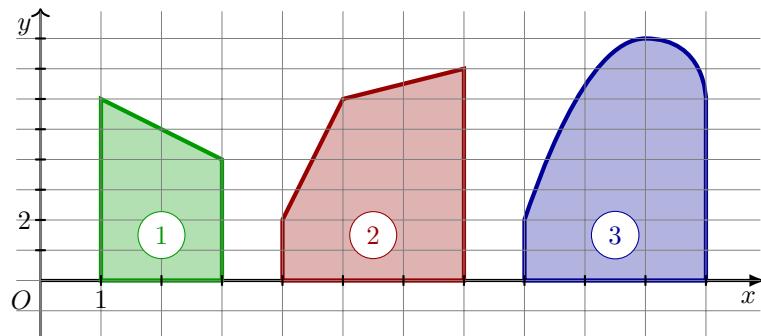
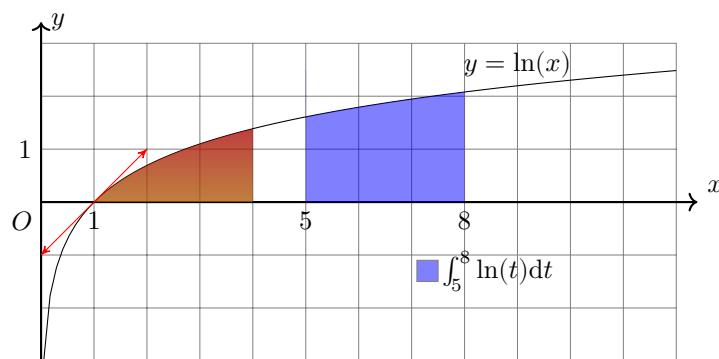
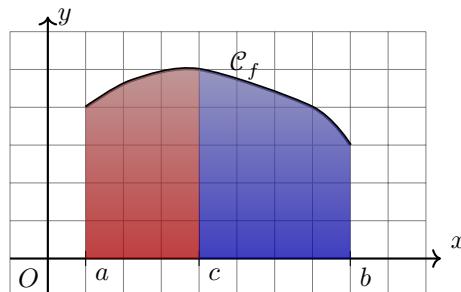


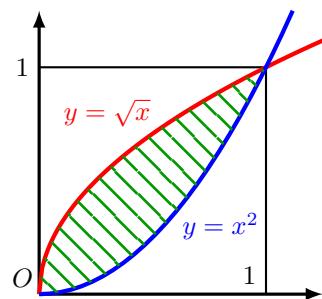
2.3 Courbe de fonction



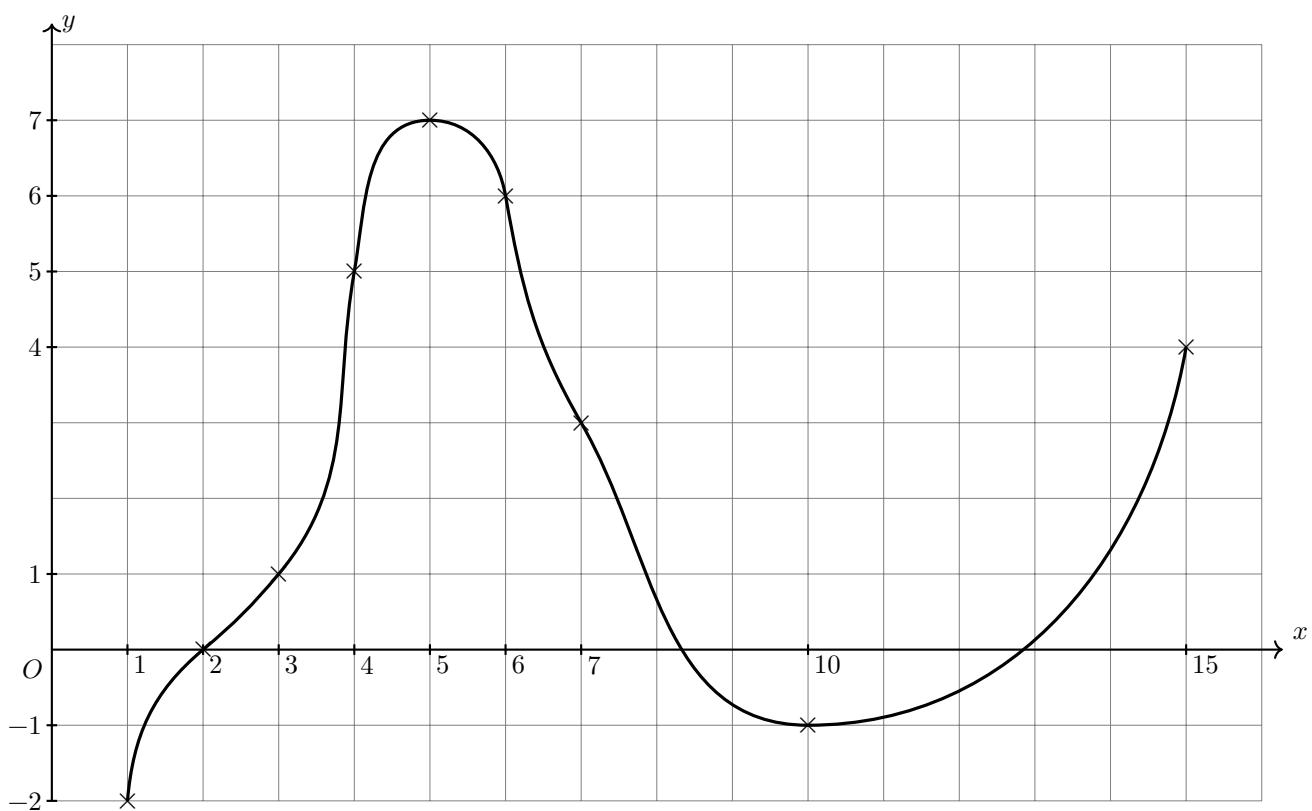
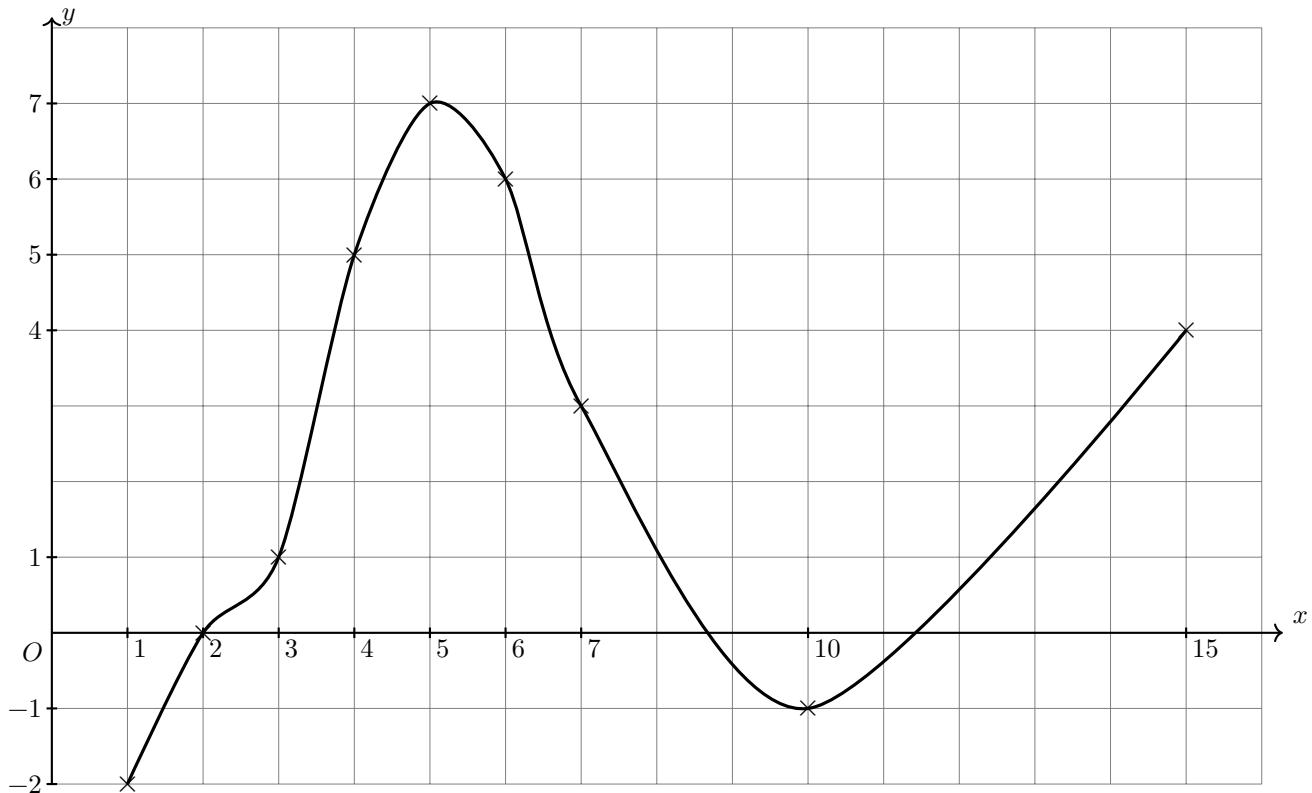


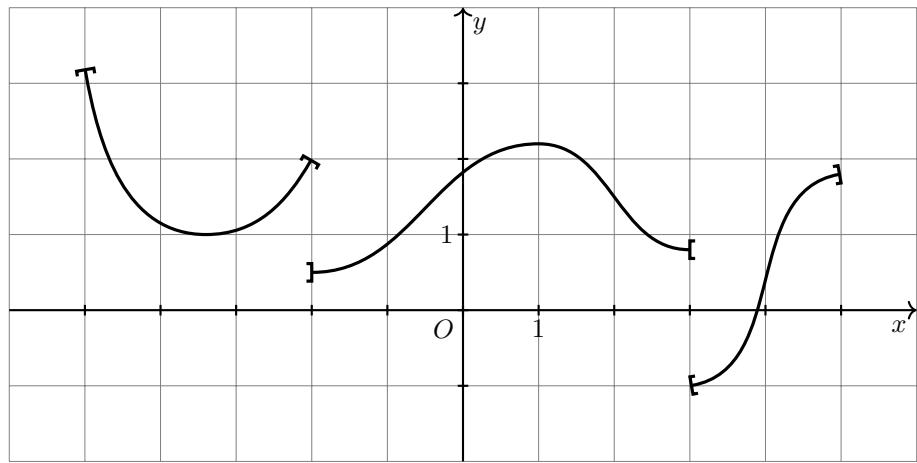
2.4 Intégrale



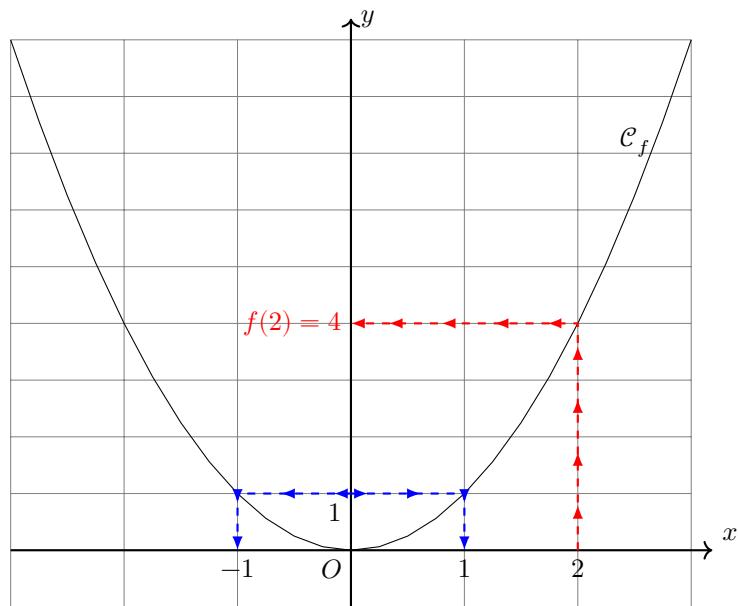


2.5 Courbe passant par des points



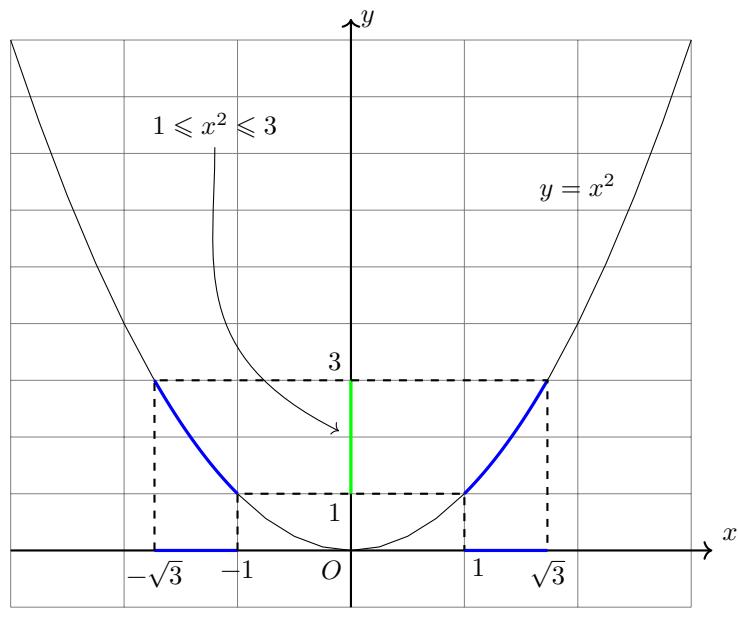


2.6 Résolution graphique



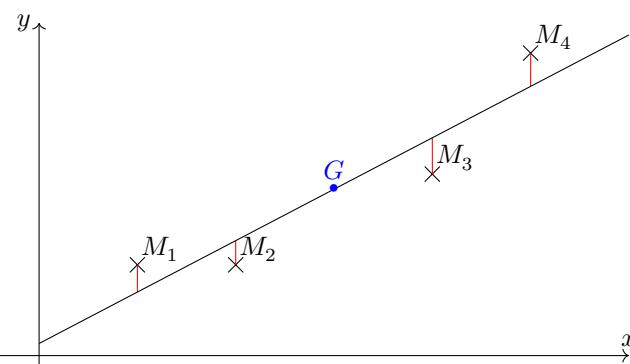
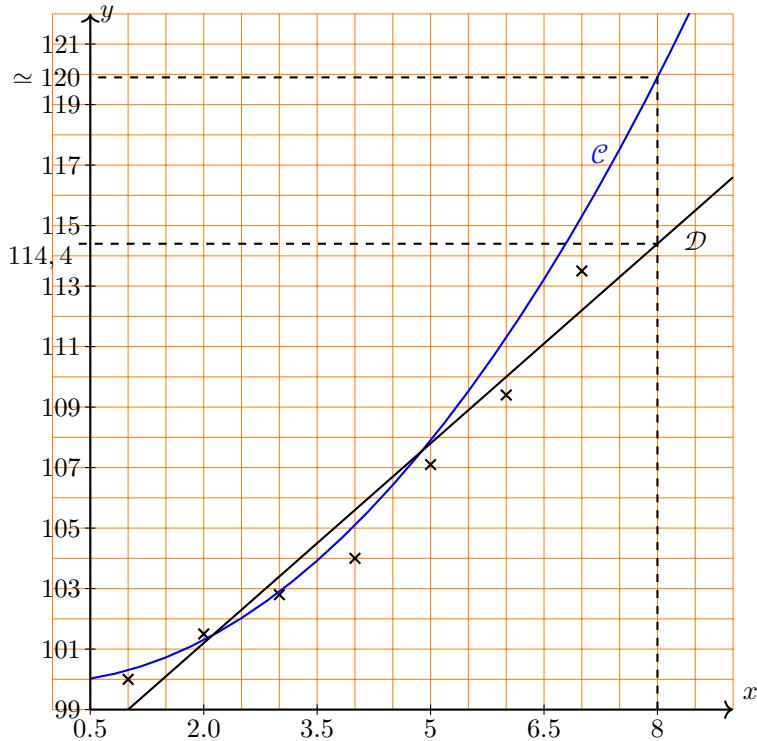
2 a pour image 4 par f : $f(2) = 4$.

1 a pour antécédents -1 et 1 par f : $f(-1) = f(1) = 1$.



