



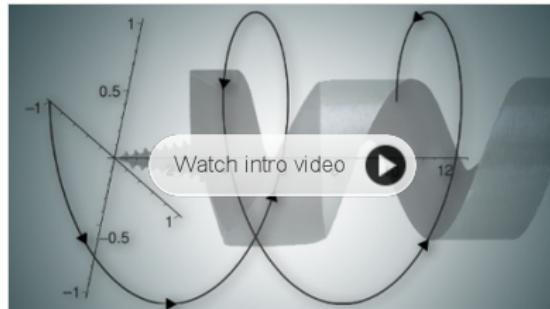
**Jim Fowler**  
OSU Mathematics Department



# Calculus One

Jim Fowler

Calculus One is a first introduction to differential and integral calculus, emphasizing engaging examples from everyday life.



## Current Session:

Jan 7th 2013 (15 weeks long)

[Sign Up](#)

**Workload:** 6-10 hours/week



## About the Course

Calculus is about the very large, the very small, and how things change. The surprise is that something seemingly so abstract ends up explaining the real world. Calculus plays a starring role in the biological, physical, and social sciences. By focusing outside of the classroom, we will see examples of calculus appearing in daily life.

This course is a first and friendly introduction to calculus, suitable for someone who

## About the Instructor



**Jim Fowler**  
Ohio State University



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# 85k enrollments

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### About the Instructor



Jim Fowler  
Ohio State University

fowler.291@osu.edu

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All Genres

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Courses Collections

Ohio State Calculus One The Ohio State ...	Philosophy of Mind University of Ne...	LA TROBE UNIVERSITY AUSTRALIA Principles of Human Nutrition	STANFORD Coding Together: Developing Apps for	ARKANSAS Spanish I	INTEGRATED SKILLS UAEU English Level 2 Integrated Skills UAEU
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3. Principles of Human Nutrition  
La Trobe Univer...

4. Coding Together: Developing Apps for Stanford

5. Spanish I  
Arkansas

6. English Level 2 Integrated Skills  
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7. Leading Wisely  
TED

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Yale University

9. Digital Storytelling  
Dawson Educati...

10. History of the US Since 1877  
Missouri State U...

11. iOS Game Development...  
Instituto Politécnico...

12. Introduction to Philosophy  
University of Ne...

**INTEGRATED SKILLS**

English Level 2 Integrated Skills UAEU

This screenshot shows the iTunes U application on a Mac OS X desktop. The window title is 'iTunes U'. At the top, there are navigation buttons for back, forward, and search, along with the Apple logo. Below the title bar are tabs for Music, Movies, TV Shows, App Store, Books, Podcasts, and 'iTunes U'. A dropdown menu for 'All Genres' is open. The main content area is titled 'Top Courses' and displays a grid of twelve course covers. Each cover includes the course name, provider, and a thumbnail image. The courses listed are: 1. Calculus One (Ohio State), 2. Philosophy of Mind (University of Nebraska-Lincoln), 3. Principles of Human Nutrition (La Trobe University), 4. Coding Together: Developing Apps for Stanford, 5. Spanish I (Arkansas), 6. English Level 2 Integrated Skills (UAEU), 7. Leading Wisely (TED), 8. European Civilization, 1648-1945 (Yale University), 9. Digital Storytelling (Dawson Education), 10. History of the US Since 1877 (Missouri State University), 11. iOS Game Development... (Instituto Politécnico de Madrid), and 12. Introduction to Philosophy (University of Nebraska-Lincoln). A sidebar on the right is titled 'INTEGRATED SKILLS' and lists 'English Level 2 Integrated Skills' from 'UAEU'.

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Ohio State University

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All Genres

## Top Courses

Courses Collections

1. Calculus One  
The Ohio State ...

2. Philosophy of Mind  
University of Ne...

3. Principles of Human Nutrition  
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Calculus is about the very large, the very small, and how things change. The surprise is that something seemingly so abstract ends up explaining the real world.

Calculus plays a starring role in the biological, physical, and social sciences. By focusing outside of the classroom we can see calculus everywhere in our daily life.

