“Mathématique et Citoyenneté”

44e congrès de la Société Belge des Professeurs de Mathématique d’expression française

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Création d’un dispositif mathématique en ligne avec Maple-Möbius Assessment-Möbius CourseWare

Support.2

Création de questions aléatoires Exemples d’algorithmes

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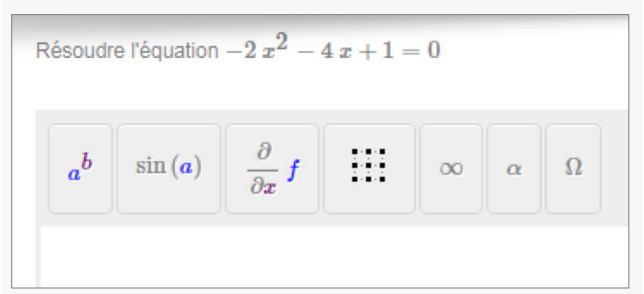
1. Résoudre une équation de second degré

Aperçu de la prévisualisation :

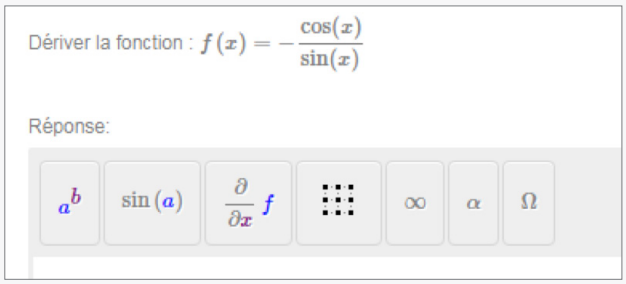


Algorithme :

```
#Générer un polynôme de second degré, ordonné et complet#
$eqn=maple(“randomize();
f:=sort(randpoly(x,coeffs=rand(-9..9),degree=2,dense));”);
# Editer l’équation  mathématique #
$Eqn=maple(“printf(MathML[ExportPresentation]($eqn=0))”);
# Calculer le discriminant de l’équation générée#
$delta=maple(“discrim($eqn,x)”);
# insérer une condition sur delta, ici supérieur à 0 #
condition : gt($delta,0);
# Résoudre l’équation en x  #
$ans=maple(“solve($eqn,x)”);
```

2. Dérivée d’un quotient de fonctions trigonométriques

Aperçu de la prévisualisation :

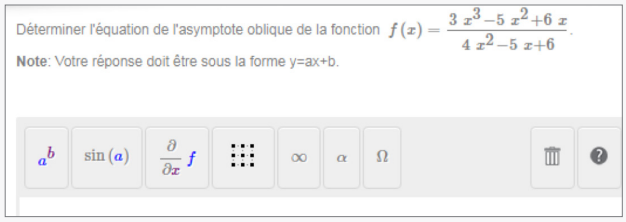


Algorithme :

```
#Générer des nombres aléatoires, en alternant les signes#
$a=switch(rint(2),range(1,5),range(-5,-1));
#Définir la fonction#
$question=maple("($a*cos(x))/(sin(x))");
# Editer la function#
$displayquestion=maple("printf(MathML[ExportPresentation](f(x)=$question))");
# dériver et simplifier la réponse #
$reponse=maple("simplify(diff($question,x))");
# Editer la réponse pour une éventuelle rétroacation #
$displayreponse=maple("printf(MathML[ExportPresentation]($reponse))");
```

3. Asymptote oblique d'une fonction rationnelle

Aperçu de la prévisualisation :

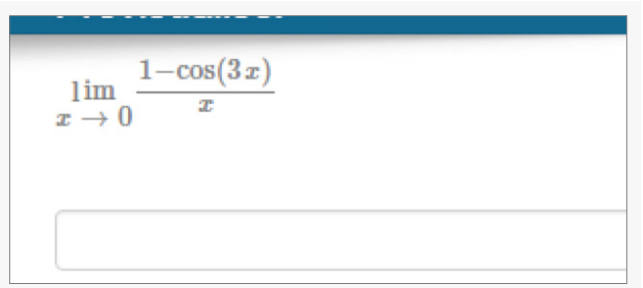


Algorithme :

```
$a=2+rint(4);
$bs=switch(rint(2), "minus", "plus");
$b=$a+1+rint(3);
$cs=switch(rint(2), "minus", "plus");
$c=$b+1;
$d=$a+1;
$i=rint(2);
$es=switch($i, "minus", "plus");
$e=2+rint(5);
$fs=switch(rint(2), "minus", "plus");
$f=1+rint(9);
$ynum=switch($i, if(eq("$bs", "plus"), $b*$d+$a*$e, -$b*$d+$a*$e), if(eq("$bs", "plus"), $b*$d-$a*$e, -$b*$d-$a*$e));
$sign=if(lt($ynum, 0), "minus", "plus");
$sign1=if(lt($ynum, 0), "-", "+");
$yden=$d*$d;
$gcd=gcd($ynum, $yden);
$yn=abs($ynum/$gcd);
$yd=$yden/$gcd;
condition:ne($yd, 1);
$ans="y=($a/$d*x)$sign1($yn/$yd)";
```