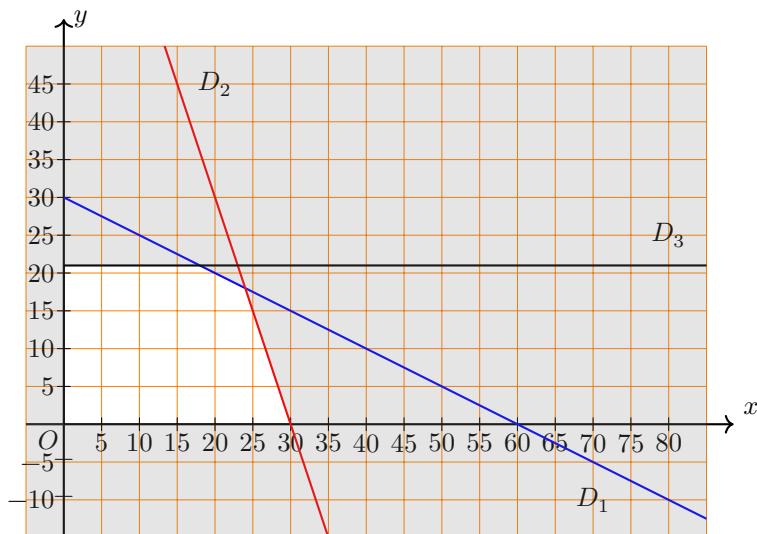
$$\mathcal{S} = [-\sqrt{3}; -1] \cup [1; \sqrt{3}]$$

2.7 Nuage de points, ajustement



La droite passe par G et réduit la somme des carrés des longueurs rouges

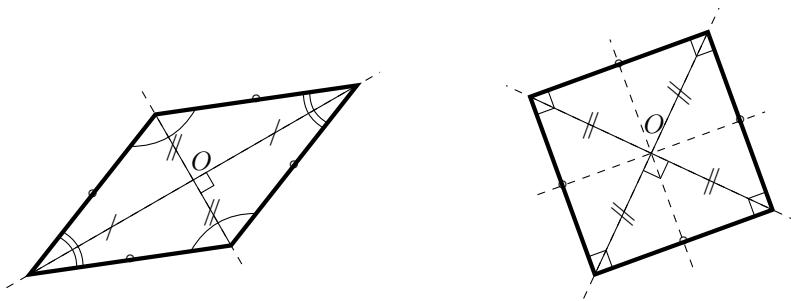
2.8 Programmation linéaire ; Régionnement de plan



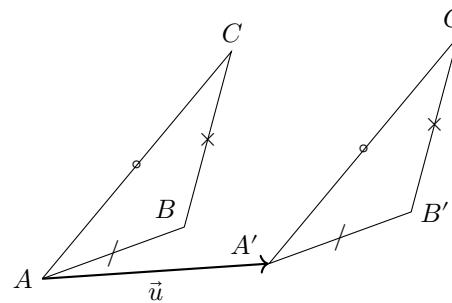
3 Figures de géométrie

3.1 Dans le plan

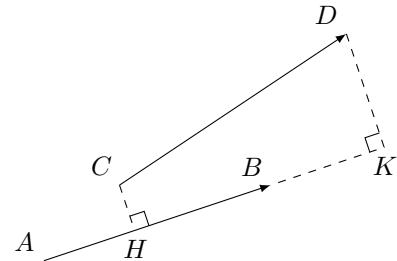
3.1.1 Losange et carré



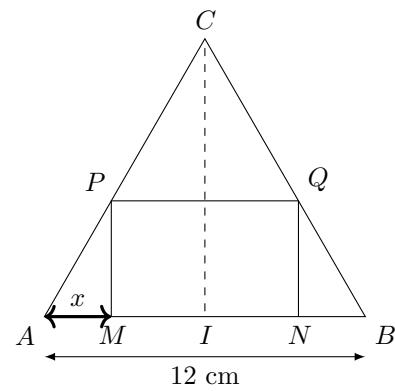
3.1.2 Triangle et translation



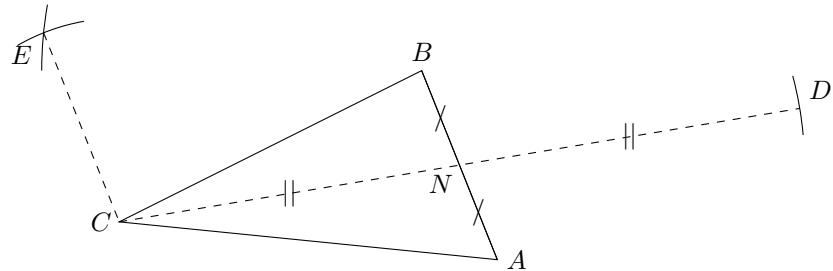
3.1.3 Vecteurs et projection

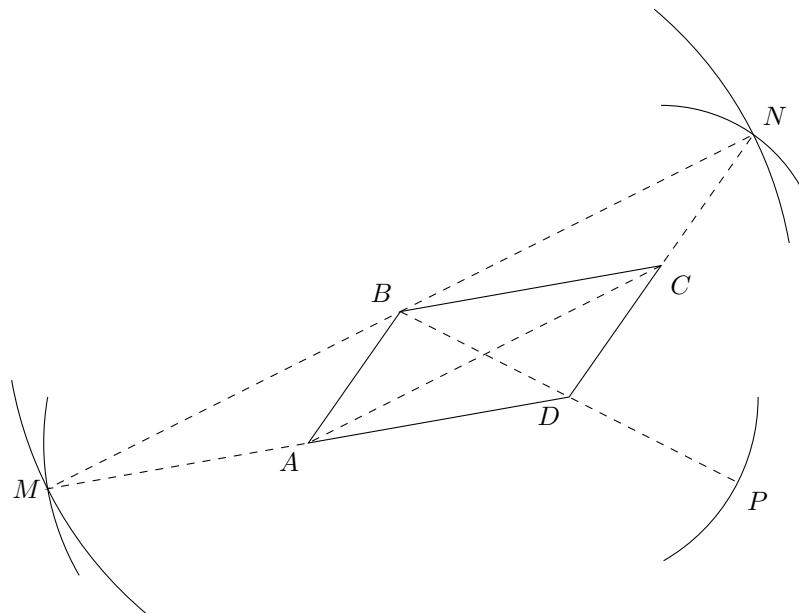


3.1.4 Avec un peu de trigonométrie

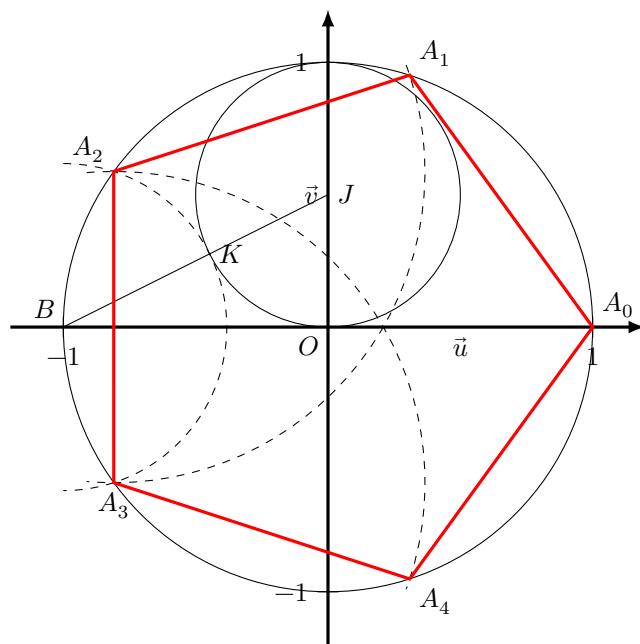


3.1.5 Arc de cercle à partir d'un centre

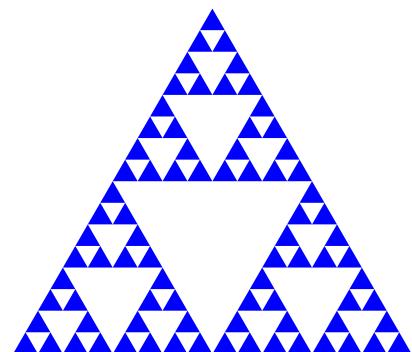
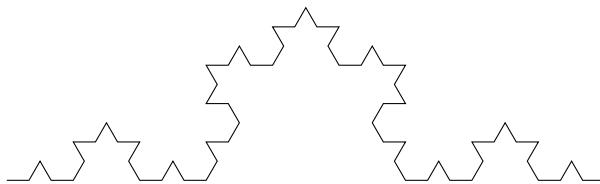




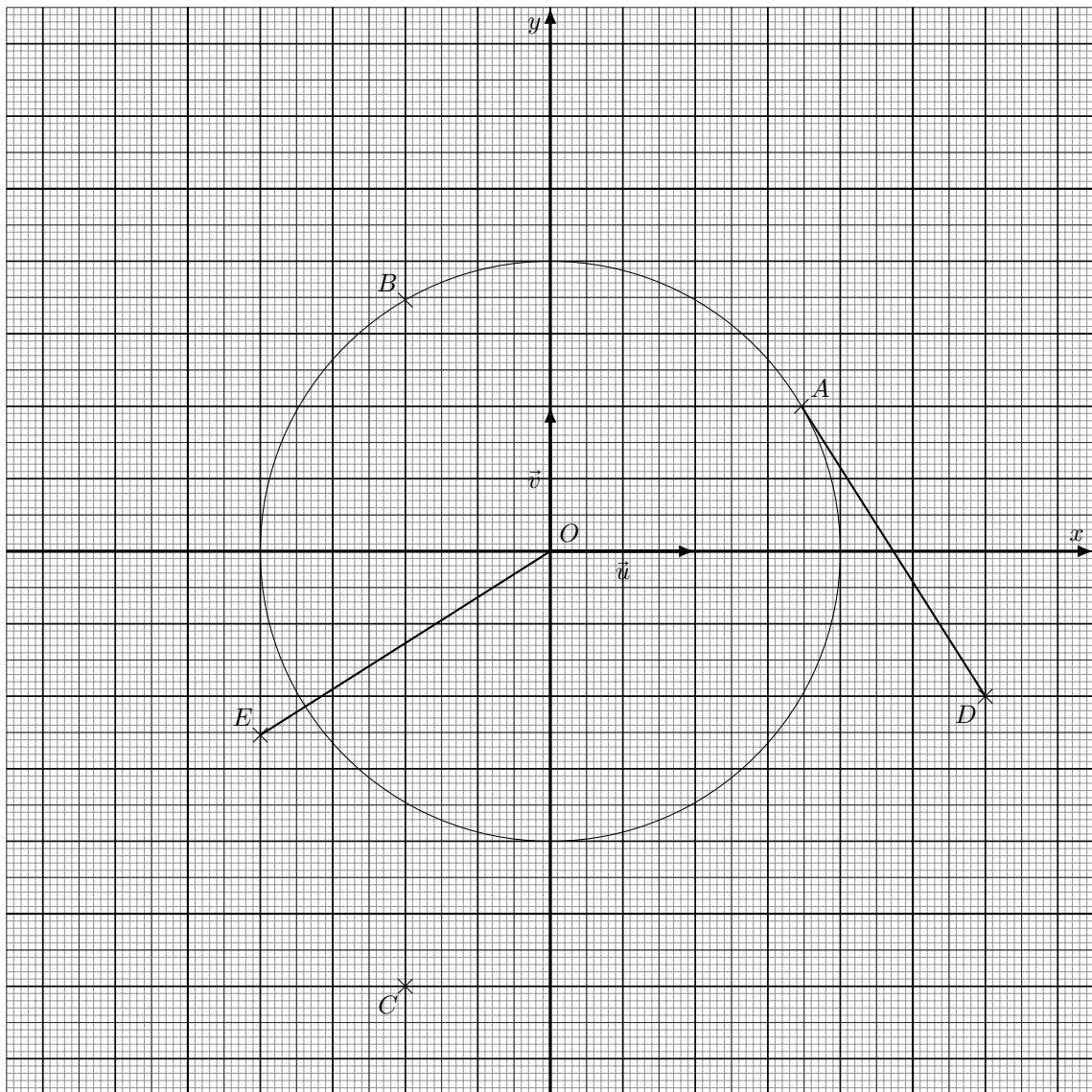
3.1.6 Construction d'un pentagone régulier



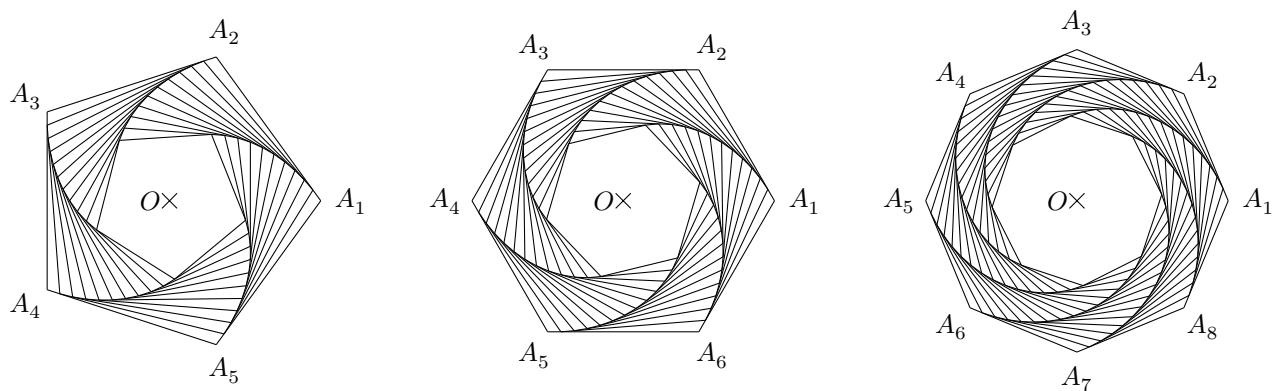
3.1.7 Figures récursives



3.1.8 Papier millimétré et rotation



3.1.9 Polygones imbriqués

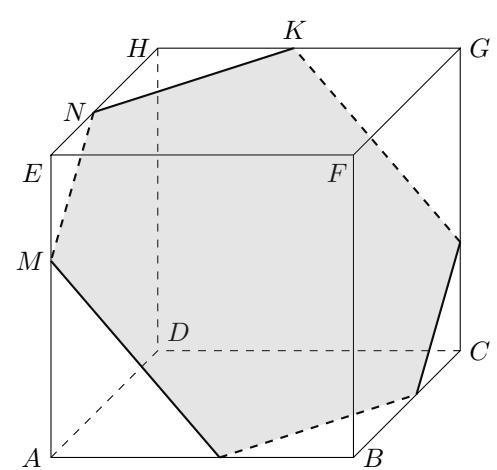
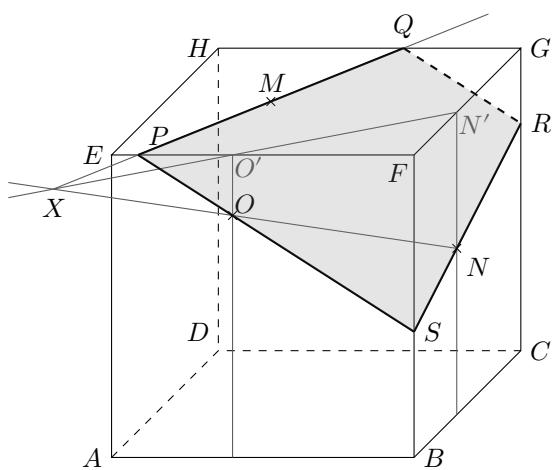


3.1.10 Et avec des couleurs



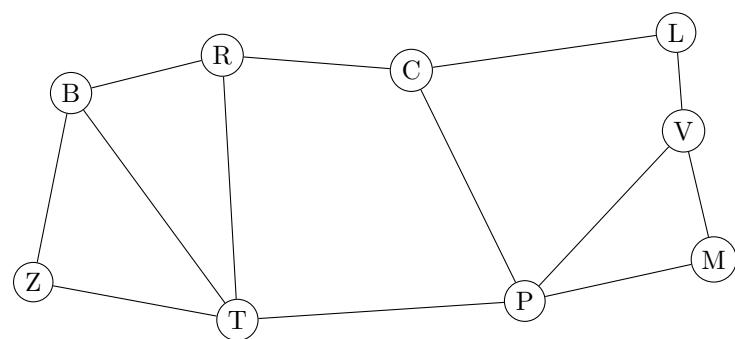
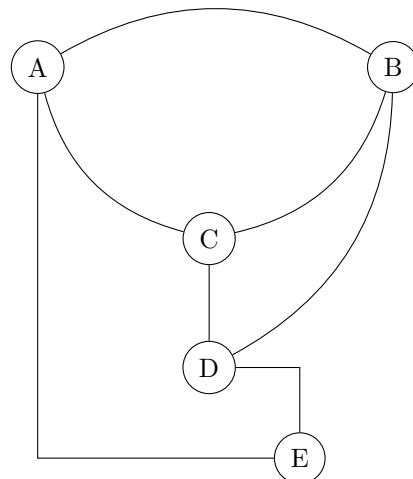
3.2 Dans l'espace

