# Online Linear Algebra Tools from the MAA Course Communities

David Strong

Pepperdine University

# MAA MathDL


http://www.maa.org/programs/faculty-and-departments/course-communities

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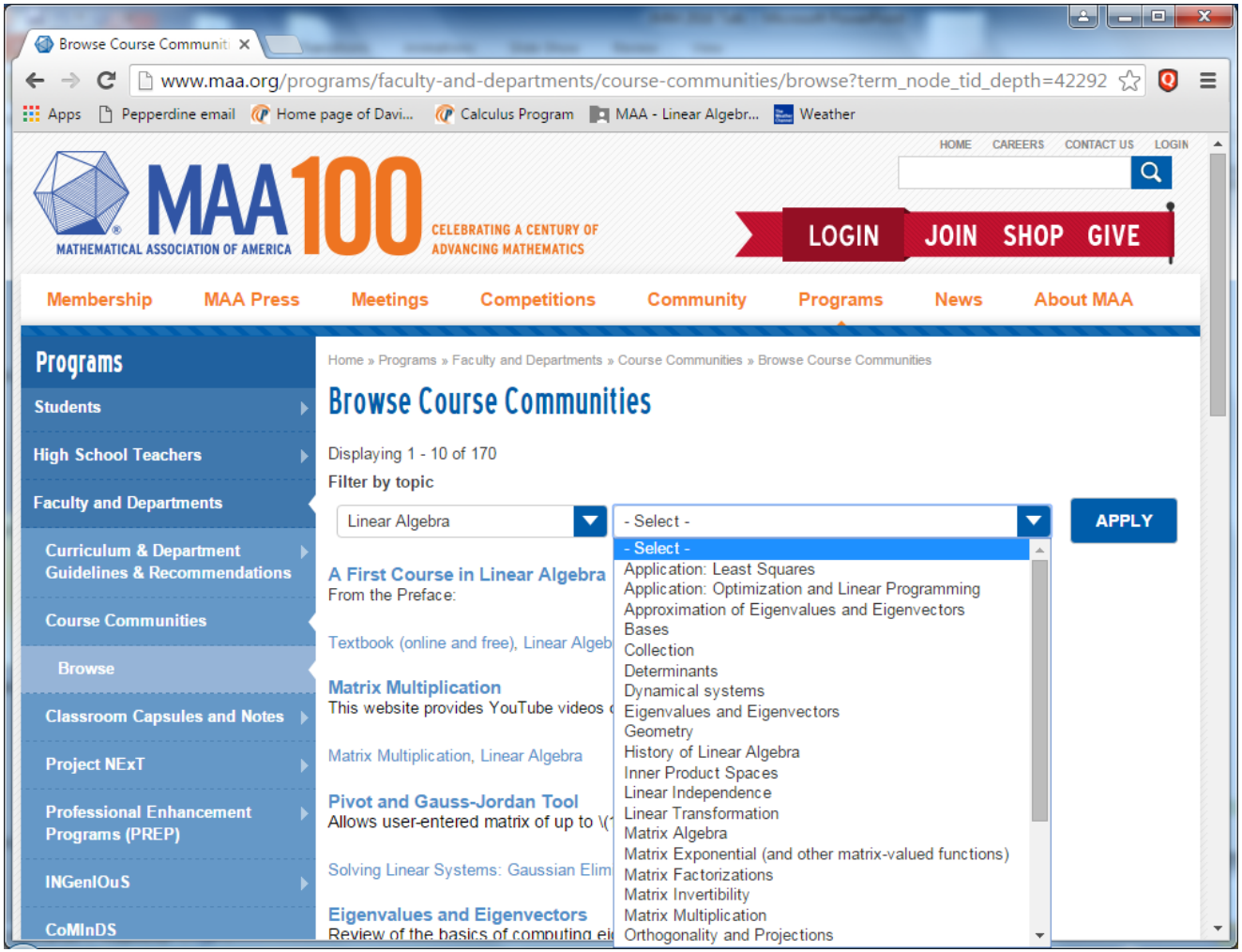
# Course Community for linear algebra

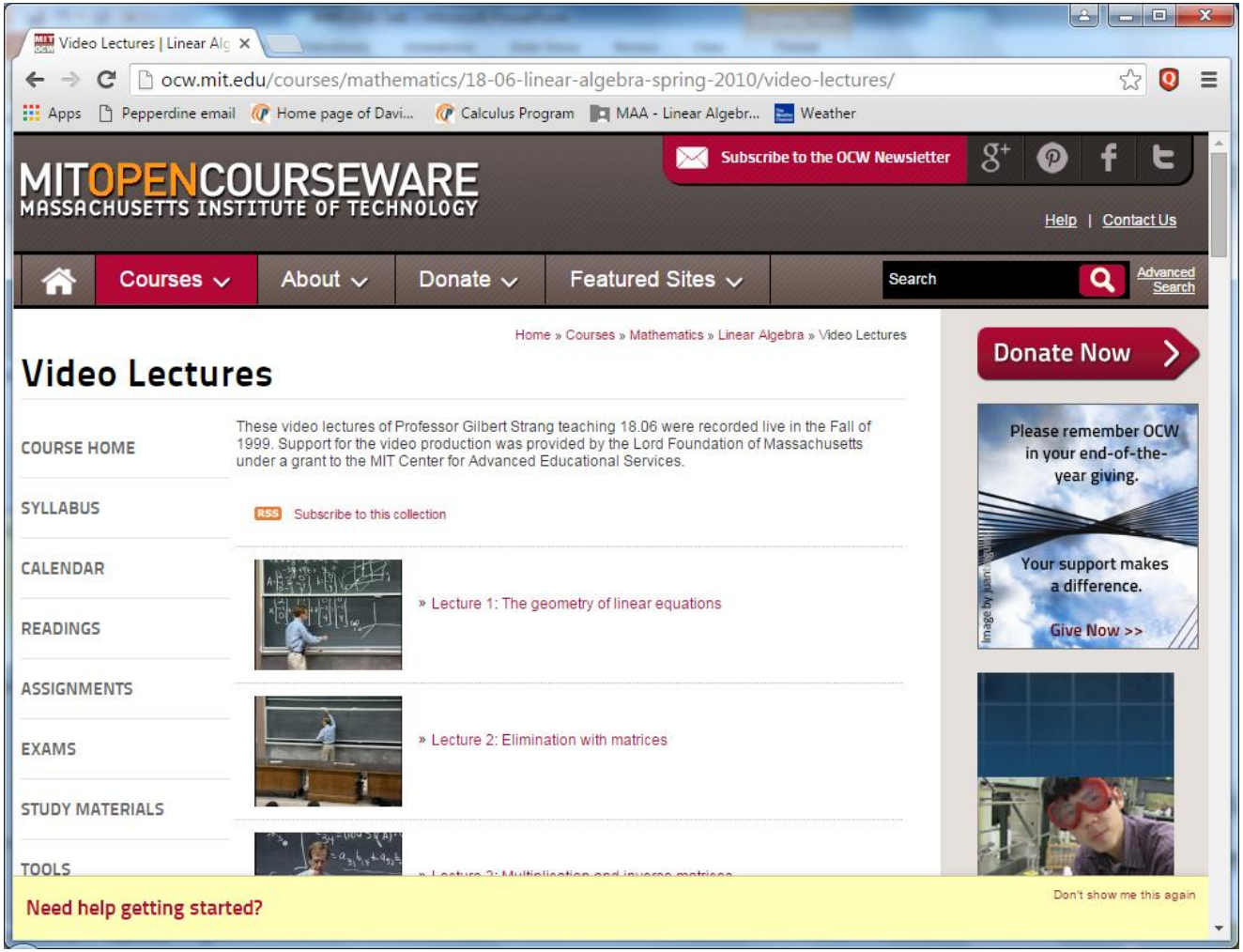



http://www.maa.org/programs/faculty-and-departments/course-communities

# Some of the tools/resources

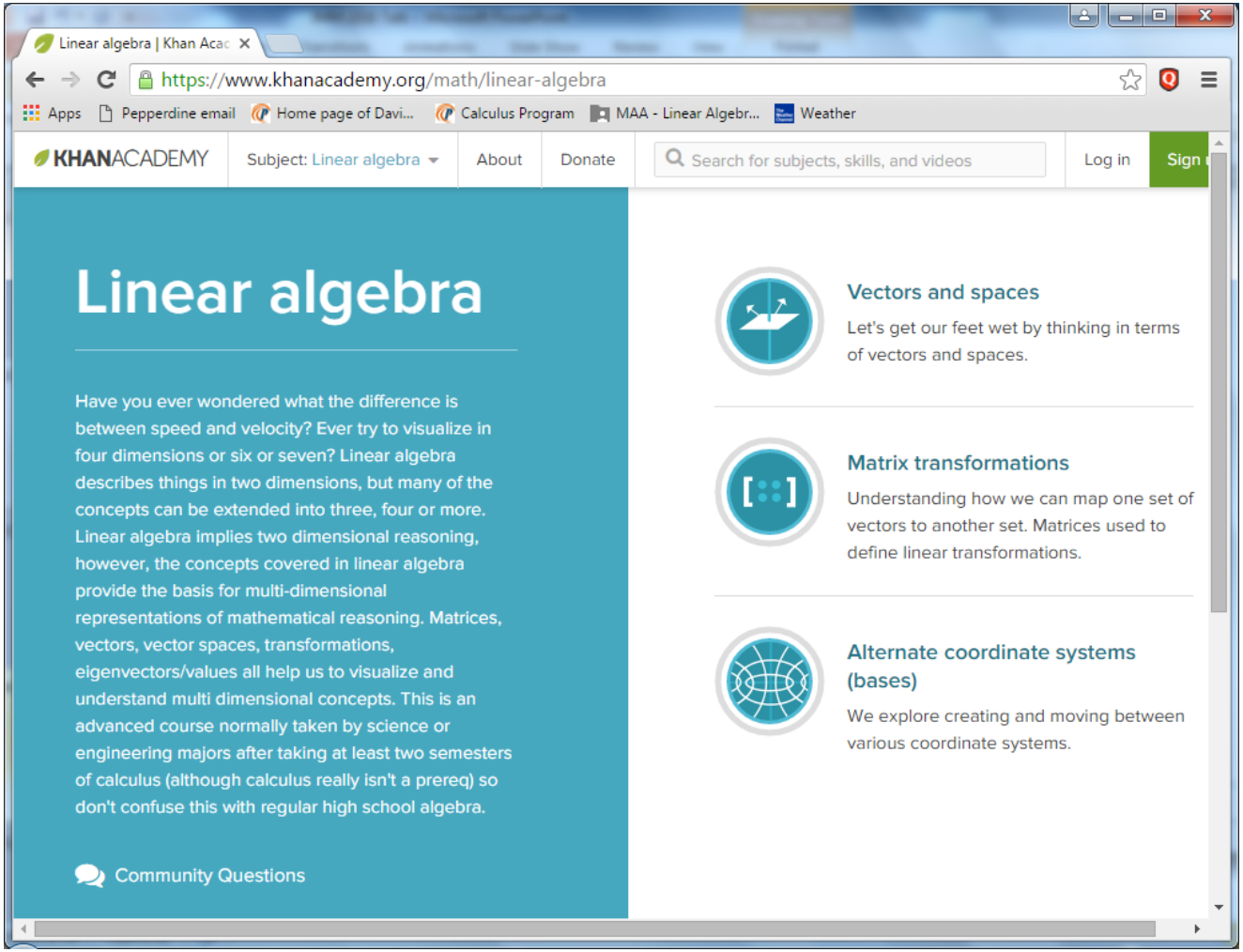
- Videos
- Books/tutorials
- Articles/tutorials
- Interactive tools:
  - Visualization of linear transformations
  - Guassian elimination
  - Wolfram CDF tools
- Classroom “clicker” questions
- Past JMM linear algebra talks

