MathBook XML and APEX Calculus

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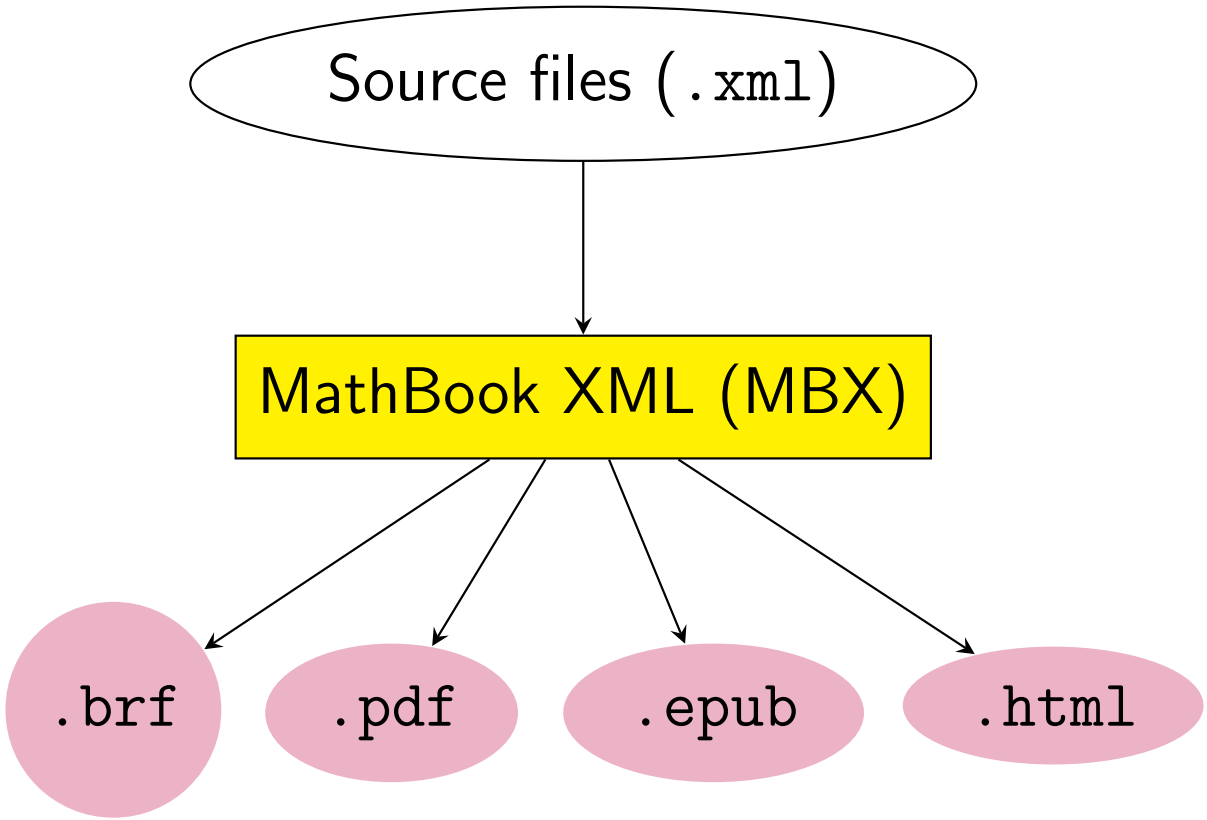
My introduction to MBX

- Met Rob Beezer of U. Puget Sound in June 2013.
- Rob explained a new-and-different approach to book-writing.
- Intriguing to fellow PCC instructor Chris Hughes and myself.
- Seed planted to use MBX for a precalculus text.

What is MBX?