3.2.1 Cube avec section

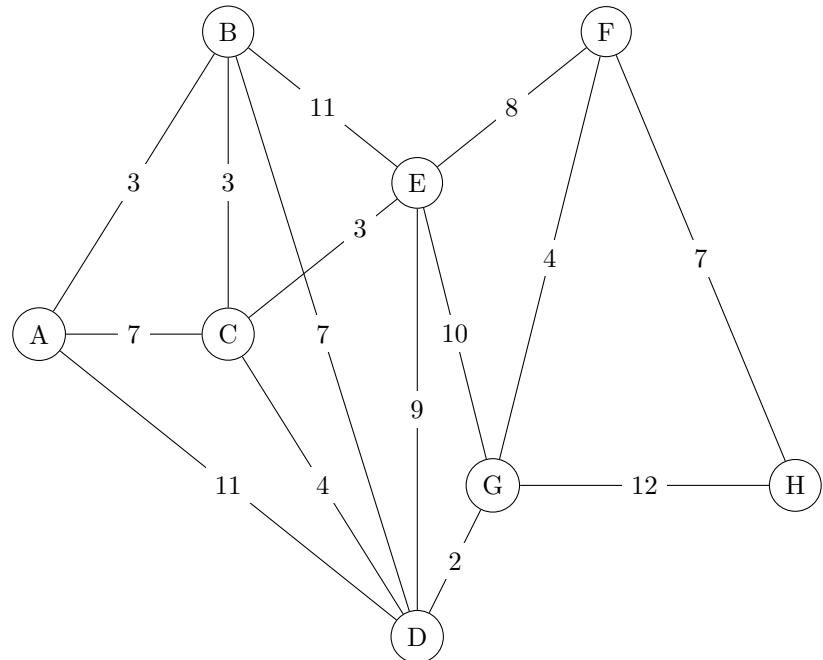


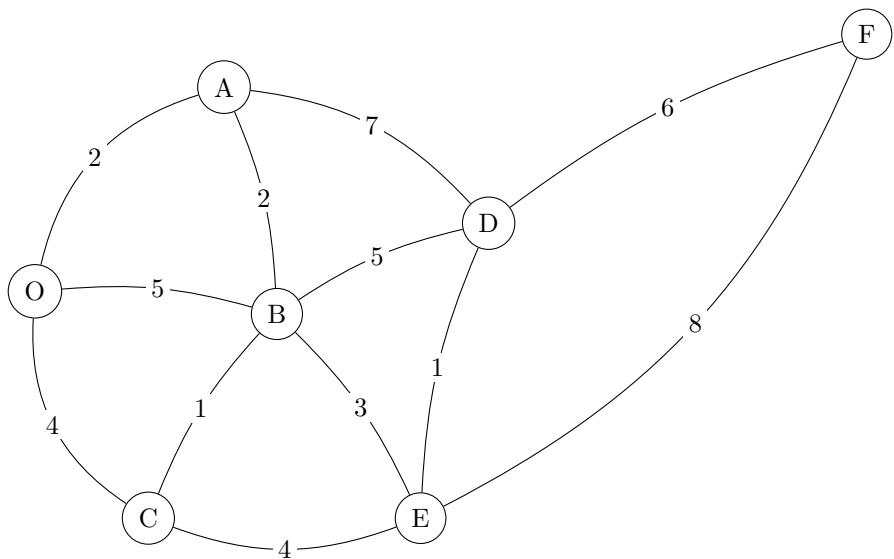
4 Graphes

4.1 Graphe simple

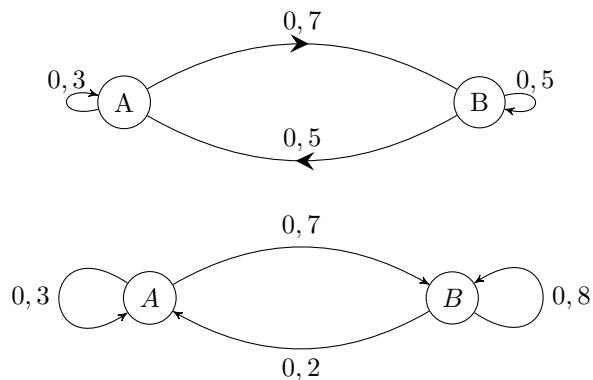


4.2 Graphe étiqueté





4.3 Graphes orientés ; graphes probabilistes

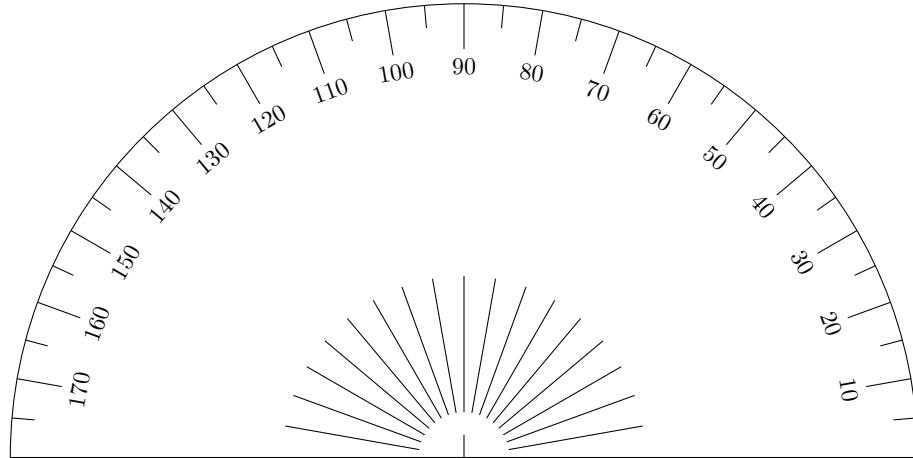


5 Autres

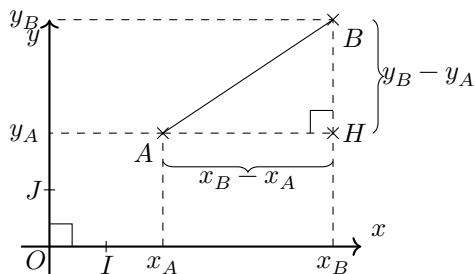
5.1 Panneau Attention



5.2 Rapporteur

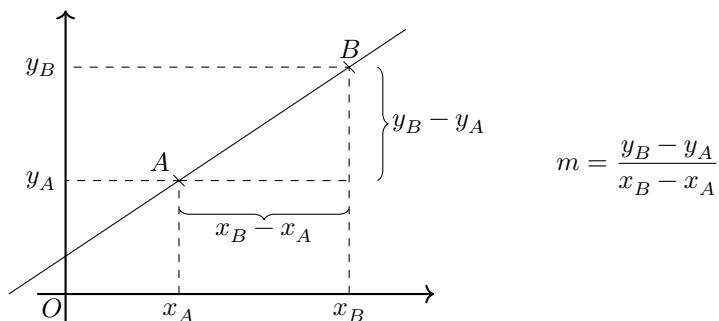


5.3 Accolades et utilisation de baseline



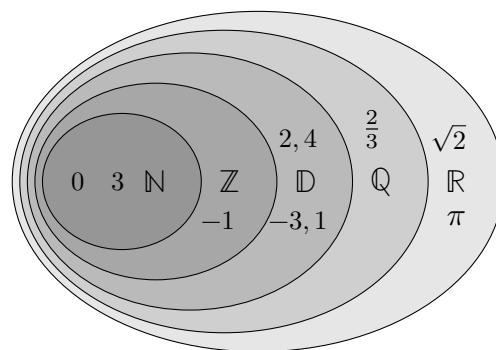
On utilise le théorème de Pythagore dans le triangle ABH rectangle en H :

$$\begin{aligned} AB^2 &= AH^2 + HB^2 \\ &= (x_B - x_A)^2 + (y_B - y_A)^2 \end{aligned}$$

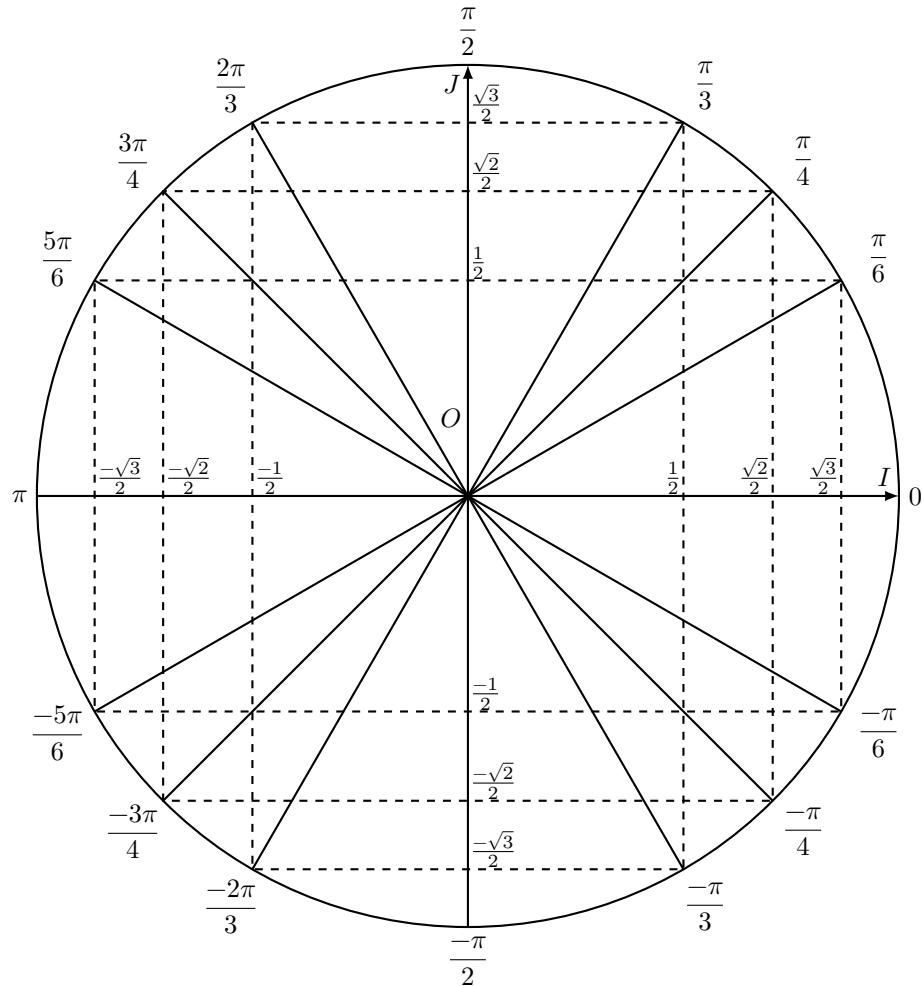


$$m = \frac{y_B - y_A}{x_B - x_A}$$

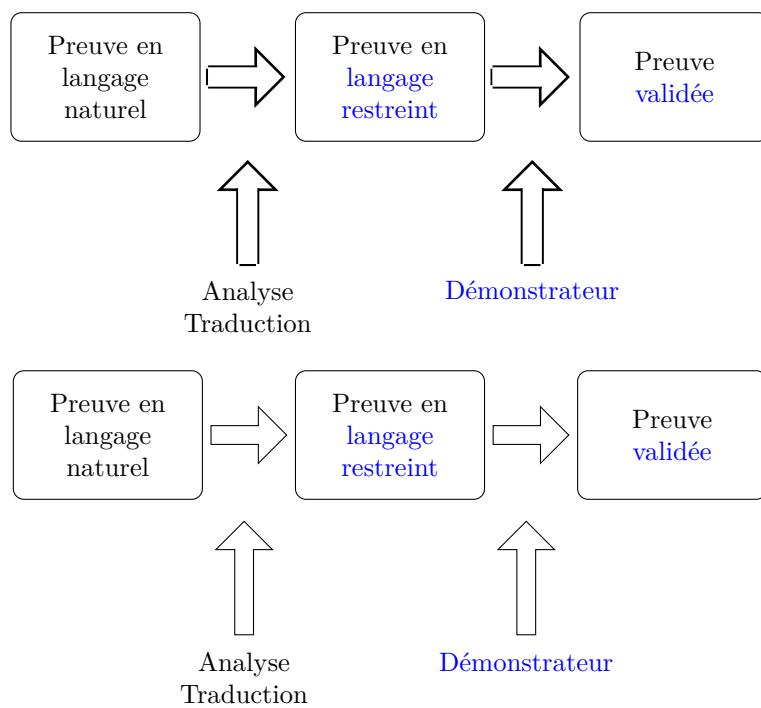
5.4 Inclusion des ensembles de nombres



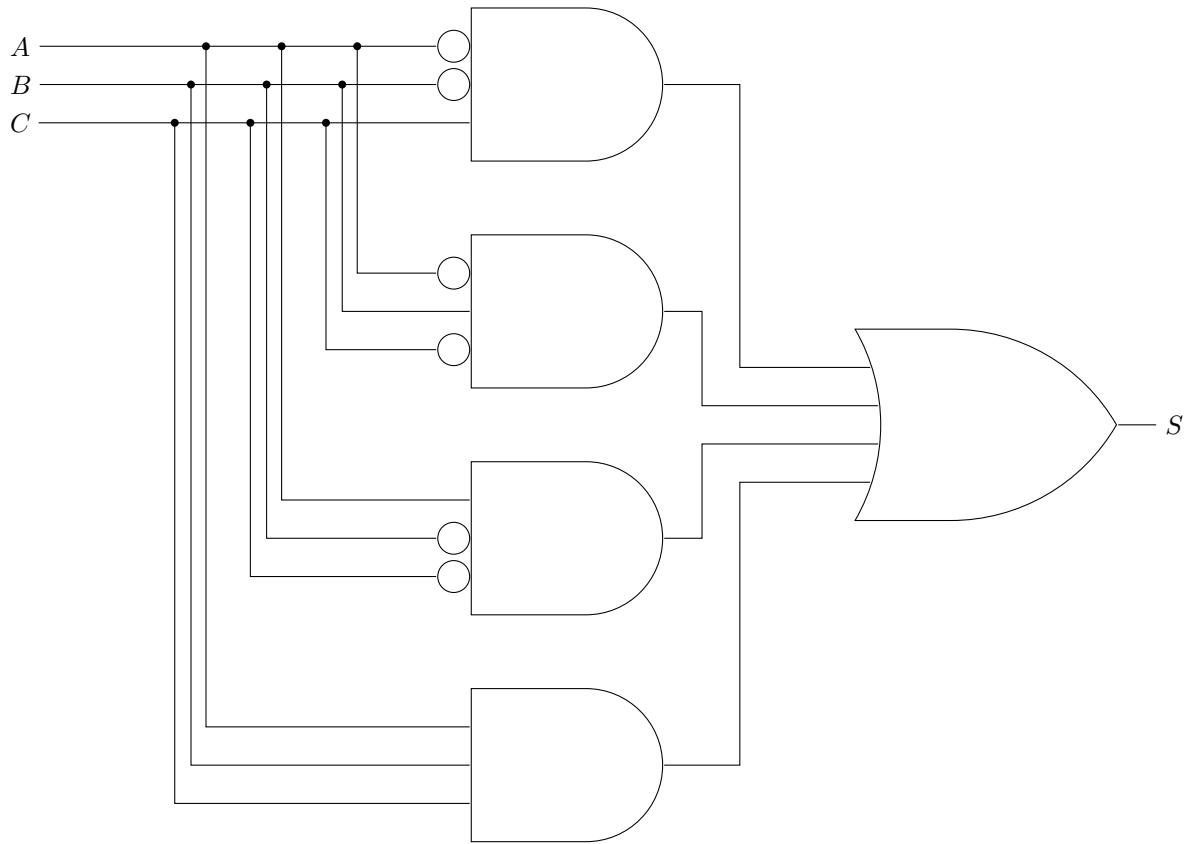
5.5 Cercle trigonométrique



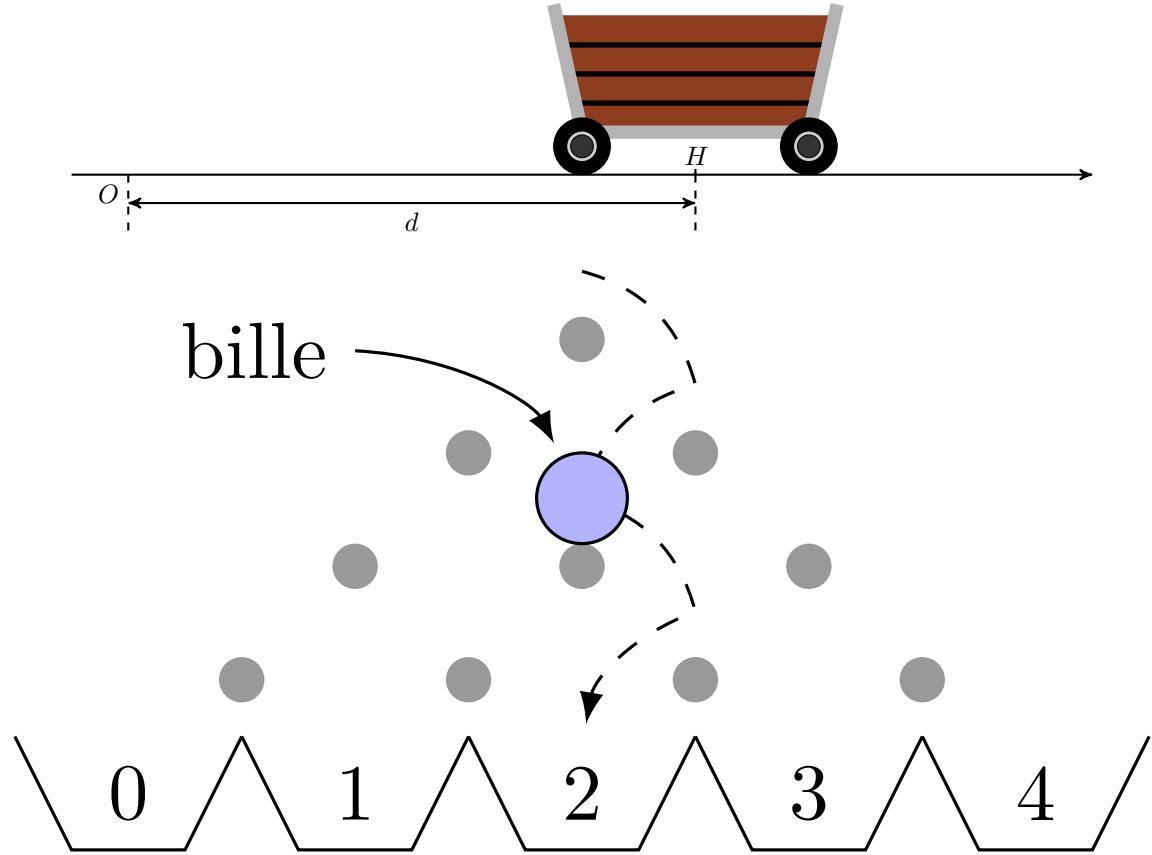
5.6 Schéma avec grosses flèches



5.7 Circuit logique



5.8 Des dessins



Le code ci-dessous permet d'obtenir les figures ci-dessus.
Une fois copié depuis le fichier pdf, remplacer les stealth' par stealth'.

```
\documentclass{article}
\usepackage[a4paper,top=1cm, bottom=1cm, left=1cm, right=1cm]{geometry}
\usepackage[french]{babel}
\usepackage{fontspec}
\usepackage{unicode-math}
\usepackage{amsmath,mathrsfs}
\usepackage{tikz,tkz-tab}
\usepackage{minted} % Nécessite l'installation de pygments
                    % Compiler avec --enable-write18
% compiler avec lualatex
\usetikzlibrary{positioning}
\usetikzlibrary{decorations.markings}
\usetikzlibrary{shapes.arrows}
\usetikzlibrary{shapes.geometric}
\usetikzlibrary{calc}
\usetikzlibrary{intersections}
\usetikzlibrary{decorations.pathreplacing}
\usetikzlibrary{lindenmayersystems}
\usetikzlibrary{circuits.logic.US}
\usepgflibrary{arrows.meta}
\usepgflibrary{patterns.meta}

\usepackage{pgfplots}
\pgfplotsset{compat=1.18}

\usepackage{hyperref}

\begin{document}
\setlength{\parindent}{0pt}
\pagestyle{empty}

\section{Probabilités}

\subsection{Un Diagramme de Venn}

\begin{center}
\begin{tikzpicture}[scale=.75]
\draw (0,0) rectangle (6,4) ;
\def\A{(2,2) circle[x radius=2cm, y radius=1.2cm, rotate=40] } ;
\def\B{(4,2) circle[x radius=1.5cm, y radius=1cm, rotate=-20] } ;
\begin{scope}
\clip \A ;
\fill[black!20!] \B ;
\end{scope}
\draw \A ;
\draw (1,1) node{$A$} ;
\draw \B ;
\draw (4.5,1.5) node{$B$} ;
\end{tikzpicture}
\end{center}

\subsection{Arbres horizontaux pondérés}

\begin{center}
\hfill
\begin{tikzpicture}[grow=right, level distance=3cm,scale=.75]
\coordinate
    child[sibling distance=30mm]
    {node {$\overline{R}$}
        child[sibling distance=15mm]
        {node {$\overline{O}$}
            edge from parent
            node[below=2pt] {\dots}
        }
    }
\end{tikzpicture}
\hfill