# Videos



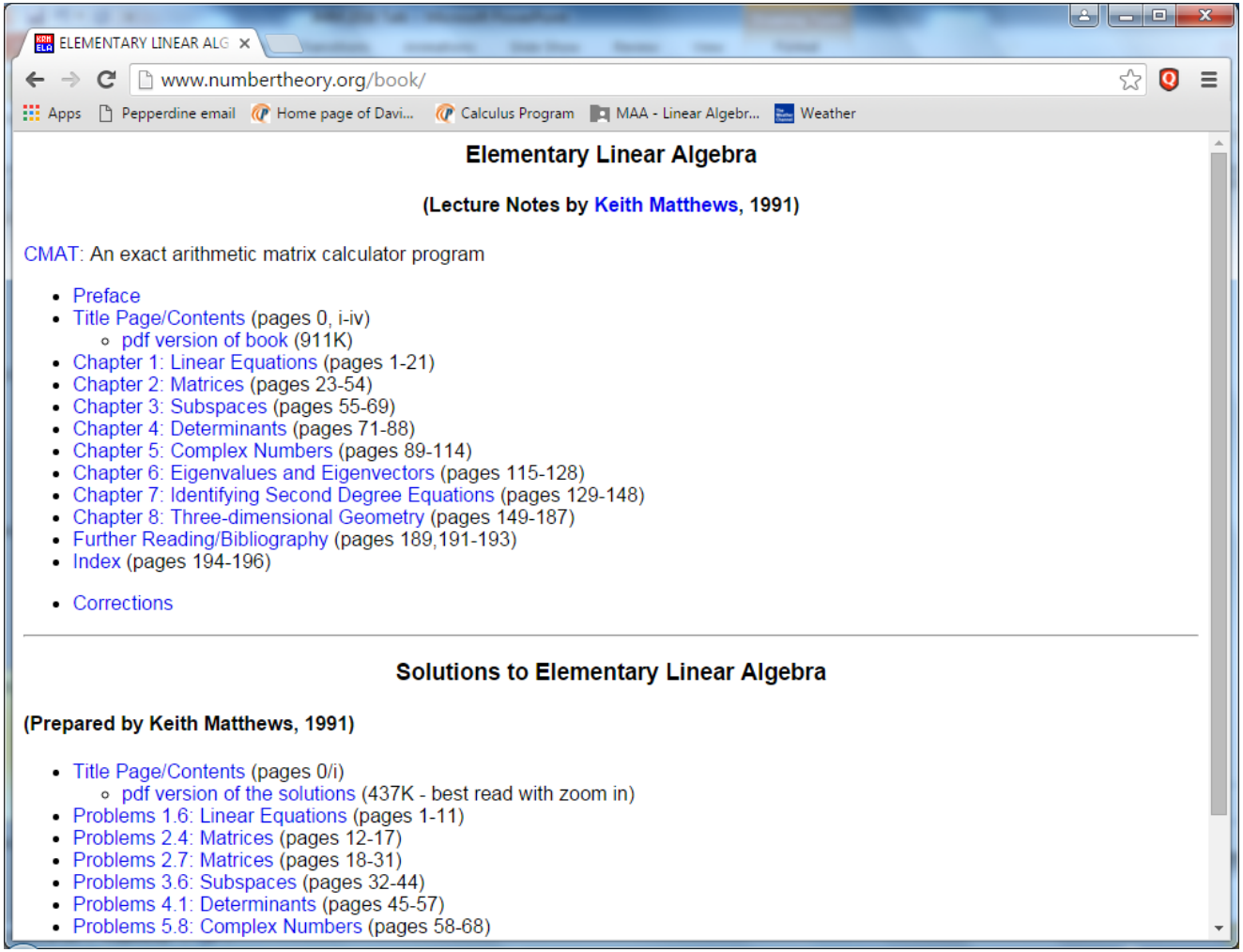

http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/

# Videos




https://www.khanacademy.org/math/linear-algebra

# Books/tutorials




http://www.numbertheory.org/book/

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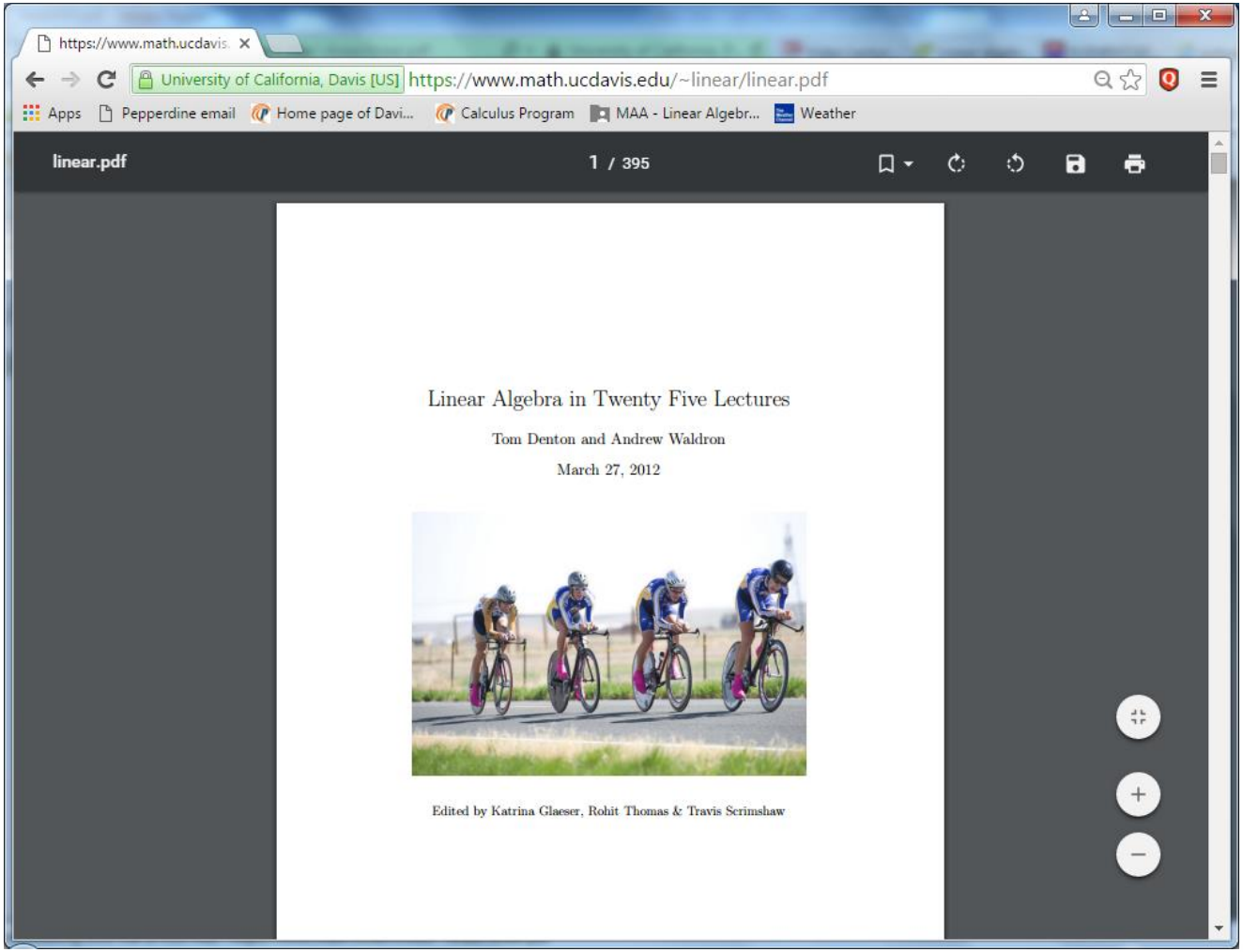


https://www.math.ucdavis.edu/~linear/linear.pdf

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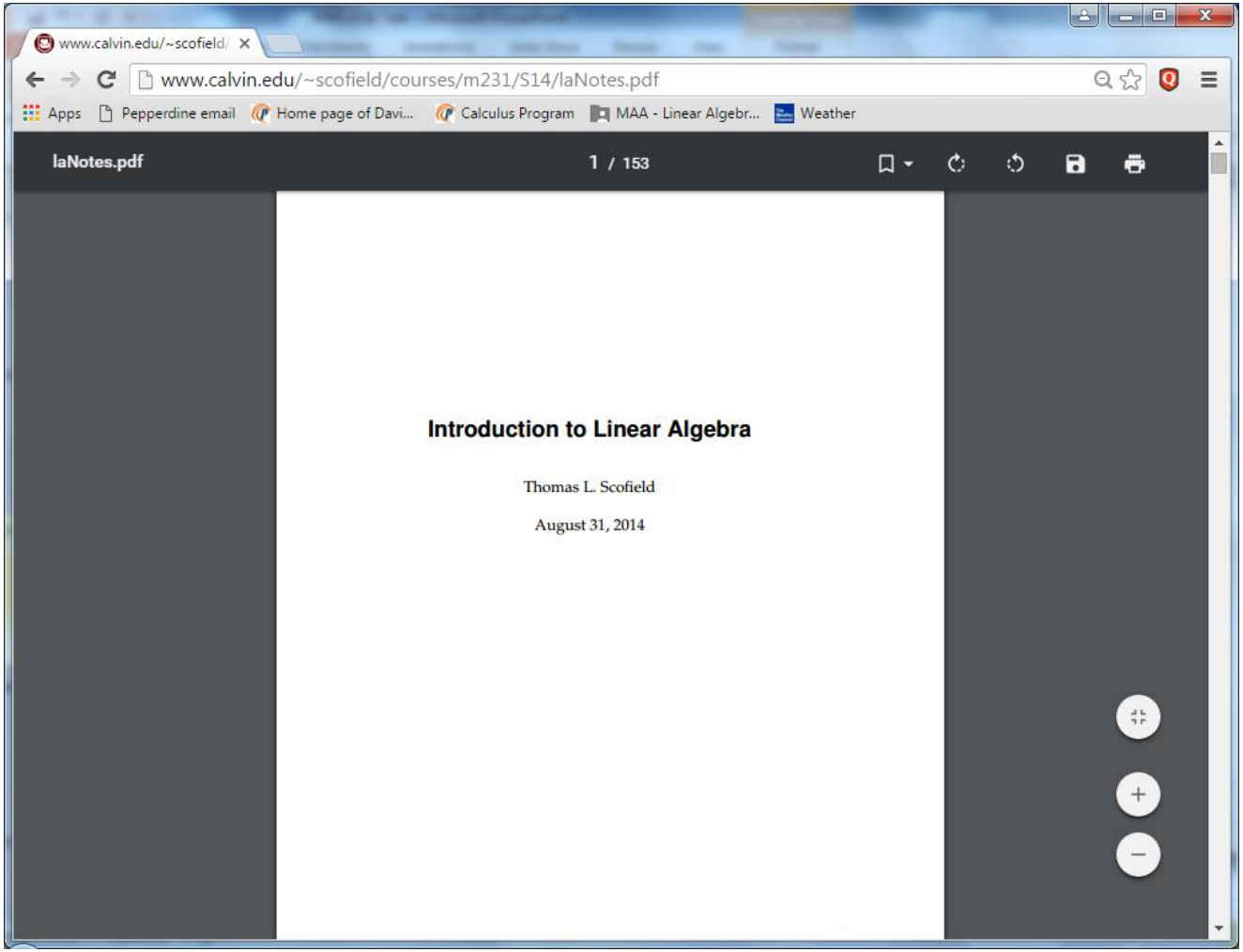