4. Règle de l'Hospital

Aperçu de la prévisualisation :



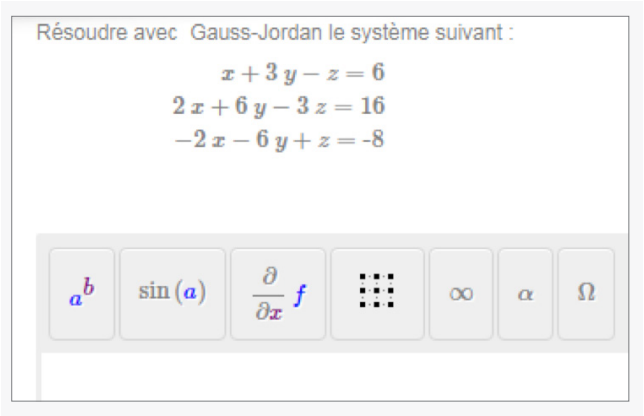
Algorithme :

```
$a=rint(5)+2;
$b=rint(5)+2;
$bs=$b*$b;
$z=rint(6);
$f=switch($z , "sin($b*x)/tan($a*x)","(1-cos($b*x))/x","(1-cos($b*x))/x^2","x/sin($a*x)","tan(x)/tan($b*x)","sin($b*x)/x");
$step1=switch($z , "($b*cos($b*x))/($a*(sec($a*x))^2)","($b*sin($b*x))/1","($b*sin($b*x))/2*x","1/($a*cos($a*x))","(sec(x))^2/($b*(sec($b*x))^2)","$b*cos($b*x)/1");
$step2=switch($z , "($b*cos($b*x)*(cos($a*x))^2)/($a)","($b*sin($b*x))","($bs*cos($b*x))/2","1/($a*cos($a*x))","(cos($b*x))^2/($b*(cos(x))^2)","$b*cos($b*x)");
$step3=switch($z , "($b)/($a)","0","($bs)/2","1/($a)","1/($b)","$b");
```

```
$reason=switch($z, “”, “”, “par L’Hospital “, “”, “”, “”);
$if=switch($z, “”, “”, ‘”0/0”’, “”, “”, “”);
$F=mathml($f);
$Step1=mathml(“$step1”);
$Step2=mathml(“$step2”);
$Step3=mathml(“$step3”);
```

5. Résolution adaptative d’un système linéaire (Gauss-Jordan)

Aperçu de la prévisualisation :



Algorithme :