Intimidated by XML

Wanted to learn MBX, but code was intimidating:

```
<section xml:id="section-function-basics">

    <title>The Basics of Function Vocabulary</title>

    <outcomes>
        <outcome>Understand the definition of a function.</outcome>
        <outcome>Use standard notation for functions correctly, and recogn
        <outcome>Recognize some real examples of functions in your life.</
    </outcomes>

    <sidebyside>
       <!-- <paragraphs valign="top" width="60%">-->
            <p valign="top" width="60%">Most of us are familiar with the <
       <!-- </paragraphs>-->

        <table xml:id="table-squareroots" valign="top" width="40%">
            <caption>Values of <m>\sqrt{x}</m></caption>
            <tabular halign="center">
                <thead />
                <row><cell><m>\sqrt{9}</m></cell><cell><m>{}={}</m></cell>
                <row><cell><m>\sqrt{\sfrac{1}{4}}</m></cell><cell><m>{}={}
                <row><cell><m>\sqrt{2}</m></cell><cell><m>{}\approx{}</m><
                <tfoot />
            </tabular>
            <todo>Make better table</todo>
        </table>
```

Intimidated by XSL

MBX itself's code even moreso:

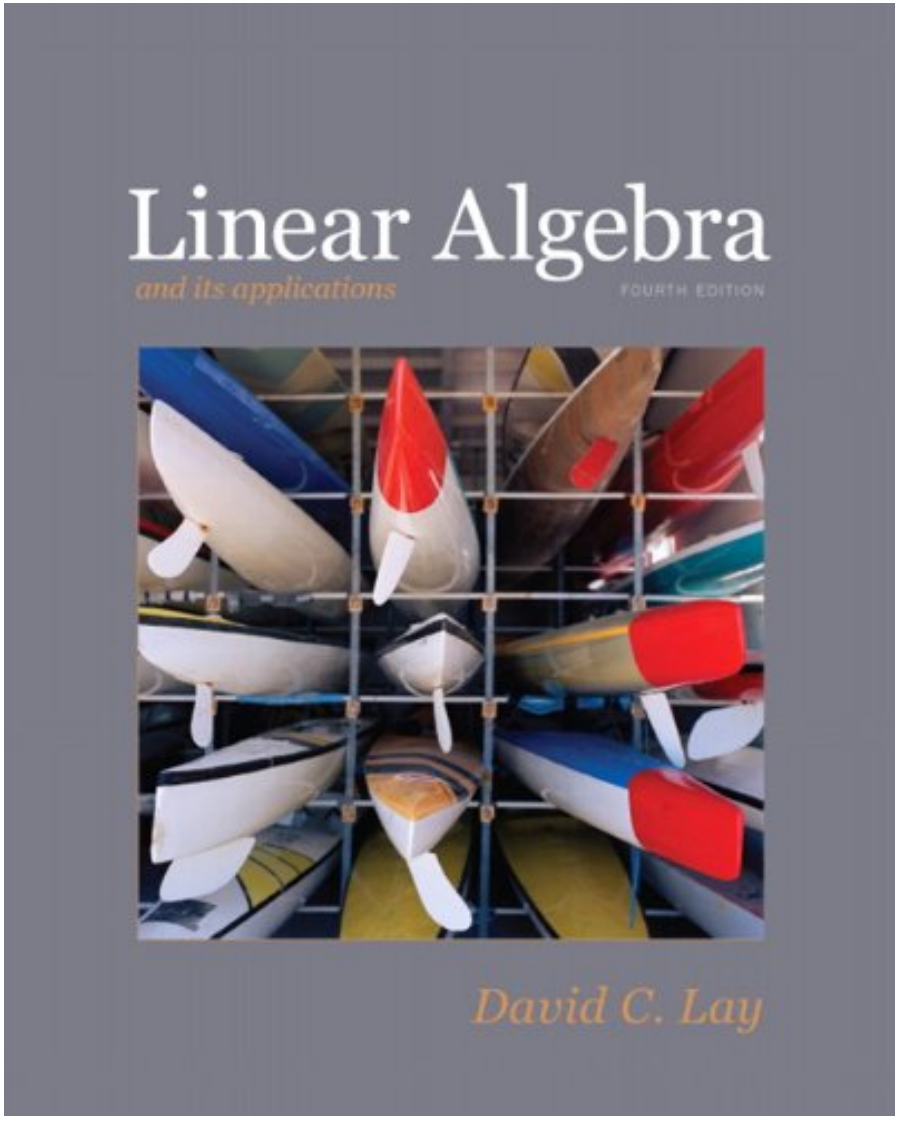
```
<xsl:template match="sidebyside">
    <xsl:text>\begin{figure}&#xa;</xsl:text>
    <xsl:text>\centering&#xa;</xsl:text>
    <xsl:apply-templates select="*[not(self::caption)]" mode="sidebyside"/
    <!-- output the child nodes -->
    <xsl:text>\popValignCaptionBottom&#xa;</xsl:text>
    <!-- global caption -->
    <xsl:apply-templates select="caption" />
    <xsl:text>\end{figure}&#xa;</xsl:text>
</xsl:template>

<!-- vertical alignment of objects inside sidebyside -->
<xsl:template match="*" mode="sidebyside-subitem-valign">
    <!-- process the width attritbute -->
    <xsl:variable name="width">
        <!-- the width of a <object/> inside a sidebyside is translated in
             a fraction of \textwidth
             we do this by stripping the % sign, and
             adding a leading .
             for example 50% is turned into .50\textwith
               -->
        <xsl:choose>
            <xsl:when test="@width">
                <xsl:value-of select="substring-before(@width,'%')" />
            </xsl:when>
            <xsl:otherwise>
              <!-- default width is calculated by computing 100/(number of
                   for example, if there are 4 figures, the default width
```