http://www.calvin.edu/~scofield/courses/m231/S14/laNotes.pdf

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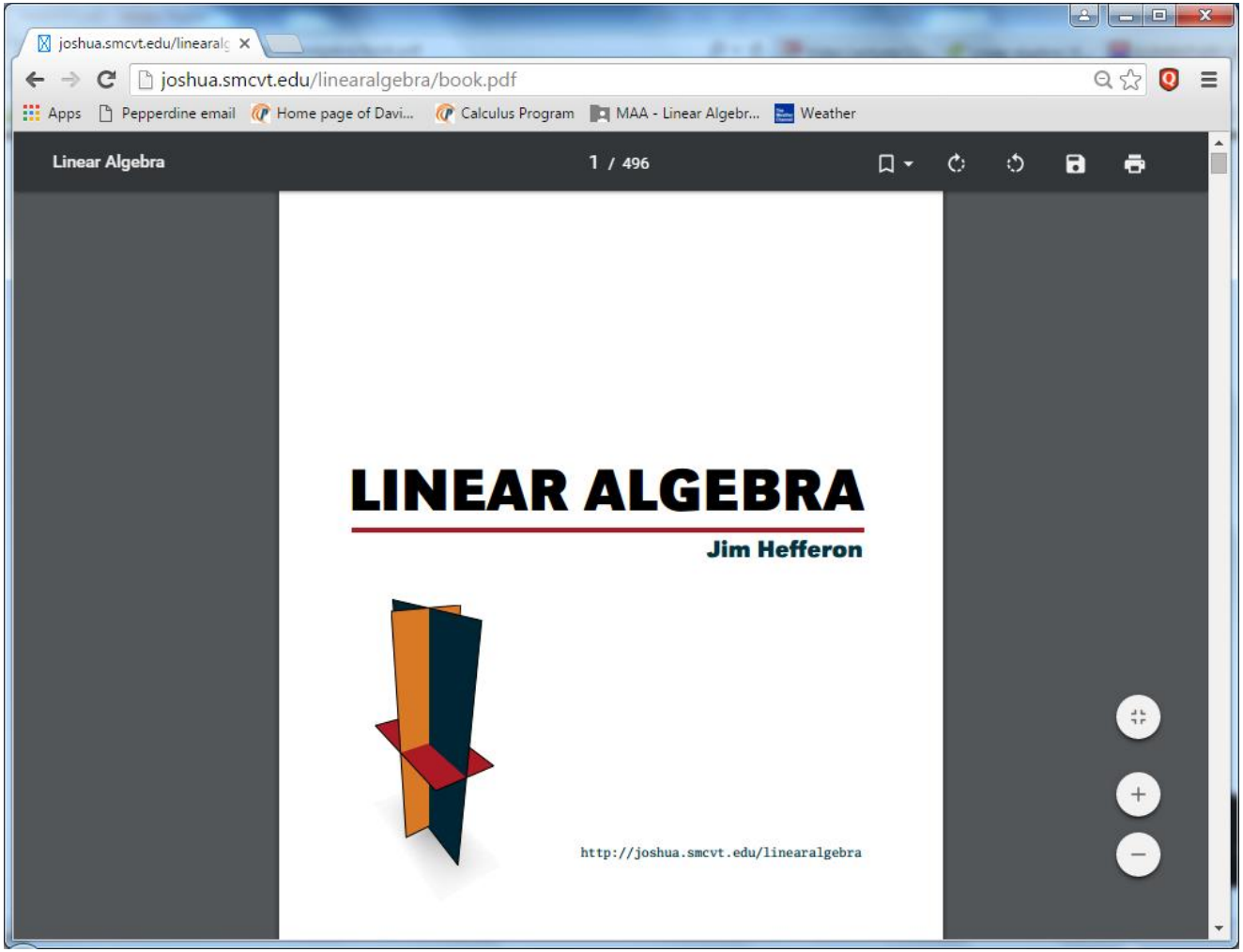
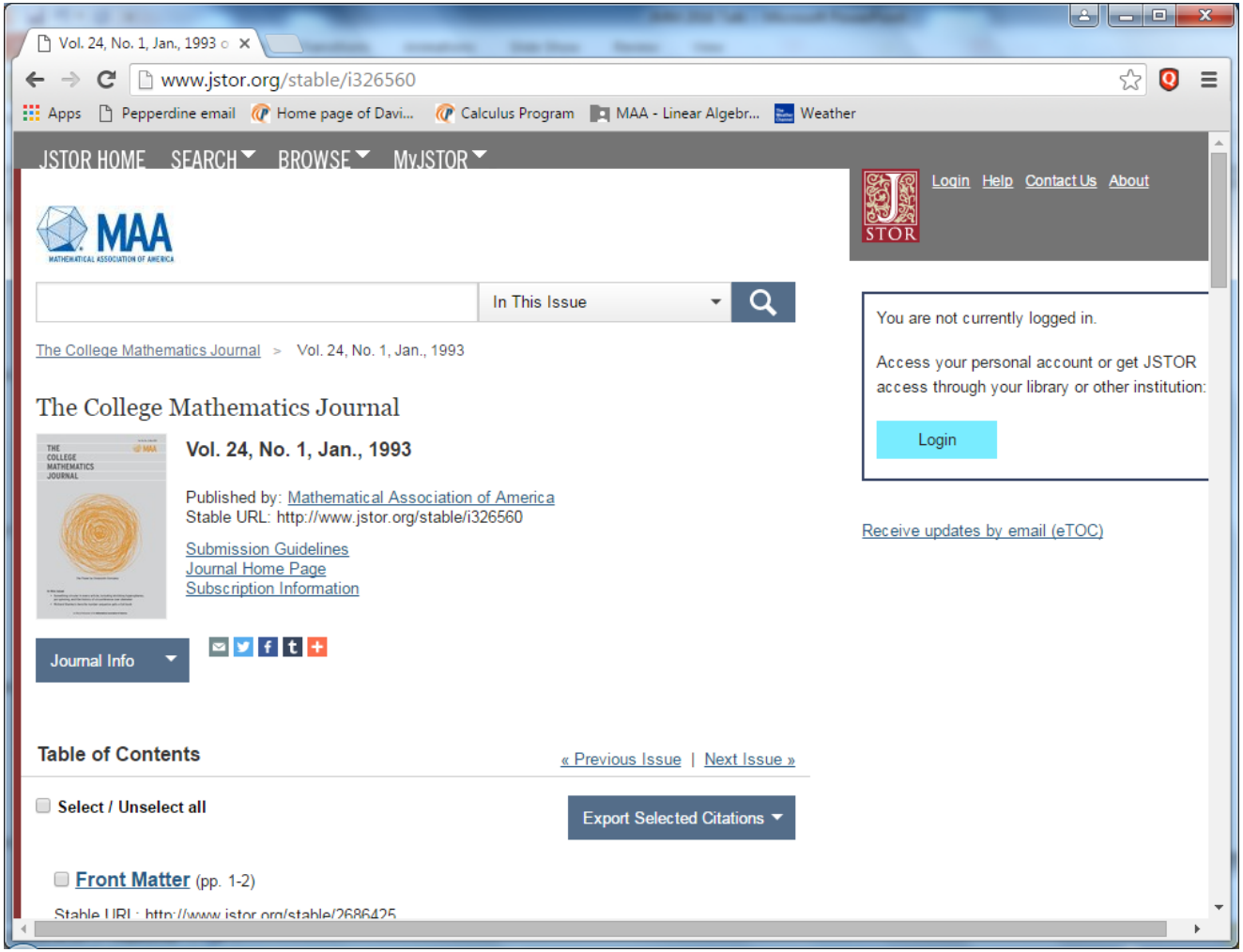



http://joshua.smcvt.edu/linearalgebra/book.pdf

# Articles/tutorials




http://www.jstor.org/stable/i326560

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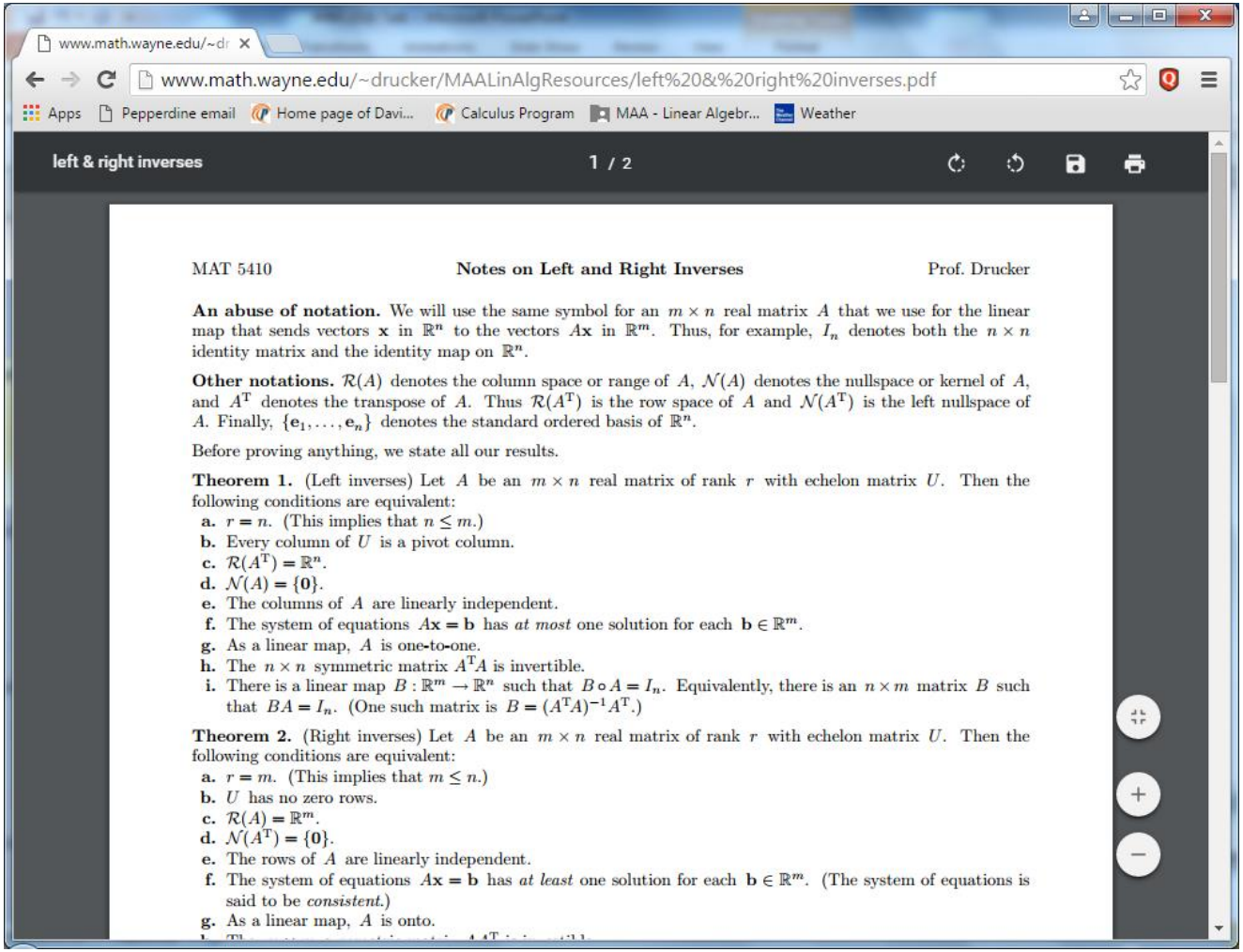


http://www.math.wayne.edu/~drucker/MAALinAlgResources/left%20&%20right%20inverses.pdf

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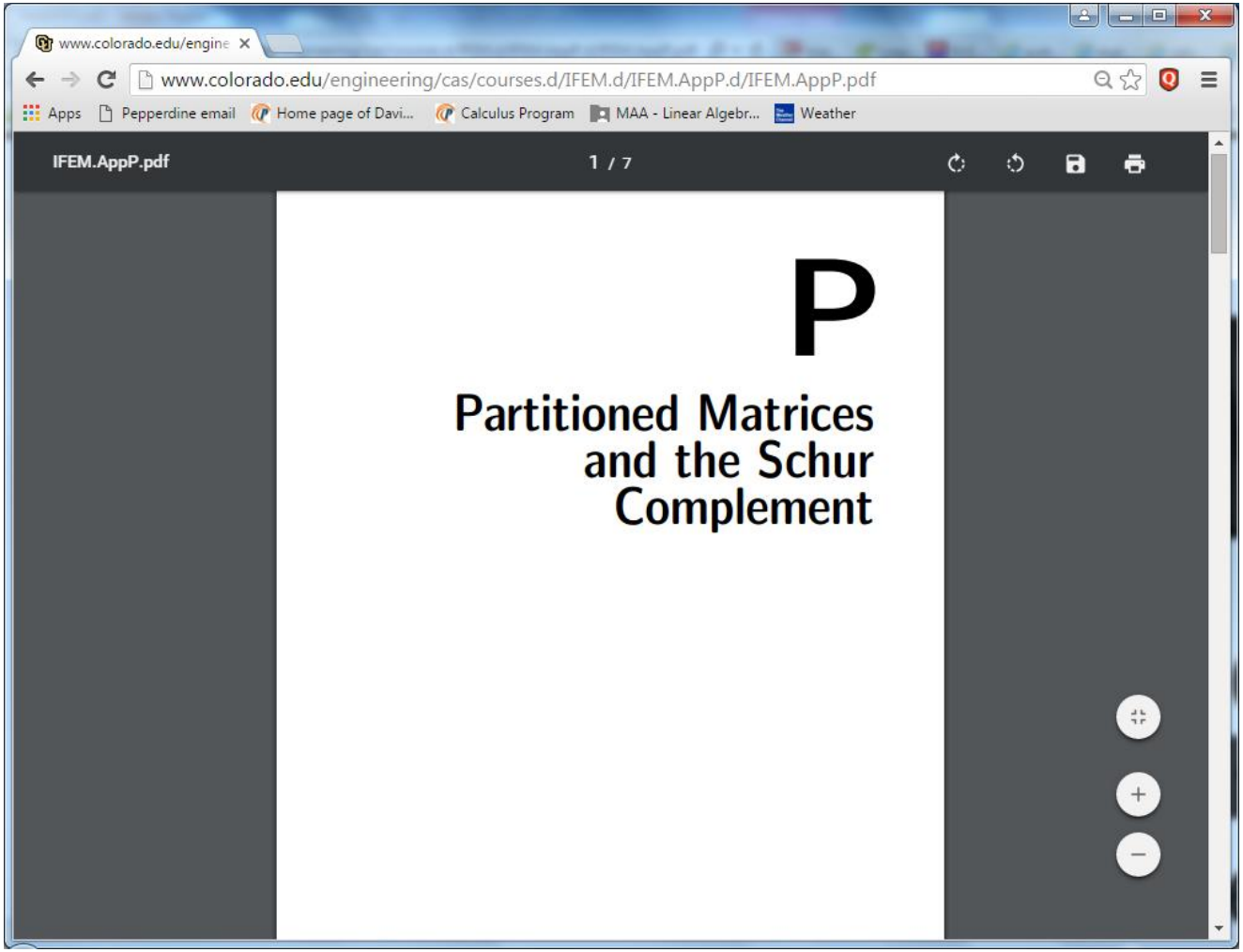


http://www.colorado.edu/engineering/cas/courses.d/IFEM.d/IFEM.AppP.d/IFEM.AppP.pdf

