Exemples de figures mathématiques réalisées avec PSTricks/PST-eucl

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Il existe de nombreuses façons d'inclure des dessins dans les documents LaTeX. Une possibilité est d'utiliser le système PSTricks qui permet d'insérer des instructions postscript dans le code LaTeX. On dispose alors à la fois du puissant modèle graphique de postscript et des capacités de typographie mathématique de LaTeX. Les possibilités de ce système sont immenses (toutes sortes de schémas peuvent être créés), mais son utilisation peut être rebutante au premier abord.

Ce document contient une liste de figures mathématiques avec leur code PSTricks, qui peuvent servir d'exemples pour faciliter l'apprentissage du système. J'essaye de couvrir plus ou moins l'ensemble des figures que l'on peut être amenés à faire dans le cadre des mathématiques du Lycée. Ces figures pourront donc aussi servir de point de départ pour la réalisation de figures similaires. Deux sous modules de PSTricks sont utilisés ici :

- `pst-plot` module standard, qui permet de tracer facilement de belles courbes,
- `pst-eucl`[1], un nouveau sous module non standard qui fournit un ensemble de primitives spécialisées et très pratiques pour la réalisation de dessins géométriques. La lecture de sa documentation (qui contient aussi un grand nombre d'exemples) est vivement recommandée ! Commentaires et questions à envoyer à `elviok@free.fr`.

Remarque sur les fichiers DVI : les visualisateurs de fichier DVI ne sont pas capables d'interpréter correctement toutes les instructions postscript générées par les pstricks et fournissent donc un affichage incomplet ou erroné. Pour obtenir un affichage correct et complet il faut donc générer un fichier postscript.

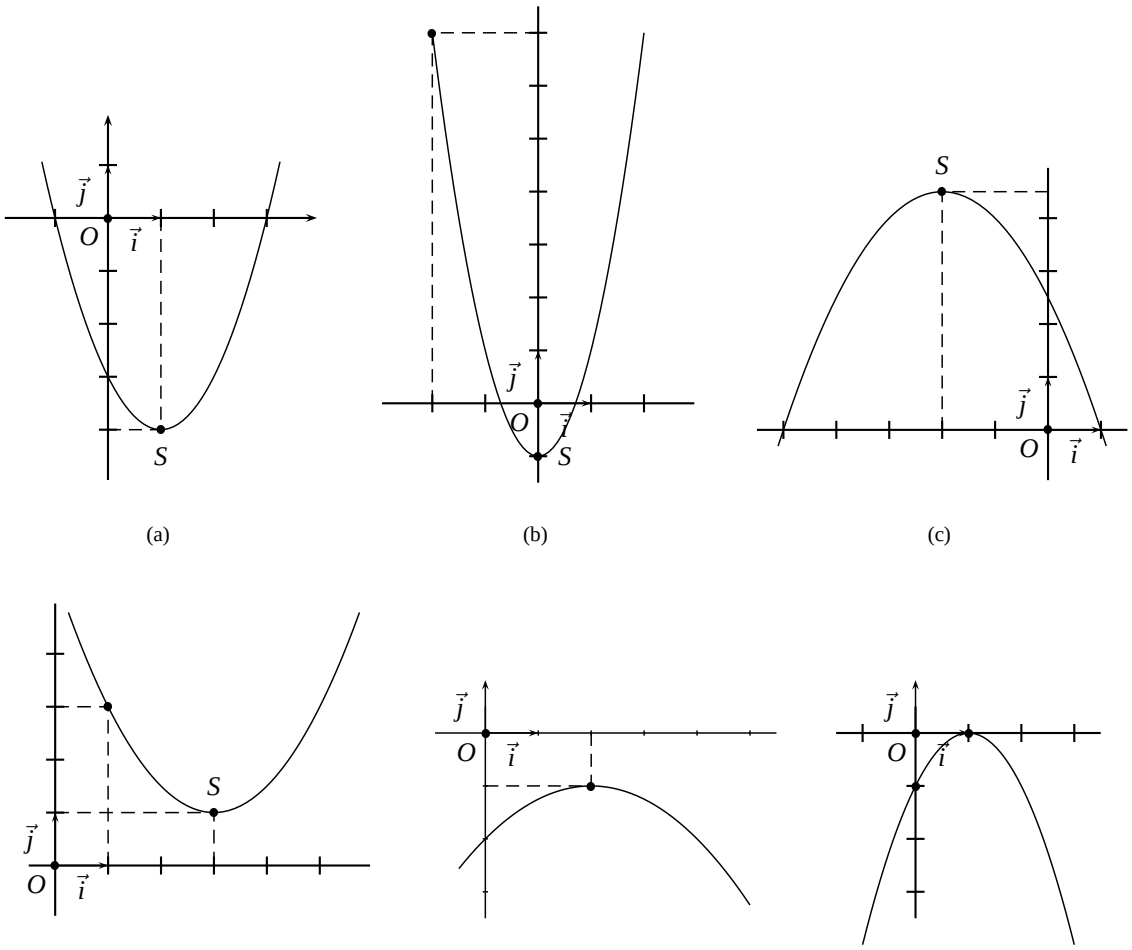
1 Représentations graphiques de fonctions

Inclure le module `pst-plot` (`\usepackage{pst-plot}`).
Définitions supplémentaires utilisées dans certaines figures :

```
\newcommand{\repere}{
  \psset{ticksize=.7pt,linewidth=.7\pslinewidth,labelsep=2.5pt}
  \pstGeonode[PosAngle=-135]{O}
  \pcline{->}(0,0)(1,0)\rput(0.5,-0.4){$\vec i$}
  \pcline{->}(0,0)(0,1)\rput(-0.5,0.5){$\vec j$}}

\newcommand{\markpoint}[4][]{\pstGeonode[#1](#2,#3){#4}
  \psline[linestyle=dashed](0,#3)(#2,#3)(#2,0)}
```

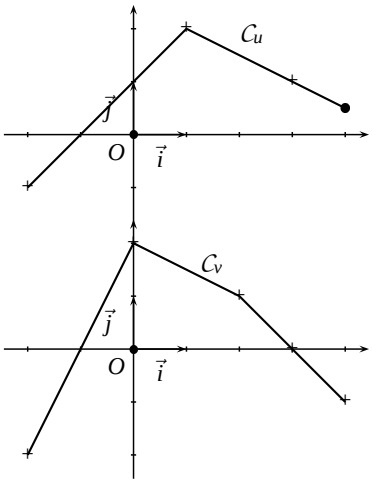
```
\begin{toimage}
\psset{unit=7mm,labels=none}
\end{toimage}

\begin{figure*}[h]
\centering
\subfigure[]{\begin{pspicture}(-2,-5)(4,2)
  \psaxes{->}(0,0)(-1.95,-4.95)(3.95,1.95)
  \repere
  \def\F{x 1 sub 2 exp 4 sub}
  \psplot{-1.25}{3.25}{\F}
%  \pstGeonode[PosAngle=-90](1,-4){S}
%  \psline[linestyle=dashed](0,-4)(1,-4)(1,0)
  \markpoint[PosAngle=-90]{1}{-4}{S}
\end{pspicture}}
\qquad
\subfigure[]{\begin{pspicture}(-3,-1.5)(3,7.5)
  \psaxes{-}(0,0)(-2.95,-1.5)(2.95,7.5)
  \repere
  \def\F{x 2 exp 2 mul 1 sub}
  \psplot{-2}{2}{\F}
  \pstGeonode(0,-1){S}
  \markpoint[PosAngle=90,PointName=none]{-2}{7}{I}
\end{pspicture}}
\qquad
\subfigure[]{\begin{pspicture}(-5.5,-1)(1.5,5)
  \psaxes{-}(0,0)(-5.5,-0.95)(1.5,4.95)
  \repere
  \def\F{x 2 add 2 exp -1 2 div mul 9 2 div add}
  \psplot{-5.1}{1.1}{\F}
  \markpoint[PosAngle=90]{-2}{4.5}{S}
\end{pspicture}}

\subfigure[]{\begin{pspicture}(-.5,-1)(6,5)
  \psaxes{-}(0,0)(-.5,-.95)(5.95,4.95)
  \repere
  \def\F{x 2 exp 2 div x 3 mul sub 11 2 div add}
  \psplot{.25}{5.75}{\F}
  \markpoint[PosAngle=90]{3}{1}{S}
  \markpoint[PointName=none]{1}{3}{I}
\end{pspicture}}
\qquad
\subfigure[]{\begin{pspicture}(-1,-3.5)(5.5,.5)
  \repere
  \psaxes{-}(0,0)(-.95,-3.5)(5.5,.5)
  \def\F{x 2 exp -1 4 div mul x add 2 sub}
```