```

```

        }
        child[sibling distance=15mm]
        {node {$0$}
         edge from parent
         node[above=2pt] {\dots}
        }
        edge from parent
        node[below=4pt] {\dots}
    child[sibling distance=30mm]
    {node {$R$}
     child[sibling distance=15mm]
     {node {$\overline{0}$}
      edge from parent
      node[below=2pt] {\dots}
     }
     child[sibling distance=15mm]
     {node {$0$}
      edge from parent
      node[above=2pt] {\dots}
     }
     edge from parent
     node[above=4pt] {$\dots$}
    }
;
\end{tikzpicture}
\hfill
\begin{tikzpicture}[grow=right, thick, level distance=3cm, scale=.75]
\coordinate
    child[sibling distance=20mm]
    {node[] {$C$}
     child[sibling distance=10mm]
     {node[] {$\overline{S}$}
      edge from parent
      node[below] {$0,96$}
     }
     child[sibling distance=10mm]
     {node[] {$S$}
      edge from parent
      node[above] {$0,04$}
     }
     edge from parent
     node[below=4pt] {$0,05$}
    }
    child[sibling distance=20mm]
    {node[] {$T$}
     child[sibling distance=10mm]
     {node[] {$\overline{S}$}
      edge from parent
      node[below] {$0,92$}
     }
     child[sibling distance=10mm]
     {node[] {$S$}
      edge from parent
      node[above] {$0,08$}
     }
     edge from parent
     node[above=-4pt] {$0,4$}
    }
    child[sibling distance=20mm]
    {node[] {$A$}
     child[sibling distance=10mm]
     {node[] {$\overline{S}$}
      edge from parent
      node[below] {$0,8$}
     }
     child[sibling distance=10mm]
    }

```

```

{node[] {$S$}
  edge from parent
  node[above] {$0,2$}
}
edge from parent
node[above=2pt] {$0,55$}
;
\end{tikzpicture}
\hfill
\end{center}

\begin{center}
\begin{tikzpicture}[grow=right,level distance=3cm,scale=.75]
\coordinate
  child[sibling distance=40mm]
  {node[rectangle,draw] {C}
    edge from parent
    node[above] {$\frac{1}{3}$}}
  child[sibling distance=40mm]
  {node[rectangle,draw] {S}
    child[sibling distance=15mm]
    {node[rectangle,draw] {P}
      edge from parent
      node[below] {$\frac{1}{2}$}}
    }
    child[sibling distance=15mm]
    {node[rectangle,draw] {B}
      edge from parent
      node[near end,above=-2pt] {$\frac{1}{4}$}}
    }
    child[sibling distance=15mm]
    {node[rectangle,draw] {O}
      child {node[rectangle,draw] {S,O}}
      edge from parent
      node[above] {$\frac{1}{4}$}}
    }
    edge from parent
    node[above] {$\frac{2}{3}$}
  }
;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}[grow=right,level distance=3cm,scale=.75]
\coordinate
  child[sibling distance=30mm]
  {node[rectangle,draw] {$\overline{A}$}
    child[sibling distance=15mm]
    {node[rectangle,draw] {$\overline{B}$}
      child{node[right]{$\overline{A} \cap \overline{B} \neq$}
        \mathbb{P}(\overline{A} \cap \overline{B})=
        \mathbb{P}(\overline{A}) \times
        \mathbb{P}(\overline{A}) (\overline{B})$}
      edge from parent[dashed]}
    edge from parent
    node[below=2pt] {$\mathbb{P}(\overline{A} \cap \overline{B})$}
  }
    child[sibling distance=15mm]
    {node[rectangle,draw] {$B$}
      child{node[right]{$\overline{A} \cap B \neq$}
        \mathbb{P}(\overline{A} \cap B)=
        \mathbb{P}(\overline{A}) \times
        \mathbb{P}(B)$}
      edge from parent[dashed]}
    }
  }
;
\end{tikzpicture}
\end{center}

```

```

    edge from parent
    node[above=2pt] {${\mathbb{P}}_{{\overline{A}}}(B)$}
}
edge from parent
node[below=4pt] ${\mathbb{P}}({\overline{A}})$
child[sibling distance=30mm]
{node[rectangle,draw] {$A$}
    child[sibling distance=15mm]
    {node[rectangle,draw] ${\overline{B}}$}
        child{node[right] {${A \cap {\overline{B}}} = {\mathbb{P}}(A) \times {\mathbb{P}}_{{\overline{A}}}(B)$}}
            edge from parent[dashed]
        edge from parent
        node[below=2pt] ${\mathbb{P}}_A({\overline{B}})$
    }
    child[sibling distance=15mm]
    {node[rectangle,draw] {$B$}
        child{node[right] {${A \cap B} = {\mathbb{P}}(A) \times {\mathbb{P}}_A(B)$}}
            edge from parent[dashed]
        edge from parent
        node[above=2pt] ${\mathbb{P}}_A(B)$
    }
}
edge from parent
node[above=4pt] ${\mathbb{P}}(A)$
}

;

\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}[grow=right, level distance=2cm]
\coordinate
    child[sibling distance=24mm]
    {node ${\overline{S}}$}
        child[sibling distance=12mm]
        {node ${\overline{S}}$}
            child[sibling distance=6mm]
            {node ${\overline{S}}$}
                child[level distance=1cm]{node[right]{$x=0$}}
                    edge from parent[dashed]
                edge from parent
                node[below=-1pt] {$1-p$}
            }
            child[sibling distance=6mm]
            {node ${\overline{S}}$}
                child[level distance=1cm]{node[right]{$x=1$}}
                    edge from parent[dashed]
                edge from parent
                node[above=-1pt] {$p$}
            }
        edge from parent
        node[below=1pt] {$1-p$}
    }
    child[sibling distance=12mm]
    {node ${\overline{S}}$}
        child[sibling distance=6mm]
        {node ${\overline{S}}$}
            child[level distance=1cm]{node[right]{$x=1$}}
                edge from parent[dashed]
            edge from parent
            node[below=-1pt] {$1-p$}
        }

```

```

        child[sibling distance=6mm]
        {node {$S$}
            child[level distance=1cm]{node[right]{$X=2$}}
            edge from parent[dashed]
            edge from parent
            node[above=-1pt] {$p$}
        }
        edge from parent
        node[above=1pt] {$p$}
    }
    edge from parent
    node[below=4pt] {$1-p$}
}
child[sibling distance=24mm]
{node {$S$}
    child[sibling distance=12mm]
    {node {$\overline{S}$}
        child[sibling distance=6mm]
        {node {$\overline{S}$}
            child[level distance=1cm]{node[right]{$X=1$}}
            edge from parent[dashed]
            edge from parent
            node[below=-1pt] {$1-p$}
        }
        child[sibling distance=6mm]
        {node {$S$}
            child[level distance=1cm]{node[right]{$X=2$}}
            edge from parent[dashed]
            edge from parent
            node[above=-1pt] {$p$}
        }
        edge from parent
        node[below=1pt] {$1-p$}
    }
    child[sibling distance=12mm]
    {node {$S$}
        child[sibling distance=6mm]
        {node {$\overline{S}$}
            child[level distance=1cm]{node[right]{$X=2$}}
            edge from parent[dashed]
            edge from parent
            node[below=-1pt] {$1-p$}
        }
        child[sibling distance=6mm]
        {node {$S$}
            child[level distance=1cm]{node[right]{$X=3$}}
            edge from parent[dashed]
            edge from parent
            node[above=-1pt] {$p$}
        }
        edge from parent
        node[above=1pt] {$p$}
    }
    edge from parent
    node[above=4pt] {$p$}
}
;
\end{tikzpicture}
\end{center}

\section{Analyse}

\subsection{Tableaux de signes et de variations}

\begin{center}

```

```

\begin{tikzpicture} %nécessite tkz-tab
\tkzTabInit[lgt=3,espcl=2.8]{x/0.5,-x^2+2x+2/0.5,x(x+1)/0.5,
 $h'(x)/0.5,varyations\\ de $h$/2}
{$-1$,$1-\sqrt{3}$,$0$,$1+\sqrt{3}$,$+\infty$}
\tkzTabLine{t,-,z,+,t,+,z,-}
\tkzTabLine{z,-,t,-,z,+,t,+}
\tkzTabLine{d,+,z,-,d,+,z,-}
\tkzTabVar{D-/$-\infty$,+$h(1-\sqrt{3})$,-D-/$-\infty$/$-\infty$,
 +/$h(1+\sqrt{3})$,-/$-\infty$}
\tkzTabVal[draw]{3}{4}{0.55}{$\alpha_1$}{$0$}
\tkzTabVal[draw]{4}{5}{0.55}{$\alpha_2$}{$0$}
\end{tikzpicture}
\end{center}

```

```

\begin{center} %nécessite tkz-tab
\begin{tikzpicture}
\tkzTabInit[lgt=1.2,espcl=1.5]{x/0.5,f(x)/1.5}
{$-10$,$-5$,$1$,$2$,$4$,$5$}
\tkzTabVar{+/$3$,R /,-/$-2$,R /,+$2$,-/$1$}
\tkzTabVal{1}{3}{0.5}{$0$}
\tkzTabVal{3}{5}{0.5}{$0$}
\end{tikzpicture}
\end{center}

```

\subsection{Repères}

```

\begin{center}
\begin{tikzpicture}
\def\xscale{1};
\def\yscale{1};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (-4,-3) grid (4,5) ;
\draw[thick,->] (-4,0) -- (4+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-3) -- (0,5+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {-4,-3,-2,-1,1,2,3,4}
\draw[thick] (\x,0) node[below]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {-3,-2,-1,1,2,3,4,5}
\draw[thick] (0,\y) node[left]{$\y$} +(-\dx,0) -- +(\dx,0) ;
\end{tikzpicture}
\end{center}

```

```

\begin{center}
\begin{tikzpicture}[x={(1cm,0cm)}, y={(0.5cm,0.7cm)}]
\def\xscale{1};
\def\yscale{0.86}; %sqrt(0.5^2+0.7^2)
\def\d{0.1};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\foreach \x in {-4,-3,...,6} \draw[very thin, gray] (\x,-3) -- (\x,7) ;
\foreach \y in {-3,-2,...,7} \draw[very thin, gray] (-4,\y) -- (6,\y) ;
\draw[thick,->] (-4,0) -- (6+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-3) -- (0,7+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below]{$0$} ;
\foreach \x in {-4,-3,-2,-1,1,2,3,4,5,6}
\draw[thick] (\x,0) node[below left=1pt]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {-3,-2,-1,1,2,3,4,5,6}
\draw[thick] (0,\y) node[left]{$\y$} +(-\dx,0) -- +(\dx,0) ;
\end{tikzpicture}
\end{center}

```

\subsection{Courbe de fonction}

```

\begin{center}
\begin{tikzpicture}[xscale=2.5,yscale=5]
\def\xscale{2.5};
\def\yscale{5};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[gray] (0,0) grid[xstep=0.2,ystep=0.1] (5,1) ;
\draw[thick,->,>=stealth] (0,0) -- (5,0) node[below right=-5pt]{$x$} ;
\draw[thick,->,>=stealth] (0,0) -- (0,1.1) node[above left=-2pt]{$y$} ;
\foreach \x in {1,2,3,4}
\draw (\x,0) node[below]{$\x$} ;
\foreach \y in {0.1,0.2,...,1}
\draw (0,\y) -- ++(-\dx,0)
node[left]{$\pgfmathprintnumber[fixed,fixed zerofill,
precision=1,set decimal separator={,}]{\y}$} ;
\draw[thick,domain=0:5] plot[samples=50](\x,{\x*exp(-\x)}) ;
\draw[thick,domain=0:5,densely dotted]
plot[samples=50](\x,{-(\x+1)*exp(-\x)+exp(0)}) ;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}[yscale=0.138*0.7,xscale=1.6*0.7]
\def\xscale{1.6*0.7};
\def\yscale{0.138*0.7};
\def\d{0.1};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, orange] (-1,-20) grid[xstep=0.2,ystep=2] (7.2,70) ;
\draw[thick,->] (-1,0) -- (7.2+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-20) -- (0,70+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {-1,1,2,3,4,5,6,7}
\draw[thick] (\x,0) node[below=1pt]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {-20,-10,10,20,30,40,50,60}
\draw[thick] (0,\y) node[left=1pt]{$\y$} +(-\dx,0) -- +(\dx,0) ;
\draw[domain=0:7,thick,blue] plot[samples=30](\x,{\x^3-11*\x^2+23*\x+52}) ;
\draw (2,64) node{$\mathcal{C}_g$} ;
\draw (0,52) node{\color{blue}\bullet} ;
\draw (7,17) node{\color{blue}\bullet} ;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}[scale=1.5]
\def\xscale{1.5};
\def\yscale{1.5};
\def\d{0.08};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[thin, gray] (-2,-1) grid[step=0.25] (4,4) ;
\draw[thick,->] (-2,0) -- (4+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-1) -- (0,4+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {-2,-1,1,2,3,4}
\draw[thick] (\x,0) node[below=2pt]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {-1,1,2,3,4}
\draw[thick] (0,\y) node[left=1pt]{$\y$} +(-\dx,0) -- +(\dx,0) ;
\draw[domain=-2:4,thick] plot[samples=100](\x,{(\x+2)*exp(-\x)}) ;
\draw (3,0.25) node[above]{$\mathscr{C}$} ;
\draw[domain=-2:3,thick] plot(\x,{-\x+2}) ;
\draw (2.5,-0.5) node[above right]{$\mathscr{T}$} ;
\draw (0,2) node[above right]{$B$} node{\bullet} ;
\draw[thick,<->] (-1,2.718) node[below]{$A$}

```

```

node{$\bullet$} +(-0.5,0) -- +(0.5,0);
\end{tikzpicture}
\end{center}

\begin{center} % Situation où LaTeX ne peut pas faire les calculs
% nécessite \usepackage{pgfplots}
% \shorthandoff{; !?} % nécessaire avec babel et pdflatex
\begin{tikzpicture}[declare function={f(\x)=433/2138400*(\x)^6
+1231/2138400*(\x)^5 +6301/2138400*(\x)^4 -1867/26400*(\x)^3
-47741/118800*(\x)^2 +\x +3;
fp(\x)=433/356400*\x^5 +1231/427680*\x^4 +6301/534600*\x^3
-1867/8800*x^2 -47741/59400*x+1;},scale=1.15]
\begin{axis}[
    width=12cm,
    height=9cm,
    axis lines=middle,
    xlabel=$x$,
    xlabel style={below left},
    ylabel=$y$,
    xmin=-6,xmax=6,
    ymin=-5,ymax=4,
    grid=major,
    grid style={very thin, gray},
    xtick={-6,...,6},
    ytick={-5,...,4},
    xticklabels={,,,...,1},
    yticklabels={,,,...,1},
]
\addplot [ultra thick,red,domain=-6:6,samples=100] {f(x)};
\addplot [ultra thick,blue!60!black,domain=-6:6,samples=100] {fp(x)};
\node[red] at (3.5,1.5) {$C_1$} ;
\node[blue!60!black] at (-4.5,-3.5) {$C_2$} ;
\node[below left] at (0,0) {$O$} ;
\end{axis}
\end{tikzpicture}
% \shorthandoff{; !?}
\end{center}

\begin{center}
\begin{tabular}{cc}
\begin{tikzpicture}[xscale=0.09,yscale=20]
\def\xscale{0.1};
\def\yscale{20};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[thick,->] (0,0) -- (78,0) node[right]{$x$} ;
\draw[thick,->] (0,0) -- (0,0.1) node[left]{$y$} ;
\foreach \x in {0,10,...,70}
\draw (\x,0) node[below]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\def\s{5}
\foreach \m/\c in {20/blue,40/green,60/red}
\draw[\c!50!black] [domain=0:75] plot[samples=100]
(\x,{(1/(sqrt(2*3.1415)*\s))*exp(-1/2*((\x-\m)/\s)^2)}) ;
\draw[\c!50!black,dashed] (\m,0) -- ++(0,{1/(sqrt(2*3.1415)*\s)}) node[above]{$\mu=\m$} ;
\end{tikzpicture}
&
\begin{tikzpicture}[xscale=0.09,yscale=12]
\def\xscale{0.09};
\def\yscale{12};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};