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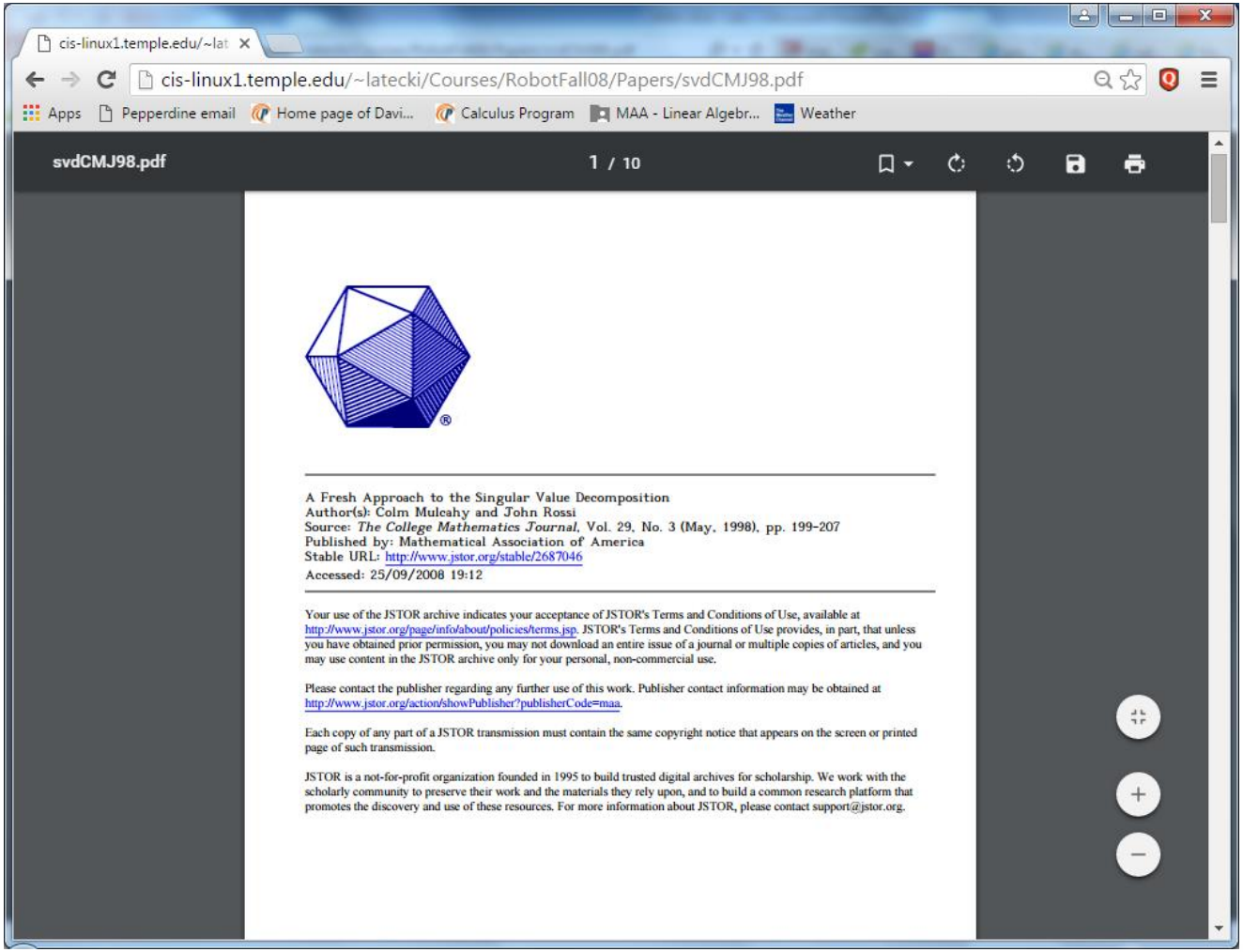


http://cis-linux1.temple.edu/~latecki/Courses/RobotFall08/Papers/svdCMJ98.pdf

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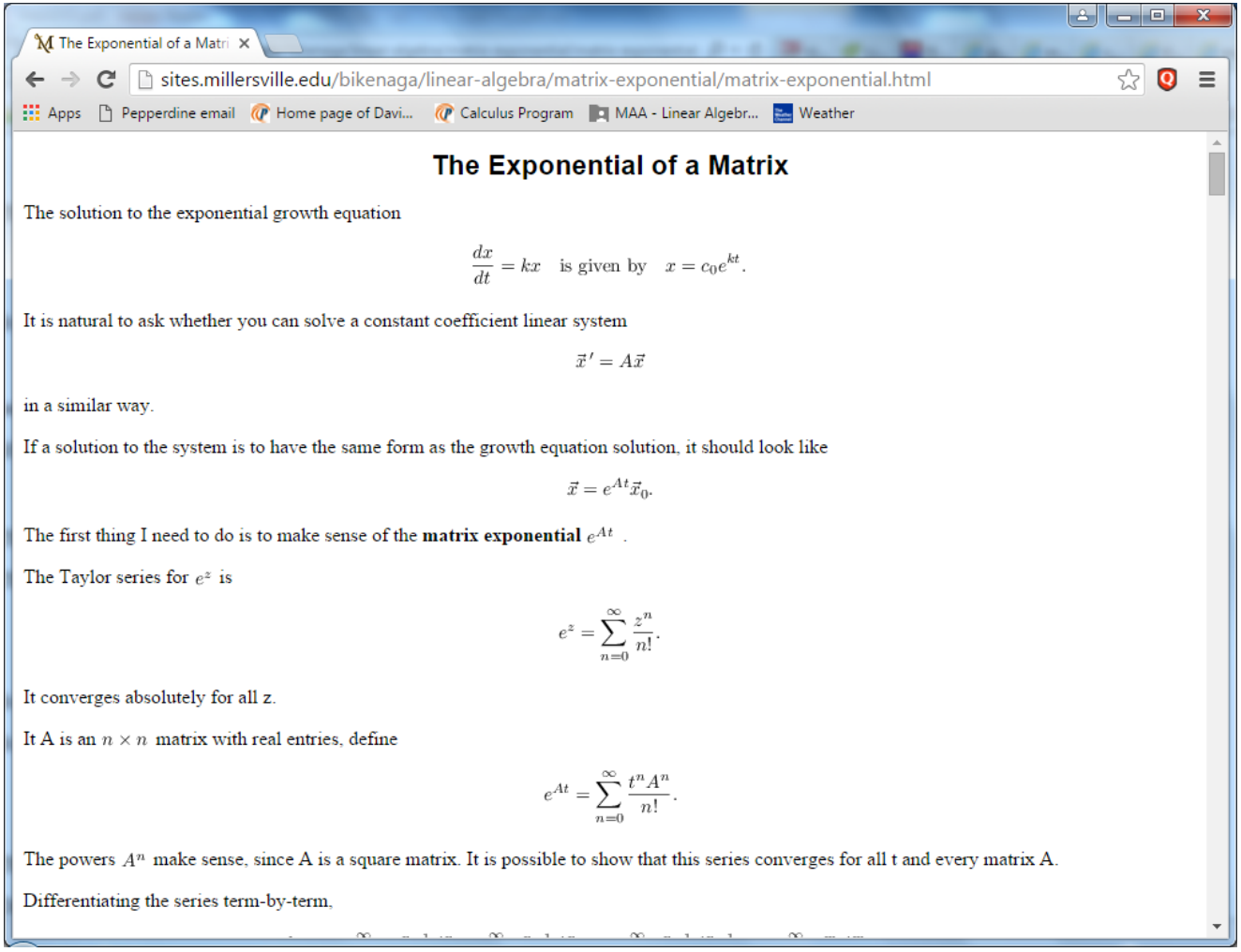



## The Exponential of a Matrix

The solution to the exponential growth equation

$$\frac{dx}{dt} = kx \quad \text{is given by} \quad x = c_0 e^{kt}.$$

It is natural to ask whether you can solve a constant coefficient linear system

$$\vec{x}\,' = A\vec{x}$$

in a similar way.

If a solution to the system is to have the same form as the growth equation solution, it should look like

$$\vec{x} = e^{At}\vec{x}_0.$$

The first thing I need to do is to make sense of the **matrix exponential** $e^{At}$ .

The Taylor series for $e^z$ is

$$e^z = \sum_{n=0}^{\infty} \frac{z^n}{n!}.$$

It converges absolutely for all z.

It A is an $n \times n$ matrix with real entries, define

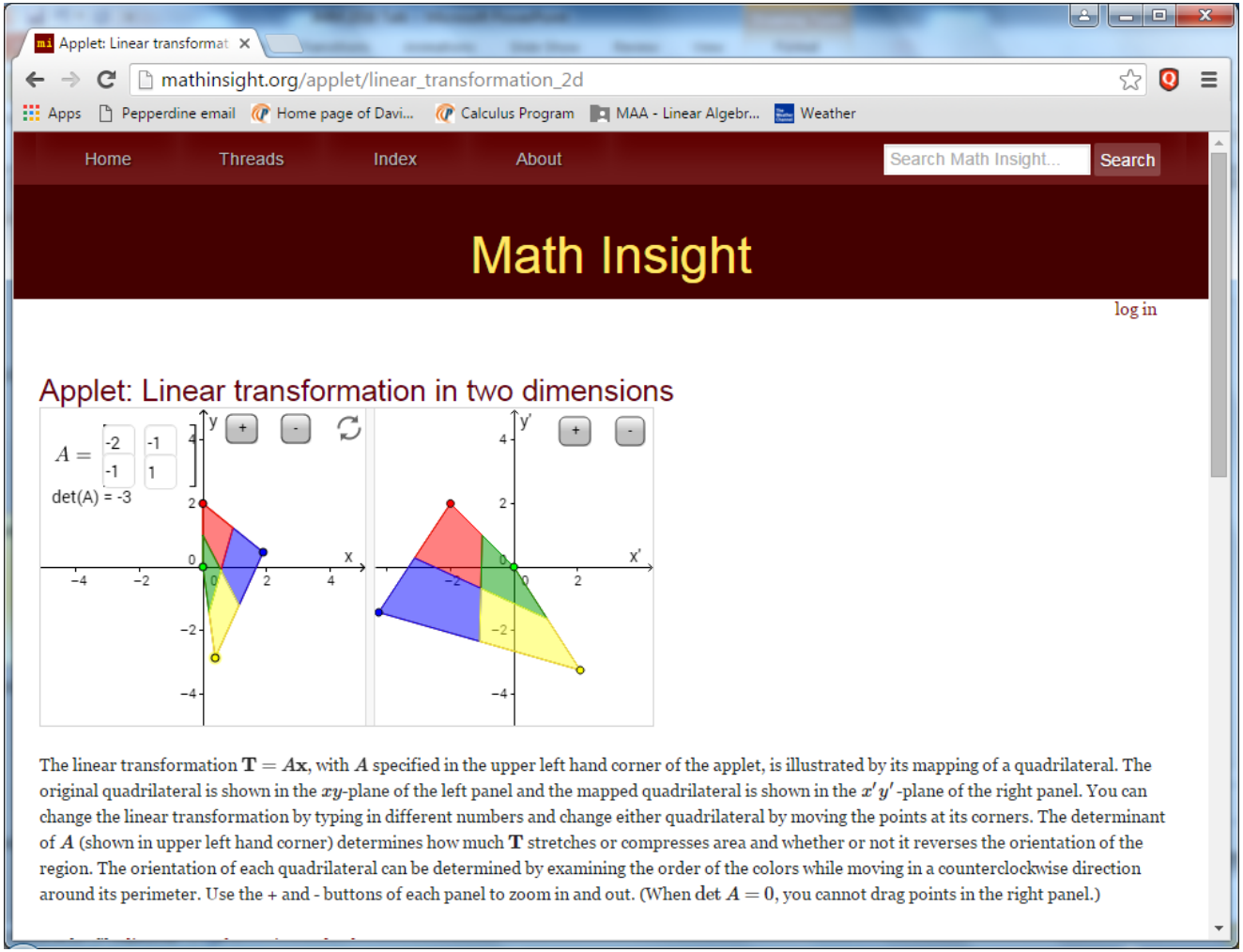
$$e^{At} = \sum_{n=0}^{\infty} \frac{t^n A^n}{n!}.$$

The powers $A^n$ make sense, since A is a square matrix. It is possible to show that this series converges for all t and every matrix A.