[1] `http://dominique.rodriguez.9online.fr/pst-eucl`

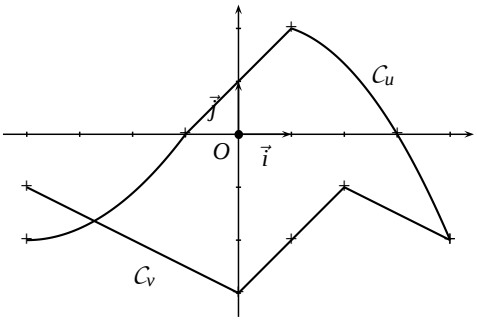


Figures de l’exercice 5

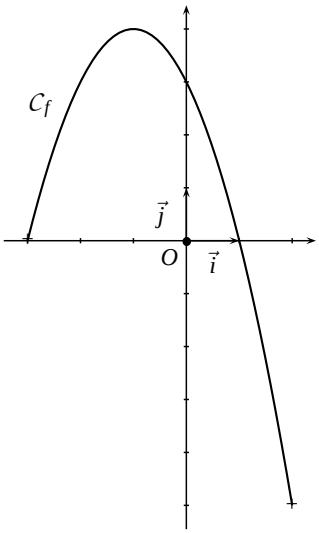
```
  \psplot{-.5}{5}{\F}
  \markpoint[PointName=none]{2}{-1}{S}
\end{pspicture}}
\qquad
\subfigure[]{\begin{pspicture}(-1.5,-3.5)(3.5,.5)
  \psaxes{-}(0,0)(-1.5,-3.5)(3.5,.5)
  \repere
  \def\F{x 2 mul x 2 exp sub 1 sub}
  \psplot{-1}{3}{\F}
  \pstGeonode[PointName=none](1,0){S}
  \pstGeonode[PointName=none](0,-1){S}
\end{pspicture}}
\label{figs}
\centerline{Figures de l’exercice 5}
\end{figure*}
```



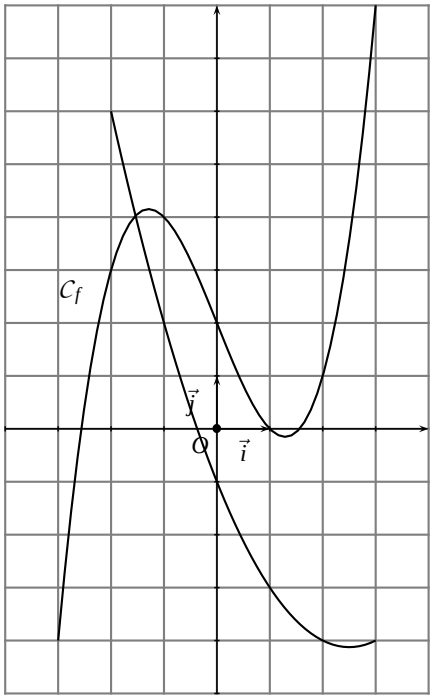

```
\begin{pspicture}(-2.5,-1.5)(4.5,2.5)
  { \repere
    \psaxes{->}(0,0)(-2.45,-1.75)(4.45,2.45)}
  \psset{PointName=none,PointSymbol=+}
  \pstGeonode(-2,-1){A}\pstGeonode(1,2){B}\pstGeonode(3,1){C}
  \pstGeonode[PointSymbol=*](4,.5){D}
  \psline(A)(B)(C)(D)
  \put(2,1.8){$\mathcal{C}_u$}
\end{pspicture}

\begin{pspicture}(-2.5,-2.5)(4.5,2.5)
  {\repere
    \psaxes{->}(0,0)(-2.45,-2.45)(4.45,2.45)}
  \psset{dotstyle=+}
  \psdots(-2,-2)(0,2)(2,1)(3,0)(4,-1)
  \psline(-2,-2)(0,2)(2,1)(3,0)(4,-1)
  \put(1.25,1.5){$\mathcal{C}_v$}
\end{pspicture}
```



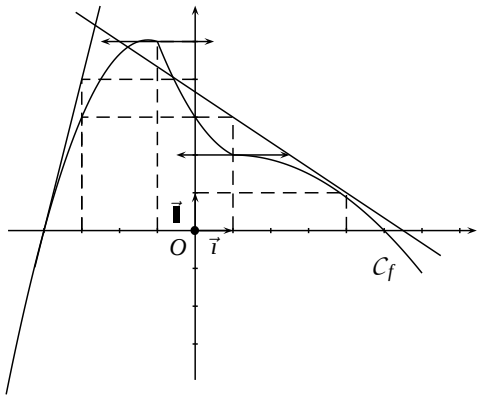

```
\begin{pspicture}(-4.5,-3.5)(4.5,2.5)
  {\repere
    \psaxes{->}(0,0)(-4.45,-3.45)(4.45,2.45)}
  \psset{dotstyle=+}
  \psdots(-4,-1)(0,-3)(1,-2)(2,-1)(4,-2)
  \psline(-4,-1)(0,-3)(1,-2)(2,-1)(4,-2)

  \psdots(-4,-2)(-1,0)(1,2)(3,0)(4,-2)
  \def\Fa{2 9 div x 1 add mul x 7 add mul}
  \def\Fc{0 1 sub 3 div x 3 sub mul x 2 add mul}
  \psplot{-4}{-1}{\Fa}
  \psplot{1}{4}{\Fc}
  \psline(-1,0)(1,2)
  \put(-2,-2.8){$\mathcal{C}_v$}
  \put(2.5,1){$\mathcal{C}_u$}
\end{pspicture}
```



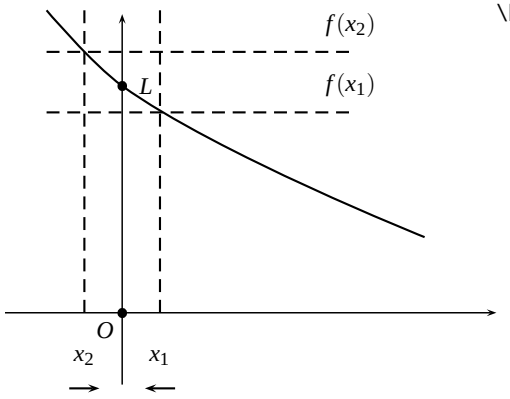

```
\begin{pspicture}(-3.5,-5.5)(2.5,4.5)
  {\repere
    \psaxes{->}(0,0)(-3.45,-5.45)(2.45,4.45)}
  \psset{dotstyle=+}
  \psdots(-3,0)(2,-5)
  \def\F{0 x 1 sub sub x 3 add mul}
  \psplot{-3}{2}{\F}
  \put(-3,2.5){$\mathcal{C}_f$}
\end{pspicture}
```