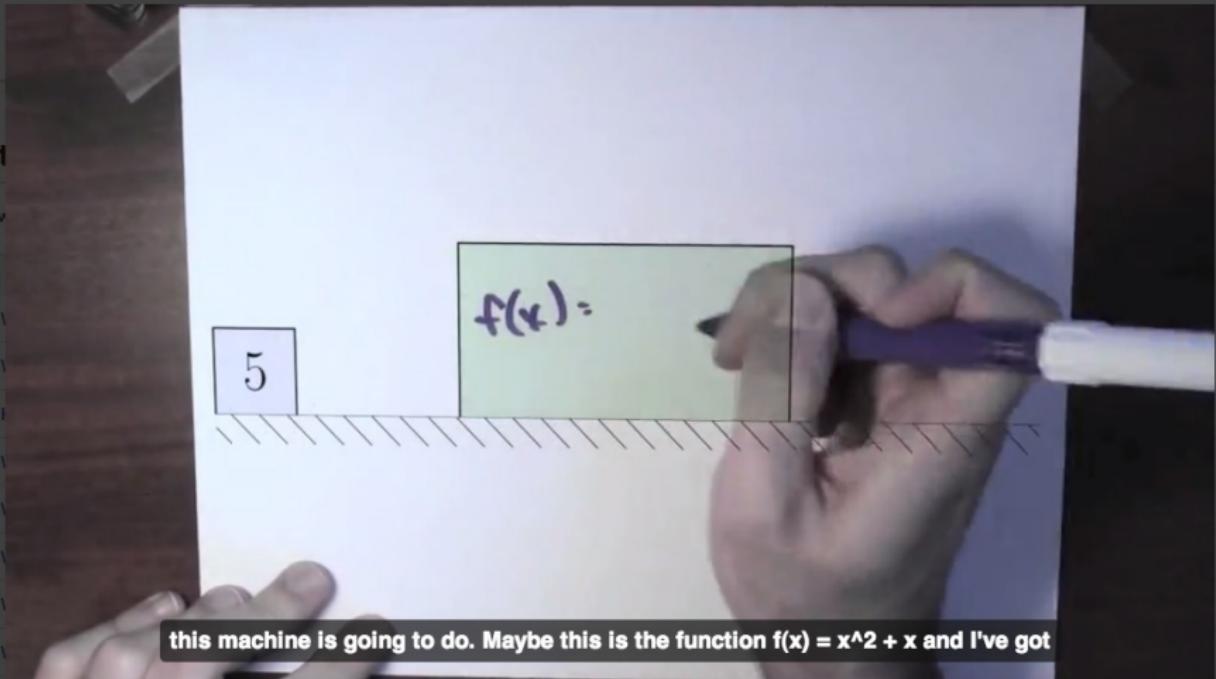
# 37k subscribed on iTunes U

This course is a first and friendly introduction to calculus, suitable for someone who

### About the Instructor



Jim Fowler  
Ohio State University



this machine is going to do. Maybe this is the function  $f(x) = x^2 + x$  and I've got

12.08 ► [progress bar]

04:31 | 11:19

12.09 « Previous

Press H for shortcuts

1.01 What is a function? [11:19]

-

Speed: 1.75x

+

Next »

12.10 What is the sum of  $n^4$  for  $n = 1$  to  $n = k$ ? [9:24]

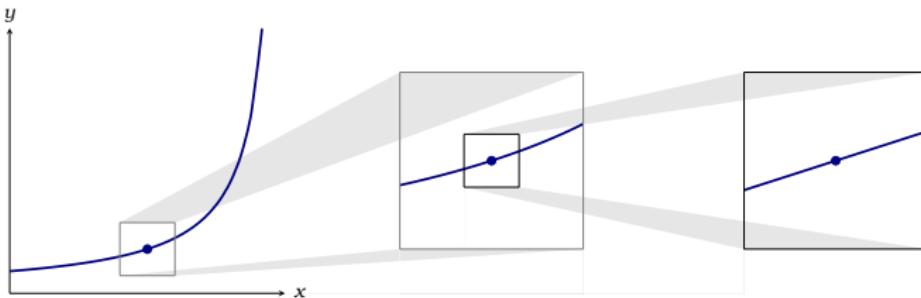


Figure 2.1: Given a function  $f(x)$ , if one can “zoom in” on  $f(x)$  sufficiently so that  $f(x)$  seems to be a straight line, then that line is the **tangent line** to  $f(x)$  at the point determined by  $x$ .