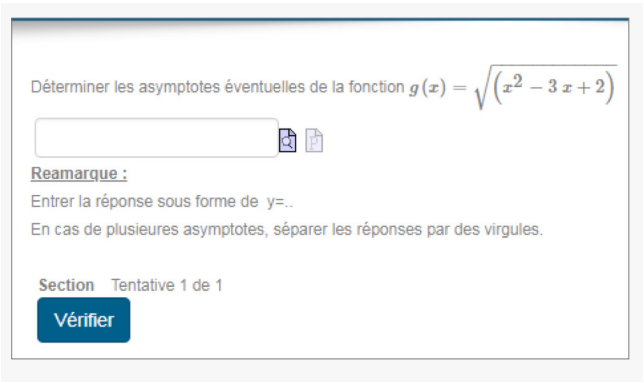
```
$n = 3;
$BaseInfo = maple(“ randomize():
opt1 :=  rand(0..1)();
opt2 :=  rand(0..1)();
 A := LinearAlgebra[RandomMatrix]($n, $n, generator = rand(-4 .. 4));
 while LinearAlgebra[Determinant](A) <> 1 do
  A := LinearAlgebra[RandomMatrix]($n, $n, generator = rand(-4 .. 4));
 end do;
 Base := Matrix($n, $n+1, 0);
  Base[1, 1] := 1;
  Base[1, 2] := (rand(2 .. 5))()*(2*(rand(0 .. 1))()-1);
  Base[1, 3] := (rand(2 .. 5))()*(2*(rand(0 .. 1))()-1);
  Base[1, 4] := (rand(2 .. 5))()*(2*(rand(0 .. 1))()-1);
 if opt1 = 0 then
  Base[1, 2] := 0;
  Base[2, 2] := 1;
  Base[2, 3] := (rand(2 .. 5))()*(2*(rand(0 .. 1))()-1);
  Base[2, 4] := (rand(2 .. 5))()*(2*(rand(0 .. 1))()-1);
 else
  Base[1, 3] := 0;
  Base[2, 3] := 1;
  Base[2, 4] := (rand(2 .. 5))()*(2*(rand(0 .. 1))()-1);
 end if;
 if opt2 = 0 then
  Base[3, 4] := 1;
 end if;
 Aug := LinearAlgebra[MatrixMatrixMultiply](A, Base);
BaseInfo := Matrix(1,4); BaseInfo[1,1] := opt1; BaseInfo[1,2] := opt2;
 BaseInfo[1,3] := Aug; BaseInfo[1,4] := Base;
BaseInfo;
“);
$PrBaseInfo = maple(“printf(MathML[ExportPresentation]($BaseInfo))”) ;
$Aug = maple(“Aug := $BaseInfo[1,3]; Aug”);
$PrAug = maple(“printf(MathML[ExportPresentation]($Aug))”);
$Base = maple(“Base := $BaseInfo[1,4]; Base”);
$PrBase = maple(“printf(MathML[ExportPresentation]($Base))”);
$howmany = maple(“2*$BaseInfo[1,2]+1”);
# $HowMany = maple(“$howmany”);
$values = maple(“
 if $BaseInfo[1,2] = 0 then
  xvalue := None;  yvalue := None; zvalue := None;
 else
  if $BaseInfo[1,1] = 0 then
   xvalue := $Base[1,4] - $Base[1,3]*t;
   yvalue := $Base[2,4] - $Base[2,3]*t;
   zvalue := t;
  else
```

```
    xvalue := $Base[1,4]-$Base[1,2]*y;
    yvalue := y;
    zvalue := $Base[2,4];
  fi;
fi;
  Vector(3, [xvalue, yvalue, zvalue])
  ");
```

```
$PrValues = maple("printf(MathML[ExportPresentation]($values))");
$xval = maple("$values[1];");
$yval = maple("$values[2];");
$zval = maple("$values[3];");
$Eqn1 = maple("printf(MathML[ExportPresentation]($Aug[1,1]*x+$Aug[1,2]*y+$Aug[1,3]*z=$Aug[1,4]))");
$Eqn2 = maple("printf(MathML[ExportPresentation]($Aug[2,1]*x+$Aug[2,2]*y+$Aug[2,3]*z=$Aug[2,4]))");
$Eqn3 = maple("printf(MathML[ExportPresentation]($Aug[3,1]*x+$Aug[3,2]*y+$Aug[3,3]*z=$Aug[3,4]))");
$xvar =  maple("printf(MathML:-ExportPresentation(x))");
$yvar =  maple("printf(MathML:-ExportPresentation(y))");
$zvar =  maple("printf(MathML:-ExportPresentation(z))");
$equal = '=';
$PrT =  maple("printf(MathML:-ExportPresentation(t))");
```

6. Asymptotes d'une fonction irrationnelle avec illustration graphique

Aperçu de la prévisualisation :