A year and a half later...

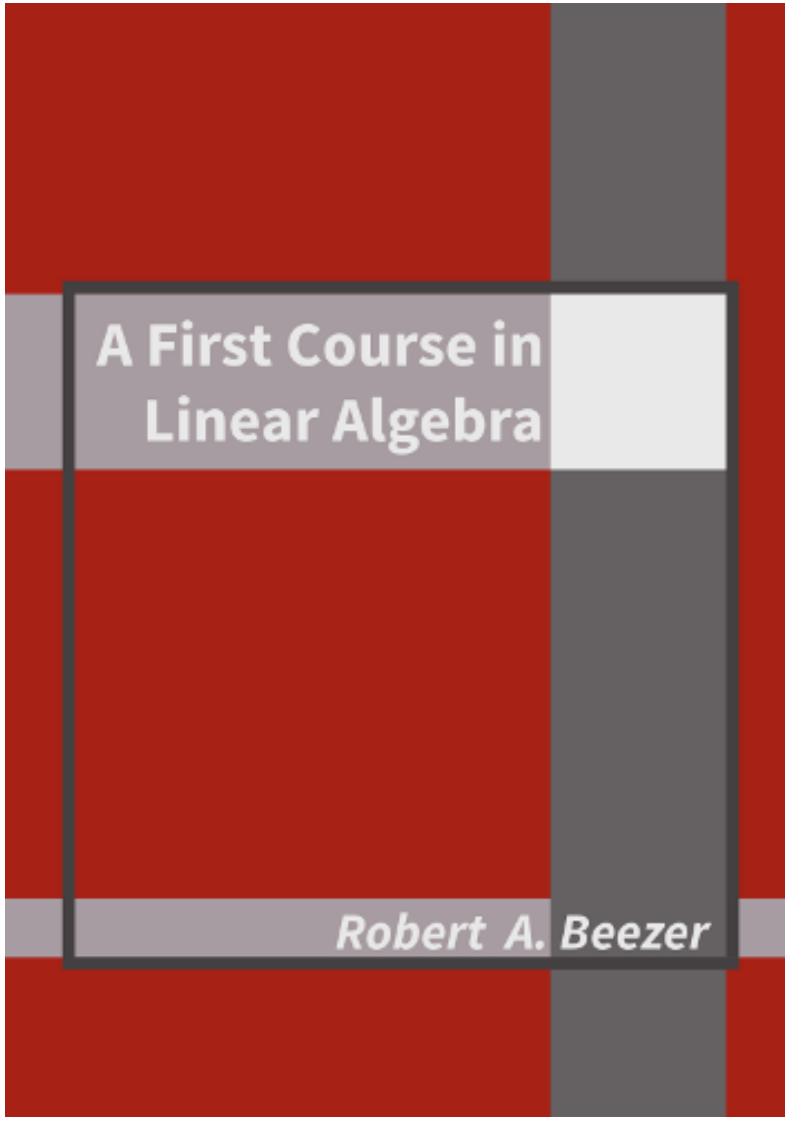
Great book, but too expensive: $177.70 new at PCC bookstore.

For CC students, books are 30% of education expenses.



Pitch Rob's book to colleagues

Free HTML, inexpensive physical, but is it good?