at two points. The slope of any secant line that passes through the points  $(x, f(x))$  and  $(x + h, f(x + h))$  is given by

$$\frac{\Delta y}{\Delta x} = \frac{f(x + h) - f(x)}{(x + h) - x} = \frac{f(x + h) - f(x)}{h},$$

see Figure 2.2. This leads to the *limit definition of the derivative*:

**Definition of the Derivative** The **derivative** of  $f(x)$  is the function

$$\frac{d}{dx} f(x) = \lim_{h \rightarrow 0} \frac{f(x + h) - f(x)}{h}.$$

If this limit does not exist for a given value of  $x$ , then  $f(x)$  is not **differentiable** at  $x$ .

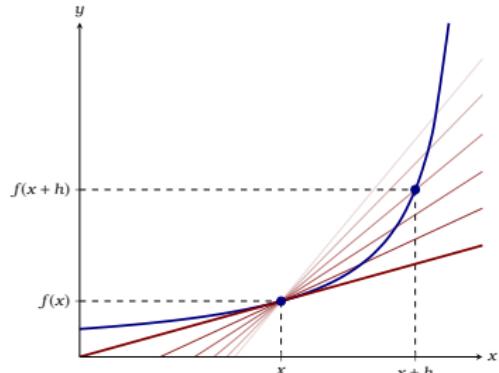


Figure 2.2: Tangent lines can be found as the limit of secant lines as the distance between the two points on the curve approaches zero.

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### Mooculus

1,360 commits 3 branches 0 releases 11 contributors

branch: master / mooculus

Merge branch 'development'

Jim Fowler authored 4 days ago latest commit 5fa772c991

File	Commit Message	Time Ago
app	Longer explanation about backslashes	4 days ago
config	Permitting Google logins	3 months ago
curriculum	Version to be submitted	a month ago
db	stuff	a month ago
doc	assessor is now the root	9 months ago
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<https://github.com/ASCTech/mooculus>

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## ASCTech / mooculus

branch: master

Bart Snapp 9 days ago Fixed typo

1 contributor

file | 1464 lines (1211 sloc) | 51.474 kb

Edit Raw Blame History Delete

```
\chapter{Curve Sketching}

Whether we are interested in a function as a purely mathematical object or in connection with some application to the real world, it is often useful to know what the graph of the function looks like. We can obtain a good picture of the graph using certain crucial information provided by derivatives of the function and certain limits.

\section{Extrema}

Local \textit{extrema} on a function are points on the graph where the $y$ coordinate is larger (or smaller) than all other $y$ coordinates on the graph at points ``close to'' $(x,y)$.

\begin{definition}\hfill\index{maximum/minimum!local}
\begin{enumerate}
\item A point $(x,f(x))$ is a \textit{local maximum} if there is an interval $a < x < b$ with $f(x) \geq f(z)$ for every $z$ in $(a,b)$.
\item A point $(x,f(x))$ is a \textit{local minimum} if there is an interval $a < x < b$ with $f(x) \leq f(z)$ for every $z$ in $(a,b)$.
\end{enumerate}