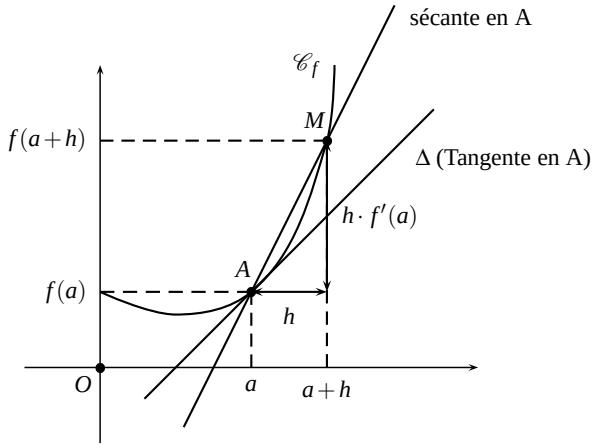

```
\psset{unit=0.7cm}\begin{pspicture}(-4,-5)(4.5,8)
\psset{gridcolor=gray,gridlabels=0pt,subgriddiv=0}\psgrid(-4,-5)(4,8)
  {\repere
    \psaxes{->}(0,0)(-4,-5)(4,8)}
  \psset{dotstyle=+}
  \def\F{x 3 exp 1 2 div mul x 5 2 div mul sub 2 add}
  \def\G{x 2 exp 1 2 div mul x 5 2 div mul sub 1 sub}
  \psplot{-3}{3}{\F}
  \psplot{-2}{3}{\G}
  \put(-3,2.5){$\mathcal{C}_f$}
\end{pspicture}
```




```
\psset{unit=5mm,labels=none}
\begin{pspicture}(-5,-4)(7.5,6)
\renewcommand{\repere}{
  \psset{ticksize=.7pt,linewidth=.7\pslinewidth,labelsep=2.5pt}
  \pstGeonode[PosAngle=-135]{O}
  \pcline{->}(0,0)(1,0)\rput(0.5,-0.4){$\vec \imath$}
  \pcline{->}(0,0)(0,1)\rput(-0.5,0.5){$\vec \jmath$}}

\renewcommand{\markpoint}[4][]{\pstGeonode[#1](#2,#3){#4}
  \psline[linestyle=dashed](0,#3)(#2,#3)(#2,0)}
\newcommand{\hor}[2]{\rput(#1,#2){\pcline{<->}(-1.5,0)(1.5,0)}}

\repere
\psaxes{->}(0,0)(-4.95,-3.95)(7.45,5.95)
\def\f{x 4 add -2 3 div x mul 1 add mul}
\def\g{1 2 div x 2 exp mul -3 2 div x mul add 3 add}
\def\h{-1 8 div x 5 sub x 3 add mul mul}
\psplot{-5}{-1}{\f}
\psplot{-1}{1}{\g}
\psplot{1}{6}{\h}

\pcline[nodesepA=-1,nodesepB=-2](-4,0)(-3,4)
\pcline[nodesepA=-5,nodesepB=-3](1,3)(4,1)

\psset{PointSymbol=none}
\markpoint{-3}{3}{a}\markpoint{-3}{4}{b}
\markpoint{1}{3}{c}\markpoint{4}{1}{d}
\markpoint{-1}{5}{e}

\hor{-1}{5} \hor{1}{2}
\rput(5,-1){${\cal C}_f$}
\end{pspicture}
```




```
\psset{unit=1cm}
\begin{pspicture}(-2.5,-1)(5,4)
  \psaxes[ticks=none,linewidth=.7\pslinewidth,labels=none]{->}%
  (0,0)(-1.55,-.95)(4.95,3.95)
  \pstGeonode[PosAngle=-135]{O}

  \pstGeonode(0,3){L}
  \pscurve(-1,4)(L)(4,1)
  \psset{linestyle=dashed}
  \pcline(-1,3.45)(3,3.45)\aput(1){$f(x_2)$}
  \pcline(-1,2.65)(3,2.65)\aput(1){$f(x_1)$}
  \pcline(-.5,0)(-.5,4)\lput(-.15){$x_2$}
  \lput(-.25){\psline[linestyle=solid]{->}(-.2,0)(.2,0)}
  \pcline(.5,0)(.5,4)\lput(-.15){$x_1$}
  \lput(-.25){\psline[linestyle=solid]{<-}(-.2,0)(.2,0)}
\end{pspicture}
```

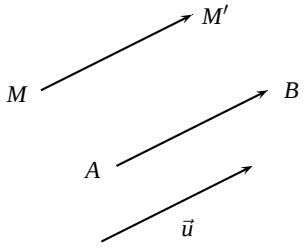



```
\psset{unit=1cm}
\begin{pspicture}(-.5,-1)(6,5)
  \psaxes[ticks=none,linewidth=.7\pslinewidth,labels=none]{->}%
  (0,0)(-1,-1)(5,4)
  \pstGeonode[PosAngle=-135]{O}

  \pstGeonode[PointSymbol=none](0,1){fa}
  \pstGeonode[PosAngle=110](2,1){A}
  \pstGeonode[PosAngle=120](3,3){M}
  \psset{PointSymbol=none}
  \pstGeonode(3.1,4){Cf}
  \pstGeonode(4,0){x}
  \pstProjection{O}{fa}{M}{fah}
  \pstProjection{O}{x}{A}{a}
  \pstProjection{O}{x}{M}{ah}
  \pstProjection{M}{ah}{A}{h}

  \pscurve(fa)(1,.7)(A)(M)(Cf)
  \uput[l](Cf){$\mathscr{C}_f$}
  \pcline[nodesep=-2](A)(M)\bput(1){sécante en A}
  \pcline[nodesep=-2](A)(3,2)\bput(.9){$\Delta$ (Tangente en A)}

  \pcline{<->}(A)(h)\Bput{$h$}
  \pcline{<->}(h)(M)\Bput{$h\cdot f'(a)$}

  \psset{linestyle=dashed}
  \pcline(fa)(A)\uput[l](fa){$f(a)$}
  \pcline(a)(A)\uput[d](a){$a$}
  \pcline(fah)(M)\uput[l](fah){$f(a+h)$}
  \pcline(ah)(M)\uput[d](ah){$a+h$}
\end{pspicture}
```

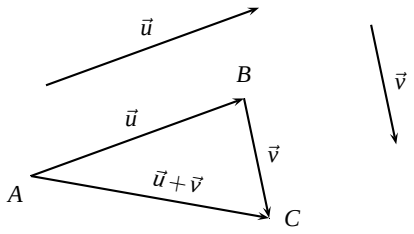
2 Vecteurs

Définitions supplémentaires utilisées dans certaines figures :

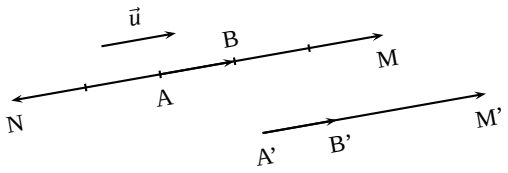
```
\newcommand{\pstLineABD}[4][]{\pstLineAB[#1]{#2}{#3}\bput(1){$\cal #4$}}
\newcommand{\pstLineABd}[4][]{\pstLineAB[#1]{#2}{#3}\bput(1){$#4$}}

\newcommand{\pstick}[1]{\rput(#1){\psline(0,-.05)(0,0.05)}}

% \pstplan{lx}{ly}{nom}
\newcommand{\pstplan}[3]{\psline(0,0)(#2;70)\psline(0,0)(#1;0)
  \rput(#2;70){\psline(0,0)(#1;0)\uput[dl](#1;0){$\cal #3$}}
  \rput(#1;0){\psline(0,0)(#2;70)}}
```



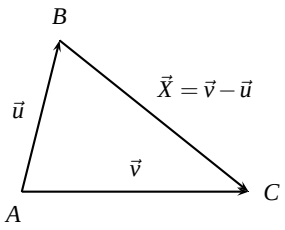

```
\begin{pspicture}(4,3.5)
  \psset{dotscale=0.1}
  \pstGeonode[PosAngle=190](1,3){M}\pstGeonode(3,4){M'}\psline{->}(M)(M')
  \pstGeonode[PosAngle=190](2,2){A}\pstGeonode(4,3){B} \psline{->}(A)(B)
  \psset{PointSymbol=none}
  \pstGeonode[PosAngle=190](1.8,1){u}\pstGeonode(3.8,2){v}
  \pcline{->}(u)(v)\Bput{$\vec u$}
\end{pspicture}
```

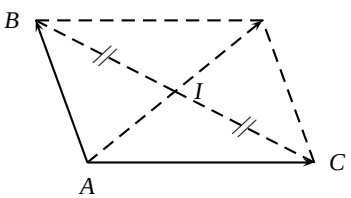



```
\begin{pspicture}(-1,-1)(5.5,2)%\psgrid
  \psset{dotscale=0.1, labelsep=3pt, arrows=->}
  \pstGeonode[PosAngle=-130]{A}
  \pstGeonode[PosAngle=90](3;20){B}
  \pstGeonode(3.2;-10){C}
  \ncline{A}{B}\Aput{$\vec u$}
  \ncline{B}{C}\Aput{$\vec v$}
  \ncline{A}{C}\aput{:U}(.6){$\vec u+\vec v$}

  \psset{PointSymbol=none}
  \pstGeonode(.2,1.2){uA}
  \pstTranslation{A}{B}{uA}{uB}
  \ncline{uA}{uB}\Aput{$\vec u$}

  \pstGeonode(4.5,2){vB}
  \pstTranslation{B}{C}{vB}{vC}
  \ncline{vB}{vC}\Aput{$\vec v$}
\end{pspicture}
```