```

```

\draw[thick,->] (0,0) -- (78,0) node[right]{$x$} ;
\draw[thick,->] (0,0) -- (0,0.15) node[left]{$y$} ;
\foreach \x in {0,10,...,70}
  \draw (\x,0) node[below]{$x$} +(0,-\dy) -- +(0,\dy) ;
\def\m{40}
\foreach \s/\c in {3/blue,5/green,10/red}
  {\draw[\c!50!black] [domain=0:75] plot[samples=100]
   (\x,{(1/(sqrt(2*3.1415)*\s)*exp(-1/2*((\x-\m)/\s)^2)}) ;
  \draw[\c!50!black] (\m,0) ++(\s,{1/(sqrt(2*3.1415)*\s)}) node[right]{$\sigma=\s$} ;
  } ;
\draw[dashed] (\m,0) -- ++(0,{1/(sqrt(2*3.1415)*3)}) ;
\end{tikzpicture}
\end{tabular}
\end{center}

\subsection{Intégrale}

```

```

\begin{center}
\begin{tikzpicture}[scale=0.5]
\def\xscale{0.5};
\def\yscale{0.5};
\def\d{0.1};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (-1,-1) grid (10,6) ;
\draw[thick,->] (-1,0) -- (10+2*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-1) -- (0,6+2*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x/\n in {1/$a$,4/$c$,8/$b$}
  \draw (\x,0) node[below right]{$\n$} +(0,\dy) -- +(0,-\dy) ;
\draw[very thick] plot[smooth] coordinates
  {(1,4) (2.2,4.7) (4,5) (7,4) (8,3)} ;
\draw (5.2,5.1) node{$C_f$} ;
\begin{scope}
\clip (1,0) rectangle (4,6) ;
\fill[bottom color=red,top color=red!30!white, opacity=0.5]
  (1,0) -- plot[smooth] coordinates
  {(1,4) (2.2,4.7) (4,5) (7,4) (8,3)} -- (8,0) -- cycle ;
\end{scope}
\begin{scope}
\clip (4,0) rectangle (8,6) ;
\fill[bottom color=blue,top color=blue!30!white, opacity=0.5]
  (4,0) -- plot[smooth] coordinates
  {(1,4) (2.2,4.7) (4,5) (7,4) (8,3)} -- (8,0) -- cycle ;
\end{scope}
\end{tikzpicture}
\end{center}

```

```

\begin{center}
\begin{tikzpicture}[scale=0.7]
\def\xscale{0.7};
\def\yscale{0.7};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (0,-3) grid (12,3) ;
\draw[thick,->] (0,0) -- (12+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-3) -- (0,3+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {1,5,8}
  \draw (\x,0) node[below]{$x$} ;
\draw (0,1) node[left]{$1$} ;
\draw [domain={exp(-3)}:12] plot[samples=100] (\x,{ln(\x)}) ;
\draw (9,2.6) node{$y=\ln(x)$} ;

```

```

\fill[bottom color=orange,top color=red, opacity=0.5]
(1,0) -- plot [domain=1:4] ({\x},{ln(\x)}) -- (4,0) --cycle ;
\fill [color=blue,opacity=0.5]
(5,0) -- (5,2.4849) -- plot [domain=5:8] ({\x},{ln(\x)}) -- (8,0) -- cycle ;
\draw [fill=blue,opacity=0.5] (7.1,-1.5) rectangle (7.5,-1.1) ;
\draw (7.4,-1.3) node[right]{\int_5^8\ln(t)\,dt} ;
\draw[<->,color=red,>=stealth'] (1,0) +(-1,-1*1) -- +(1,1*1) ;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}[xscale=0.8,yscale=0.4]
\def\xscale{0.8};
\def\yscale{0.4};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thick,->,>=latex] (0,0) -- (12,0) node[below left]{$x$} ;
\draw[thick,->] (0,-2) -- (0,9) node[below left]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\draw[ultra thick,green!60!black,fill=green!60!black!30!white]
(1,0) -- (1,6) -- (3,4) -- (3,0) -- cycle ;
\draw[ultra thick,red!60!black,fill=red!60!black!30!white]
(4,0) -- (4,2) -- (5,6) -- (7,7) -- (7,0) -- cycle ;
\draw[ultra thick,blue!60!black,fill=blue!60!black!30!white]
(8,0) -- (8,2) to [controls+=(80:1) and +(180:1)] (10,8)
to[out control+=(0:1),in=100] (11,6) -- (11,0) -- cycle ;
\draw[very thin, gray] (-0.4,-1.9) grid (11.9,8.9) ;
\foreach \x in {1,...,11}
\draw[thick] (\x,0) +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {1,...,8}
\draw[thick] (0,\y) +(-\dx,0) -- +(\dx,0) ;
\draw (1,0) node[below]{$1$} ;
\draw (0,2) node[left]{$2$} ;
\draw[green!60!black] (2,1.5) node[draw,circle,fill=white]{$1$} ;
\draw[red!60!black] (5.5,1.5) node[draw,circle,fill=white]{$2$} ;
\draw[blue!60!black] (9.5,1.5) node[draw,circle,fill=white]{$3$} ;
\end{tikzpicture}
\end{center}

\pgfdeclarepattern{ % nécessite patterns.meta
name=hache,
parameters={\hachesize,\hacheangle,\hachelinewidth},
bottom left={\pgfpoint{0pt}{0pt}},
top right={\pgfpoint{\hachesize}{\hachesize}},
tile size={\pgfpoint{\hachesize}{\hachesize}},
tile transformation={\pgftransformrotate{\hacheangle}},
code={
\pgfsetlinewidth{\hachelinewidth}
\pgfpathmoveto{\pgfpoint{0}{0}}
\pgfpathlineto{\pgfpoint{\hachesize}{0}}
\pgfusepath{stroke}
}
}
\tikzset{
hache size/.store in=\hachesize,
hache angle/.store in=\hacheangle,
hache line width/.store in=\hachelinewidth,
hache size=5pt,
hache angle=0pt,
hache line width=.5pt,
}

\begin{center}
\begin{tikzpicture}[scale=3] % nécessite patterns.meta (et code ci-dessus)

```

```

\draw[very thick,->,>=latex] (0,0) node[above left=-2pt]{$0$} -- (1.25,0) ;
\draw[very thick,->,>=latex] (0,0) -- (0,1.25) ;
\draw[thick] (1,0) node[above left]{$1$} |- (0,1) node[left]{$1$} ;
\draw[ultra thick,red] plot [domain=0:1.25,samples=100] (\x,{sqrt(\x)}) ;
\draw[ultra thick,blue] plot [domain=0:sqrt(1.25)] (\x,{(\x)^2}) ;
\fill[pattern=hache,pattern color=green!60!black,hache size=6pt,
      hache line width=2pt,hache angle=-45]
plot [domain=0:1,samples=100] (\x,{sqrt(\x)})
plot [domain=[sqrt(1)]:0] (\x,{(\x)^2}) ;
\draw[red] (0.3,0.8) node {$y=\sqrt{x}$} ;
\draw[blue] (0.8,0.3) node{$y=x^2$} ;
\end{tikzpicture}
\end{center}

```

\subsection{Courbe passant par des points}

```

\begin{center}
\begin{tikzpicture}
\def\xscale{1};
\def\yscale{1};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (0,-2) grid (16,8) ;
\draw[thick,->] (0,0) -- (16+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-2) -- (0,8+2*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {1,2,3,4,5,6,7,10,15}
\draw[thick] (\x,0) node[below right=-2pt]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {-2,-1,1,4,5,6,7} \draw[thick]
(0,\y) node[left]{$\y$} +(-\dy,0) -- +(\dy,0) ;
\foreach \x/\y in {1/-2,2/0,3/1,4/5,5/7,6/6,7/3,10/-1,15/4}
\draw (\x,\y) node{{\large $\mathbf{\times}$}} ;
\draw[very thick] plot[smooth] coordinates
{(1,-2) (2,0) (3,1) (4,5) (5,7) (6,6) (7,3) (10,-1) (15,4)} ;
\end{tikzpicture}
\end{center}

```

```

\begin{center}
\begin{tikzpicture}
\def\xscale{1};
\def\yscale{1};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (0,-2) grid (16,8) ;
\draw[thick,->] (0,0) -- (16+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-2) -- (0,8+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {1,2,3,4,5,6,7,10,15}
\draw[thick] (\x,0) node[below right=-2pt]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {-2,-1,1,4,5,6,7}
\draw[thick] (0,\y) node[left]{$\y$} +(-\dx,0) -- +(\dx,0) ;
\foreach \x/\y in {1/-2,2/0,3/1,4/5,5/7,6/6,7/3,10/-1,15/4}
\draw (\x,\y) node{{\large $\mathbf{\times}$}} ;
\draw[very thick] (1,-2) to[out=85,in=40-180] (2,0)
to[out=40,in=50-180] (3,1) to[out=50,in=80-180] (4,5)
to[out=80,in=0-180] (5,7) to[out=0,in=-80+180] (6,6)
to[out=-80,in=-60+180] (7,3) to[out=-60,in=0+180] (10,-1)
to[out=0,in=80-180] (15,4) ;
\end{tikzpicture}
\end{center}

```

```

\begin{center}
\begin{tikzpicture} % nécessite arrows.meta

```

```

\def\xscale{1};
\def\yscale{1};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (-6,-2) grid (6,4) ;
\draw[thick,->] (-6,0) -- (6,0) node[below left]{$x$} ;
\draw[thick,->] (0,-2) -- (0,4) node[below right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {-5,-4,...,5}
\draw[thick] (\x,0) +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {-1,0,...,3}
\draw[thick] (0,\y) +(-\dx,0) -- +(\dx,0) ;
\draw (1,0) node[below]{$1$} ;
\draw (0,1) node[left]{$1$} ;
\draw[Bracket[]]-[Bracket[],very thick] (-5,3.2)
to[out=-80,in=-180] (-3.4,1) to[out=0,in=-120] (-2,2) ;
\draw[Bracket[reversed,length=0.07cm]]-[Bracket[reversed,length=0.07cm]],
shorten <=-0.07cm,shorten >=-0.07cm,very thick]
(-2,0.5) to[out=0,in=-180] (1,2.2) to[out=0,in=-180] (3,0.8) ;
\draw[Bracket[]]-[Bracket[],very thick] (3,-1) to[out=10,in=-170] (5,1.8) ;
\end{tikzpicture}
\end{center}


```

\subsection{Résolution graphique}

```

\begin{center} % Nécessite decorations.markings
\begin{tikzpicture}[yscale=0.75,xscale=1.5,decoration={
markings,% switch on markings
mark=between positions 0.1 and 1 step 7mm with {\arrow{latex}}}]
\def\xscale{1.5};
\def\yscale{0.75};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (-3,-1) grid (3,9) ;
\draw[thick,->] (-3,0) -- (3+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-1) -- (0,9+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\foreach \x in {-1,1,2}
\draw (\x,0) node[below]{$\x$} ;
\draw (0,1) node[below left]{$1$} ;
\draw [domain=-3:3] plot(\x,{\x*\x}) ;
\draw[-latex,dashed,thick,red,postaction={decorate}]
(2,0) |- (0,4) node[left]{$f(2)=4$} ;
\draw[-latex,dashed,thick,blue,postaction={decorate}]
(0,1) -| (1,0) ;
\draw[-latex,dashed,thick,blue,postaction={decorate}]
(0,1) -| (-1,0) ;
\draw (2.5,7.2) node{$\mathcal{C}_f$} ;
\draw (0,-1.5) node{$2$ a pour image $4$ par $f$ : $f(2)=4$.} ;
\draw (0,-2.2)
node{$1$ a pour antécédents $-1$ et $-1$ par $f$ : $f(-1)=f(1)=1$.} ;
\end{tikzpicture}
\end{center}


```

```

\begin{center}
\begin{tikzpicture}[yscale=0.75,xscale=1.5]
\def\xscale{1.5};
\def\yscale{0.75};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, gray] (-3,-1) grid (3,9) ;
\draw[thick,->] (-3,0) -- (3+4*\dx,0) node[above right]{$x$} ;


```

```

\draw[thick,->] (0,-1) -- (0,9+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left]{$0$} ;
\draw (1,0) node[below right=-1pt]{$1$} ;
\draw (0,1) node[below left]{$1$} ;
\draw (-1,0) node[below]{$-1$} ;
\draw (-1.732,0) node[below]{$-\sqrt{3}$} ;
\draw (1.732,0) node[below]{$\sqrt{3}$} ;
\draw (0,3) node[above left]{$3$} ;
\draw [domain=-3:3] plot(\x,{\x*\x}) ;
\draw[color=green,very thick] (0,1) -- (0,3) ;
\draw[domain=-sqrt(3):-1,color=blue,very thick] plot(\x,{\x*\x}) ;
\draw[domain=1:sqrt(3),color=blue,very thick] plot(\x,{\x*\x}) ;
\draw[color=blue,very thick] (-1.732,0) -- (-1,0) (1,0) -- (1.732,0) ;
\draw[dashed,thick] (-1.732,0) |- (0,3) -| (1.732,0) ;
\draw[dashed,thick] (-1,0) |- (0,1) -| (1,0) ;
\draw (2,6.4) node{$y=x^2$} ;
\node (I) at (-1.2,7.5) {$1 \leq x^2 \leq 3$} ;
\draw[->,shorten >=5pt] (I) to[out=-90] (0,2) ;
\draw (0,-1.5) node{$\mathcal{S} = [-\sqrt{3}; -1] \cup [1; \sqrt{3}]$} ;
\end{tikzpicture}
\end{center}


```

Nuage de points, ajustement

```

\begin{center}
\begin{tikzpicture}[yscale=0.4]
\def\xscale{1};
\def\yscale{0.4};
\def\d{0.07};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, orange] (0,99) grid[xstep=0.5,ystep=1] (9,122) ;
\draw[thick,->] (0.5,99) -- (9,99) node[above right]{$x$} ;
\draw[thick,->] (0.5,99) -- (0.5,122) node[right]{$y$} ;
\foreach \x in {0.5,2.0,...,8.0}
    \draw (\x,99) node[below]{$\x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {99,101,...,121}
    \draw (0.5,\y) node[left]{$\y$} +(-\dx,0) -- +(\dx,0) ;
\foreach \x/\y in {1/100,2/101.5,3/102.8,4/104,5/107.1,6/109.4,7/113.5}
    \draw[thick] (\x,\y) +(-\dx,-\dy) -- +(\dx,\dy) +(-\dx,\dy) -- +(\dx,-\dy) ;
\begin{scope}
\clip (0.5,99) rectangle (9,122) ;
\draw[color=blue,thick,domain=0.5:8.5] plot(\x,{0.3*\x*\x+0.1*\x+99.9}) ;
\draw[color=blue] (7,118) node[below right]{$\mathcal{C}$} ;
\draw[thick,domain=0.5:9] plot(\x,{2.2*\x+96.8}) ;
\draw (8.5,114.5) node{$\mathcal{D}$} ;
\end{scope}
\draw[dashed, thick] (8,99) |- (0.3,2.2*8+96.8)
    node[below left=-4pt]{$114.4$} ;
\draw[dashed, thick] (8,114.4) |- (0.5,119.9)
    node[left]{$120$} ;
\end{tikzpicture}
\end{center}


```

```

\begin{center}
\begin{tikzpicture}[yscale=0.4,xscale=1.3]
\def\xscale{1.3};
\def\yscale{0.4};
\def\d{0.1};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\def\aa{1.7} ;
\def\bb{0.4} ;
\draw[->] (-0.5,0) -- (6,0) node[above]{$x$} ;
\draw[->] (0,-0.5) -- (0,11) node[left]{$y$} ;

```

```

\foreach \i/\x/\y in {1/1/3,2/2/3,3/4/6,4/5/10}
{\draw (\x,\y) coordinate (M\i) node[above right=-3pt]{$M_i$}
 +(-\dx,-\dy) -- +(\dx,\dy) +(-\dx,\dy) -- +(\dx,-\dy) ;
\draw[red] (M\i) -- (\x,\a*\x+\b) ;
};
\draw (0,\b) -- ++(6,6*\a) ;
\draw[blue] (3,5.5) node[\textbullet] node[above]{$G$} ;
\draw (3,-1) node{La droite passe par $G$}
 et réduit la somme des carrés des longueurs rouges} ;
\end{tikzpicture}
\end{center}

\subsection{Programmation linéaire ; Régionnement de plan}

\begin{center}
\begin{tikzpicture}[scale=(1/5)/2]
\def\xscale{0.1};
\def\yscale{0.1};
\def\d{0.09};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\draw[very thin, orange] (-5,-15) grid[step=5] (85,50) ;
\draw[thick,->] (-5,0) -- (85+4*\dx,0) node[above right]{$x$} ;
\draw[thick,->] (0,-15) -- (0,50+4*\dy) node[right]{$y$} ;
\draw (0,0) node[below left=-2pt]{$0$} ;
\foreach \x in {5,10,...,80}
 \draw (\x,0) node[below]{$x$} +(0,-\dy) -- +(0,\dy) ;
\foreach \y in {5,10,...,45}
 \draw (0,\y) node[left]{$y$} +(-\dx,0) -- +(\dx,0) ;
\foreach \y in {-5,-10} \draw (0,\y) node[left]{$y$} node{$-$};
\clip (-5,-15) rectangle (85,50) ;
\draw[domain=0:85,color=blue,thick] plot(\x,{-1/2*\x+30}) ;
\draw (70,-10) node{$D_1$} ;
\draw[domain=10:35,color=red,thick] plot(\x,{-3*\x+90}) ;
\draw (20,45) node{$D_2$} ;
\draw[domain=0:85,color=black,thick] plot(\x,{21}) ;
\draw (80,25) node{$D_3$} ;
\fill[color=gray,opacity=0.2]
 (-5,-15) -- (85,-15) -- (85,0) -- (-5,0) -- cycle ;
\fill[color=gray,opacity=0.2]
 (-5,0) -- (-5,50) -- (0,50) -- (0,0) --cycle ;
\fill[color=gray,opacity=0.2]
 (0,21) -- plot[domain=0:18] (\x,{21})
 -- plot[domain=18:24] (\x,{-1/2*\x+30})
 -- plot[domain=24:30] (\x,{-3*\x+90})
 -- (85,0) -- (85,50) -- (0,50) -- cycle ;
\end{tikzpicture}
\end{center}

\section{Figures de géométrie}

\subsection{Dans le plan}

\subsubsection{Losange et carré}

\begin{center}
\begin{tikzpicture}[scale=0.5,rotate=30] % nécessite calc et intersections
\coordinate (A) at (0,0) ;
\coordinate (B) at (5,2) ;
\coordinate (D) at (5,-2) ;
\coordinate (C) at ($(D)+(B)-(A)$) ;
\coordinate (AvB) at ($(A)+0.25*(B)-0.25*(A)$) ;
\coordinate (AvD) at ($(A)+0.25*(D)-0.25*(A)$) ;
\draw[double distance = 2pt] (AvB) to [bend left] (AvD) ;
\coordinate (BvC) at ($(B)+0.2*(C)-0.2*(B)$) ;