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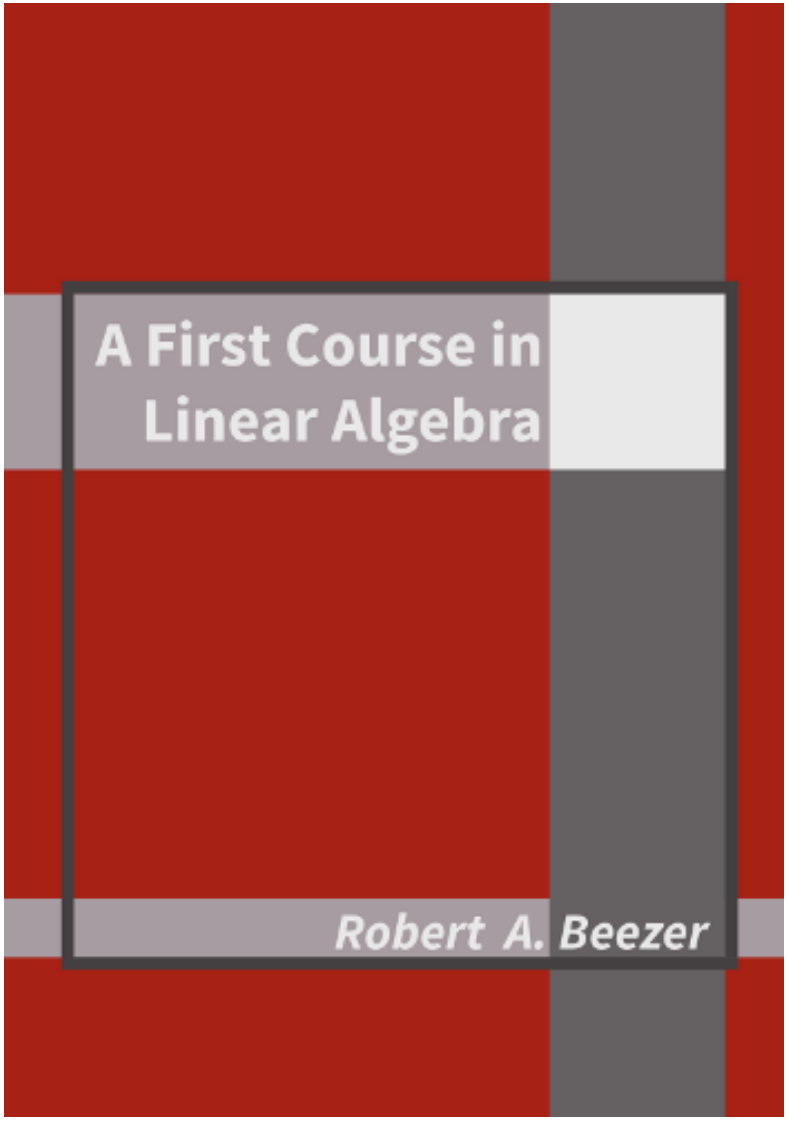
Free HTML, inexpensive physical, but is it good?

Yes!

But colleagues want more applications and some customization. . . perfect!



Contribution to Rob's Book

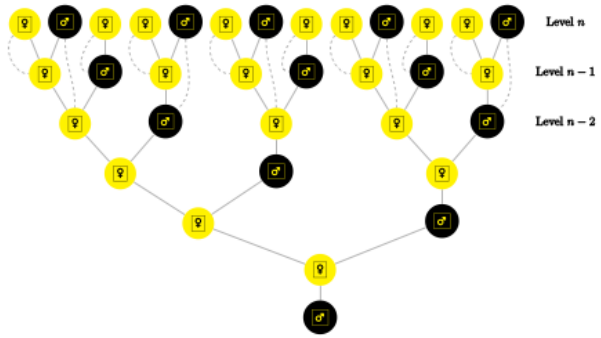
Added a chapter.

Learned MBX through this small, focused project.

Moved on with confidence.

Subsection 4.3.1 Examples

Example 4.3.2 Honeybee Ancestors . Male honeybees (also known as drones) hatch from unfertilized eggs, and so they have a mother but no father. Female honeybees (both queens and workers) hatch from fertilized eggs, and so each female honeybee has two parents (one of each sex). This leads to an interesting family tree for any single honeybee. If we consider a male, he only has one parent. That parent must have been female, so our male had two grandparents. As we continue to count, we will ignore any possibility for tangled family trees, which is admittedly unrealistic. Figure 4.3.3 displays the bees family tree going back several generations.