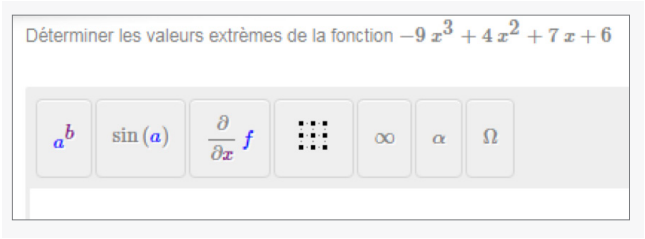


Algorithme :

```
$Test=maple("
f:=surd(x^2-3*x+2,2);
As:=Student[Calculus1][Asymptotes](f,x);
[f,As]
");
$REP=maple("{op($Test[2])}");
$F=maple("f:=$Test[1];printf(MathML[ExportPresentation](g(x)=f))");
$Fone=maple("f:=$Test[1];printf(MathML[ExportPresentation](f))");
$fct=maple("sqrt(x^2-3*x+2)");
$fctasone=maple("(sqrt(x^2-3*x+2))/x");
$fctastwo=maple("(sqrt(x^2-3*x+2))-x");
$fctastree=maple("(sqrt(x^2-3*x+2))+x");
$limiteone=maple("limit($fct,x=infinity)");
$limitetwo=maple("limit($fct,x=-infinity)");
$limitetree=maple("limit($fctasone,x=infinity)");
$limitefour=maple("limit($fctasone,x=-infinity)");
$limitefive=maple("limit($fctastwo,x=infinity)");
$limitesix=maple("limit($fctastree,x=-infinity)");
$Temp=plotmaple("
j:=surd(x^2-3*x+2,2);
A:=Student[Calculus1][Asymptotes](j,x);
P:=plots:-implicitplot(A,x=-5..5,y=-10..10,color=navy,linestyle=dash,view=[-1..3,-0.5..2]);
Q:=plot(j(x),x=-5..5,discont=true,view=[-1..3,-0.5..2]);
plots:-display({P,Q},thickness=3);
");
```

7. Valeurs extrêmes d'une fonction polynomiale

Aperçu de la prévisualisation :



Algorithme :

$Temp=maple("randomize();

with(Student[Calculus1]);

f:=sort(randpoly(x,coeffs=rand(-9..9),degree=3,dense));

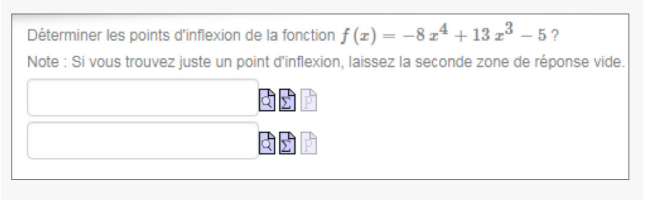
");

$fct=maple("printf(MathML[ExportPresentation]($Temp))");

$ext=maple("op(Student[Calculus1]:-ExtremePoints($Temp,x))");

8. Points d'inflexion d'une fonction

Aperçu de la prévisualisation :



Algorithme :

$a=rint(2,13);

$b=rint(2,14);

$c=rint(5,13);

condition: ne($a,$b);

$func="-$a*x^4+$b*x^3-$c";

$m = maple("

MathML[ExportPresentation]($func),

convert($b/(2*$a),string)

");

$disp=switch(0,$m);

$ANS=switch(1,$m);

9. Factorisation d'un polynôme

Aperçu de la prévisualisation :

Algorithme :

$a=range(2,4);$c=maple("min(($a)^2-2,4)");$b=range(1,$c);$p=maple("

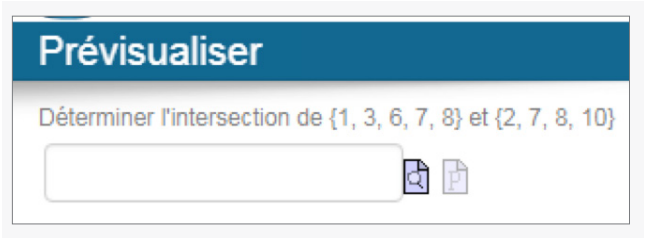
($a)^2-($b)");$q=maple("($a)^2*($b)");

evalb(StringTools[Search]("factor","$RESPONSE")=0) and

evalb($RESPONSE = factor(x^4-($p)*x^2-($q)));

10. Intersection de deux ensembles

Aperçu de la prévisualisation :



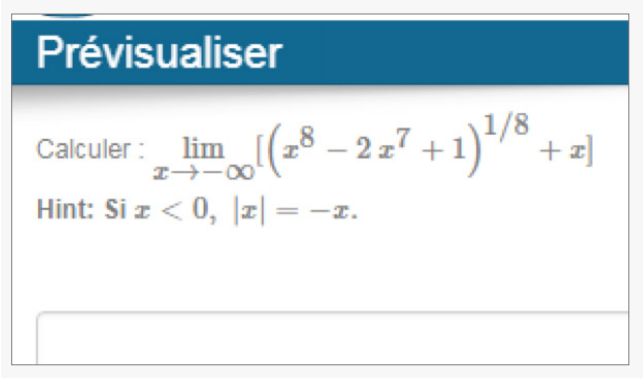
Algorithme :

$set1=maple("randomize():RandomTools[Generate](set(posint(range=8),5))");

$set2=maple("randomize():RandomTools[Generate](set(posint(range=10),4))");

11. Lever l'indetermination d'une limite

Aperçu de la prévisualisation :