```

```

\coordinate (BvA) at  $(\textcolor{blue}{B})+0.2*(\textcolor{red}{A})-0.2*(\textcolor{blue}{B})$  ;
\draw (BvC) to [bend left] (BvA) ;
\coordinate (CvD) at  $(\textcolor{blue}{C})+0.25*(\textcolor{red}{D})-0.25*(\textcolor{blue}{C})$  ;
\coordinate (CvB) at  $(\textcolor{blue}{C})+0.25*(\textcolor{blue}{B})-0.25*(\textcolor{blue}{C})$  ;
\draw[double distance = 2pt] (CvD) to [bend left] (CvB) ;
\coordinate (DvA) at  $(\textcolor{red}{D})+0.2*(\textcolor{red}{A})-0.2*(\textcolor{red}{D})$  ;
\coordinate (DvC) at  $(\textcolor{red}{D})+0.2*(\textcolor{blue}{C})-0.2*(\textcolor{red}{D})$  ;
\draw (DvA) to [bend left] (DvC) ;
\draw[dashed,shorten >=-1em, shorten <=-1em] (A) -- (C) ;
\draw[dashed,shorten >=-1em, shorten <=-1em] (B) -- (D) ;
\draw[ultra thick] (A) -- (B) node[pos=0.5]{\textcolor{red}{\circ}}
-- (C) node[pos=0.5]{\textcolor{blue}{\circ}} -- (D) node[pos=0.5]{\textcolor{red}{\circ}}
-- cycle node[pos=0.5]{\textcolor{blue}{\circ}} ;
\draw[name path=AC] (A) -- (C) node[pos=0.25]{/} node[pos=0.75]{/} ;
\draw[name path=BD] (B) -- (D) node[pos=0.25]{/\kern-0.3em/}
node[pos=0.75]{/\kern-0.3em/} ;
\draw[name intersections={of=AC and BD,by={O}}] (O) node[above,xshift=0.3em]{\$O\$} ;
\draw  $(\textcolor{red}{O})+(0.4,0)$  |-  $(\textcolor{red}{O})+(0,-0.4)$  ;
\end{tikzpicture}
\hspace{2cm}

\begin{tikzpicture}[scale=0.5,rotate=20] % nécessite calc et intersections
\coordinate (A) at (0,0) ;
\coordinate (B) at (5,0) ;
\coordinate (D) at (0,5) ;
\coordinate (C) at  $(\textcolor{red}{D})+(\textcolor{blue}{B})-(\textcolor{red}{A})$  ;
\coordinate (T) at (5.5,5.5) ;
\draw (T) ;
\draw  $(\textcolor{red}{A})+(0.5,0)$  |-  $(\textcolor{red}{A})+(0,0.5)$  ;
\draw  $(\textcolor{red}{B})+(-0.5,0)$  |-  $(\textcolor{blue}{B})+(0,0.5)$  ;
\draw  $(\textcolor{blue}{C})+(-0.5,0)$  |-  $(\textcolor{blue}{C})+(0,-0.5)$  ;
\draw  $(\textcolor{red}{D})+(0.5,0)$  |-  $(\textcolor{red}{D})+(0,-0.5)$  ;
\coordinate (MAB) at  $(0.5*(\textcolor{red}{A})+0.5*(\textcolor{blue}{B}))$  ;
\coordinate (MAD) at  $(0.5*(\textcolor{red}{A})+0.5*(\textcolor{red}{D}))$  ;
\coordinate (MBC) at  $(0.5*(\textcolor{blue}{B})+0.5*(\textcolor{blue}{C}))$  ;
\coordinate (MCD) at  $(0.5*(\textcolor{blue}{C})+0.5*(\textcolor{red}{D}))$  ;
\draw[dashed,shorten >=-1em, shorten <=-1em] (A) -- (C) ;
\draw[dashed,shorten >=-1em, shorten <=-1em] (B) -- (D) ;
\draw[dashed,shorten >=-1em, shorten <=-1em] (MAB) -- (MCD) ;
\draw[dashed,shorten >=-1em, shorten <=-1em] (MAD) -- (MBC) ;
\draw[ultra thick] (A) -- (B) node[pos=0.5]{\textcolor{red}{\circ}} -- (C) node[pos=0.5]{\textcolor{blue}{\circ}}
-- (D) node[pos=0.5]{\textcolor{red}{\circ}} -- cycle node[pos=0.5]{\textcolor{blue}{\circ}} ;
\draw[name path=AC] (A) -- (C) node[pos=0.25,rotate=70]{/\kern-0.3em/}
node[pos=0.75,rotate=70]{/\kern-0.3em/} ;
\draw[name path=BD] (B) -- (D) node[pos=0.25]{/\kern-0.3em/}
node[pos=0.75]{/\kern-0.3em/} ;
\draw[name intersections={of=AC and BD,by={O}}]
(O) node[above,xshift=0.1em,yshift=0.4em]{\$O\$} ;
\draw  $(\textcolor{red}{O})+(-0.5/\sqrt{2}),{-0.5/\sqrt{2}}$  --  $(\textcolor{red}{O})+(0,{\frac{-1}{\sqrt{2}}})$ 
--  $(\textcolor{red}{O})+({\frac{0.5}{\sqrt{2}}},{\frac{-0.5}{\sqrt{2}}})$  ;
\end{tikzpicture}
\end{center}

\subsubsection{Triangle et translation}

\begin{center}
\begin{tikzpicture}
\begin{scope}
\draw (0,0) node[left]{\$A\$}
-- ++(20:2) node[midway]{\$/\$} node[above left]{\$B\$}
-- ++(75:2.4) node[midway]{\$*\$} node[above]{\$C\$}
-- (0,0) node[midway]{\textcolor{red}{\circ}} ;
\draw [thick,->] (0,0) -- (3,0.2)
node[midway,below]{\textcolor{blue}{\overrightarrow{u}}} ;
\end{scope}
\begin{scope}[xshift=3cm,yshift=0.2cm]


```

```

\draw (0,0) node[above left]{$A$} -- ++(20:2)
node[midway]{$/\$} node[right]{$B$}
-- +(75:2.4) node[midway]{$\times$} node[above]{$C$} -- (0,0)
node[midway]{$\circ$} ;
\end{scope}
\end{tikzpicture}
\end{center}

\subsubsection{Vecteurs et projection}

\begin{center}%
\begin{tikzpicture} % Nécessite calc
\coordinate (A) at (0,0) ;
\coordinate (B) at (3,1) ;
\coordinate (C) at (1,1) ;
\coordinate (D) at (4,3) ;
\foreach \n in {A,B,C,D}
\draw (\n) node[above left]{$\n$} ;
\draw[-,>=latex] (A) -- (B) ;
\draw[-,>=latex] (C) -- (D) ;
\def\d{0.2/veclen(3-0,1-0)} ;
\draw[dashed] (C) -- ($ (A)! (C) ! (B) $) node[below]{$H$} ;
\draw ($ (A)! (C) ! (B) $)
++({3*\d},{\d}) -- ++({-\d},{3*\d}) -- ++({-3*\d},{-\d}) ;
\draw[dashed] (D) -- ($ (A)! (D) ! (B) $) node[below]{$K$} -- (B) ;
\draw ($ (A)! (D) ! (B) $)
++({-3*\d},{-\d}) -- ++({-\d},{3*\d}) -- ++({3*\d},{\d}) ;
\end{tikzpicture}
\end{center}%
\subsubsection{Avec un peu de trigonométrie}

\begin{center}
\begin{tikzpicture}[scale=0.25*29.7/21]
\draw (0,0) node[below left]{$A$} -- +(0:12) node[below right]{$B$}
-- +(180-60:12) node (C) {} node[above]{$C$} -- cycle ;
\draw[<-,>=latex] (0,-1.5) -- +(12,0) node[midway,below]{$12$ cm} ;
\draw[dashed] (C) -- (6,0) node[below]{$I$} ;
\def\x{2.5} ;
\draw[very thick,<->] (0,0) -- +(\x,0) node[midway,above]{$x$} ;
\draw (\x,0) node[below]{$M$} -- (\x,{\x*tan(60)}) node[above left]{$P$}
-- +(2*(6-\x),0) node[above right]{$Q$}
-- +(0,{-\x*tan(60)}) node[below]{$N$} ;
\end{tikzpicture}
\end{center}

\subsubsection{Arc de cercle à partir d'un centre}

\begin{center}
\begin{tikzpicture}[scale=0.5]
\draw (0,0) node[left]{$C$} -- (10,-1) node[right]{$A$}
-- (8,4) node[above]{$B$} -- cycle ;
\draw (10,-1) -- (9,1.5) node[below left]{$N$} node[midway]{$/$} ;
\draw (8,4) node[midway]{$/$} ;
\draw[dashed] (0,0) -- (9,1.5) node[midway]{$||$}
-- (18,3) node[midway]{$||$} ;
\draw[dashed] (-2,5) node[below left=2pt]{$E$} -- (0,0) ;
\draw (18,3) node[above right]{$D$} ;
\draw ([shift=(5:{veclen(9,1.5)}])9,1.5) arc (5:15:{veclen(9,1.5)}) ;
% On se décale, à partir du centre, de la longueur du rayon et de l'angle initial
\draw ([shift=(170:{veclen(10,-1)})]8,4) arc (170:180:{veclen(10,-1)}) ;
\draw ([shift=(100:{veclen(-2,5)})]0,0) arc (100:120:{veclen(-2,5)}) ;
\end{tikzpicture}
\end{center}

```

```

\begin{center}
\begin{tikzpicture}[scale=0.5,rotate=10] % nécessite calc et intersections
\coordinate (A) at (0,0) ;
\coordinate (B) at (3,3) ;
\coordinate (D) at (7,0) ;
\coordinate (C) at ($(D)+(B)-(A)$) ;

\draw (A) node[below left]{$A$} -- (B) node[above left]{$B$}
-- (C) node[below right]{$C$} -- (D) node[below left]{$D$}
-- cycle ;

\draw[name path=arc1]
let \p1 = ($(A)-(C)$), \n1 = {veclen(\x1,\y1)} in
 ([shift=(180:{veclen(\x1,\y1)})]B)
 arc (180:220:{veclen(\x1,\y1)}) ;
\draw[name path=arc2]
let \p1 = ($(B)-(C)$), \n1 = {veclen(\x1,\y1)} in
 ([shift=(160:{veclen(\x1,\y1)})]A)
 arc (160:200:{veclen(\x1,\y1)}) ;
\draw[name intersections={of=arc1 and arc2,by={M}}]
(M) node[left]{$M$} ;
\draw[dashed] (C) -- (A) -- (M) -- (B) ;

\draw[name path=arc3]
let \p1 = ($(B)-(A)$), \n1 = {veclen(\x1,\y1)} in
 ([shift=(20:{veclen(\x1,\y1)})]C)
 arc (20:80:{veclen(\x1,\y1)}) ;
\draw[name path=arc4]
let \p1 = ($(C)-(A)$), \n1 = {veclen(\x1,\y1)} in
 ([shift=(0:{veclen(\x1,\y1)})]B)
 arc (0:40:{veclen(\x1,\y1)}) ;
\draw[name intersections={of=arc3 and arc4,by={N}}]
(N) node[above right]{$N$} ;
\draw[dashed] (B) -- (N) -- (C) ;

\draw[name path=arc5]
let \p1 = ($(D)-(B)$), \n1 = {veclen(\x1,\y1)} in
 ([shift=(-10:{veclen(\x1,\y1)})]D)
 arc (-10:-70:{veclen(\x1,\y1)}) ;
\draw[dashed] (B) -- (D)
-- ($(D)+(D)-(B)$) node[below right]{$P$} ;
\end{tikzpicture}
\end{center}

```

\subsubsection{Construction d'un pentagone régulier}

```

\begin{center}
\begin{tikzpicture}[scale=3.5] % nécessite intersections et calc
\draw[very thick,->,>=latex] (-1.2,0) -- (0,0) -- (1,0)
node[midway,below]{$\overrightarrow{u}$} -- (1.2,0) ;
\draw[very thick,->,>=latex] (0,-1.2) -- (0,0) -- (0,1)
node[midway,left]{$\overrightarrow{v}$} -- (0,1.2) ;
\draw (0,0) node[below left]{$O$} ;
\draw[name path=T] (0,0) circle(1) ;
\draw (-1,0) +(0,0.04) -- +(0,-0.04) node[below]{$-1$} ;
\draw (1,0) +(0,0.04) -- +(0,-0.04) node[below]{$1$} ;
\draw (0,-1) +(0.04,0) -- +(-0.04,0) node[left]{$-1$} ;
\draw (0,1) +(0.04,0) -- +(-0.04,0) node[left]{$1$} ;
\coordinate (B) at (-1,0) ;
\coordinate (J) at (0,0.5) ;
\draw[name path=BJ] (B) node[above left]{$B$} -- (J) node[right]{$J$} ;
\draw[name path=C] (J) circle(0.5) ;
\draw[name intersections={of=BJ and C,by={K}}] (K) node[right]{$K$} ;
\draw[dashed,name path=arc1]
let \p1 = $(B)-(K)$, \n1 = {veclen(\x1,\y1)} in

```

```

(B) ++(90:\n1) arc[start angle=90,end angle=-90,radius=\n1] ;
\draw[name intersections={of=T and arc1,by={A2,A3}}]
(A2) node[above left]\$A_2\$ (A3) node[below]\$A_3\$ ;
\draw[dashed,name path=arc2]
let \p1 = (\A2)-(\A3), \n1 = {veclen(\x1,\y1)} in
(A2) ++(20:\n1) arc[start angle=20,end angle=-95,radius=\n1] ;
\draw[name intersections={of=T and arc2,by={A1}}]
(A1) node[above right]\$A_1\$ ;
\draw[dashed,name path=arc3]
let \p1 = (\A2)-(\A3), \n1 = {veclen(\x1,\y1)} in
(A3) ++(95:\n1) arc[start angle=95,end angle=-20,radius=\n1] ;
\draw[name intersections={of=T and arc3,by={A4,A5}}]
(A4) node[below right]\$A_4\$ ;
\coordinate (A0) at (1,0) ;
\draw (A0) node[above right]\$A_0\$ ;
\draw[very thick,red] (A0) -- (A1) -- (A2) -- (A3) -- (A4) -- cycle ;
\end{tikzpicture}
\end{center}

\subsubsection{Figures récursives} % nécessite lindenmayersystems
```

```

\begin{center}
\pgfdeclarelindenmayersystem{Koch curve}{\rule{F -> F+F--F+F}}
\begin{tikzpicture}[scale=1.5]
\def\o{3};
\draw[l-system={Koch curve, step=150/3^\o pt, angle=60, axiom=F, order=\o}]
lindenmayer system;
\end{tikzpicture}
\qquad
\pgfdeclarelindenmayersystem{Sierpinski triangle}{%
\rule{F -> F+F+F+ff}\rule{f -> ff}}
\begin{tikzpicture}[scale=1.5]
\def\o{4};
\fill[blue,l-system={Sierpinski triangle, step=100/2^\o pt,
angle=120, axiom=F+F+F+f, order=\o}]
lindenmayer system ;
\end{tikzpicture}
\end{center}
```

```
\subsubsection{Papier millimétré et rotation}
```

```

\begin{center}%
\shorthandoff{:}\shorthandoff{!} % nécessaire avec babel
\begin{tikzpicture}[scale=1] % nécessite calc
\def\min{-7.5} ;
\def\max{15+\min} ;
\def\u{2}
\draw[thin,black!40] (\min,\min) grid[step=0.1] (\max,\max) ;
\draw[black!80] (\min,\min) grid[step=0.5] (\max,\max) ;
\draw[semithick] (\min,\min) grid (\max,\max) ;
\draw[thick] (\min,\min) grid[step=5] (\max,\max) ;
\draw[very thick,-,>=latex]
(\min,0) -- (\max,0) node[above left]\$x\$ ;
\draw[very thick,-,>=latex]
(0,0) -- (\u,0) node[midway,below]\$\overrightarrow{u}\$ ;
\draw[very thick,-,>=latex]
(0,\min) -- (0,\max) node[below left]\$y\$ ;
\draw[very thick,-,>=latex]
(0,0) -- (0,\u) node[midway,left]\$\overrightarrow{v}\$ ;

\draw (0,0) node[above right]\$0\$ ;
\draw (0,0) circle (2*\u) ;

\draw (30:2*\u) node[above right]\$A\$+
(-0.1,-0.1) -- +(0.1,0.1) ;
\draw (120:2*\u) node[above left]\$B\$
```

```

+(-0.1,0.1) -- +(0.1,-0.1) ;
\draw (-1*\u,-3*\u) node[below left]{$C$}
+(-0.1,-0.1) -- +(0.1,0.1) +(-0.1,0.1) -- +(0.1,-0.1) ;
\coordinate (d) at ($ (0,0) !1! 90:(-2,-6) $) ;
\draw (d) node[below left]{$D$}
+(-0.1,-0.1) -- +(0.1,0.1) +(-0.1,0.1) -- +(0.1,-0.1) ;
\draw (120:2*\u) ++(-3*\u,-3*\u) node[above left]{$E$}
+(-0.1,-0.1) -- +(0.1,0.1) +(-0.1,0.1) -- +(0.1,-0.1) ;

\draw[thick] (120:2*\u) ++(-1*\u,-3*\u) -- (0,0) ;
\draw[thick] (30:2*\u) -- (d) ;
\end{tikzpicture}
\end{center} %\shorthand{!}\shorthand{:}

\subsubsection{Polygones imbriqués}

\begin{center}
\begin{tikzpicture}[scale=2] % nécessite calc
\def\d{0.05}
\def\np{
\coordinate (vA) at (A1) ;
\foreach \k in {2,...,\s}
{\path let \n4={int(\k-1)},
      \p1 = {$(A\k)-(A\n4)$},
      \n1 = {veclen(\x1,\y1)},
      \n3={\dx em/\n1},
      \n2={1-\n3} in
      coordinate (A\n4) at ($\n2*(A\n4)+\n3*(A\k)$) ; } ;
\path let \p1 = {$(vA)-(A\s)$},
      \n1 = {veclen(\x1,\y1)},
      \n3={\dx em/\n1},
      \n2={1-\n3} in
      coordinate (A\s) at ($\n2*(A\s)+\n3*(vA)$) ;
}
\def\fig{
\foreach \k in {1,...,\s}
\coordinate (A\k) at ({360/\s*(\k-1)}:1) ;
\coordinate (0) at (0,0) ;
\foreach \k in {2,...,\s}
\draw let \n1={int(\k-1)} in (A\n1) -- (A\k)
(barycentric cs:A\k=1,0=-0.15) node{$A_{\k}$} ;
\draw (A\s) -- (A1)+(0:0.2) node{$A_1$} ;
\draw (0) node[left]{$0$} +(\d,\d) -- +(-\d,-\d) +(-\d,\d) -- +(\d,-\d) ;
\foreach \x in {1,...,\nf}
{\np
\foreach \k in {2,...,\s}
\draw let \n1={\k-1} in (A\k) -- (A\n1) ;
\draw (A1) -- (A\s) ;
} ;
}
\foreach \s/\nf/\dx/\sh in {5/10/0.25/0,6/12/0.25/3,8/15/0.25/6}
{\begin{scope}[xshift = \sh cm]
\fig
\end{scope}
} ;
\end{tikzpicture}
\end{center}

\subsubsection{Et avec des couleurs}

\begin{center}
\begin{tikzpicture}[scale=8.5] % nécessite calc
\def\s{10}
\def\nf{130}
\def\dx{0.075}