Differentiating the series term-by-term,

http://sites.millersville.edu/bikenaga/linear-algebra/matrix-exponential/matrix-exponential.html

# Linear transformations




http://mathinsight.org/applet/linear_transformation_2d

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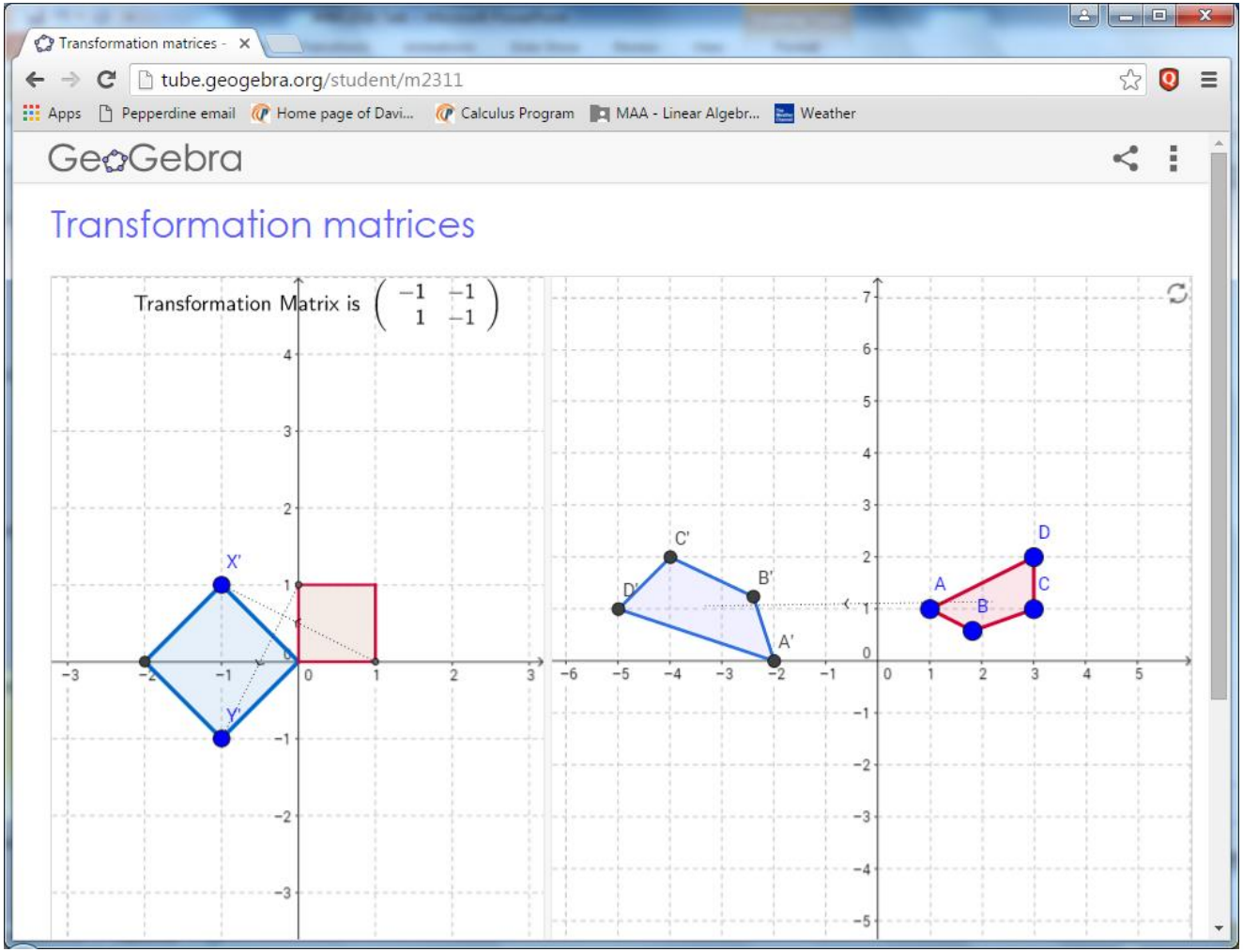
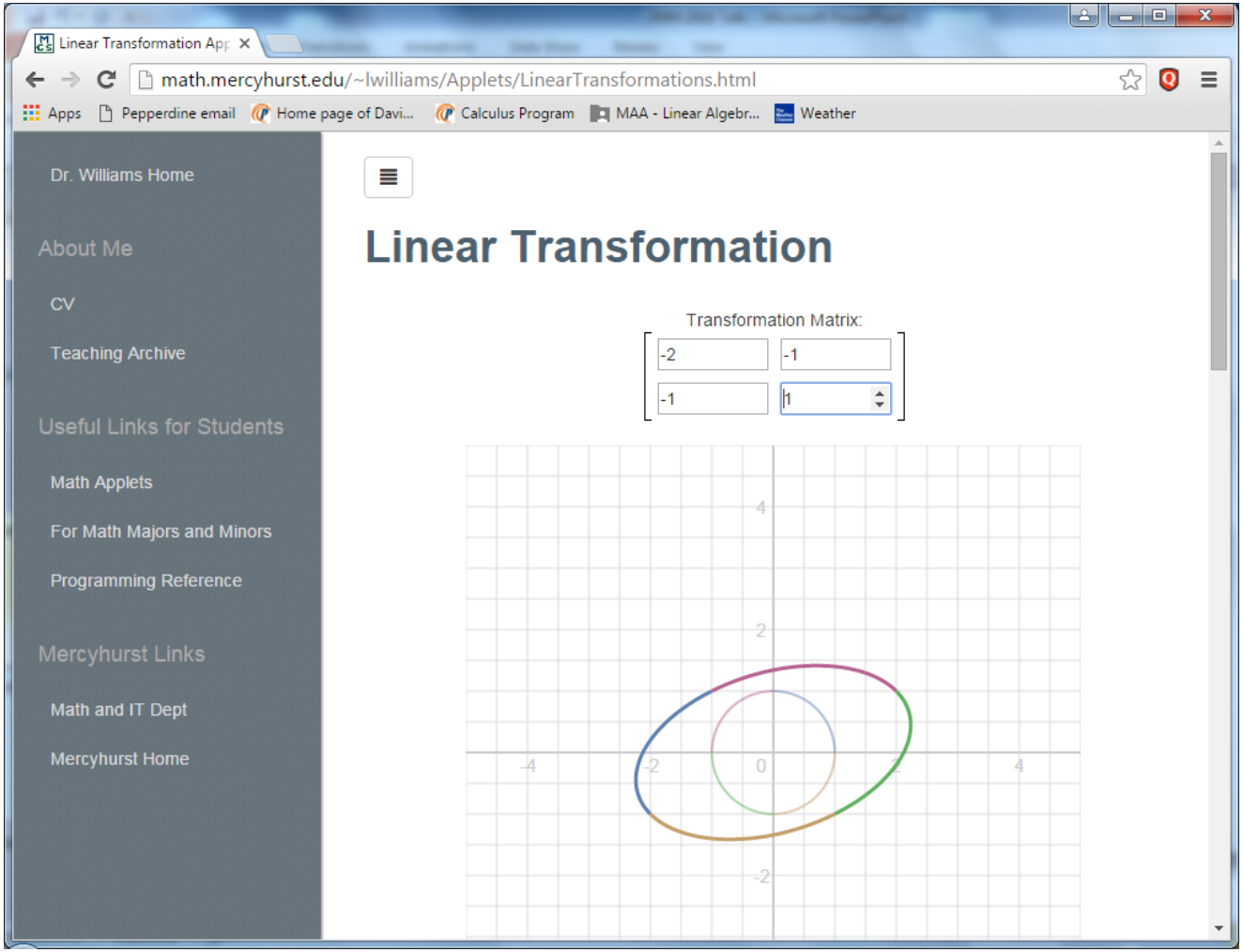