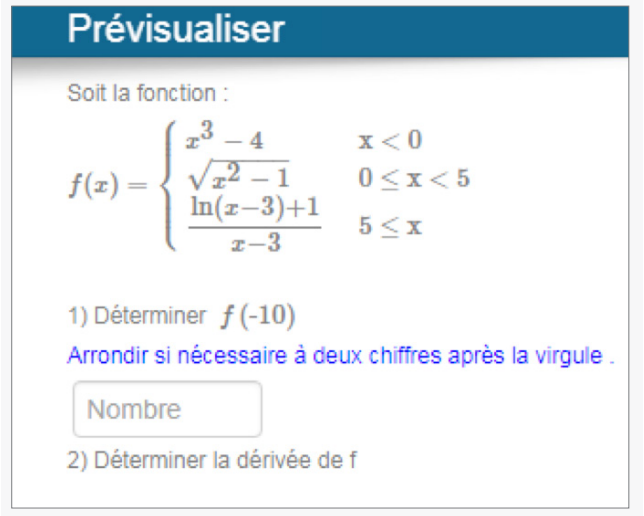


Algorithme :

```
$a=range(2,5);
$b=range(1,9);
$n=range(4,10,2);
$m=switch(rint(4), $n-1,$n-1,$n-1,$n-2);
$f=switch(rint(2),"(x^$n+$a*x^$m+$b)^(1/$n)+x",
"(x^$n-$a*x^$m+$b)^(1/$n)+x");
$F=maple("printf(MathML[ExportPresentation]($f))");
limit($f,x=-infinity);
```

12. Fonctions par morceaux

Aperçu de la prévisualisation :



Algorithme :

```
$questionInput=range(-10,10,1);
$callout=maple("
f:=unapply(x^3-4,x);
g:=unapply(sqrt(x^2-1),x);
h:=unapply((ln(x-3)+1)/(x-3),x);
condtion1 := x < 0;
condtion2 := 0 <= x and x < 5;
condtion3 := x >= 5;
piece := unapply(piecewise(condtion1, f(x), condtion2,
g(x), condtion3, h(x)),x);
answer:=piece($questionInput);
[f(x),g(x),h(x),answer];
");
$functionF=maple("latex($callout[1])");
$functionG=maple("latex($callout[2])");
$functionH=maple("latex($callout[3])");
$answer=decimal(2,switch(3,$callout));
```

13. Tangente à une courbe

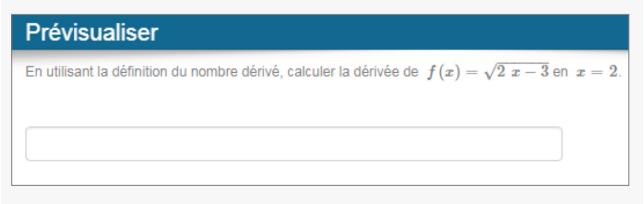
Aperçu de la prévisualisation :

Algorithme :

```
$temp=maple("randomize();
with(Student[Calculus1]);
f:=sort(randpoly(x,coeffs=rand(-9..9),degree=2,dense));
sol:=CriticalPoints(f,x);
[f,sol,MathML[ExportPresentation](g(x)=f)]
");
$rep=switch(1,$temp);
$F=switch(2,$temp);
```

14. Nombre dérivé

Aperçu de la prévisualisation :

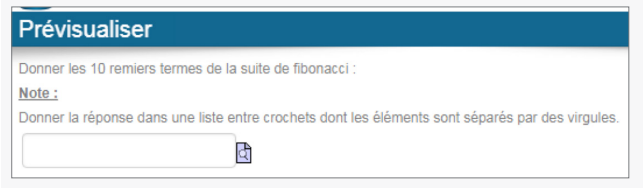


Algorithme :

```
$i=rint(6);
$b=switch($i, 2, -2, 2, -2, -2, 2);
$bs=if(lt($b, 0), “minus”, “”);
$B1=abs($b);
$B=if(eq($B1, 1), “”, $B1);
$c=switch($i, 3, -3, -3, -5, 3, -5);
$cs=if(lt($c, 0), “minus”, “plus”);
$C1=abs($c);
$C=if(lt($C1, 1), “”, $C1);
$a=switch($i, -1, -2, 2, -3, 1, 3);
$A=abs($a);
$as=if(lt($a, 0), “minus”, “”);
$ans=switch($i, 1, -1, 1, -1, -1, 1);
$ANS=abs($ans);
$sa=if(lt($ans, 0), “minus”, “”);
condition:eq($ANS, int($ANS));
```

15. Termes d’une suite (Fibonacci)

Aperçu de la prévisualisation :