```

```

\definecolor{mc1}{rgb}{0.98,1,0.9}
\definecolor{mc2}{rgb}{0.9,1,0.98}
\definecolor{mc3}{rgb}{0.2,0.0,0.3}
\def\np{
\coordinate (vA) at (A1) ;
\foreach \k in {2,...,\s}
{\path let \n4={int(\k-1)}, \p1 = ($(\A\k)-(A\n4)$),
\n1 = {veclen(\x1,\y1)}, \n3={\dx em/\n1}, \n2={1-\n3} in
coordinate (A\n4) at (barycentric cs:A\n4=\n2,A\k=\n3) ; } ;
\path let \p1 = ($(\vA)-(A\s)$), \n1 = {veclen(\x1,\y1)},
\n3={\dx em/\n1}, \n2={1-\n3} in
coordinate (A\s) at ($\n2*(A\s)+\n3*(vA)$) ;
}
\foreach \k in {1,...,\s}
\coordinate (A\k) at ({360/\s*(\k-1)}:1) ;
\coordinate (0) at (0,0) ;
\foreach \x in {0,...,\nf}
{
% \pgfmathsetmacro\pc{int((- (\x/\nf-1)^2+1)*100)}
\pgfmathsetmacro\pc{int(\x/\nf*100)}
\foreach \k in {2,...,\s}
{\pgfmathsetmacro\pcd{int((4*((\k-1)/(\s-1)-1)*(\k-1)/(\s-1)+1)*(100-\pc))}
\pgfmathsetmacro\pct{int(100-\pc-\pcd)}
\draw[very thick,color={rgb:mc3,\pc;mc2,\pcd;mc1,\pct}] let \n1={\k-1} in (A\k) -- (A\n1) ;
}
\pgfmathsetmacro\pcd{int((100-\pc)}
\pgfmathsetmacro\pct{int(100-\pc-\pcd)}
\draw[very thick,color={rgb:mc3,\pc;mc2,\pcd;mc1,\pct}] (A1) -- (A\s) ;
\np
} ;
\end{tikzpicture}
\end{center}

```

\subsection{Dans l'espace}

\subsubsection{Cube avec section}

```

\begin{center}
\begin{tikzpicture} % nécessite intersections et calc
[scale=4, x={(1cm,0cm)}, y={(0.353cm,0.353cm)}, z={(0cm,1cm)}]
\def\xscale{7};
\def\yscale{7};
\def\d{0.1};
\def\dx{\d/\xscale};
\def\dy{\d/\yscale};
\def\croix{+(-\dx,0,\dy) -- +(\dx,0,-\dy) +(-\dx,0,-\dy) -- +(\dx,0,\dy)} ;

\coordinate (A) at (0,0,0) ; \coordinate (B) at (1,0,0) ;
\coordinate (C) at (1,1,0) ;
\coordinate (D) at (0,1,0) ; \coordinate (E) at (0,0,1) ;
\coordinate (F) at (1,0,1) ;
\coordinate (G) at (1,1,1) ; \coordinate (H) at (0,1,1) ;
\draw (E) -- (A) -- (B) -- (C) -- (G) -- (F) -- (E) -- (H) -- (G) ;
\draw (F) -- (B) ;
\draw [dashed] (A) -- (D) -- (C) ; \draw [dashed] (H) -- (D) ;
\draw (A) node[left]\$A\$; \draw (B) node[right]\$B\$;
\draw (C) node[right]\$C\$; \draw (D) node[above left]\$D\$;
\draw (E) node[left]\$E\$; \draw (F) node[below left]\$F\$;
\draw (G) node[right]\$G\$; \draw (H) node[left]\$H\$;

\def\xM{0.35} ;
\def\yM{0.5} ;
\def\x0{0.4} ;
\def\z0{0.8} ;

```

```

\def\yN{0.4} ;
\def\zN{0.55} ;

\coordinate (M) at (\xM,\yM,1) ;
\coordinate (N) at (1,\yN,\zN) ;
\coordinate (O) at (\xO,0,\zO) ;

\draw (M) node[above]{$M$} \croix ;
\draw (N) node[below right]{$N$} \croix ;
\draw (O) node[above right=-4pt]{$O$} \croix ;

\coordinate (O') at (\xO,0,1) ;
\draw[black!65] (\xO,0,0) -- +(0,0,1) node[below right=-4pt]{$O'$} ;
\coordinate (N') at (1,\yN,1) ;
\draw[black!65] (1,\yN,0) -- +(0,0,1) node[below right=-4pt]{$N'$} ;

\draw[name path=NO,black!65] (N) -- (barycentric cs:0=-2,N=1) ;
\draw[name path=N'0',black!65] (N') -- (barycentric cs:0'=-2,N'=1) ;
\draw[name intersections={of=NO and N'0',by={X}}] (X) node[below]{$X$} ;

\path[name path=EF] (E) -- (F) ;
\path[name path=HG] (H) -- (G) ;
\draw[name path=XM,black!65] (X) -- (barycentric cs:M=-2,X=1) ;
\draw[thick,name intersections={of=EF and XM,by={P}},name intersections={of=HG and XM,by={Q}}]
(P) node[above right]{$P$} -- (Q) node[above]{$Q$} ;

\path[name path=BF] (B) -- (F) ;
\path[name path=PO] (P) -- (barycentric cs:0=-1.4,P=1) ;
\draw[thick,name intersections={of=BF and PO,by={S}}]
(P) -- (S) node[right]{$S$} ;

\path[name path=CG] (C) -- (G) ;
\path[name path=PSparQ] (Q) -- +($0.5*(S)-0.5*(P)$) ;
\draw[thick,dashed,name intersections={of=CG and PSparQ,by={R}}]
(Q) -- (R) node[right]{$R$} ;
\draw[thick] (S) -- (R) ;

\fill [color=gray,opacity=0.2] (P) -- (Q) -- (R) -- (S) ;
\end{tikzpicture}
~

\begin{tikzpicture} % nécessite intersections et calc
[scale=4, x={(1cm,0cm)}, y={(0.353cm,0.353cm)}, z={(0cm,1cm)}]

\coordinate (A) at (0,0,0) ; \coordinate (B) at (1,0,0) ;
\coordinate (C) at (1,1,0) ;
\coordinate (D) at (0,1,0) ; \coordinate (E) at (0,0,1) ;
\coordinate (F) at (1,0,1) ;
\coordinate (G) at (1,1,1) ; \coordinate (H) at (0,1,1) ;
\draw (E) -- (A) -- (B) -- (C) -- (G) -- (F) -- (E) -- (H) -- (G) ;
\draw (F) -- (B) ;
\draw [dashed] (A) -- (D) -- (C) ; \draw [dashed] (H) -- (D) ;
\draw (A) node[left]{$A$} ; \draw (B) node[right]{$B$} ;
\draw (C) node[right]{$C$} ; \draw (D) node[above right]{$D$} ;
\draw (E) node[below left]{$E$} ; \draw (F) node[below left]{$F$} ;
\draw (G) node[right]{$G$} ; \draw (H) node[left]{$H$} ;

\coordinate (M) at (0,0,0.65) ;
\coordinate (N) at (0,0.4,1) ;
\coordinate (K) at (0.45,1,1) ;
\draw (M) node[left]{$M$} ; \draw (N) node[left]{$N$} ; \draw (K) node[above]{$K$} ;

\draw[thick] (K) -- (N) ; \draw[thick,dashed] (N) -- (M) ;

\path[name path=KN] (K) -- (barycentric cs:N=-2.2,K=1) ;

```

```

\path[name path=EF] (F) -- (barycentric cs:E=-3.2,F=1) ;
\path[name path=XM, name intersections={of=KN and EF,by={X}}]
(X) -- (barycentric cs:M=-3,X=2) ;
\path[name path=AB] (A) -- (B) ;
\draw[thick,name intersections={of=XM and AB,by={L}}] (M) -- (L) ;
\path[name path=NKparL] (L) -- +($1.2*(K)-1.2*(N)$) ;
\path[name path=BC] (B) -- (C) ;
\draw[thick,dashed,name intersections={of=BC and NKparL,by={I}}] (L) -- (I) ;
\path[name path=MLparK] (K) -- +($2*(L)-2*(M)$) ;
\path[name path=CG] (C) -- (G) ;
\draw[thick,name intersections={of=CG and MLparK,by={J}}] (I) -- (J) ;
\draw[thick,dashed] (J) -- (K) ;

\fill [color=gray,opacity=0.2] (K) -- (N) -- (M) -- (L) -- (I) -- (J) -- cycle ;
\end{tikzpicture}
\end{center}

\section{Graphes}

\subsection{Graphe simple}


```

```

\begin{center}
\begin{tikzpicture} % Nécessite positioning
\node[draw,circle] (A) {A} ;
\node[draw,circle] (B) [right=4cm of A] {B} ;
\node[draw,circle] (C) [below right=2.5cm of A] {C} ;
\node[draw,circle] (D) [below=1cm of C] {D} ;
\node[draw,circle] (E) [below right=1cm of D] {E} ;
\draw (A) to[bend left] (B) ;
\draw (A) to[bend right] (C) ;
\draw (A) |- (E) ;
\draw (B) to[bend left] (C) ;
\draw (B) to[bend left] (D) ;
\draw (C) -- (D) ;
\draw (D) -| (E) ;
\end{tikzpicture}
\end{center}


```

```

\begin{center}
\begin{tikzpicture}[every node/.style={circle,draw,inner sep=2pt}]
\node (Z) at (0.5,0.5) {Z} ;
\node (B) at (1,3) {B} ;
\node (T) at (3.2,0) {T} ;
\node (R) at (3,3.5) {R} ;
\node (C) at (5.5,3.3) {C} ;
\node (P) at (7,0.25) {P} ;
\node (L) at (9,3.8) {L} ;
\node (V) at (9.1,2.5) {V} ;
\node (M) at (9.5,0.8) {M} ;
\draw (Z) -- (B) -- (R) -- (C) -- (L) -- (V)
-- (M) -- (P) -- (T) -- (Z) ;
\draw (B) -- (T) -- (R) ;
\draw (C) -- (P) -- (V) ;
\end{tikzpicture}
\end{center}


```

```

\subsection{Graphe étiqueté}


```

```

\begin{center}
\begin{tikzpicture}[xscale=2.5,yscale=2]
\node[draw,circle] (A) at (0,2) {A} ;
\node[draw,circle] (B) at (1,4) {B} ;
\node[draw,circle] (C) at (1,2) {C} ;
\node[draw,circle] (D) at (2,0) {D} ;
\node[draw,circle] (E) at (2,3) {E} ;

```

```

\node[draw,circle] (F) at (3,4) {F} ;
\node[draw,circle] (G) at (2.4,1) {G} ;
\node[draw,circle] (H) at (4,1) {H} ;
\draw (A) -- (B) node[midway,fill=white]{$3$} ;
\draw (A) -- (C) node[midway,fill=white]{$7$} ;
\draw (A) -- (D) node[midway,fill=white]{$11$} ;
\draw (B) -- (C) node[midway,fill=white]{$3$} ;
\draw (B) -- (D) node[midway,fill=white]{$7$} ;
\draw (B) -- (E) node[midway,fill=white]{$11$} ;
\draw (C) -- (D) node[midway,fill=white]{$4$} ;
\draw (C) -- (E) node[near end,fill=white]{$3$} ;
\draw (D) -- (E) node[midway,fill=white]{$9$} ;
\draw (D) -- (G) node[midway,fill=white]{$2$} ;
\draw (E) -- (F) node[midway,fill=white]{$8$} ;
\draw (E) -- (G) node[midway,fill=white]{$10$} ;
\draw (F) -- (G) node[midway,fill=white]{$4$} ;
\draw (F) -- (H) node[midway,fill=white]{$7$} ;
\draw (G) -- (H) node[midway,fill=white]{$12$} ;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}[scale=1,
    s/.style={draw,circle},
    p/.style={fill=white,inner sep=2pt}]
\node[s] (B) at (6.5,10.4) {B} ;
\node[s] (A) at (5.8,13.4) {A} ;
\node[s] (O) at (3.3,10.7) {O} ;
\node[s] (C) at (4.8,7.7) {C} ;
\node[s] (E) at (8.4,7.7) {E} ;
\node[s] (D) at (9.3,11.6) {D} ;
\node[s] (F) at (14.3,14.1) {F} ;
\path (F) [bend right=10] edge node[p]{$6$} (D) ;
\path (D) [bend right=20] edge node[p]{$7$} (A) ;
\path (A) [bend right] edge node[p]{$2$} (O) ;
\path (O) [bend right] edge node[p]{$4$} (C) ;
\path (C) [bend right=20] edge node[p]{$4$} (E) ;
\path (E) [bend left=10] edge node[p]{$1$} (D) ;
\path (D) [bend right=10] edge node[p]{$5$} (B) ;
\path (B) [bend right=10] edge node[p]{$2$} (A) ;
\path (O) [bend left=10] edge node[p]{$5$} (B) ;
\path (B) [bend right=10] edge node[p]{$1$} (C) ;
\path (E) [bend right=10] edge node[p]{$3$} (B) ;
\path (E) [bend right=20] edge node[p]{$8$} (F) ;
\end{tikzpicture}
\end{center}

```

\subsection{Graphes orientés ; graphes probabilistes}

```

\begin{center}
\begin{tikzpicture} % Nécessite decorations.markings et positioning
[decoration={markings,mark=at position 0.52 with
{\arrow[line width=2pt]{stealth}}}]
\node[draw,circle] (A) {A} ;
\node[draw,circle] (B) [right=4cm of A] {B} ;
\draw[-,>=stealth'] (A) to[loop left] node[midway,above]{$0,3$} (A) ;
\draw[postaction=decorate] (A) to[bend left] node[midway,above]{$0,7$} (B) ;
\draw[postaction=decorate] (B) to[bend left] node[midway,above]{$0,5$} (A) ;
\draw[-,>=stealth'] (B) to[loop right] node[midway,above]{$0,5$} (B) ;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}
\node[draw,circle] (A) at (-2,0) {$A$} ;