Calculus Lab Manual

PCC's calculus I lab manual.

Activity 10

Many limit values do not exist. Sometimes the non-existence is caused by the function value either increasing without bound or decreasing without bound. In these special cases we use the symbols ∞ and $-\infty$ to communicate the non-existence of the limits. Figures 10.1-10.3 can be used to illustrate some ways in which we communicate the ***non-existence*** of these type of limits.

In Figure 10.1 we could (correctly) write $\lim_{x\to 2} k(x) = \infty$, $\lim_{x\to 2^-} k(x) = \infty$, and $\lim_{x\to 2^+} k(x) = \infty$.

In Figure 10.2 we could (correctly) write $\lim_{t\to 4} w(t) = -\infty$, $\lim_{t\to 4^-} w(t) = -\infty$, and $\lim_{t\to 4^+} w(t) = -\infty$.

In Figure 10.3 we could (correctly) write $\lim_{x\to -3^-} T(x) = \infty$ and $\lim_{x\to -3^+} T(x) = -\infty$. There is no shorthand way of communicating the non-existence of the two sided limit $\lim_{x\to -3} T(x)$.

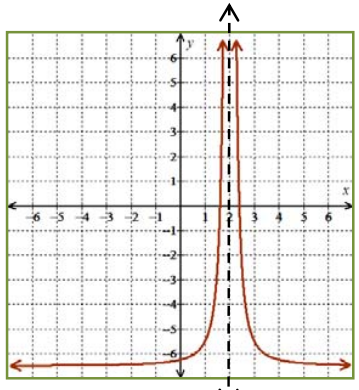


Figure 10.1: k $x = 2$

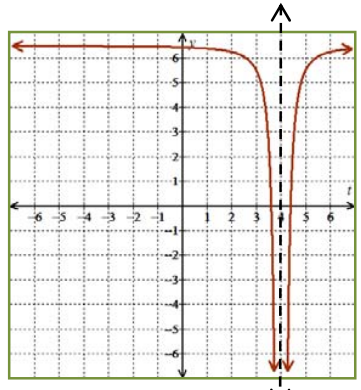
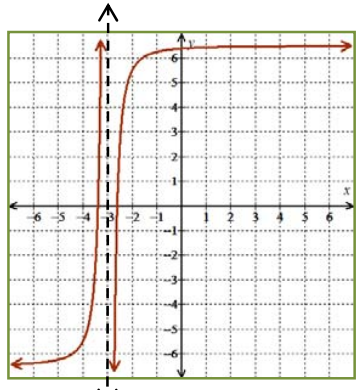


Figure 10.2: w $t = 4$



$x = -3$ **Figure 10.3:** T

Problem 10.1

Draw onto Figure 10.4 a single function f that satisfies each

Calculus Lab Manual

PCC's calculus I lab manual.

Not ADA accessible, hard to upkeep, and could have better features in HMTL.

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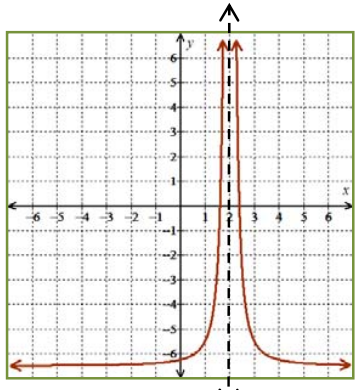

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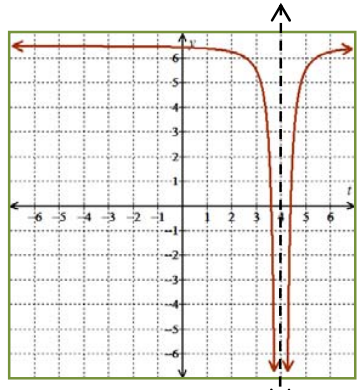
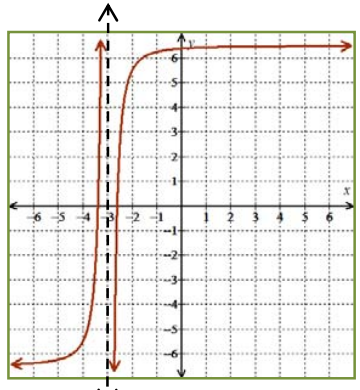


Figure 10.2: w $t = 4$



$x = -3$ Figure 10.3: T

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Draw onto Figure 10.4 a single function f that satisfies each

XML conversion

Converted to MBX.