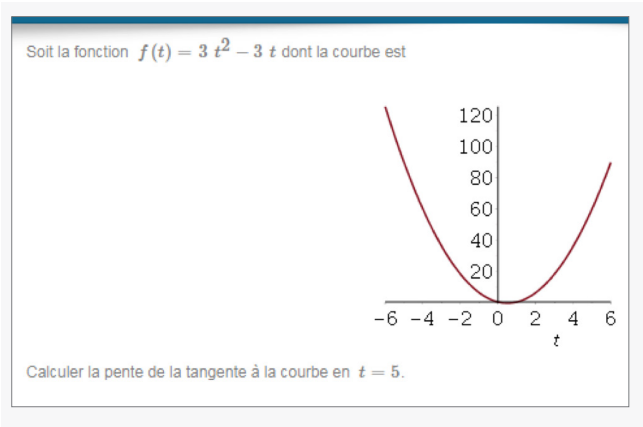


Algorithme :

```
$fibo=maple(“[seq(combinat[fibonacci](i),i=0..10)]”);
```

16. Pente d’une droite

Aperçu de la prévisualisation :



Algorithme :

```
$a=range(1,5);
$cp=switch(rint(6), 1, 2, 3, 5, 6, 7);
$c=$cp-4;
$cs=if(lt($c, 0), “minus”, “”);
$Cs=if(lt($c, 0), -1, 1);
$C1=abs($c);
$C=if(eq($C1, 1), “”, $C1);
$dp=switch(rint(9), 1, 2, 3, 4, 5, 7, 8, 9, 10);
$d=$dp-6;
$ds=if(lt($d, 0), “minus”, “plus”);
$Ds=if(lt($d, 0), -1, 1);
$D1=abs($d);
$D=if(eq($D1, 1), “”, $D1);
$m=($c)*2*($a)+($d);
$ms=if(lt($m, 0), “minus”, “”);
$M=abs($m);
$ya=(($c)*($a)*($a)+($d)*($a));
```

$A=abs($ya);

$as=if(lt($ya, 0), “minus”, “”);

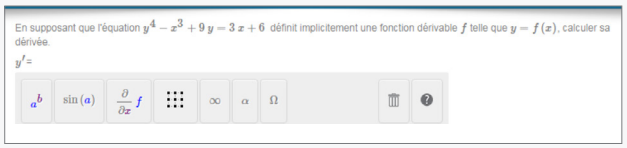
$yint=(($c)*($a)*($a)+($d)*($a))-($m*$a);

$plotm=plotmaple(“plot($c*t^2+($d)*t, t=-6..6), plotoptions=’height=500,width=500’”);

$plot=plotmaple(“plot([($c)*t^2+($d)*t, ($m)*t+($yint)], t=-6..6), plotoptions=’height=500,width=500’”);

17. Dérivée implicite

Aperçu de la prévisualisation :



Algorithme :

$a=range(1,10,1);

$b=range(1,8,1);

$c=range(1,8,2);

$d=range(2,8,2);

condition :ne($a,0);

condition:ne($b,0);

condition:ne($c,0);

condition:ne($d,0);

$f=maple(“y^4+($a)*y-($b)*x^3=($c)*x+$d”);

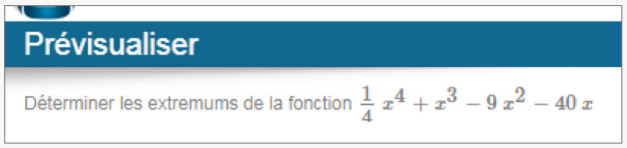
$F=maple(“printf(MathML[ExportPresentation]($f))”);

$sol=maple(“implicitdiff($f,y,x)”);

$prod1=maple(“eval(3*$b)”);

18. Extremums d’une fonction

Aperçu de la prévisualisation :



Algorithme :

$a=rint(-1,5);

$b=rint(-5,-1);

$c=rint(-6,-1);

$d=rint(-10,10);

$r=int(($a)+($b)+($c));

$q=int(($a)*($b)*($c));

$p=int((($a)*($b))+(($a)+($b))*($c));

$f=maple(“simplify(expand((x-($a))*(x-($b))*(x-($c))))”);

$F=maple(“int($f,x)”);

$g=maple(“printf(MathML:-ExportPresentation($f))”);

