Elementary Functions
Part 1, Functions
Lecture 1.2a, Graphs of Functions: Introduction

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Sam Houston State University
Spring 2013
If we describe our function using an equation $y = f(x)$ with inputs $x$ and outputs $y$, then we may view the inputs, $x$, as elements of a horizontal line in the plane and record outputs $y$ on a vertical line. The graph of a function in the Cartesian plane is the set of values $(x, f(x))$. Combining functions with the geometry of the plane gives us a nice visual way to see and understand a function.

This idea was first introduced in the 17th century by (among others) Rene Descartes and so the plane in which we draw our graph is called the Cartesian plane.
Representing functions visually

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A table of values

Many graphs of functions $y = f(x)$ can be sketched by creating a table of values $(x, y)$ and then making some reasonable assumptions as to how these points should be connected.

For example, consider the function $f(x) = x^2$. We can create a table of values.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-2$</td>
<td>4</td>
</tr>
<tr>
<td>$-1$</td>
<td>1</td>
</tr>
<tr>
<td>$-0.5$</td>
<td>0.25</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
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We then plot the points $(-2, 4), (-1, 1), (-0.5, 0.25), ...$ on the Cartesian plane and use these points to guide us on filling in the rest of the curve.
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For example, consider the function \( f(x) = x^2 \). We can create a table of values.

\[
\begin{array}{|c|c|}
\hline
x & f(x) \\
\hline
-2 & 4 \\
-1 & 1 \\
-0.5 & 0.25 \\
0 & 0 \\
0.5 & 0.25 \\
1 & 1 \\
2 & 4 \\
\hline
\end{array}
\]

We then plot the points \((-2, 4), (-1, 1), (-0.5, 0.25), \ldots\) on the Cartesian plane and use these points to guide us on filling in the rest of the curve.
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Graphing our quadratic

We plot the points \((-2, 4), (-1, 1), (-0.5, 0.25), \ldots\) on the Cartesian plane and then fill in the rest of the curve.
Graphing our quadratic

We plot the points $(-2, 4), (-1, 1), (-0.5, 0.25), ...$ on the Cartesian plane and then fill in the rest of the curve.
Some worked examples.
For each function, create a table of values (with at least 5 points, where at least one of which does not have integer value for $x$) and then graph the function.

1. $f(x) = x^3 - x$
2. $f(x) = |x|$
3. $f(x) = \sqrt[3]{x}$
Graphing a cubic

1. Graph \( f(x) = x^3 - x \)

**Solutions.**

1. Here is a table of a few values for the function \( f(x) = x^3 - x \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = x^3 - x )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>-6</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>-0.5</td>
<td>-0.625</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>
Graphing a cubic

1. Graph $f(x) = x^3 - x$ ...

Solutions.

1. Here is a table of a few values for the function $f(x) = x^3 - x$

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Graphing a cubic

If we connect the dots, we should get something like this:
Graph \( f(x) = |x| \) ....

Here is a table of values for the function \( f(x) = |x| \). 

| \( x \)  | \( f(x) = |x| \) |
|---------|------------------|
| -2      | 2                |
| -1      | 1                |
| -0.5    | 0.5              |
| 0       | 0                |
| 1       | 1                |
| 2       | 2                |
Graph $f(x) = |x|$....

Here is a table of values for the function $f(x) = |x|$.

| $x$  | $f(x) = |x|$ |
|------|-------------|
| $-2$ | 2           |
| $-1$ | 1           |
| $-0.5$ | 0.5         |
| 0    | 0           |
| 1    | 1           |
| 2    | 2           |
Graphing the absolute value function

If we connect the dots, we should get something like this:
Graph $f(x) = \sqrt[3]{x}$.

Here is a table of values for the function $f(x) = \sqrt[3]{x}$:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = \sqrt[3]{x}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-8$</td>
<td>$-2$</td>
</tr>
<tr>
<td>$-1$</td>
<td>$-1$</td>
</tr>
<tr>
<td>$-\frac{1}{8}$</td>
<td>$-\frac{1}{2}$</td>
</tr>
<tr>
<td>$0$</td>
<td>$0$</td>
</tr>
<tr>
<td>$1$</td>
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</tr>
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Graphing the cube root function

3 Graph \( f(x) = \sqrt[3]{x} \)...

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If we connect the dots, we should get something like this:
In the next presentation we will discuss finding intercepts of functions and looking at places where functions rise or fall.

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