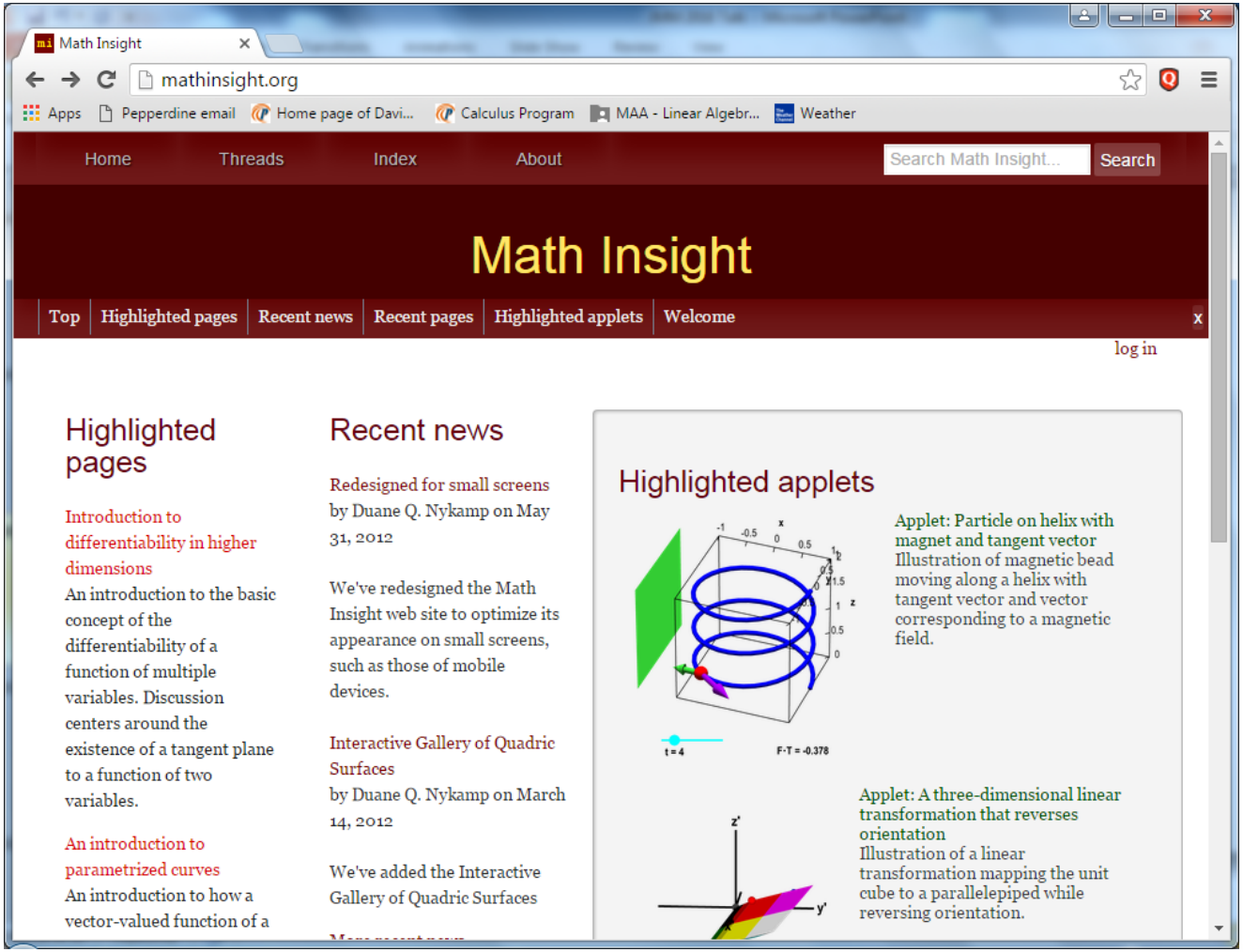

http://tube.geogebra.org/student/m2311

# Linear transformations




http://math.mercyhurst.edu/~lwilliams/Applets/LinearTransformations.html

# Other experimentation/visualization

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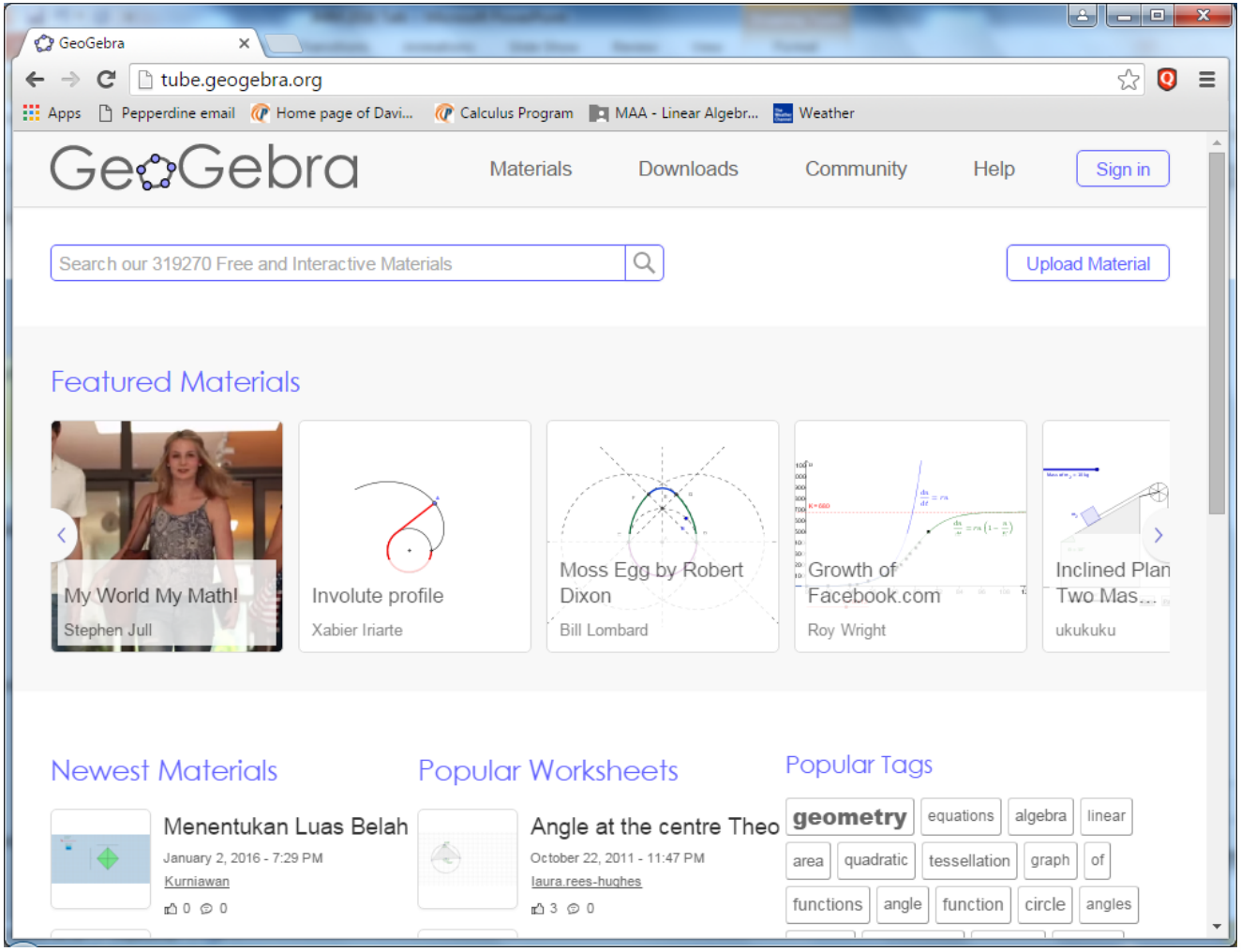


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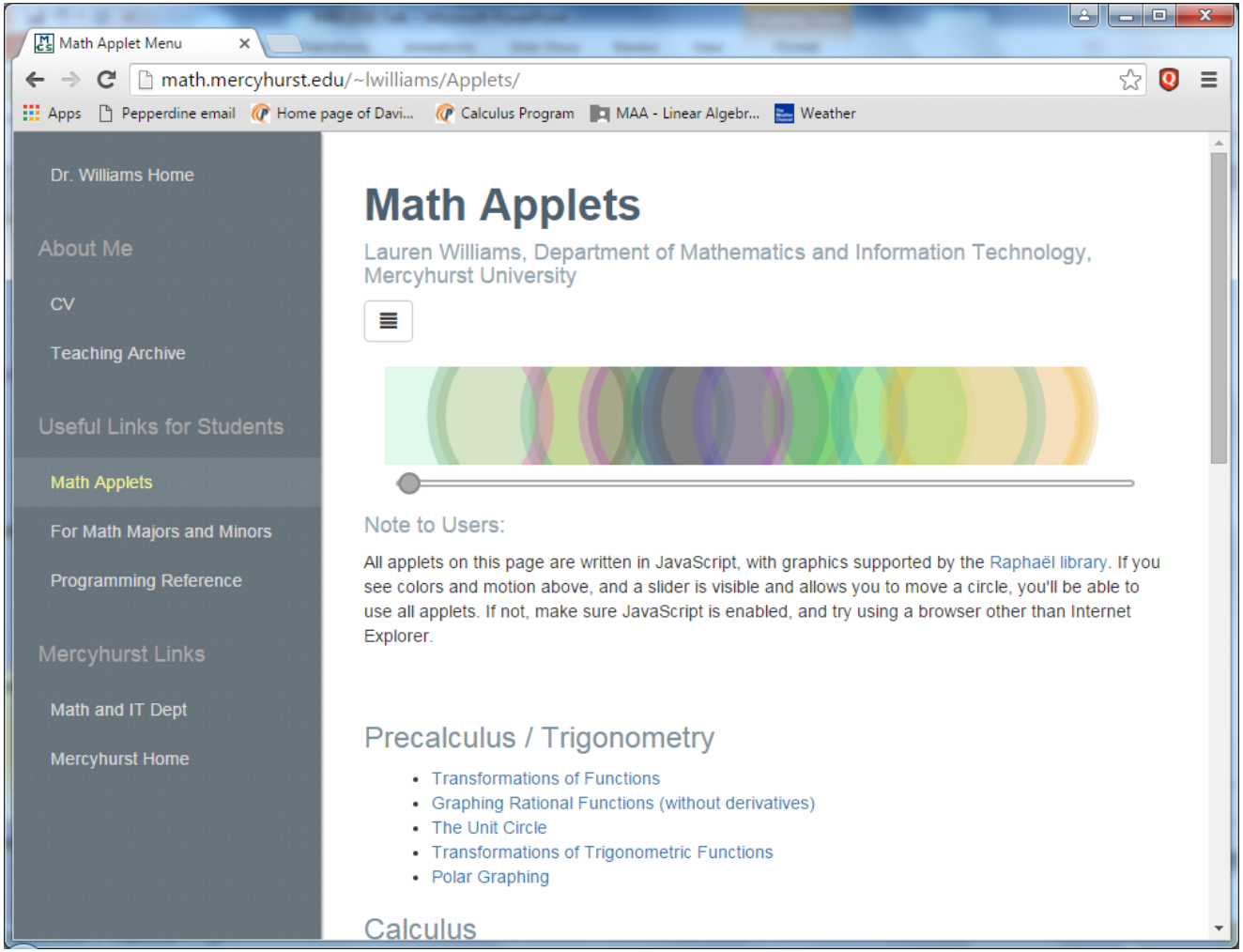
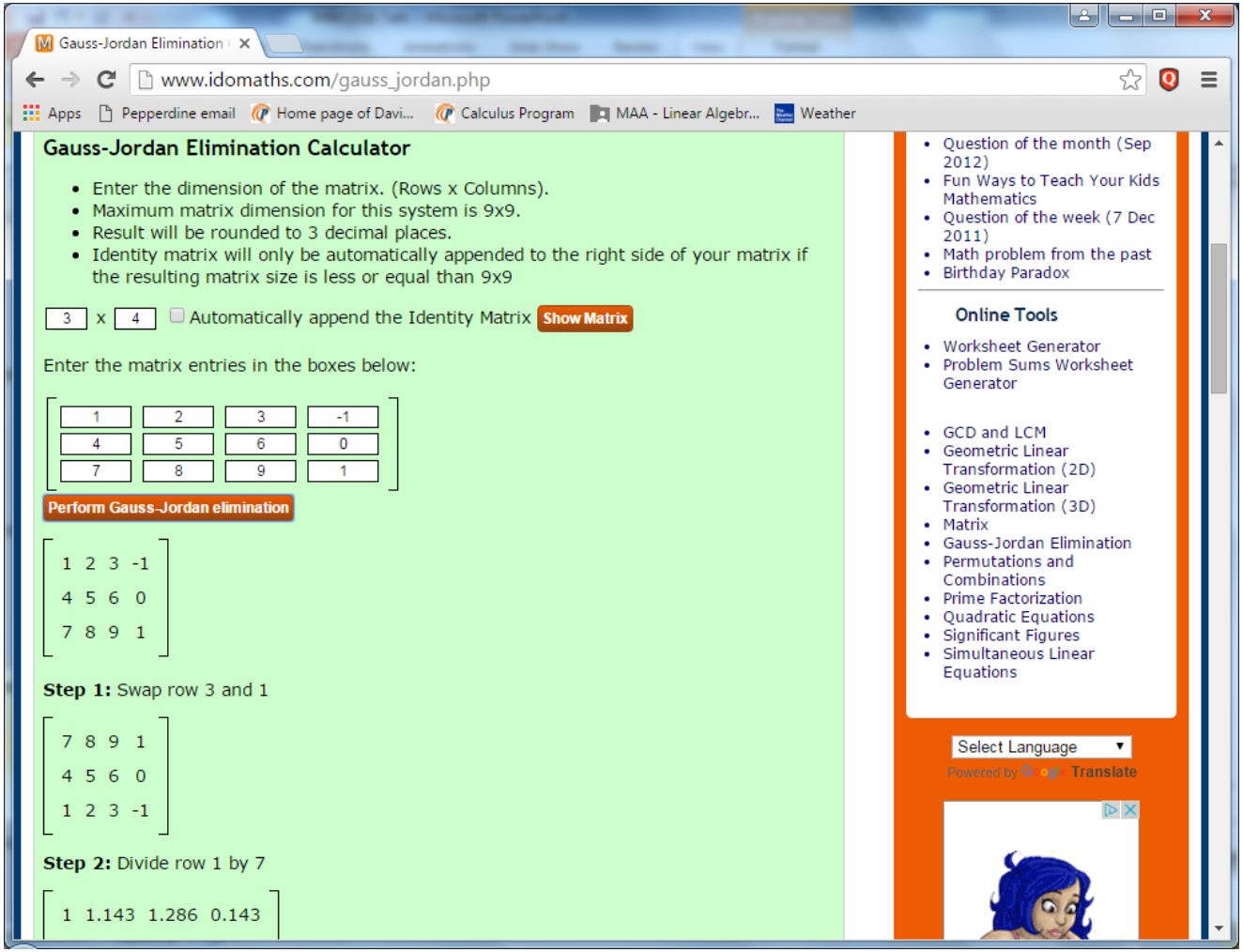