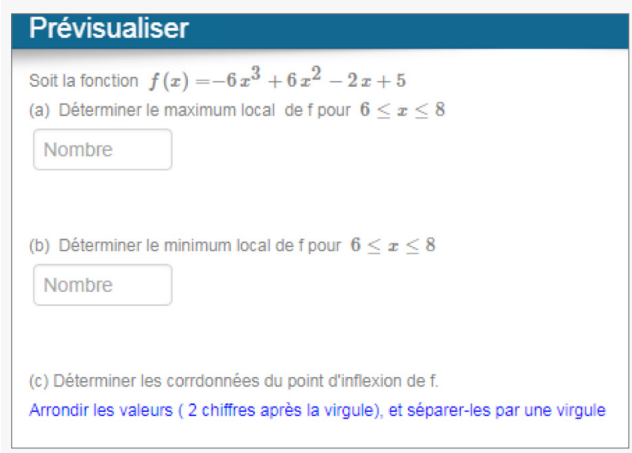
$G=maple(“printf(MathML:-ExportPresentation($F))”);

$sol=maple(“convert(Student[Calculus1][Roots]($f), set)”);

$Retro=plotmaple(“plot($f,x,view=[min($a,$b,$c)-1..max($a,$b,$c)+1,-10..100])”);

19. Points remarquables d’une fonction

Aperçu de la prévisualisation :



Algorithme :

$lowerBound=range(-10,10,1);

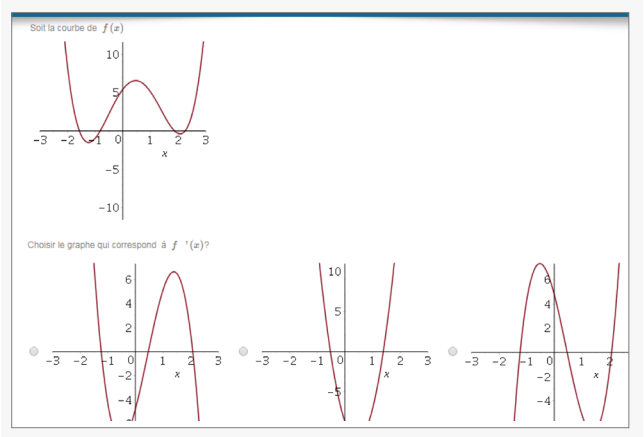
$upperBound=range($lowerBound+1,20,1);

$randomizer=rint(1000);

```
$callout=maple(“
randomize($randomizer):
polynomial:=randpoly(x, coeffs=rand(-9..9), terms=4, degree=3);
display:=latex(polynomial,output=string);
max:=maximize(polynomial,x=$lowerBound..$upperBound);
min:=minimize(polynomial,x=$lowerBound..$upperBound);
with(Student[Calculus1
inflectionX:=InflectionPoints(polynomial);
inflectionY:=eval(polynomial,x=inflectionX);
[polynomial,display,max,min,inflectionX,inflectionY];
“);
$function=switch(0,$callout);
$Function=maple(“printf(MathML[ExportPresentation]($function))”);
$displayF=switch(1,$callout);
$answerA=decimal(0,switch(2,$callout));
$answerB=decimal(0,switch(3,$callout));
$answerCx=decimal(2,switch(4,$callout));
$answerCy=decimal(2,switch(5,$callout));
```

20. Association graphique d’une fonction à sa dérivée (QCM)

Aperçu de la prévisualisation :



Algorithme :

```
$xwidth = “x=-3..3”;
$p_options = “plotoptions=’height=250, width=250’”;
$temp=maple(“randomize();
with(RandomTools):
rint := rand(4 .. 6);
zero1 := Generate(float(range = -2..-1.5, digits = 3));
zero2 := Generate(float(range = -1.3..-0.8, digits = 3));
zero3 := Generate(float(range = -0.6..-0.1, digits = 3));
zero4 := Generate(float(range = 0.1..0.6, digits = 3));
zero5 := Generate(float(range = 0.8..1.3, digits = 3));
zero6 := Generate(float(range = 1.5..2, digits = 3));
zero7 := Generate(float(range = 2.2..2.7, digits = 3));
zero8 := Generate(float(range = -2.7..-2.2, digits = 3));
numZeros := rint();
zeroSet := {zero1,zero2,zero3,zero4,zero5,zero6,zero7,zero8};
numSet := Generate(set(posint(range = 8), numZeros));
while nops(numSet) < numZeros do numSet := Generate(set(posint(range = 8), numZeros)) end do;
plotfcn := 1;
for k from 1 to numZeros do plotfcn := plotfcn*(x-zeroSet[numSet[k]]);
end do;
tempMax := extrema(plotfcn, {}, x, ‘s’);
maxes := [seq(subs(s[i], plotfcn), i = 1 .. nops(s))];
count := 1;
for m in maxes do if type(m, realcons) then maxset[count] := abs(m);
count := count+1 end if end do;
lim:=max(seq(maxset[i], i = 1 .. count-1));
difffcn := diff(plotfcn, x);
tempMax2 := extrema(difffcn, {}, x, ‘s2’);
maxes2 := [seq(subs(s2[i], difffcn), i = 1 .. nops(s2))];
count := 1;
```