```

```

\node[draw,circle] (B) at (2,0) {$B$} ;
\draw[-,>=stealth'] (A) .. controls +(-1.5,1) and +(-1.5,-1) ..
  node[midway,left]{$0,3$} (A) ;
\draw[-,>=stealth'] (A) to[bend left] node[midway,above]{$0,7$} (B) ;
\draw[-,>=stealth'] (B) to[bend left] node[midway,below]{$0,2$} (A) ;
\draw[-,>=stealth'] (B) .. controls +(1.5,-1) and +(1.5,1) ..
  node[midway,right]{$0,8$} (B) ;
\end{tikzpicture}
\end{center}

\section{Autres}

\subsection{Panneau Attention}

\begin{center}
\begin{tikzpicture}[scale=0.6]
\draw[fill=red,rounded corners=1.5pt]
(0,0) -- (1,0) -- (0.5,1) -- cycle ;
\draw[fill=white,rounded corners=2pt]
(0.13,0.08) -- (0.87,0.08) -- (0.5,0.8) -- cycle ;
\draw[fill=black,rounded corners=1pt]
(0.5,0.3) -- (0.55,0.6) -- (0.45,0.6) -- cycle ;
\fill (0.5,0.2) circle(0.04) ;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}[scale=4]
\draw[fill=red,rounded corners=10pt]
(0,0) -- (1,0) -- (0.5,1) -- cycle ;
\draw[fill=white,rounded corners=12pt]
(0.13,0.08) -- (0.87,0.08) -- (0.5,0.8) -- cycle ;
\draw[fill=black,rounded corners=6pt]
(0.5,0.3) -- (0.55,0.6) -- (0.45,0.6) -- cycle ;
\fill (0.5,0.2) circle(0.04) ;
\end{tikzpicture}
\end{center}

\subsection{Rapporteur}

\begin{center}
\begin{tikzpicture}[scale=1.2]
\draw (-5,0) -- +(2*5,0) ;
\draw (0,0) -- (0,0.25) ;
\draw (5,0) arc (0:180:5) ;
\foreach \a in {10,20,...,170}
\draw (0,0) ++(\a:0.5) -- ++(\a:1.5) ++(\a:2.5)
  node[rotate=\a-90,below]{$\small \alpha$} -- ++(\a:0.5);
\foreach \a in {5,15,...,175} \draw (0,0) ++(\a:4.75) -- ++(\a:0.25);
\end{tikzpicture}
\end{center}

\subsection{Accolades et utilisation de baseline}

\begin{center}
\begin{tabular}{lp{8cm}}
\begin{tikzpicture}[scale=0.75,baseline=(Y.base)]
% Nécessite decorations.pathreplacing
\draw[thick,->] (-0.5,0) -- (5.5,0) node[above right]{$x$} ;
\draw[thick,->] (0,-0.5) -- (0,4) node[below left] (Y) {$y$} ;
\draw (0,0) node[below left=-3pt]{$0$} +(0,0.4) -| +(0.4,0) ;
\draw (1,0) node[below]{$I$} ;
\draw (0,1) node[left]{$J$} ;
\draw (1,0) +(0,-0.1) -- +(0,0.1) ;
\draw (0,1) +(-0.1,0) -- +(0.1,0) ;


```

```

\draw (2,2) node[below left]{$A$}
+(-0.1,-0.1) -- +(0.1,0.1) +(-0.1,0.1) -- +(0.1,-0.1) ;
\draw (5,4) node[below right]{$B$}
+(-0.1,-0.1) -- +(0.1,0.1) +(-0.1,0.1) -- +(0.1,-0.1) ;
\draw[dashed] (2,2) -- (5,2) ;
\draw (5,2) node[right]{$H$}
+(-0.1,-0.1) -- +(0.1,0.1) +(-0.1,0.1) -- +(0.1,-0.1) ;
\draw (5,2) +(-0.4,0) |- +(0,0.4) ;
\draw (2,2) -- (5,4) ;
\draw[dashed] (2,0) node[below]{$x_A$} |- (0,2) node[left]{$y_A$} ;
\draw[dashed] (5,0) node[below]{$x_B$} |- (0,4) node[left]{$y_B$} ;
\draw[decorate,decoration={brace,mirror,amplitude=4pt}]
(2,1.5) -- (5,1.5) node[midway,below]{$x_B-x_A$} ;
\draw[decorate,decoration={brace,amplitude=4pt}]
(5.7,4) -- (5.7,2) node[midway,right]{$y_B-y_A$} ;
\end{tikzpicture}
&
On utilise le théorème de Pythagore dans le triangle $ABH$ rectangle en $H$ :
{\begin{aligned*}
AB^2 &= AH^2+HB^2 \\
&= (x_B-x_A)^2+(y_B-y_A)^2
\end{aligned*}}
\end{tabular}
\end{center}

\begin{center}
\begin{tikzpicture}[scale=0.75,baseline=(current bounding box.center)]
% Nécessite decorations.pathreplacing
\draw[thick,->] (-0.5,0) -- (6.5,0) ;
\draw[thick,->] (0,-0.5) -- (0,5) ;
\draw (0,0) node[below left=-3pt]{$O$} ;
\draw (2,2) node[above left]{$A$}
+(-0.1,0.1) -- +(0.1,-0.1) ;
\draw (5,4) node[above]{$B$}
+(-0.1,0.1) -- +(0.1,-0.1) ;
\draw[dashed] (2,2) -- (5,2) ;
\draw (-1,0) -- (6,{4+2/3}) ;
\draw[dashed] (2,0) node[below]{$x_A$} |- (0,2) node[left]{$y_A$} ;
\draw[dashed] (5,0) node[below]{$x_B$} |- (0,4) node[left]{$y_B$} ;
\draw[decorate,decoration={brace,mirror,amplitude=4pt}]
(2,1.5) -- (5,1.5) node[midway,below=2pt]{$x_B-x_A$} ;
\draw[decorate,decoration={brace,amplitude=4pt}]
(5.5,4) -- (5.5,2) node[midway,right=2pt]{$y_B-y_A$} ;
\end{tikzpicture}
\$ \quad m=\frac{y_B-y_A}{x_B-x_A} \$ 
\end{center}

\subsection{Inclusion des ensembles de nombres}

\begin{center} % Nécessite positioning et shapes.geometric
\begin{tikzpicture}[somestyle/.style={draw,ellipse,fill,fill opacity=0.1}]
\node[somestyle,
      minimum width=6.5cm, minimum height=4.5cm,
      label={[right = -0.9 cm,name=r_ens]east:\large{$\mathbb{R}$}}] at (0,0) {};
\node[somestyle,
      minimum width=5.4cm, minimum height=4cm,
      label={[right = -0.9cm,name=q_ens]east:\large{$\mathbb{Q}$}},
      left= 0.1cm of r_ens,
      anchor=east] {};
\node[somestyle,
      minimum width=4.3cm, minimum height=3.4cm,
      label={[right = -0.9cm,name=d_ens]east:\large{$\mathbb{D}$}}},
      left= 0.1cm of q_ens,
      anchor=east] {};
\node[somestyle,

```

```

    minimum width=3.2cm, minimum height=2.6cm,
    label={[right = -0.9cm,name=z_ens]east:\large{$\mathbb{Z}$}},
    left= 0.1cm of d_ens,
    anchor=east] {};
\node[somestyle,
    minimum width=2.1cm, minimum height=1.8cm,
    label={[right = -0.9cm,name=n_ens]east:\large{$\mathbb{N}$}},
    left= 0.1cm of z_ens,
    anchor=east] {};
\node[left] at (n_ens.west) {$0\quad 3$} ;
\node[below] at (z_ens.240) {-1} ;
\node[above] at (d_ens.110) {2,4} ;
\node[below] at (d_ens.250) {-3,1} ;
\node[above] at (q_ens.110) {\large{$\frac{23}{3}$}} ;
\node[above] at (r_ens.110) {$\sqrt{2}$} ;
\node[below] at (r_ens.south) {\large{$\pi$}} ;
\end{tikzpicture}
\end{center}

\subsection{Cercle trigonométrique}

\begin{center}
\begin{tikzpicture}[scale=5.7]
\draw[thick] (0,0) circle (1) ;
\foreach \a/\n in {30/6,45/4,60/3}
{
\draw[thick] (0,0) -- (\a:1) ++(\a:0.1) node{$\frac{\pi}{\n}$} ;
\def\nm{\pgfmathparse{int(\n-1)}\pgfmathresult}
\def\pa{180 - \a}
\draw[thick] (0,0) -- (\pa:1) ++(\pa:0.1) node{$\frac{\pi}{\nm}$} ;
\def\paf{-1 * \a}
\draw[thick] (0,0) -- (\paf:1) ++(\paf:0.1) node{$\frac{-\pi}{\n}$} ;
\def\nm{\pgfmathparse{int(1-\n)}\pgfmathresult}
\def\paf{-180 + \a}
\draw[thick] (0,0) -- (\paf:1) ++(\paf:0.1) node{$\frac{\pi}{\nm}$} ;
\draw[thick,dashed] (\a:1)
-- (180-\a:1)
-- (-180+\a:1)
-- (-\a:1)
-- cycle ;
}
\foreach \v\n in {1/1,\sqrt{2}/2,\sqrt{3}/3}
{
\draw ({\sqrt(\n)/2},0) node[above left=-4pt]{$\frac{\v}{2}$} ;
\draw (0,{\sqrt(\n)/2}) node[above right=-4pt]{$\frac{\v}{2}$} ;
\draw ({-\sqrt(\n)/2},0) node[above right=-4pt]{$\frac{-\v}{2}$} ;
\draw (0,{-\sqrt(\n)/2}) node[above right=-4pt]{$\frac{-\v}{2}$} ;
}
\draw[thick,->,>=latex]
(-90:1) node[below]{$\frac{-\pi}{2}$}
-- ( 90:1) node[above]{$\frac{\pi}{2}$}
node[below left]{$J$} ;
\draw[thick,->,>=latex]
(-180:1) node[left]{$\pi$}
-- ( 0:1) node[right]{$0$}
node[above left]{$I$} ;
\draw (-0.04,0.18) node{$0$} ;
\end{tikzpicture}
\end{center}

\subsection{Schéma avec grosses flèches}

\begin{center}
\begin{tikzpicture}[scale=0.9] % Nécessite decorations.markings et positioning
\tikzstyle{vecArrow} = [thick, decoration={markings,mark=at position

```

```

-0.1cm with {\arrow[scale=2.5]{open triangle 90}},  

mark=at position 0.1cm with {\arrow[thick]{!}{}}},  

double distance=0.25cm, shorten >= 0.5cm, shorten <=0.1cm,  

preaction = {decorate},  

postaction = {draw,line width=0.25cm, white, shorten <=0.1cm,shorten >= 0.4cm}]  

\node[draw,rounded corners,align=center,minimum width=2.5cm,minimum height=1.7cm]  

(Pln) [Preuve en \\ langage \\ naturel] ;  

\node[right=0.5cm of Pln] (k1) {} ;  

\node[draw,rounded corners,align=center,minimum width=2.5cm,minimum height=1.7cm]  

(Plr) [right=0.5cm of k1]  

{Preuve en \\ {\color{blue}langage} \\ {\color{blue}restreint}} ;  

\node[right=0.5cm of Plr] (k2) {} ;  

\node[draw,rounded corners,align=center,minimum width=2.5cm,minimum height=1.7cm]  

(Pv) [right=0.5cm of k2] {Preuve \\ {\color{blue}validée}} ;  

\node[below=0.6cm of k1] (k1s) {} ;  

\node[below=0.6cm of k2] (k2s) {} ;  

\node[below=1.6cm of k1s,align=center] (A) {Analyse \\ Traduction} ;  

\node[below=1.6cm of k2s,align=center] (D) {{\color{blue}Démonstrateur}} ;  

\draw[vecArrow] (Pln) to (Plr) ;  

\draw[vecArrow] (Plr) to (Pv) ;  

\draw[vecArrow] (A) to (k1s) ;  

\draw[vecArrow] (D) to (k2s) ;  

\end{tikzpicture}  

\end{center}

\begin{center}
\begin{tikzpicture}[scale=0.9] % Nécessite positioning et shapes.arrows  

\node[draw,rounded corners,align=center,minimum width=2.5cm,minimum height=1.7cm]  

(Pln) [Preuve en \\ langage \\ naturel] ;  

\node[right=0.1cm of Pln,draw, single arrow, minimum height=1cm] (k1) {} ;  

\node[draw,rounded corners,align=center,minimum width=2.5cm,minimum height=1.7cm]  

(Plr) [right=0.1cm of k1]  

{Preuve en \\ {\color{blue}langage} \\ {\color{blue}restreint}} ;  

\node[right=0.1cm of Plr,draw, single arrow, minimum height=1cm] (k2) {} ;  

\node[draw,rounded corners,align=center,minimum width=2.5cm,minimum height=1.7cm]  

(Pv) [right=0.1cm of k2] {Preuve \\ {\color{blue}validée}} ;  

\node[below=1cm of k1,draw, single arrow, shape border rotate=90,  

minimum height=1.5cm] (k1s) {} ;  

\node[below=1cm of k2,draw, single arrow, shape border rotate=90,  

minimum height=1.5cm] (k2s) {} ;  

\node[below=0.1cm of k1s,align=center] (A) {Analyse \\ Traduction} ;  

\node[below=0.1cm of k2s,align=center] (D) {{\color{blue}Démonstrateur}} ;  

\end{tikzpicture}  

\end{center}

\subsection{Circuit logique}

\begin{center}
\begin{tikzstyle}[branch]=[fill,shape=circle,minimum size=3pt,inner sep=0pt]
\begin{tikzpicture}[porte/.style={draw,scale=3}]
% nécessite positioning, circuits.logic.US et calc
\node[and gate US,porte,logic gate inputs=iin] at (0,0) (And1) {};
\node[and gate US,porte,logic gate inputs=ini] at ($(And1)+(0,-3)$) (And2) {};
\node[and gate US,porte,logic gate inputs=nii] at ($(And2)+(0,-3)$) (And3) {};
\node[and gate US,porte,logic gate inputs=nnn] at ($(And3)+(0,-3)$) (And4) {};
\node (A) at ($(And1.input 1)+(-5.5,0)$) {$A$};  

\node (B) at ($(And1.input 2)+(-5.5,0)$) {$B$};  

\node (C) at ($(And1.input 3)+(-5.95,0)$) {$C$};

\node[or gate US,logic gate inputs=nnnn,draw,scale=3]
at ($1/2*(And2.output)+1/2*(And3.output)+(4,0)$) (Or) {};

\draw (A.east) -- (And1.input 1) ;
\draw (B.east) -- (And1.input 2) ;
\draw (C.east) -- (And1.input 3) ;

```

```

\draw ($(A.east)+(4.2,0)$) node[branch] {} |- (And2.input 1) ;
\draw ($(B.east)+(4,0)$) node[branch] {} |- (And2.input 2) ;
\draw ($(C.east)+(3.8,0)$) node[branch] {} |- (And2.input 3) ;

\draw ($(A.east)+(3.2,0)$) node[branch] {} |- (And3.input 1) ;
\draw ($(B.east)+(3,0)$) node[branch] {} |- (And3.input 2) ;
\draw ($(C.east)+(2.8,0)$) node[branch] {} |- (And3.input 3) ;

\draw ($(A.east)+(2.2,0)$) node[branch] {} |- (And4.input 1) ;
\draw ($(B.east)+(2,0)$) node[branch] {} |- (And4.input 2) ;
\draw ($(C.east)+(1.8,0)$) node[branch] {} |- (And4.input 3) ;

\draw (And1.output) -- ($(And1.output)+(1,0)$) |- (Or.input 1) ;
\draw (And2.output) -- ($(And2.output)+(0.5,0)$) |- (Or.input 2) ;
\draw (And3.output) -- ($(And3.output)+(0.5,0)$) |- (Or.input 3) ;
\draw (And4.output) -- ($(And4.output)+(1,0)$) |- (Or.input 4) ;

\draw (Or.output) -- ($(Or.output)+(0.5,0)$) node[right]{$\$S\$} ;
\end{tikzpicture}
\end{center}

\subsection{Des dessins}

\begin{center}
\begin{tikzpicture}[scale=0.75]
\draw[thick,->,>=stealth'] (-1,0) -- (0,0) node[below left]{$0$} -- (10,0)
node[above]{$H$} -- +(0,0.1) +(0,0) -- (17,0) ;
\draw[thick,dashed] (0,0) -- +(0,-1) (10,0) -- +(0,-1) ;
\draw[thick,<-,>=stealth'] (0,-0.5) -- (10,-0.5) node[midway,below]{$d$} ;
\draw[fill,color=brown!60!black!80!red] (7.5,2.8) -- (8,0.75) -- (12,0.75) -- (12.5,2.8) -- cycle ;
\begin{scope}
\clip (7.5,2.8) -- (8,0.75) -- (12,0.75) -- (12.5,2.8) -- cycle ;
\foreach \i in {1,2,3}
\draw[line width=2pt,black] (7.5,[0.75+\i*0.5125}) -- (12.5,[0.75+\i*0.5125]) ;
\end{scope}
\draw[line width=5pt,black!30!white] (7.5,3) -- (8,0.75) -- (12,0.75) -- (12.5,3) ;
\foreach \x in {8,12}
{\draw[fill=black] (\x,0.5) circle (0.5) ;
\draw[fill=black!20!white] (\x,0.5) circle (0.27) ;
\draw[fill=black!80!white] (\x,0.5) circle (0.2) ;
} ;
\end{tikzpicture}
\end{center}

\begin{center}
\begin{tikzpicture}
\foreach \x in {0,1,2,3}
\fill[fill=black!40!white] (\x,0) circle(0.1cm) ;
\foreach \x in {0.5,1.5,2.5}
\fill[fill=black!40!white] (\x,0.5) circle(0.1cm) ;
\foreach \x in {1,2}
\fill[fill=black!40!white] (\x,1) circle(0.1cm) ;
\draw[dashed,->,>=latex,shorten >=3pt]
(1.5,1.8) to[bend left] (2,1.3) to[bend right] (1.5,0.8)
to[bend left] (2,0.3) to[bend right] (1.5,-0.3) ;
\fill[fill=black!40!white] (1.5,1.5) circle(0.1cm) ;
\draw[fill=blue!30!white] (1.5,0.8) circle[radius=0.2cm] node(B){} ;
\draw[->,>=latex,shorten >=0.2cm+2pt] (0.5,1.45) node[left]{bille} to[bend left] (B.center) ;
\begin{scope}[shift={(-0.5,-0.5)}]
\foreach \x in {0,...,4}
\draw ({\x},0) node{$\x$} +(-0.5,0.25) -- +(-0.25,-0.25)
-- +(0.25,-0.25) -- +(0.5,0.25) ;
\end{scope}
\end{tikzpicture}
\end{center}

```

```
\end{tikzpicture}
}
\end{center}
```

```
\newpage
```

Le code ci-dessous permet d'obtenir les figures ci-dessus.

Une fois copié depuis le fichier pdf,
remplacer les stealth' par stealth\textrightsingle.

```
\inputminted{latex}{Figures_tikz.tex}
```

```
\end{document}
```