```



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```
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6 object or in connection with some application to the real world, it is
7 often useful to know what the graph of the function looks like. We can
8 gain some information about the graph by using certain crucial information
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10
11 \section{Extrema}
12
13 Local \textit{extrema} on a function are points on the graph where the
14 $y$ coordinate is larger (or smaller) than all other $y$ coordinates
15 on the graph at points ``close to'' $(x,y)$.
16
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24 \end{enumerate}
```

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Sep 22, 2013

Merge branch 'development'  
Jim Fowler authored 4 days ago 5fa772c991 + Browse code ↗

Added hints for the ultimate differentiation challenge  
Jim Fowler authored 4 days ago e835edfd97 + Browse code ↗

Merge branch 'development'  
Jim Fowler authored 4 days ago 04b7e5b52a + Browse code ↗

Longer explanation about backslashes  
Jim Fowler authored 4 days ago d174346bcd + Browse code ↗

Added explanation to use the Plain Text mode to enter the hinted answer  
Jim Fowler authored 4 days ago 58f10ee716 + Browse code ↗

Sep 20, 2013

Merge branch 'development'  
Jim Fowler authored 6 days ago 76d69aa2f8 + Browse code ↗

Merge pull request #67 from mateor/dev1 ...  
kisonecat authored 6 days ago 5e9d919221 + Browse code ↗

Merge pull request #68 from clark-archer/s5.2#8 ...  
kisonecat authored 6 days ago 271738aaef + Browse code ↗

Merge branch 'development' of github.com:ASCTech/mooculus into develo...  
Jim Fowler authored 6 days ago cb0bbe8300 + Browse code ↗

# Complete history of changes

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Closed clark-archer wants to merge 1 commit into ASCTech:master from clark-archer:s6.2#15 #69

Discussion Commits 1 Files Changed 1

clark-archer opened this pull request 2 days ago

**corrected sign error in answer for 6.2 #15**

No one is assigned No milestone

Fairly confident that the text answer is incorrect.

[https://class.coursera.org/calct1-002/forum/thread?thread\\_id=886](https://class.coursera.org/calct1-002/forum/thread?thread_id=886)

2 participants

clark-archer added a commit 2 days ago

clark-archer corrected sign error in answer for 6.2 #15 5998923

kisonecat commented on 5998923 2 days ago

I've merged it into the development branch. It will be updated in the next recompile.

kisonecat commented 2 days ago

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**Closed** clark-archer wants to merge 1 commit into `ASCTech:master` from `clark-archer:s6.2#15` #69

Discussion Commits Files Changed

clark-archer opened this pull request 2 days ago **Closed** Edit 1 addition 1 deletion

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# Students make edits

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kisonecat commented 9 days ago

# Students make edits cMOOC meets xMOOC

# What's the benefit?

# What's the benefit?

Cheaper?

# What's the benefit?

Cheaper?      Better!

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## Calculus Two: Sequences and Series

Jim Fowler, PhD

Calculus Two: Sequences and Series is an introduction to sequences, infinite series, convergence tests, and Taylor series. The course emphasizes not just getting answers, but asking the question "why is this true?"

Workload: 6-8 hours/week

Taught In: English

Subtitles Available In: English

Sessions:

Sep 27th 2013 (6 weeks long)

You are enrolled!

Future sessions

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39

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### About the Course

Sequences and Series will challenge us to think very carefully about "infinity." What does it mean to add up an unending list of numbers? How can an infinite task result in a finite answer? These questions lead us to some very deep concepts—but also to some powerful computational tools which are used not only in math but in many quantitative disciplines.

### About the Instructor



**Jim Fowler**  
The Ohio State  
University

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Workload: 6-8 hours/week

Language: English

Platform: Available English



Watch Intro video

# Starts... today!

Sessions:

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The Ohio State  
University

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kisonecat sequences-and-series

Course materials for a Calculus MOOC — Edit

35 commits 1 branch 0 releases 1 contributor

branch: master sequences-and-series

First chapter looks good except for missing exercises

Author	Commit Message	Date
Jim Fowler	authored 13 hours ago	latest commit bd40cd2920
branding	Answered Tom Evans questions summarizing the course	2 months ago
emails	Drafted an email inviting students to take a short demographic survey	24 days ago
identifiers	Easier if I can track my names for the videos versus Coursera ident...	23 days ago
lectures	Ignore autogenerated png and tex files from title generator	2 days ago
logo	The python code generates the pov file, so I don't want to store it i...	4 days ago
pages	Need improvements still for the first week landing page	2 days ago
quizzes	Gentle discouragement when students input the wrong answer	2 months ago
textbook	First chapter looks good except for missing exercises	13 hours ago
videos	Automate as many video processing steps as possible	2 days ago
.gitignore	PDFs are output files which should not be in the repo	25 days ago
LICENSE.txt	Textbook is creative commons; everything else is GPL v3	25 days ago

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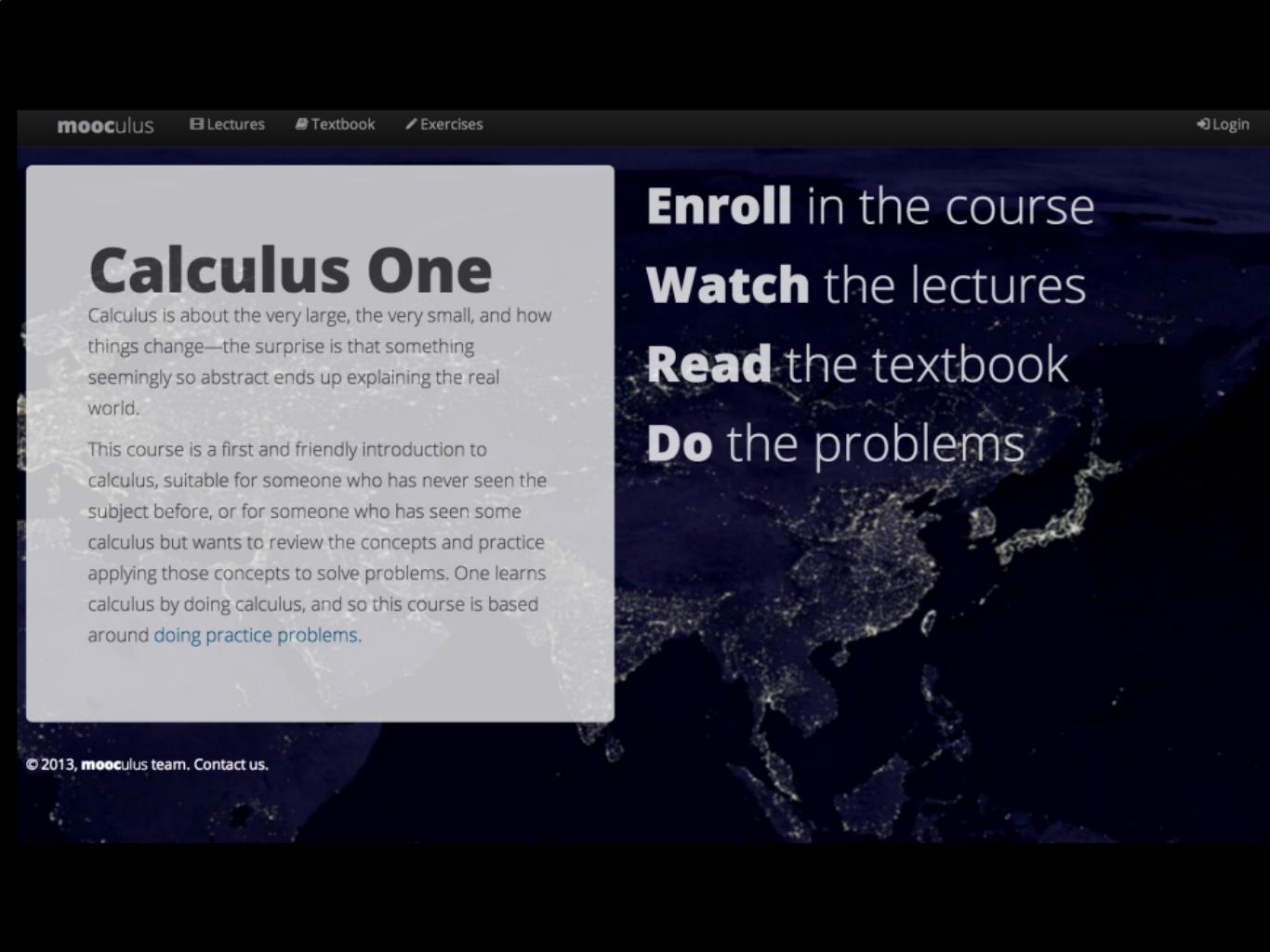
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# Calculus One

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This course is a first and friendly introduction to calculus, suitable for someone who has never seen the subject before, or for someone who has seen some calculus but wants to review the concepts and practice applying those concepts to solve problems. One learns calculus by doing calculus, and so this course is based around **doing practice problems**.



**Enroll** in the course  
**Watch** the lectures  
**Read** the textbook  
**Do** the problems

# What is **MOOCulus** ?



massive open online calculus

# What is **MOOCulus** ?



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Open textbook,

# What is **MOOCulus** ?

massive open online calculus

Open textbook,  
online homework,

# What is **MOOCulus** ?

massive open online calculus

Open textbook,  
online homework, with  
a hidden Markov model.

## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

### Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

### Do you need help?

I'd like a hint

### Progress



## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

Do you need help?

I'd like a hint

Progress



## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

We've built a  
computer algebra  
system  
in JavaScript.

Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

Do you need help?

I'd like a hint

Progress



## Exercise Computing Derivatives Of Polynomials

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### Answer

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**Answer**[Acceptable formats](#)[WYSIWYG](#)[Plain Text](#)[Check Answer](#)**Do you need help?**[I'd like a hint](#)**Progress**

## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

### Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

### Do you need help?

I'd like a hint

### Progress



## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

$$\frac{d}{dx} (-3x^2 - 2x - 1) = \frac{d}{dx} (-3x^2) + \frac{d}{dx} (-2x^1) + \frac{d}{dx} (-1) \text{ by the sum rule.}$$

### Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

### Do you need help?

### Progress



## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

$$\frac{d}{dx} (-3x^2 - 2x - 1) = \frac{d}{dx} (-3x^2) + \frac{d}{dx} (-2x^1) + \frac{d}{dx} (-1) \text{ by the sum rule.}$$

$$= -3 \frac{d}{dx} (x^2) - 2 \frac{d}{dx} (x^1) + 0 \text{ by the constant factor rule.}$$

### Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

### Do you need help?

I'd like another hint (3 steps left)

### Progress



## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

$$\frac{d}{dx} (-3x^2 - 2x - 1) = \frac{d}{dx} (-3x^2) + \frac{d}{dx} (-2x^1) + \frac{d}{dx} (-1) \text{ by the sum rule.}$$

$$= -3 \frac{d}{dx} (x^2) - 2 \frac{d}{dx} (x^1) + 0 \text{ by the constant factor rule.}$$

$$= (-3 \cdot 2)x^1 + (-2 \cdot 1)x^0 \text{ by the power rule.}$$

### Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

### Do you need help?

I'd like another hint (2 steps left)

### Progress



## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

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$$= -3 \frac{d}{dx} (x^2) - 2 \frac{d}{dx} (x^1) + 0 \text{ by the constant factor rule.}$$

$$= (-3 \cdot 2)x^1 + (-2 \cdot 1)x^0 \text{ by the power rule.}$$

$$= -6x - 2$$

### Answer

Acceptable formats

WYSIWYG

Plain Text

Check Answer

### Do you need help?

I'd like another hint (1 step left)

### Progress



## Exercise Computing Derivatives Of Polynomials

Find the derivative of  $-3x^2 - 2x - 1$  using the sum rule and the power rule.

$$\frac{d}{dx} (-3x^2 - 2x - 1) = \frac{d}{dx} (-3x^2) + \frac{d}{dx} (-2x^1) + \frac{d}{dx} (-1) \text{ by the sum rule.}$$

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$$= (-3 \cdot 2)x^1 + (-2 \cdot 1)x^0 \text{ by the power rule.}$$

$$= -6x - 2$$

### Answer

Acceptable formats

 WYSIWYG  Plain TextCheck Answer

### Do you need help?

### Progress



**Problem****Progress**

Abscissas And Ordinates Of Ordered Pairs



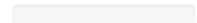
Graphing Points



Points On Functions



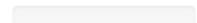
Points On Functions 2



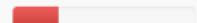
Evaluating A Function At A Point In Its Domain



Could These Points Be On The Graph Of A Function?



Basic Relationships Between Functions



Identifying Where A Function Is Positive Or Negative



Identifying Increasing And Decreasing Behavior Of Functions



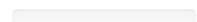
Identifying Local Maxima And Minima



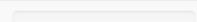
Identifying Concavity



Approximating Limits Graphically



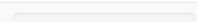
Approximating Limits Numerically With Graphical Assistance



Approximating Limits Numerically



Understanding Limit Laws