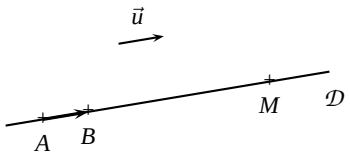



```
\begin{pspicture}(8,2)%\psgrid
  \small
  \rput{10}(3,1){
%    \psaxes[labels=none, ticks=x, ticksize=1pt]{<->}(-2,0)(3,0)
    \pcline{<->}(-2,0)(3,0)
    \multips(-1,0)(1,0){4}{\psline(0,-.05)(0,.05)}
    \bput(0){N}\bput(1){M}\bput(0.4){A}\aput(0.6){B}
    \psline{->}(0,0)(1,0)
    \pcline{->}(-.7,.5)(.3,.5)\Aput{$\vec u$}

    \pcline{->}(1.2,-1)(4.2,-1)
    \bput(0){A'}\bput(1){M'}
    \pcline{->}(1.2,-1)(2.2,-1)\bput(1){B'}
  }
\end{pspicture}
```

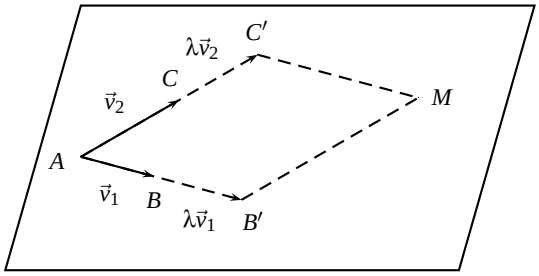




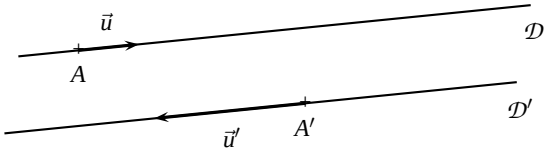

```
\begin{pspicture}(-2,-.5)(5,5.5)%\psgrid
  \psset{dotscale=0.1}

  % triangle
  \pstGeonode[PosAngle=-110](-1,3){A}
  \pstGeonode(2,3){C}
  \pstGeonode[PosAngle=90](-0.5,5){B}

  \pcline{->}(A)(B)\Aput{$\vec u$}
  \pcline{->}(A)(C)\Aput{$\vec v$}
  \pcline{->}(B)(C)\Aput{$\vec X = \vec v - \vec u$}

  % parallélogramme
  \pstGeonode[PosAngle=-90](0,0){A}
  \pstGeonode[PosAngle=180](2;110){B}
  \pstGeonode(3;0){C}

  \pstMiddleAB{B}{C}{I}
  \pstTranslation[PointName=none]{A}{C}{B}{D}
  \psline{->}(A)(B)\psline{->}(A)(C)
  \psset{linestyle=dashed}
  \psline{->}(A)(D)\psline(B)(D)(C)
  \pstSegmentMark{B}{I}\pstSegmentMark{I}{C}
\end{pspicture}
```



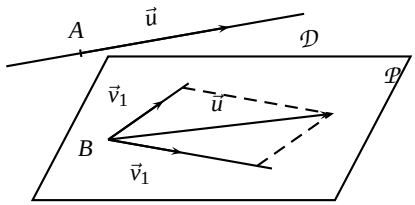

```
\begin{pspicture}(5,3)
  \psset{PointSymbol=+, PosAngle=-90}
  \pstGeonode(1,1){A}
  \pstGeonode(4,1.5){M}
  \pstLineAB[nodesep=-.5,nodesepB=-.8]{A}{M}
  \bput(1){$\cal D$}
  \pstHomO[HomCoef=.2]{A}{M}{B}
  \pcline[linewidth=1.5\pslinewidth]{->}(A)(B)

  \psset{PointSymbol=none}
  \pstGeonode(2,2){u}
  \pstTranslation{A}{B}{u}{uu}
  \pcline{->}(u)(uu)\Aput{$\vec u$}
\end{pspicture}
```



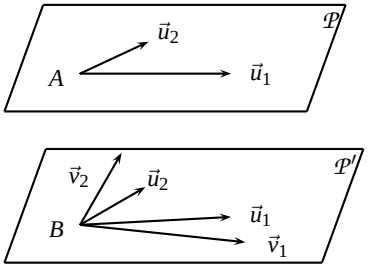

```
\begin{pspicture}(-1,-1.5)(5,2)
  \psset{dotscale=0.1}
  \pspolygon(-1,-1.5)(0,2)(6,2)(5,-1.5)

  % A, B, C
  \pstGeonode[PosAngle=-170](0,0){A}
  \pstGeonode[PosAngle=110](1.5;30){C}
  \pstGeonode[PosAngle=-90](1;-15){B}
  \pcline{->}(A)(C)\Aput{$\vec v_2$}
  \pcline{->}(A)(B)\Bput{$\vec v_1$}

  % B', C'
  \pstHomO[PosAngle=90, HomCoef=1.8]{A}{C}{C'}
  \pstHomO[PosAngle=-60, HomCoef=2.2]{A}{B}{B'}
  \psset{linestyle=dashed}
  \pcline{->}(A)(C')\aput(.8){$\lambda \vec v_2$}
  \pcline{->}(A)(B')\bput(.8){$\lambda \vec v_1$}

  % M
  \pstTranslation{A}{B'}{C'}{M}
  \psline(C')(M)(B')
\end{pspicture}
```



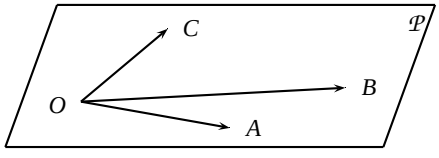

```
\begin{pspicture}(5,1.5)
  \psset{PosAngle=-90, PointSymbol=+}
  \pstGeonode(2,1.2){A}
  \pstGeonode(5,.5){A'}

  % droites
  \psset{PointSymbol=none}
  \pstGeonode(7,0.7){BB}
  \pstTranslation{A'}{BB}{A}{AA}
  \pstLineABD[nodesepA=-.8, nodesepB=-4]{A}{AA}{D}
  \pstLineABD[nodesepA=-4, nodesepB=-.8]{A'}{BB}{D'}

  % vecteurs
  \psset{linewidth=1.5\pslinewidth}
  \pstHomO[HomCoef=.4]{A}{AA}{Au}
  \pcline{->}(A)(Au)\Aput{$\vec u$}
  \pstHomO[HomCoef=-1]{A'}{BB}{A'u}
  \pcline{->}(A')(A'u)\Aput{$\vec u'$}
\end{pspicture}
```



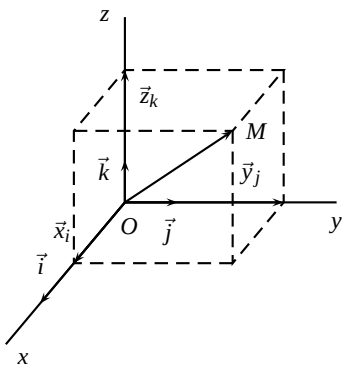

```
\begin{pspicture}(6,3)
  \psset{dotscale=0.1}
  \rput{10}(2,0){
    \pstGeonode[PosAngle=90](1,2){A}
    \pstick{A}
    \pstGeonode[PointSymbol=none](3,2){aa}
    \ncline{->}{A}{aa}\Aput{$\vec u$}
    \pstLineABD[nodesep=-1]{A}{aa}{D}
  }
  \rput(3,1){
    \pspolygon(-1,-.8)(0,1.1)(4,1.1)(3,-.8)
    \uput[dl](4,1.1){$\cal P$}
    \pstGeonode[PosAngle=-160]{B}
    \psset{PointSymbol=none}
    \pstGeonode(1;-10){v1}
    \pstGeonode(2;-10){v11}
    \ncline{->}{B}{v1}\Bput{$\vec v_1$}
    \pstLineAB[nodesepB=-.2]{B}{v11}

    \pstGeonode(.9;35){v2}
    \pstGeonode(1.2;35){v22}
    \ncline{->}{B}{v2}\Aput{$\vec v_1$}
    \pstLineAB[nodesepB=-.1]{B}{v22}

    \pstTranslation{B}{v11}{v22}{u}
    \ncline{->}{B}{u}\Aput{$\vec u$}
    \psline[linestyle=dashed](v22)(u)(v11)
  }
\end{pspicture}
```