for m in maxes2 do if type(m, realcons) then maxset2[count] := abs(m);

count := count+1 end if end do;

lim2 := max(seq(maxset2[i], i = 1 .. count-1));

bad1 := abs(difffcn);

bad2 := -difffcn;

bad3 := simplify(diff(difffcn,x));

tempMax3 := extrema(bad3, {}, x, 's3');

maxes3 := [seq(subs(s3[i], bad3), i = 1 .. nops(s3))];

count := 1;

for m in maxes3 do if type(m, realcons) then maxset3[count] := abs(m);

count := count+1 end if end do;

lim3 := max(seq(maxset3[i], i = 1 .. count-1));

[plotfcn,lim,difffcn,lim2,bad1,bad2,bad3,lim3];

");

$questionfcn = switch(0,$temp);

$ymax = switch(1,$temp) + 5;

condition:lt($ymax,80);

$yheight = "-$ymax..$ymax";

$ansfcn = switch(2,$temp);

$ymax2 = switch(3,$temp);

condition:lt($ymax2,80);

$yheight2 = "-$ymax2..$ymax2";

$ymax3 = switch(7,$temp);

condition:lt($ymax3,80);

$yheight3 = "-$ymax3..$ymax3";

$questionplot = plotmaple("plot($questionfcn,$xwidth,$yheight),$p_options");

$ansplot = plotmaple("plot($ansfcn,$xwidth,$yheight2),$p_options,numpoints=500");

$badfcn1 = switch(4,$temp);

$badfcn2 = switch(5,$temp);

$badfcn3 = switch(6,$temp);

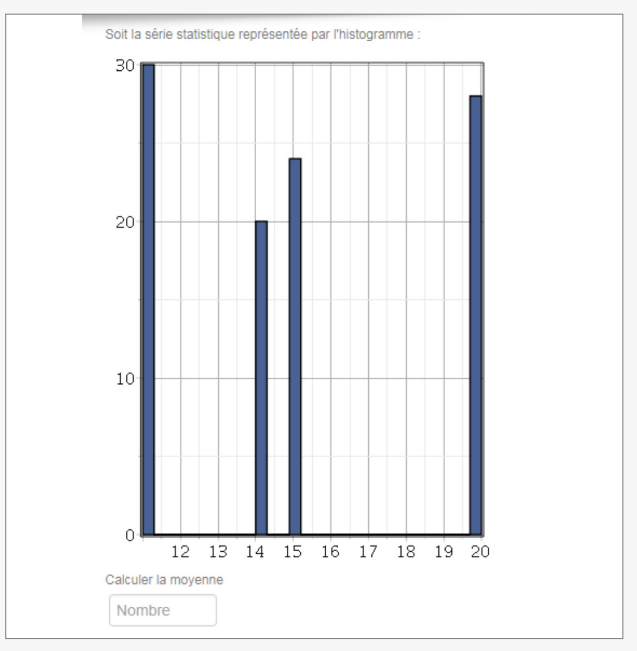
$badplot1 = plotmaple("plot($badfcn1,$xwidth,$yheight2),$p_options, numpoints=500");

$badplot2 = plotmaple("plot($badfcn2,$xwidth,$yheight2),$p_options, numpoints=500");

$badplot3 = plotmaple("plot($badfcn3,$xwidth,$yheight3),$p_options, numpoints=500");

21. Moyenne d'une série

Aperçu de la prévisualisation :



Algorithme :

$histo=maple("randomize();

x:=convert(LinearAlgebra:-RandomVector(4,generator=rand(10..20)),list);

while numelems(convert(x, set)) <> 4 do x := convert(LinearAlgebra:-RandomVector(4, generator = rand(10 .. 20)), list) end do;

p:=convert(LinearAlgebra:-RandomVector(4,generator=2*rand(10..20)),list);

m:=Statistics:-Mean(x,weights=p);

XP:=zip((u,v)->seq(u,k=1..v),x,p);

");

$Histo=plotmaple("Statistics:-Histogram($histo,frequencyscale=absolute,gridlines);");

$moy=maple("Statistics:-Mean($histo);");