# **NSF TUES Grant**

## for “Interactive Textbooks”

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## for “Interactive Textbooks”

## Joint with Bart Snapp and Herb Clemens

# **NSF TUES Grant**

## for “Interactive Textbooks”

Joint with Bart Snapp and Herb Clemens

Open source platform for  
building open source,  
interactive textbooks.

Matrizen A kontraktiv,  $A^{-1}$   
verdoppeln Zeilen der Gleichung  
dividieren

$$\left( \begin{array}{|c|c|} \hline A & I \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch 2}} \left( \begin{array}{|c|c|} \hline I & A^{-1} \\ \hline \end{array} \right)$$

#### \* Selbst Inversen:

1. Vom Koeffizientenvektor  $\neq 0$
2. Eindeutige Potenzdivision in Inversen
3. Wiederholende Potenzdivision

$$\left( \begin{array}{|c|c|} \hline a_1 a_2 a_3 & a_1 a_2 a_3 \\ \hline 0 & 1 \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_1} \left( \begin{array}{|c|c|} \hline 1 & a_2 a_3 \\ \hline 0 & 1 \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } -a_2} \left( \begin{array}{|c|c|} \hline 1 & a_2 a_3 \\ \hline 0 & 1 \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } -a_3} \left( \begin{array}{|c|c|} \hline 1 & a_2 a_3 \\ \hline 0 & 1 \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_3} \left( \begin{array}{|c|c|} \hline 1 & a_2 \\ \hline 0 & 1 \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_2} \left( \begin{array}{|c|c|} \hline 1 & 1 \\ \hline 0 & 1 \\ \hline \end{array} \right) = A^{-1}$$

$$A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$$

$$\left( \begin{array}{|c|c|} \hline a_{11} & a_{12} \\ \hline a_{21} & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_{11}} \left( \begin{array}{|c|c|} \hline 1 & a_{12} \\ \hline a_{21} & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } -a_{21}} \left( \begin{array}{|c|c|} \hline 1 & a_{12} \\ \hline 0 & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_{12}} \left( \begin{array}{|c|c|} \hline 1 & 0 \\ \hline 0 & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } a_{22}} \left( \begin{array}{|c|c|} \hline 1 & 0 \\ \hline 0 & 1 \\ \hline \end{array} \right) = A^{-1}$$

$$\left( \begin{array}{|c|c|} \hline a_{11} a_{12} & a_{11} a_{12} \\ \hline a_{21} a_{22} & a_{21} a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_{11}} \left( \begin{array}{|c|c|} \hline 1 & a_{12} \\ \hline a_{21} a_{22} & a_{21} a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } -a_{21}} \left( \begin{array}{|c|c|} \hline 1 & a_{12} \\ \hline 0 & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_{12}} \left( \begin{array}{|c|c|} \hline 1 & 0 \\ \hline 0 & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } a_{22}} \left( \begin{array}{|c|c|} \hline 1 & 0 \\ \hline 0 & 1 \\ \hline \end{array} \right) = A^{-1}$$

$$\left( \begin{array}{|c|c|} \hline a_{11} a_{12} & a_{11} a_{12} \\ \hline a_{21} a_{22} & a_{21} a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_{11}} \left( \begin{array}{|c|c|} \hline 1 & a_{12} \\ \hline a_{21} a_{22} & a_{21} a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } -a_{21}} \left( \begin{array}{|c|c|} \hline 1 & a_{12} \\ \hline 0 & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 1 durch } a_{12}} \left( \begin{array}{|c|c|} \hline 1 & 0 \\ \hline 0 & a_{22} \\ \hline \end{array} \right) \xrightarrow{\text{Zeile 2 durch } a_{22}} \left( \begin{array}{|c|c|} \hline 1 & 0 \\ \hline 0 & 1 \\ \hline \end{array} \right) = A^{-1}$$



Doing mathematics  
is better than  
watching mathematics.

# Thank You



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