http://math.mercyhurst.edu/~lwilliams/Applets/

# Gaussian elimination




http://www.idomaths.com/gauss_jordan.php

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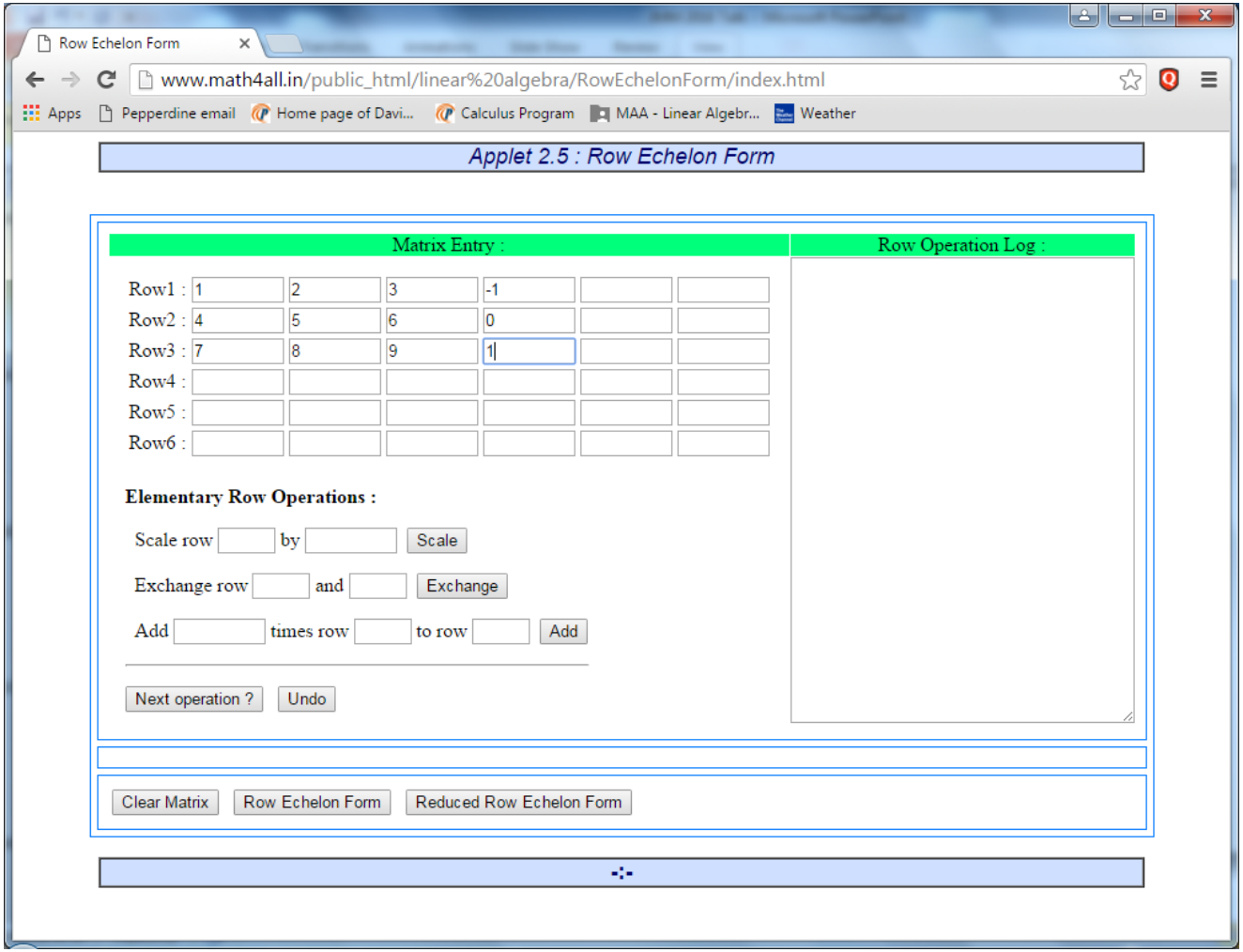


http://www.math4all.in/public_html/linear%20algebra/RowEchelonForm/index.html

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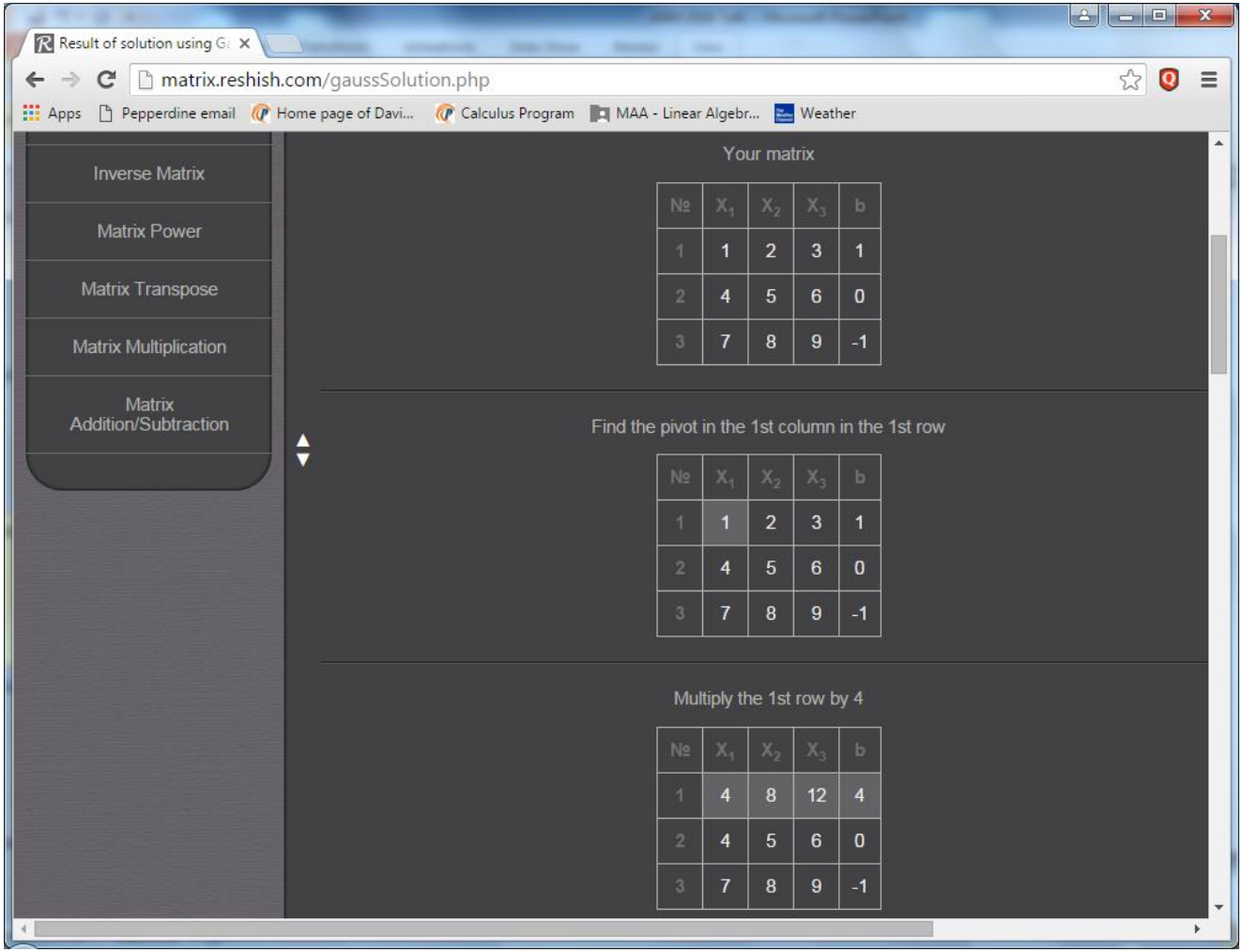


http://matrix.reshish.com/

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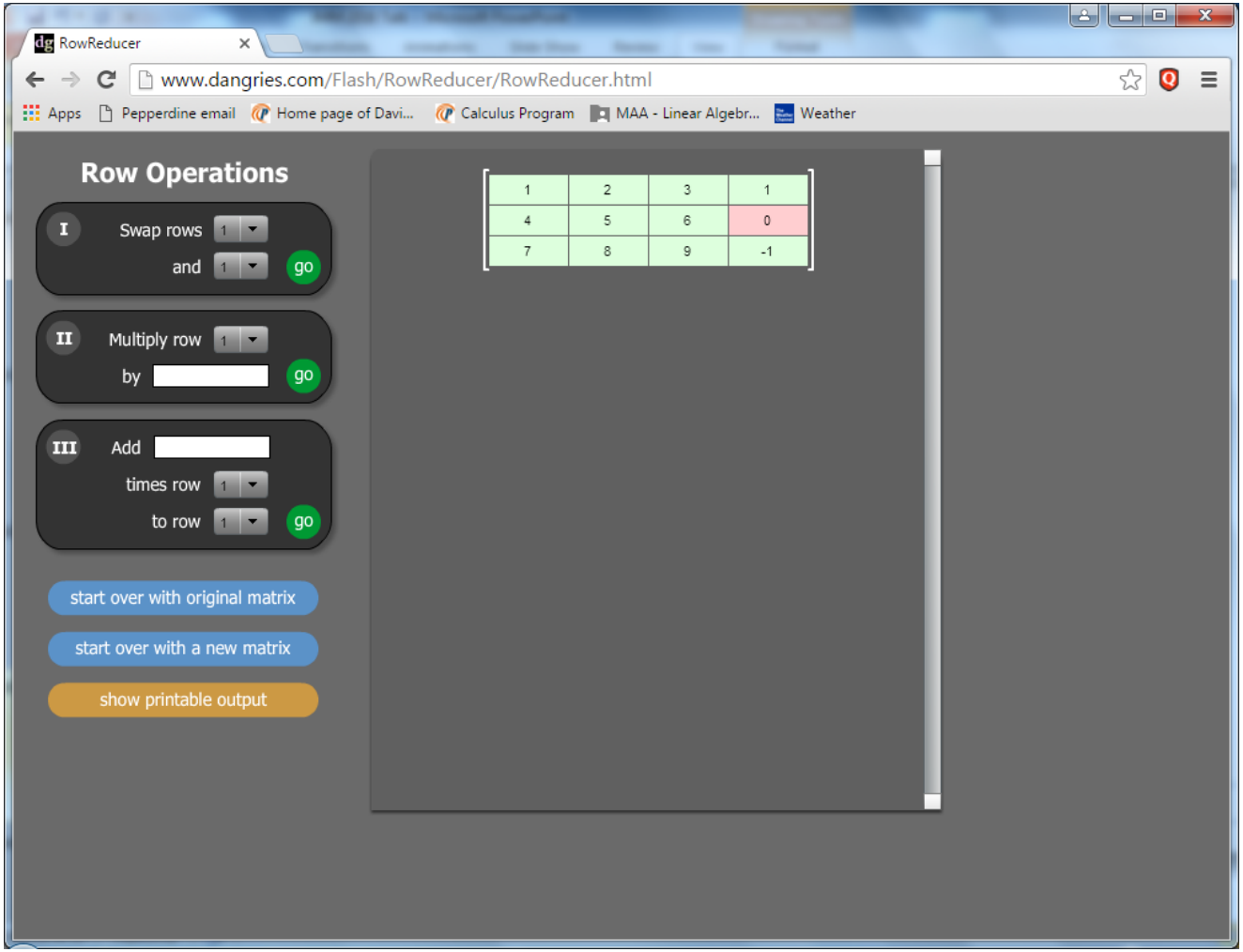
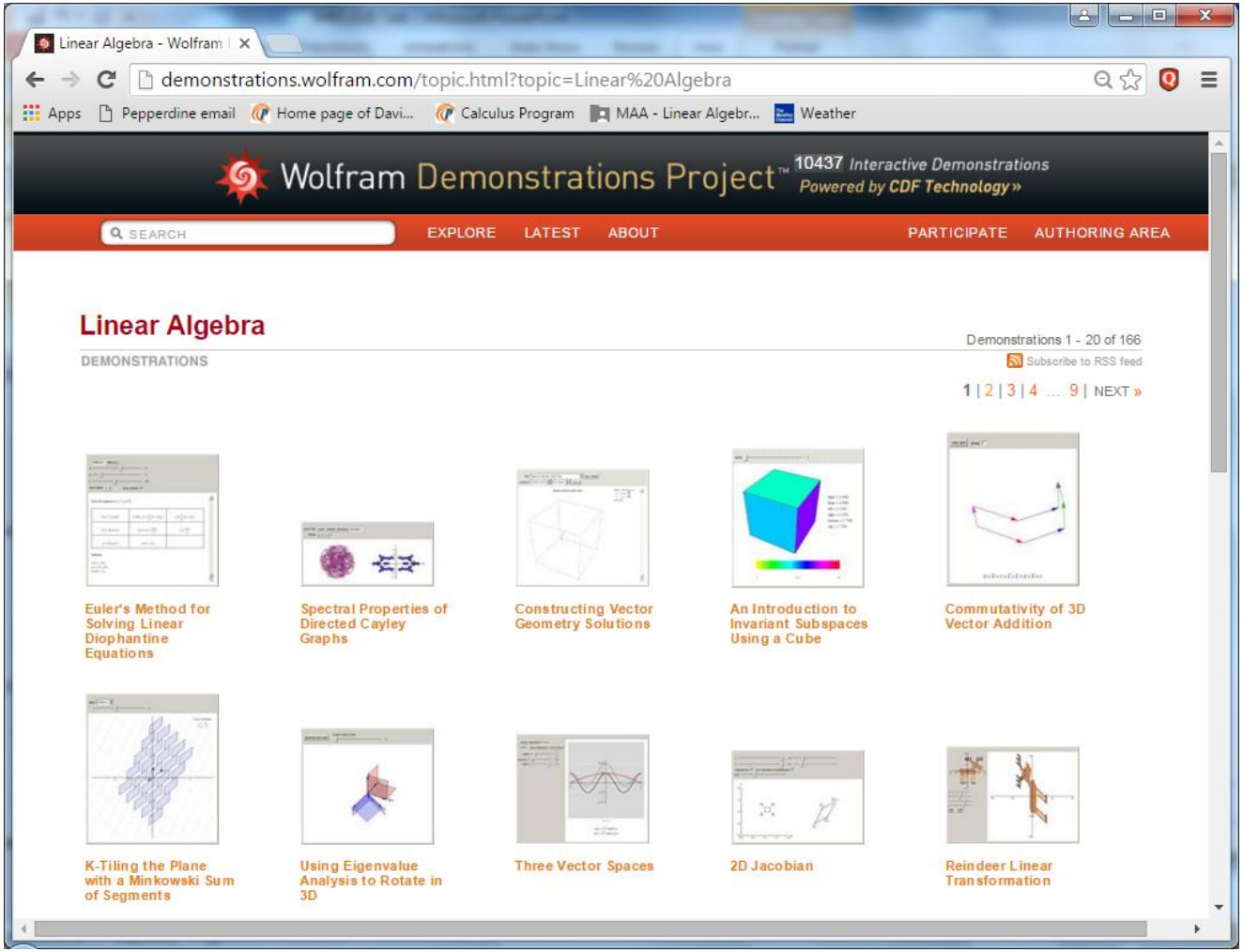