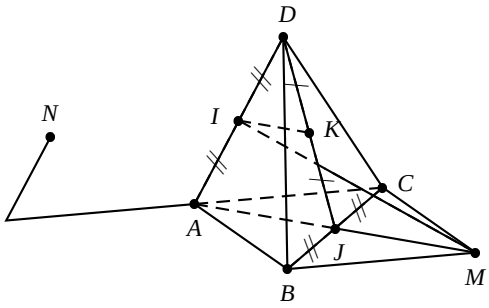

```
\begin{pspicture}(-2,0)(9,4)
  \psset{dotscale=0.1, labelsep=3pt}
  \rput(0,2){
    \pstplan{4}{1.5}{P}
    \rput(1,.5){
      \pstGeonode[PosAngle=-170]{A}
      \pcline{->}(A)(2;0)\lput(1.2){$\vec u_1$}
      \pcline{->}(A)(1;25)\lput(1.3){$\vec u_2$}
    }}

  \pstplan{4.2}{1.6}{P'}
  \rput(1,.5){
    \pstGeonode[PosAngle=-170]{B}
    \pcline{->}(B)(2.2;-6)\lput(1.2){$\vec v_1$}
    \pcline{->}(B)(2;3)\lput(1.2){$\vec u_1$}
    \pcline{->}(B)(1;30)\lput(1.2){$\vec u_2$}
    \pcline{->}(B)(1.1;60)\Aput{$\vec v_2$}
  }
\end{pspicture}
```



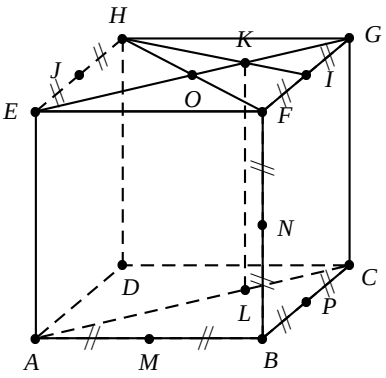

```
\begin{pspicture}(6,3)
  \psset{dotscale=0.1}
  \pstplan{5}{2}{P}
  \rput(1,.6){
    \pstGeonode[PosAngle=-170]{O}
    \pstGeonode(2;-10){A}  \ncline{->}{O}{A}
    \pstGeonode(3.5;3){B}  \ncline{->}{O}{B}
    \pstGeonode(1.5;40){C} \ncline{->}{O}{C}
  }
\end{pspicture}
```




```
\begin{pspicture}(-4,-4)(4,4)
  \psset{dotscale=0.1}

  \pstGeonode[PosAngle=-80]{O}
  \pcline{->}(O)(1;0)\bput(.8){$\vec j$}
  \pcline{->}(O)(.8;90)\aput(.8){$\vec k$}
  \pcline{->}(O)(2.5;-130)\bput(.8){$\vec i$}

  \psset{PointSymbol=none}
  \pstGeonode(3;0){yj}     \pcline{->}(O)(yj)\aput(.8){$\vec y_j$}
  \pstGeonode(2.5;90){zk}  \pcline{->}(O)(zk)\bput(.8){$\vec z_k$}
  \pstGeonode(1.5;-130){xi}\pcline{->}(O)(xi)\bput(.8){$\vec x_i$}

  \pcline(O)(4;0)\bput(1){$y$}
  \pcline(O)(3.5;90)\aput(1){$z$}
  \pcline(O)(3.5;-130)\aput(1){$x$}

  \pstTranslation{O}{yj}{xi}{xy}
  \pstTranslation{O}{xi}{zk}{zx}
  \pstTranslation{O}{yj}{zk}{zy}
  \pstTranslation[PointSymbol=*]{O}{xi}{zy}{M}
  \psline{->}(O)(M)
  \psline[linestyle=dashed](xy)(xi)(zx)(zk)(zy)(M)(zx)
  \psline[linestyle=dashed](zy)(yj)(xy)(M)
\end{pspicture}
```

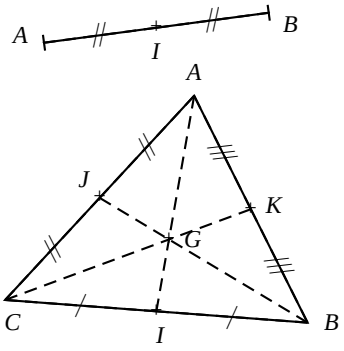



```
\begin{pspicture}(-4,-1)(4,4)
  \psset{PosAngle=-90}
  \pstGeonode{A}
  \pstGeonode(1.5;-35){B}
  \pstGeonode[PosAngle=10](2.5;5){C}
  \pstTranslation{A}{B}{C}{M}
  \pstGeonode[PosAngle=80](2.5;62){D}
  \psset{CodeFig=true, CodeFigColor=black}
  \pstMiddleAB[PosAngle=170]{A}{D}{I}
  \pstMiddleAB[PosAngle=-80]{B}{C}{J}
  \pstMiddleAB[SegmentSymbol=pstslash,PosAngle=10]{D}{J}{K}

  \pstTranslation[PointSymbol=none]{C}{A}{A}{N'}
  \pstTranslation[PosAngle=90]{A}{I}{N'}{N}

  \pspolygon(A)(B)(M)(C)(B)(D)
  \psline(D)(J)\psline(D)(C)\psline(J)(M)
  \psline(A)(N')(N)

  \psset{linestyle=dashed}
  \psline(A)(J)\psline(A)(C)\psline(I)(K)
  \psline(I)(M)
  \pcline[nodesepA=1.3, linestyle=solid](I)(M)
\end{pspicture}
```

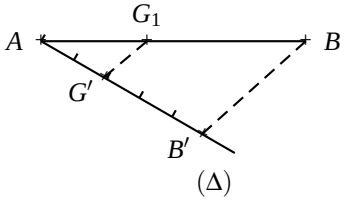


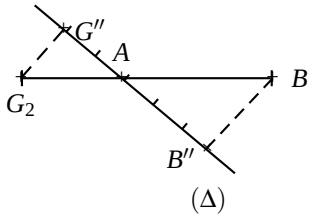

```
\begin{pspicture}(-1,-1)(4,3)
  \psset{PosAngle=-70}
  \pstGeonode[PosAngle=-100]{A}
  \pstGeonode(3;0){B}
  \pstGeonode(1.5;40){D}
  \pstTranslation[PosAngle=-30]{A}{B}{D}{C}
  \pstGeonode[PosAngle=180](3;90){E}
  \pstTranslation[PosAngle=-10]{A}{B}{E}{F}
  \pstTranslation[PosAngle=100]{A}{D}{E}{H}
  \pstTranslation[PosAngle=10]{A}{B}{H}{G}
  {\psset{CodeFig=true, CodeFigColor=black}
    \pstMiddleAB[PosAngle=170]{E}{H}{J}
    \pstMiddleAB[PosAngle=-10]{F}{G}{I}
    \pstMiddleAB[PosAngle=-90]{A}{B}{M}
    \pstMiddleAB[PosAngle=-10]{B}{C}{P}
    \pstMiddleAB[PosAngle=-10]{B}{F}{N}
  }
  \pspolygon(A)(B)(F)(E)
  \psline(E)(F)(G)(H)\psline(B)(C)(G)

  \pstInterLL[PosAngle=-90]{E}{G}{H}{F}{O}
  \pstInterLL[PosAngle=90]{H}{I}{E}{G}{K}
  \psline(E)(G)\psline(H)(F)\psline(H)(I)

  \pstTranslation[PosAngle=-90]{E}{A}{K}{L}
  \psset{linestyle=dashed}
  \pspolygon(A)(D)(C)
  \psline(D)(H)\psline(K)(L)

\end{pspicture}
```

