Math 291: Lecture 11

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Outline

Introduction

- There are lots of options available with the postscript graphic creations.
- As mentioned in the Ti*k*Z lecture, pstricks works with functions much better than Ti*k*Z, which is why there are two lectures on pstricks.
- This lecture is essentially a bunch of examples showing the functionality of pstricks and related packages.
- You will need to load the pst-plot and the pst-func packages in order to use all of these commands.

Outline

Introduction

- Documentation availabe at: https://ctan.org/pkg/pst-plot (then choose the 'Package Documentation' link)
- We will also use the pspicture* environment
  - As mentioned last week, LaTeX is perfectly happy to graph outside of the area that you have set aside for the graph. The difference between the starred and unstarred versions of the pspicture environment is whether or not the graph is allowed to continue beyond the space set aside for it. In the starred version, the graph is clipped to fit the space as defined.
- In pst-plot, the functions are assumed to be inputted in Reverse Polish Notation. Since that is not how we typically think, we will use the 'algebraic' option to allow us to use normal mathematical notation.
- But be careful - you need to use * for the times sign at all times (so $2 * x$, not $2x$).

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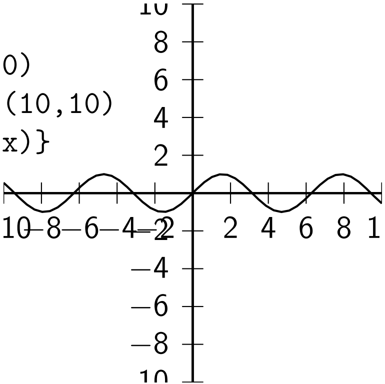
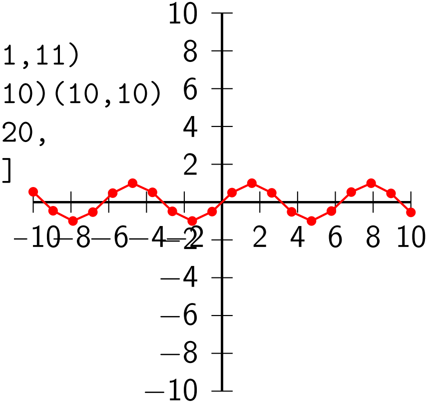
First example

```
\psset{unit=0.25cm}
\begin{pspicture*}(-10,-10)(10,10)
\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\psplot[algebraic]{-10}{10}{sin(x)}
\end{pspicture*}
```



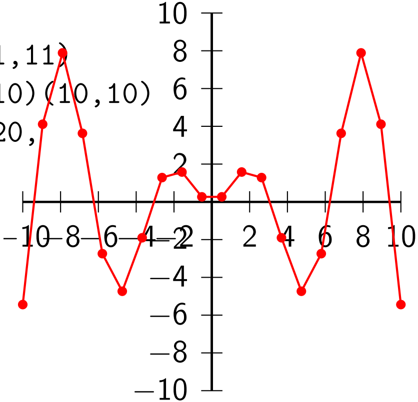
Modifications of the first example

```
\psset{unit=0.25cm}
\begin{pspicture*}(-11,-11)(11,11)
\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\psplot[algebraic,plotpoints=20,
linecolor=red,showpoints=true]
{-10}{10}{sin(x)}
\end{pspicture*}
```



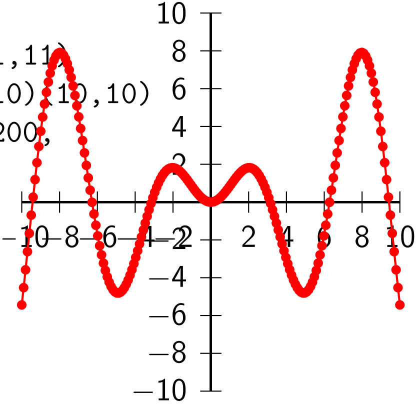
Modifications of the first example

```
\psset{unit=0.25cm}
\begin{pspicture*}(-11,-11)(11,11)
\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\psplot[algebraic,plotpoints=20,
linecolor=red,showpoints=true]
{-10}{10}{x*sin(x)}
\end{pspicture*}
```