http://www.dangries.com/Flash/RowReducer/RowReducer.html

# Wolfram CDF activities

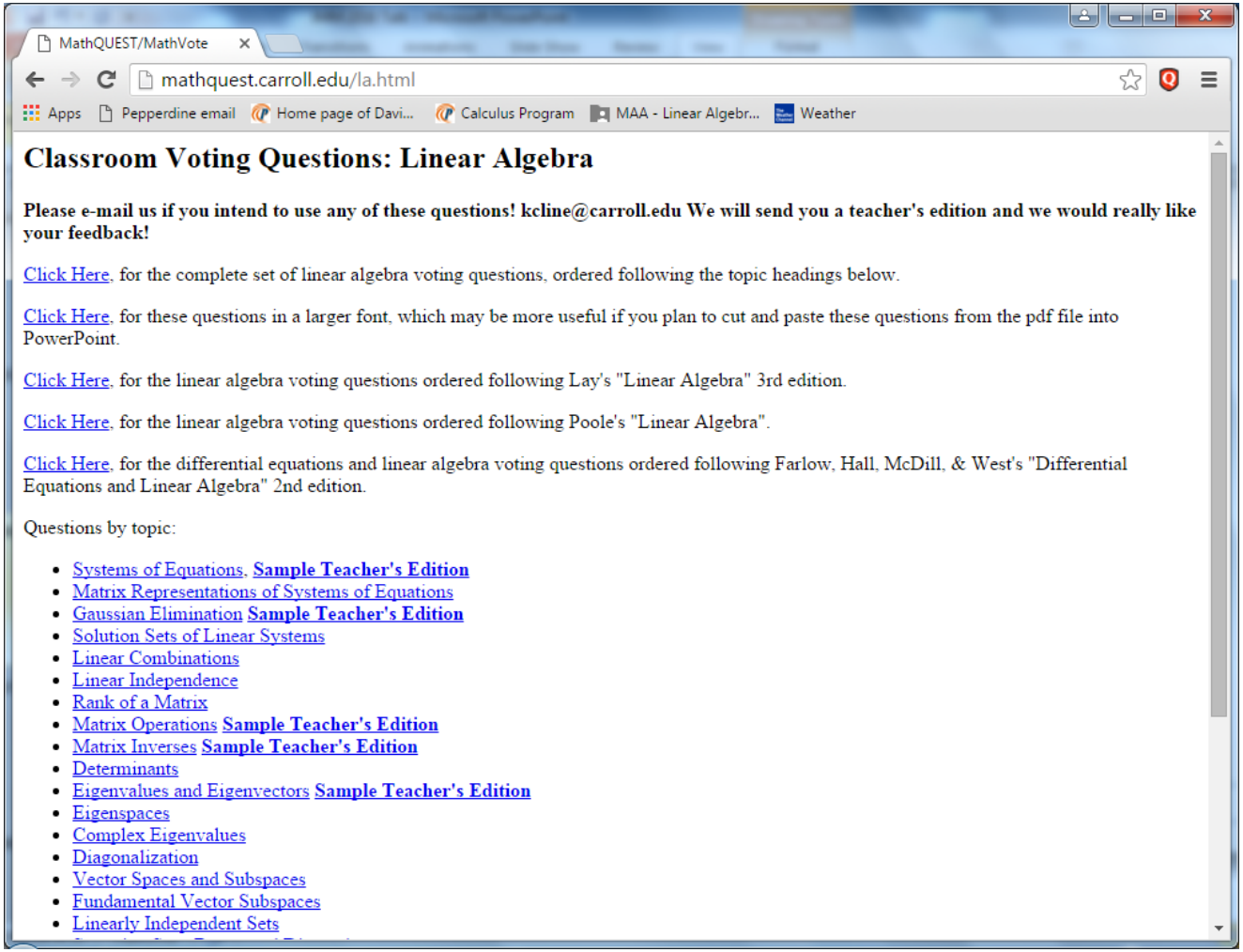



http://demonstrations.wolfram.com/topic.html?topic=Linear%20Algebra

# Other technology

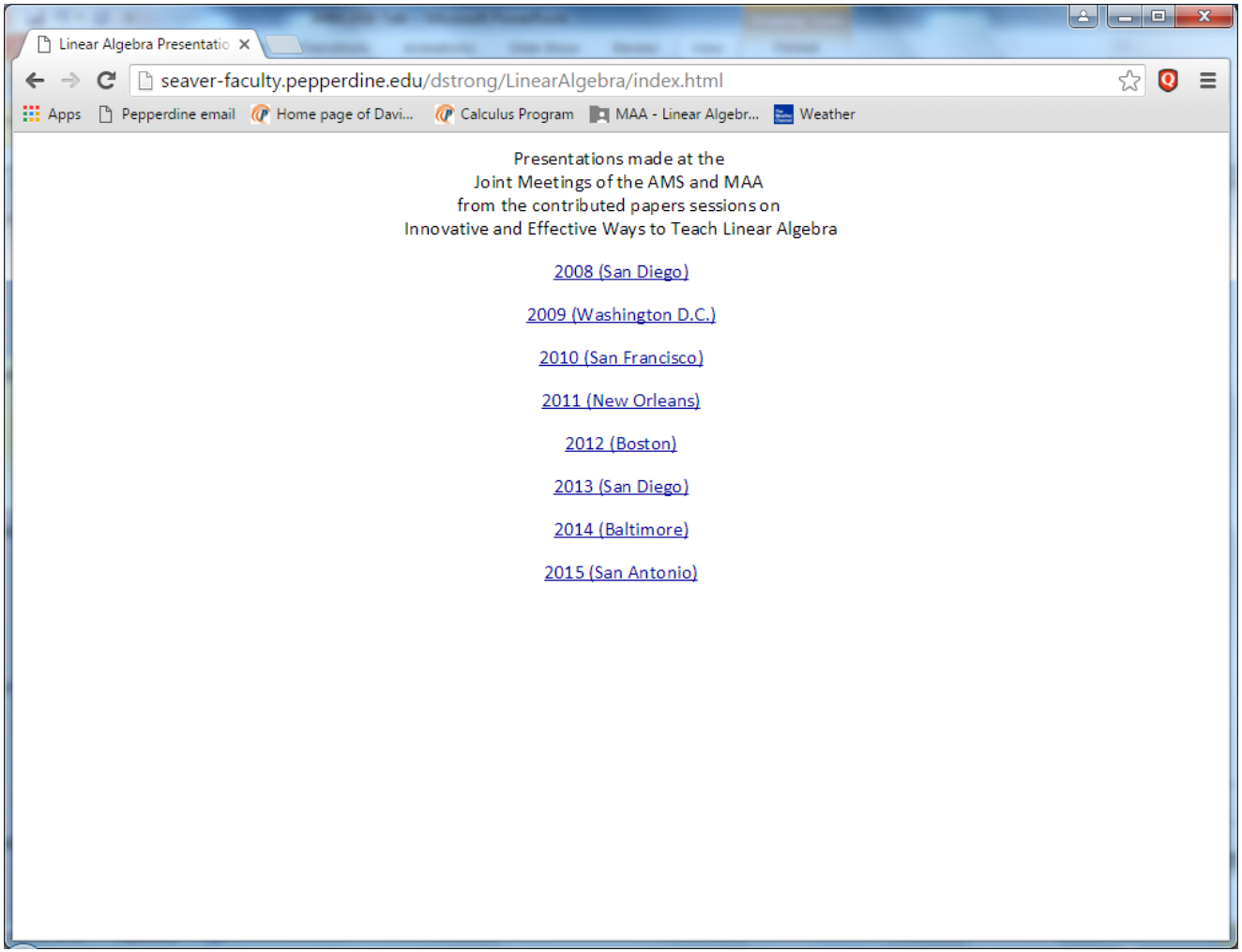
- Mathematica
- Matlab
- Maple
- Excel

# Classroom “clicker” questions




http://mathquest.carroll.edu/la.html

# Past JMM linear algebra talks




http://seaver-faculty.pepperdine.edu/dstrong/LinearAlgebra/index.html

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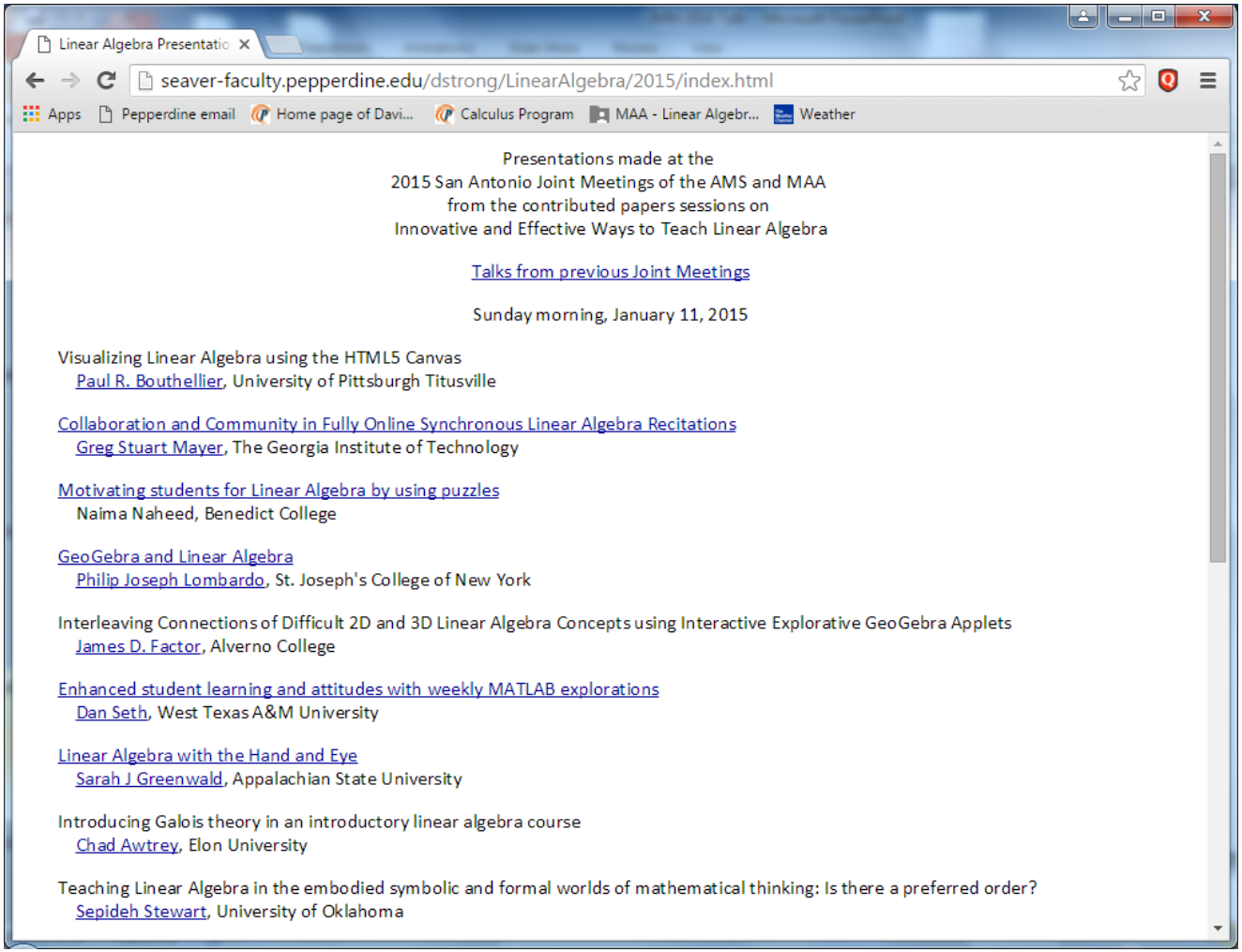


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Questions?