3 Barycentres

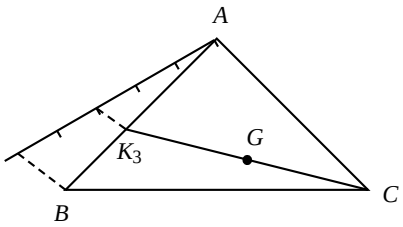


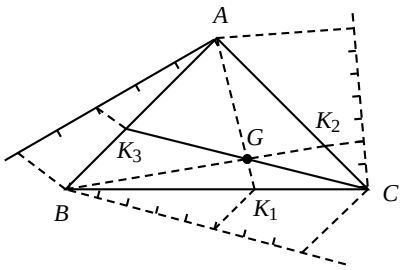

```
\begin{pspicture}(5,5)%\psgrid
  \psset{dotscale=0.1, PointSymbol=+}
  \newpsstyle{Fig}{CodeFig=true, CodeFigColor=black}

  % isobarycentre de 2 points
  \pstGeonode[PosAngle=160](1,4.2){A}
  \pstGeonode[PosAngle=-30](4,4.6){B}
  \ncline{|-|}{A}{B}
  \pstMiddleAB[dotscale=1, style=Fig, PosAngle=-90]{A}{B}{I}

  % isobarycentre de 3 points
  \pstTriangle[PosAngleA=90, PosAngleC=-70](3,3.5){A}(4.5,.5){B}(.5,.8){C}
  \psset{dotscale=1}
  \pstMiddleAB[style=Fig, PosAngle=130]{A}{C}{J}
  \pstMiddleAB[style=Fig, PosAngle=-80, SegmentSymbol=pstslash]{B}{C}{I}
  \pstMiddleAB[style=Fig,PosAngle=10,SegmentSymbol=pstslashslashslash]{A}{B}{K}
  \psset{linestyle=dashed}
  \psline(A)(I)\psline(B)(J)\psline(C)(K)
  \pstCGravABC{A}{B}{C}{G}
\end{pspicture}
```





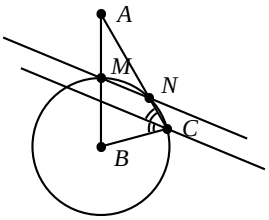
```
\begin{pspicture}(0,0)(18,3)%\psgrid
  \psset{PointSymbol=+}

  % barycentre G1 de {(A,3);(B,2)}
  \pstGeonode[PosAngle=180](3,2){A}
  \pstGeonode(6.5,2){B}
  \pstLineAB{A}{B}
  \pstHomO[PosAngle=90, HomCoef=.4]{A}{B}{G_1}
  \rput{-30}(A){
    \pstGeonode[PosAngle=-120](2.5;0){B'}
    \pstGeonode[PosAngle=-120](1;0){G'}
    \multips{0}(A)(.5,0){5}{\psline(0,0)(0,.1)}
  }
  \pstLineABd[nodesepB=-.5]{A}{B'}{(\Delta)}
  {\psset{linestyle=dashed}
    \ncline{G'}{G_1}\ncline{B'}{B}}
  % barycentre G2 de {(A,5);(B,-2)}
  \pstGeonode[PosAngle=90](12,2){A}
  \pstGeonode(14,2){B}
  \pstHomO[PosAngle=-90, HomCoef=-.666]{A}{B}{G_2}
  \rput(A){\pstGeonode(1;140){G''}}
  \ncline{|-|}{G_2}{B}
  \rput{-40}(G''){
    \pstGeonode[PosAngle=-120](2.5;0){B''}
    \multips{0}(.5,0){5}{\psline(0,0)(0,.1)}
  }
  \pstLineABd[nodesep=-.5]{G''}{B''}{(\Delta)}
  \psset{linestyle=dashed}
  \psline(G_2)(G'')\psline(B'')(B)
\end{pspicture}
```



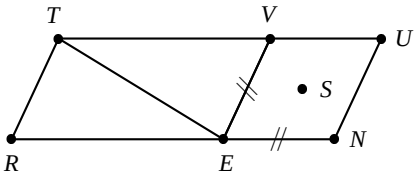



```
\begin{pspicture}(6,8)
  \psset{dotscale=0.1}
  \newcommand{\tick}{\psline(0,0)(0,.1)}
  \newcommand{\commun}{
    \pstTriangle[PosAngleA=80, PosAngleB=-100, PosAngleC=-10]
                (4,3){A}(2,1){B}(6,1){C}
    \rput{-150}(A){
      \multips{0}(.6,0){5}{\tick}
      \psline(0,0)(3.2;0)
      \pnode(1.8;0){kk}\pnode(3;0){bb}
    }
    \pstHomO[HomCoef=.6, PosAngle=-80]{A}{B}{K_3}
    \pstMiddleAB[dotscale=1, PosAngle=70]{C}{K_3}{G}
    \psline(K_3)(C)
    \psset{linestyle=dashed, dash=3pt 2pt}
    \psline(bb)(B)\psline(kk)(K_3)
  }
                                % 1er dessin
  \rput(0,4){\commun}
                                % 2ème dessin
  \commun
  \rput{-15}(B){  \multips{0}(.4,0){8}{\tick}          % 8 ticks de .4
                  \psline(0,0)(3.8,0)                  % 8*.t + .2
                  \pnode(2.0,0){kb}\pnode(3.2;0){cb}   % 5*.t, 8*t
  }
  \rput{95}(C){   \multips{0}(.3,0){7}{\tick}          % 7 ticks de .3
                  \psline(0,0)(2.3;0)                  % 7*t + .2
                  \pnode(.6;0){kc}\pnode(2.1;0){cc}    % 2*t, 7*t
  }
  \pstHomO[HomCoef=0.625, PosAngle=-60]{B}{C}{K_1}  % 5/8
  \pstHomO[HomCoef=0.286, PosAngle=80]{C}{A}{K_2}   % 2/7
  \psline(A)(K_1)\psline(B)(K_2)
  \psset{linestyle=dashed, dash=3pt 2pt}
  \psline(kb)(K_1)\psline(cb)(C)
  \psline(kc)(K_2)\psline(cc)(A)
\end{pspicture}
```

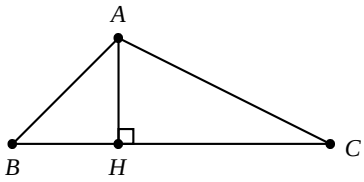
4 Configurations



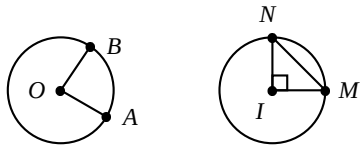

```
\begin{pspicture}(-2,-4)(2,0.5)
  \pstTriangle[PosAngleB=-30]{A}(2.5;-90){B}(2.5;-60){C}
   \pstCircleOA{B}{C}
   {\psset{PosAngleA=30,PointSymbolB=none}
     \pstInterLC{A}{B}{B}{C}{M}{none}
     \pstInterLC{A}{C}{B}{C}{N}{none}}
   \psset{nodesep=-2}
   \pstLineAB{M}{N}
   \pstTranslation[PointSymbol=none]{N}{C}{M}{C2}
   \pstLineAB{C2}{C}
   \psset{arcsep=\pslinewidth,doubleline=true}
   \pstMarkAngle{N}{C}{C2}{}
   \pstMarkAngle[MarkAngleRadius=.3]{C2}{C}{B}{}
\end{pspicture}
```



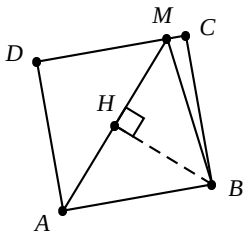

```
\begin{pspicture}(-5.5,-2.5)(2.5,0.5)
\pstTriangle[PosAngleA=90,PosAngleB=100,PosAngleC=-80]
            {V}(-4,0){T}(2.1;-115){E}
\pstGeonode(2.1;0){U}
\pstTranslation{V}{E}{U}{N}
\pstSegmentMark{V}{E}\pstSegmentMark{E}{N}
\pstLineAB{V}{U}\pstLineAB{U}{N}

\pstTranslation[PosAngle=-90]{V}{T}{E}{R}
\pstLineAB{T}{R}\pstLineAB{R}{E}

\pstMiddleAB{V}{N}{S}
\end{pspicture}
```