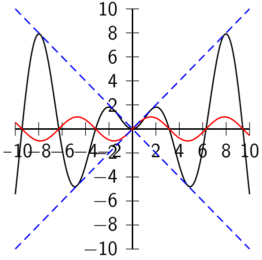
Modifications of the first example

```
\psset{unit=0.25cm}
\begin{pspicture*}(-11,-11)(11,11)
\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\psplot[algebraic,plotpoints=200,
linecolor=red,showpoints=true]
{-10}{10}{x*sin(x)}
\end{pspicture*}
```



Modifications of the first example

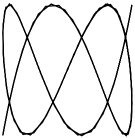
```
\psset{unit=0.25cm}
\begin{pspicture*}(-11,-11)(11,11)
\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\psplot[algebraic,plotpoints=200]
{-10}{10}{x*sin(x)}
\psplot[algebraic,plotpoints=200,linecolor=red]{-10}{10}{sin(x)}
\psplot[algebraic,plotpoints=200,linecolor=blue,linestyle=dashed]{-10}{10}{x}
\psplot[algebraic,plotpoints=200,linecolor=blue,linestyle=dashed]{-10}{10}{-x}
\end{pspicture*}
```



Outline

Second Example

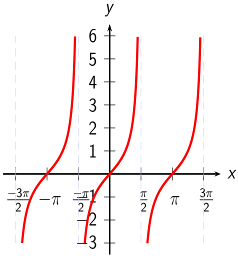
```
\begin{pspicture}(-2,-2)(2,2)
\parametricplot[algebraic,showpoints=false,plotpoints=100]
{0}{7}{sin(3*t)|sin(7*t)}
\end{pspicture}}
```



Outline

Third Example

```
\begin{pspicture}(-6.5,-4)(6.5,7.5)
\psaxes[trigLabelBase=2,dx=\psPiH,xunit=\psPi,trigLabels]
{->}(0,0)(-1.7,-3.5)(1.77,6.5)[$x$,0][$y$,90]
\psplot[yMaxValue=6,yMinValue=-3,linewidth=1.6pt,plotpoints=2000,
linecolor=red,algebraic]{-4.55}{4.55}{tan(x)}
\psset{linestyle=dashed,linecolor=blue!20,linewidth=0.25pt}
\psline(-4.71,-3)(-4.71,6)
\psline(-1.57,-3)(-1.57,6)
\psline(1.57,-3)(1.57,6)
\psline(4.71,-3)(4.71,6)
\end{pspicture}}
```



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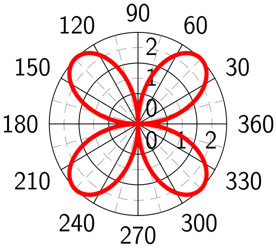
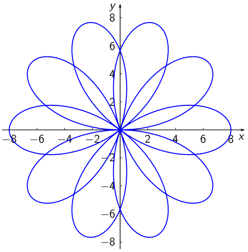
Fourth Example

```
\begin{pspicture}(-4,-4)(4,4)
\psaxes[axesstyle=polar,subticklinestyle=dashed,subticks=2](3,360)
\psplot[polarplot,algebraic,linecolor=red,linewidth=2pt,
plotpoints=2000]{0}{TwoPi}{6*sin(x)*cos(x)}
\end{pspicture}}
```



Fifth Example: Polar with rput

```
\psset{plotpoints=200,unit=0.5}
\begin{pspicture}(-8.5,-8.5)(9,9)
\psaxes[Dx=2,Dy=2,arrowlength=1.75,
ticksize=2pt,linewidth=0.17mm]{->}(0,0)
(-8.5,-8.5)(9,9)
\rput[Br](9,-.7){$x$}
\rput[tr](-.3,9){$y$}
%
\psset{linewidth=.35mm,plotstyle=curve,polarplot}
\psplot[algebraic,linecolor=blue]{0}{12.57}{8*sin(2.5*x)}
\end{pspicture}}
```