2.7 Non-existent Limits

Many limit values do not exist. Sometimes the non-existence is caused by the function value either increasing without bound or decreasing without bound. In these special cases we use the symbols ∞ and $-\infty$ to communicate the non-existence of the limits. Figures 2.7.1–2.7.3 can be used to illustrate some ways in which we communicate the **non-existence** of these types of limits.

- In Figure 2.7.1 we could (correctly) write $\lim_{x\to 2} k(x) = \infty$, $\lim_{x\to 2^-} k(x) = \infty$, and $\lim_{x\to 2^+} k(x) = \infty$.
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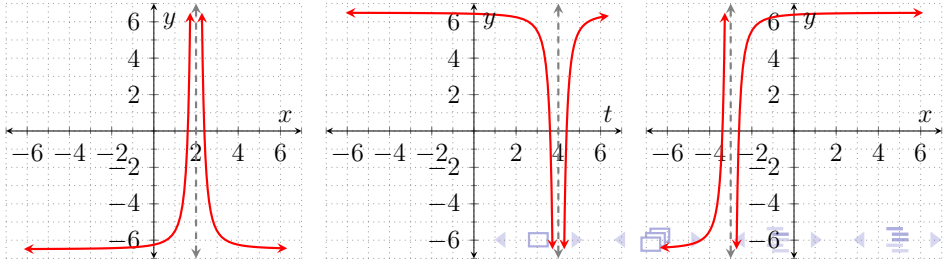
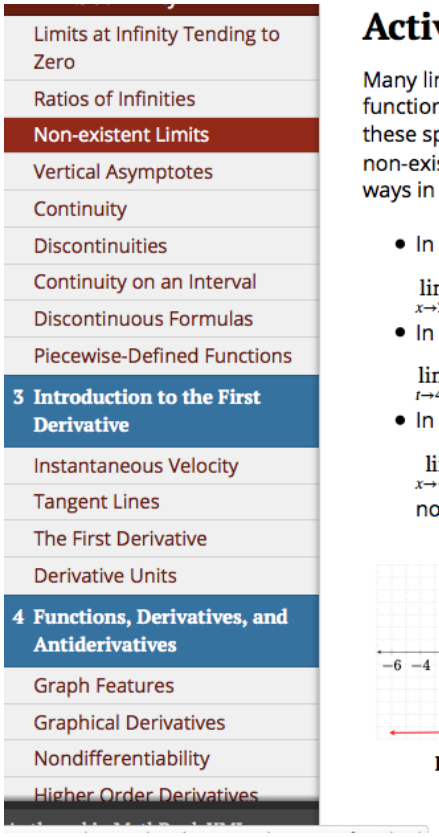


XML conversion

Converted to MBX.

Fall 2015: tablet students can stop purchasing print. All students can use extra HTML features. HTML version is ADA accessible.



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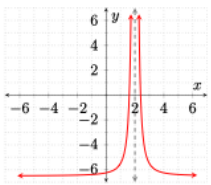

Figure 2.7.1. $y = k(x)$

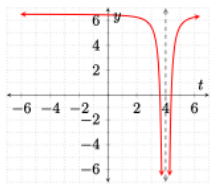

Figure 2.7.2. $y = w(t)$

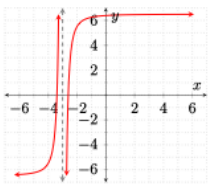

Figure 2.7.3. $y = T(x)$

WeBWorK

WeBWorK is an open-source online homework systems, with a library of 35,000 homework exercises.

A closer simulation of human instructor feedback.

Entered	Answer Preview	Result	Messages
t^112	t^{112}	incorrect	When multiplying terms with the same base, you do not multiply the exponents.

The answer above is NOT correct.