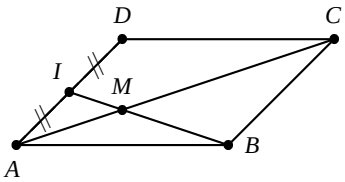

```
\begin{pspicture}(-2.5,-1)(5,2.5)
\pstTriangle[PosAngleA=90,PosAngleB=-90,PosAngleC=-10](0,2){A}(-2,0){B}(4,0){C}
\pstProjection[PosAngle=-90]{B}{C}{A}{H}
\pstLineAB{A}{H}
\pstRightAngle{C}{H}{A}
\end{pspicture}
```



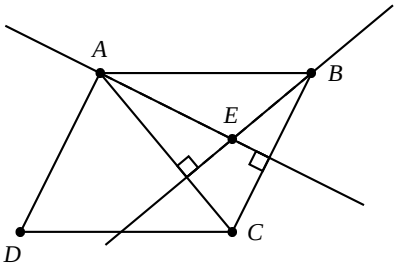

```
\begin{pspicture}(-1.5,-1.5)(6,1.5)
  \pstGeonode[PosAngle=180]{O}
  \pstGeonode(1;-30){A}
  %\pstGeonode(2;10){B}
  \pstCircleOA{O}{A}
  \pstCurvAbsNode{O}{A}{B}{\pstDistVal{1.5}}
  \ncline{O}{A}\ncline{O}{B}

  \pstTriangle[PosAngleA=-120,PosAngleC=100](4,0){I}(5,0){M}(4,1){N}
  \pstRightAngle{M}{I}{N}
  \pstCircleOA{I}{M}
\end{pspicture}
```



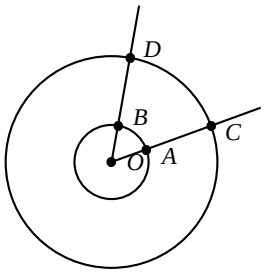

```
\begin{pspicture}(-2,-2)(2,2)
  \rput{10}{
  \pstGeonode[PosAngle=200](-1,-1){A}
  \pstGeonode[PosAngle=-20](1,-1){B}
  \pstGeonode[PosAngle=10](1,1){C}
  \pstGeonode[PosAngle=150](-1,1){D}
  \pspolygon(A)(B)(C)(D)
  \pstGeonode[PosAngle=90](0.75,1){M}
  \pstLineAB{M}{B}\pstLineAB{A}{M}
  \pstProjection[PosAngle=100,CodeFig=true,CodeFigColor=black]{A}{M}{B}{H}
}
\end{pspicture}
```



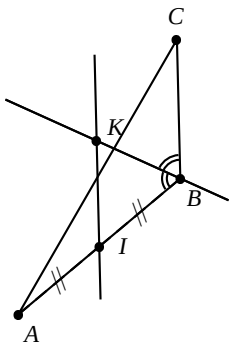

```
\begin{pspicture}(-.5,-1)(6.5,2.5)
\pstGeonode[PosAngle=-100]{A}
\pstGeonode(4,0){B}
\pstGeonode[PosAngle=90](6,2){C}
\pstGeonode[PosAngle=90](2,2){D}
\pspolygon(A)(B)(C)(D)
\psset{CodeFigColor=black}
\pstMiddleAB[CodeFig=true,PosAngle=120]{A}{D}{I}
\pstLineAB{I}{B}
\pstLineAB{A}{C}
\pstInterLL[PosAngle=90]{I}{B}{A}{C}{M}
\end{pspicture}
```



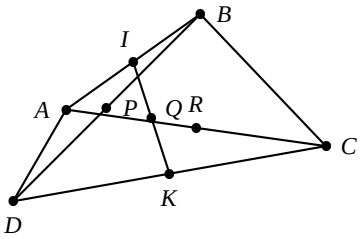

```
\begin{pspicture}(-.5,-.7)(6,3.5)
\pstTriangle[PosAngleA=-110,PosAngleC=90]{D}(4,0){C}(1.5,3){A}
\pstMiddleAB[PointSymbol=none]{A}{C}{I}
\pstSymO{I}{D}{B}
\pstLineAB{A}{B}\pstLineAB{B}{C}
\psset{CodeFig=true,CodeFigColor=black}
\pstProjection[PointSymbol=none]{A}{C}{B}{H1}
\pstProjection[PointSymbol=none]{B}{C}{A}{H2}
\psset{nodesep=-2}
\pstLineAB{A}{H2}
\pstLineAB{B}{H1}
\pstInterLL[PosAngle=90]{A}{H2}{B}{H1}{E}
\end{pspicture}
```



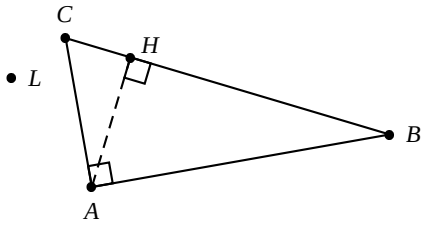

```
\begin{pspicture}(-2.5,-2.5)(2.5,2.5)%1.5)\psgrid
  \pstGeonode{O}
  \psset{nodesepB=-1}
  {\psset{PosAngle=-15}\pstGeonode(.7;20){A}  \pstGeonode(2;20){C}}
  {\psset{PosAngle=20}\pstGeonode(.7;80){B}  \pstGeonode(2;80){D}}
  \pstCircleOA{O}{A}
  \pstCircleOA{O}{C}
  \pstLineAB{O}{C}
  \pstLineAB{O}{D}
\end{pspicture}
```



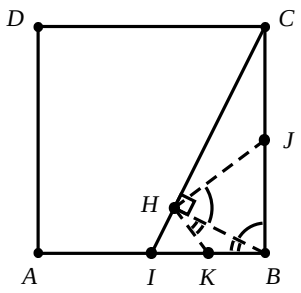

```
\begin{pspicture}(-1,-1)(4,6)%5)\psgrid
  \pstTriangle[PosAngle=-55,PosAngleC=90]{A}(4;40){B}(6;60){C}
  \psset{CodeFig=true,CodeFigColor=black,nodesep=-1}
  \pstMiddleAB{A}{B}{I}
  \pstBissectBAC[PointSymbol=none]{C}{B}{A}{K1}
  {\psset{arcsep=\pslinewidth,doubleline=true}
    \pstMarkAngle{C}{B}{K1}{}
    \pstMarkAngle[MarkAngleRadius=.3]{K1}{B}{A}{}}

  \pstLineAB{K1}{B}
  \pstTranslation[PointSymbol=none]{B}{C}{I}{K2}
  \pstLineAB{K2}{I}
  \pstInterLL[PosAngle=35]{B}{K1}{I}{K2}{K}
%  \pstGeonode[PointName=(d)](0,4){d}
\end{pspicture}
```



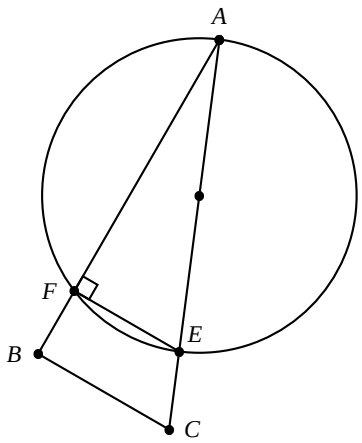

```
\begin{pspicture}(-1,-1)(7,4)%3)\psgrid
  \pstGeonode[PosAngle=-90]{D}\pstGeonode(6;10){C}
  \pstGeonode(5;45){B}\pstGeonode[PosAngle=180](2;60){A}
  \pspolygon(A)(B)(C)(D)
  \pstMiddleAB[PosAngle=110]{A}{B}{I}
  \pstMiddleAB[PosAngle=-90]{C}{D}{K}
  \pstMiddleAB{B}{D}{P}
  \pstMiddleAB[PosAngle=90]{A}{C}{R}
  \pstMiddleAB[PosAngle=20]{I}{K}{Q}
  \ncline{A}{C}\ncline{D}{B}\ncline{I}{K}
\end{pspicture}
```



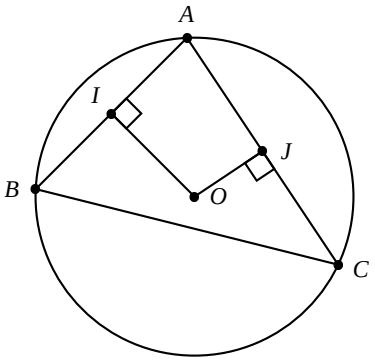

```
\begin{pspicture}(-1,-1)(5,3)
  \pstTriangle[PosAngleA=-90,PosAngleC=90]{A}(4;10){B}(2;100){C}
  \pstRightAngle{B}{A}{C}
  \pstProjection[CodeFig=true,CodeFigColor=black,PosAngle=30]{C}{B}{A}{H}
  \pstOrtSym{A}{B}{H}{K}
  \pstOrtSym{A}{C}{H}{L}
\end{pspicture}
```