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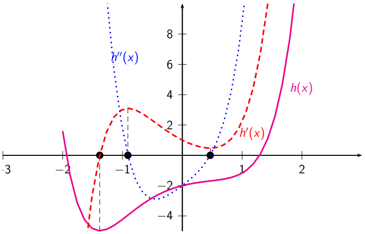
Sixth Example

```
\psset{yunit=0.5cm,xunit=2cm}
\begin{pspicture*}(-3,-5)(3,10)
\psaxes[Dy=2]{->}(0,0)(-3,-5)(3,10)
\psset{linewidth=1.5pt}
\psPolynomial[coeff=-2 1 -1 .5 .1 .025 .2 ,linecolor=magenta]{-2}{4}
\psPolynomial[coeff=-2 1 -1 .5 .1 .025 .2 ,linecolor=red,linestyle=dashed,Derivation=1,
markZeros=true,dotsize=7pt,zeroLineTo=0]{-2}{4}
\psPolynomial[coeff=-2 1 -1 .5 .1 .025 .2 ,linecolor=blue,linestyle=dotted,Derivation=2,
markZeros=true,dotsize=7pt,zeroLineTo=1]{-2}{4}
\rput[lb](1.8,4){\textcolor{magenta}{$h(x)$}}
\rput[lb](0.95,1){\textcolor{red}{$h^{\prime}(x)$}}
\rput[lb](-1.2,6){\textcolor{blue}{$h^{\prime\prime}(x)$}}
\end{pspicture*}}
```



Sixth Example

The previous example needs some explanations:

- Note that only the coefficients of the polynomial are given
- Note that for all three polynomials graphed, the same coefficients were given
- The difference is in the 'Derivation' option - that option is telling LaTeX how many derivatives to take. Note that LaTeX is using a macro to find the derivatives for the user.
- 'markZeros' is putting the dots on the axis where that function crosses. If you tell it to mark a lot of zeros, there is often a delay in the build as LaTeX finds them. It's routine is a first-level routine, not very efficient, just good enough for visual purposes.
- 'zeroLineTo=#' is telling LaTeX to draw a vertical line from the zero to the corresponding point on the derivative whose number is given.
  - It makes sense to tell it to mark the correlation between a zero on the first derivative and an extremum on the original function, or similar.
  - LaTeX will do this even if you don't graph the appropriate function. For example, if you tell it to draw the zeroLine from the zeros of the second derivative to the graph of the first derivative, but don't actually graph the first derivative, it still does it, but the vertical lines end in mid-air.
- Note that it is good form to have the graph labels match the color of the curve.

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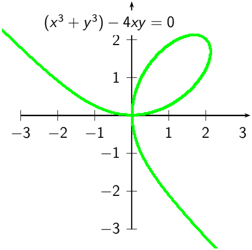
Seventh Example

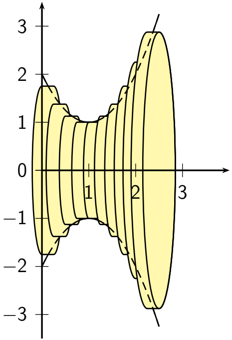
```
\psset{unit=1cm}
\begin{pspicture*}(-3.5,-3.5)(3.5,3.5)
\psaxes{->}(0,0)(-3,-3)(3.2,3)
\psplotImp[algebraic,linewidth=2pt,linecolor=green](-6,-6)(4,2.4){(x^3+y^3)-4*x*y}
\uput*[45](-2.5,2.1){$\left(x^3+y^3\right)-4xy=0$}
\end{pspicture*}}
```



Outline

Eighth Example

```
\begin{pspicture}(-0.5,-2)(5,3.5)
\infixtoRPN{x^2-2*x+2}
\psVolume[fillstyle=solid,fillcolor=yellow!40](0,2.5){10}{\RPN}
\psaxes{->}(0,0)(0,-3.5)(4,3.5)
\end{pspicture}}
```



- Note that this illustrates the disks for the volume of revolution of the given function.
- The algebraic option does not work with psVolume
- So, to avoid the Reverse Polish Notation (RPN):
  - load the package infix-RPN
  - (take Math 210 to learn infix and reverse polish!)
  - this converts from normal notation (sometimes called infix) to RPN
  - it creates a variable called \RPN, which we use in the code