(1 point) **BasicAlgebra/Exponents /exponentsMultiplication0.pg**
Use the properties of exponents to simplify the following

$$t^8 \cdot t^{14}$$

t^112

Solution:

WeBWorK

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Entered	Answer Preview	Result	Messages
12	12	incorrect	You have the solution, but the answer to this question should be in the form z = ___

The answer above is NOT correct.

(1 point) **BasicAlgebra/SolveLinearEquations /solveLinearEqnOneStepMultiDiv10.pg**
Solve the following linear equation; the answer could be in the form **z = ___ , no solution**, or **all real numbers.**

$$7z = 84$$

12

Solution:

WeBWorK

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Entered	Answer Preview	Result	Messages
25		incorrect	Your answer doesn't look like a number with units
75		incorrect	Your answer doesn't look like a number with units

At least one of the answers above is NOT correct.

(1 point) **BasicAlgebra/Geometry /RectanglePerimeterEquation20.pg**
A rectangle's perimeter is 200 cm. Its length is 3 times as long as its width. Use an equation to find the rectangle's length and width.

It's width is 25 .

Its length is 75 .

Solution:

WeBWorK

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Entered	Answer Preview	Result	Messages
[-inf,inf]		incorrect	Infinite endpoints must be open

The answer above is NOT correct.

(1 point) **BasicAlgebra/LinearInequalities /SolveSpecialInequality30.pg**
Solve this inequality.

- Use interval notation in your response.
- If there is no solution, you may enter **no solution**.
- If the solution set is all real numbers, you may enter **(-inf, inf)** or **all real numbers**.

$$-10 + 4x + 17 \geq 4x + 7$$

[-inf,inf]

Solution:

WeBWorK

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Entered	Answer Preview	Result	Messages
(y^2)+9*y+8	$y^2 + 9y + 8$	incorrect	Your answer is equivalent to the polynomial in the correct answer, but not completely factored or simplified

The answer above is NOT correct.

(1 point) **BasicAlgebra/Factoring/factoring170.pg**
Factor the given polynomial

$y^2 + 9y + 8 =$ y^2+9y+8

If the expression cannot be factored then answer with **prime**.

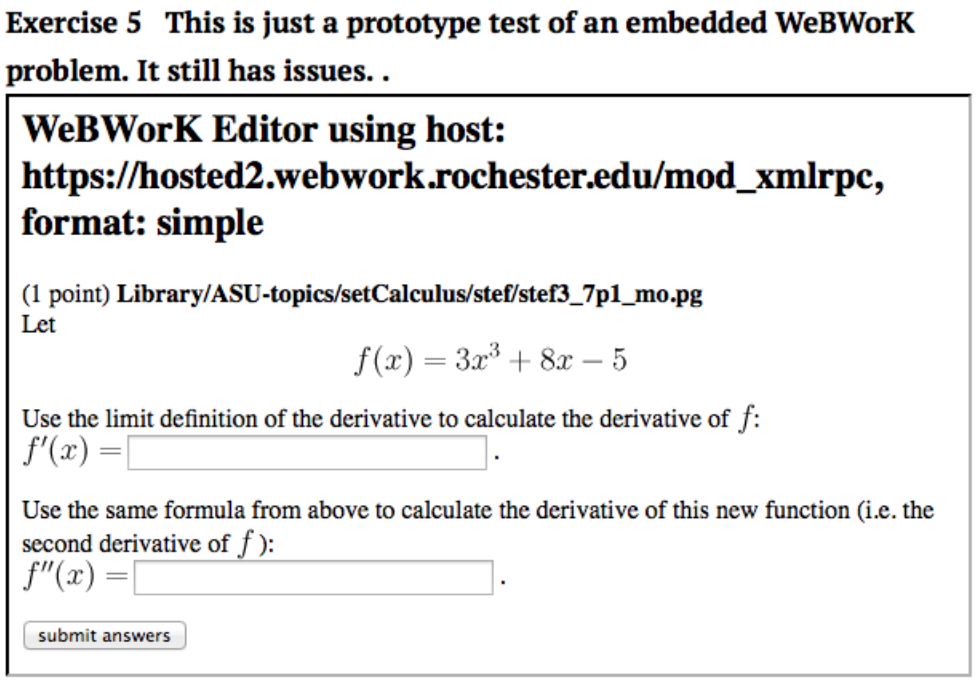
Solution:

WeBWorK and MBX

What if WeBWorK and MBX had a bridge?