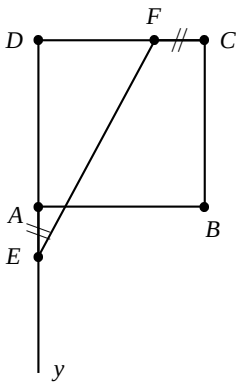

```
\begin{pspicture}(-.5,-.5)(3.5,3.5)
  \pstGeonode[PosAngle=-110](0,0){A}
  \pstGeonode[PosAngle=-70](3,0){B}
  \pstGeonode[PosAngle=20](3,3){C}
  \pstGeonode[PosAngle=160](0,3){D}
  \psset{linewidth=1.5\pslinewidth}
  \pspolygon(A)(B)(C)(D)
  \pstMiddleAB[PosAngle=-90]{A}{B}{I}
  \pstMiddleAB{B}{C}{J}
  \pstMiddleAB[PosAngle=-90]{I}{B}{K}
  \pstProjection[PosAngle=170,CodeFig=true,CodeFigColor=black,
                 RightAngleSize=.2]{I}{C}{B}{H}
  \psline(I)(C)
  {\psset{linestyle=dashed}\psline(J)(H)\psline(H)(K)}
  \psset{arcsep=1.5\pslinewidth}
  {\psset{doubleline=true}
    \pstMarkAngle{H}{B}{K}{}
    \pstMarkAngle{K}{H}{B}{}}
  \pstMarkAngle{J}{B}{H}{}
  \pstMarkAngle[MarkAngleRadius=.5]{B}{H}{J}{}
\end{pspicture}
```




```
\begin{pspicture}(-.5,-3)(6,5)
  \psset{unit=8mm}
  \pstTriangle[PosAngleA=180,PosAngleB=90](0,0){B}(6;60){A}(2.5;-30){C}
  \pstHomO[PosAngle=45,HomCoef=.8]{A}{C}{E}
  \pstCircleAB{A}{E}
  \pstMiddleAB[PointName=none]{A}{E}{O}
  \pstInterLC[PosAngleA=180,PointNameB=none]{B}{A}{O}{E}{F}{ff}
  \pstLineAB{E}{F}
  \pstRightAngle{E}{F}{A}
\end{pspicture}
```

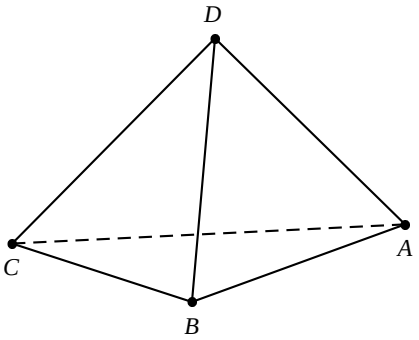



```
\begin{pspicture}(-3,-3)(3,3)
  \pstTriangle[PosAngleA=90,PosAngleB=180,PosAngleC=-10]
  (0,2){A}(-2,0){B}(2,-1){C}
  \pstCircleABC{A}{B}{C}{O}
  \psset{CodeFig=true, CodeFigColor=black, CodeFigStyle=solid}
  \pstProjection[PosAngle=130]{A}{B}{O}{I}
  \pstProjection{A}{C}{O}{J}
\end{pspicture}
```

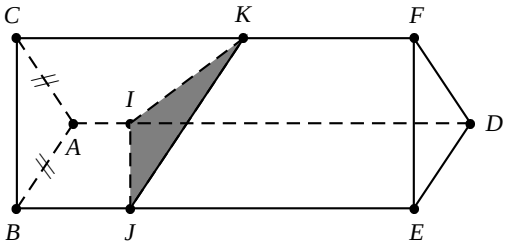



```
\begin{pspicture}(-2,-1.5)(4,2.5)
  \newlength{\cc}
  \setlength{\cc}{2.2cm}
  \pstGeonode[PosAngle=200]{A}
  \pstGeonode[PosAngle=-70](\cc,0){B}
  \pstGeonode(\cc,\cc){C}
  \pstGeonode[PosAngle=180](0,\cc){D}
  \pstHomO[PosAngle=90,HomCoef=.3]{C}{D}{F}
  \pstHomO[PosAngle=180,HomCoef=-.3]{A}{D}{E}
  \pspolygon(A)(B)(C)(D) \psline(E)(F)
  \pstSegmentMark{F}{C} \pstSegmentMark{A}{E}
  \pcline(A)(0,-\cc)\aput(1){$y$}
\end{pspicture}
```

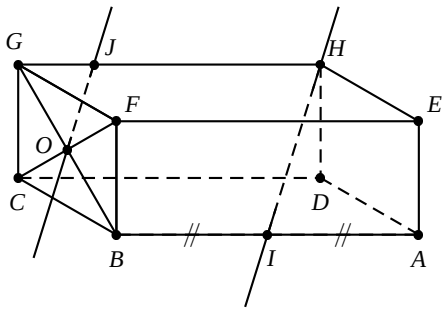
5 Espace




```
\psset{unit=1cm}
\begin{pspicture}(-3,-1)(2,3)
  \psset{PosAngle=-90}
  \pstGeonode{B}
  \pstGeonode(3;20){A}
  \pstGeonode(2.5;162){C}
  \pstGeonode[PosAngle=95](3.5;85){D}
  \pspolygon(D)(C)(B)(A)\psline(B)(D)
  \psline[linestyle=dashed](C)(A)
\end{pspicture}
```




```
\begin{pspicture}(-1,-1)(9,5)
  \psset{unit=.75cm}
  \pstGeonode[PosAngle=-100]{B}
  \pstGeonode[PosAngle=100](0,3){C}
  \pstGeonode[PosAngle=-80](7,0){E}
  \pstGeonode[PosAngle=80](7,3){F}
  \pstGeonode(8,1.5){D}
  \pstGeonode[PosAngle=-90](1,1.5){A}
  \pstGeonode[PosAngle=90](2,1.5){I}
  \pstGeonode[PosAngle=-90](2,0){J}
  \pstGeonode[PosAngle=90](4,3){K}
  \psline(F)(C)(B)(E)(D)(F)(E)
  {\psset{linestyle=dashed}
    \pstSegmentMark{B}{A}
    \pstSegmentMark{C}{A}
    \pspolygon[fillstyle=solid, fillcolor=gray](J)(I)(K)
    \psline(A)(D)}
  \psline(J)(K)
\end{pspicture}
```




```
\begin{pspicture}(-2,-1)(5,3)
  {\psset{PosAngle=-90}
    \pstGeonode{B}
    \pstGeonode(4,0){A}
    \pstGeonode(1.5;150){C}
    \pstTranslation{B}{A}{C}{D}}
  {\psset{PosAngle=45}
    \pstGeonode(0,1.5){F}
    \pstTranslation{B}{A}{F}{E}
    \pstTranslation[PosAngle=100]{B}{F}{C}{G}
    \pstTranslation{B}{A}{G}{H}}

  \pspolygon(B)(C)(G)(F)
  \pspolygon(B)(A)(E)(F)
  \psline(E)(H)(G)(F)
  \psline(C)(F)\psline(B)(G)
  \pstMiddleAB[CodeFig=true, CodeFigColor=black,PosAngle=-80]{B}{A}{I}
  \pstMiddleAB[PosAngle=170]{G}{B}{O}
  \pstHomO[HomCoef=.75, PosAngle=45]{H}{G}{J}

  \ncline[nodesepA=-1.5,nodesepB=1]{O}{J}
  \ncline[nodesepA=1,nodesepB=-.8]{O}{J}
  \ncline[nodesepA=-1,nodesepB=2]{I}{H}
  \ncline[nodesepA=2,nodesepB=-.8]{I}{H}

  \psset{linestyle=dashed}
  \psline(C)(D)(H)\psline(D)(A)\psline(I)(H)\psline(O)(J)
\end{pspicture}
```