Idea: WeBWorK cells in an HMTL page, contacting a WeBWorK server for interactive feedback.

Either specify an OPL problem in the source, or make building block WeBWorK code templates.



Exercise 5 **This is just a prototype test of an embedded WeBWorK problem. It still has issues. .**

WeBWorK Editor using host: https://hosted2.webwork.rochester.edu/mod_xmlrpc, format: simple

(1 point) **Library/ASU-topics/setCalculus/stef/stef3_7p1_mo.pg**
Let

$$f(x) = 3x^3 + 8x - 5$$

Use the limit definition of the derivative to calculate the derivative of f:
$f'(x) =$.

Use the same formula from above to calculate the derivative of this new function (i.e. the second derivative of f):
$f''(x) =$.

submit answers

Proof of concept built by Mike Gage.

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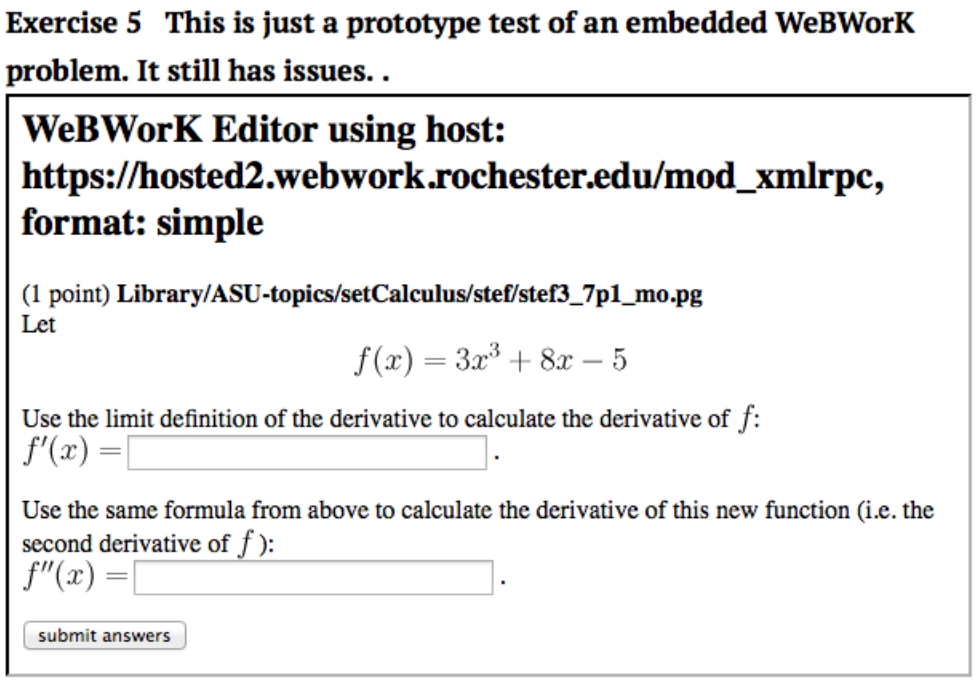

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Proof of concept built by Mike Gage. Thanks to OpenOregon funding in 2015, we built it.

APEX and Active

Our HECC grant: convert APEX Calculus and Active Calculus to MBX.

Two strong OERs in calculus: relatively mature and widely adopted already as far as calculus OERs go.

by Gregory Hartman

by Matt Boelkins

APEX and Active

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Two strong OERs in calculus: relatively mature and widely adopted already as far as calculus OERs go.

These are *much* bigger projects!

by Gregory Hartman

by Matt Boelkins

Future Work

This year has been about converting APEX and Active, not enhancing them.

More features to leverage:

- GeoGebra embeddings
- Sage cells
- YouTube videos
- Desmos graphing calculator

Getting Started

Getting started with using MathBook XML and/or WeBWorK is much easier if you have an experienced person to guide you. But here are some general resources, and with determination and grit, these will get you started too.

- MathBook XML home page, with documentaiton, getting started guide, and more
- Alternative guide to get started with an existing MBX project
- Information on WeBWorK