Online Resources for Math Majors

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March 31, 2017

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Rules of This Talk

- Only include resources that are available online. (This is not a talk about great math documentaries, textbooks, books, conferences, for undergraduates.)
- Only include resources that are accessible for WPUNJ undergraduates. (This is not a talk about resources for graduate students, math researchers or professors.)

Question and Answer Community Websites

Stack Exchange

- Developed in 2008 by Jeff Atwood and Joel Spolsky as a programming community.
- Currently has 116 Communities.
- 117 Million Unique Visitors a Month.
- Self moderating so the best questions and answers rise to the top.
- With a free account, one can save tags of interest on each of the sites.

▸ List of all Sites ▸ Math and Science Sites

Stack Exchange - History of Science and Math

- Accepts questions about history and origins of science and mathematics.
- Very accessible questions and answers regarding College Algebra, Precalculus, Calculus and Beyond.
- Really of interest to anyone who has taken math.

▸ Why is a Radical Called a Radical? ▸ Why the Horrible Notation for Inverse Sign?

▸ Who invented the power rule for derivatives? ▸ Some Top Sample Questions

Stack Exchange - Math Overflow

- For research and research level questions, so many questions are inaccessible to those not doing current research in that particular field.
- Soft questions are questions about doing research or being a researcher, without being mathematics problems themselves.

▸ Some Top Soft Questions ▸ Popular Math Games?

▸ How Much Work Does It Take To Be Successful at Mathematics?

Stack Exchange - Mathematics Educators

- For teachers of Mathematics at any level.
- Even of interest to those only tutoring math at our tutoring math.

▸ Tagged Common Student Mistakes ▸ Struggling Students ▸ Tagged Notation

Stack Exchange - TeX / LaTeX

- "Professor, how did you make the exam look so beautiful?"
- Great place for questions involving LaTeX and Beamer, the latter of which this talk was made in.
- Great place to look up very strange errors which sometimes appear.

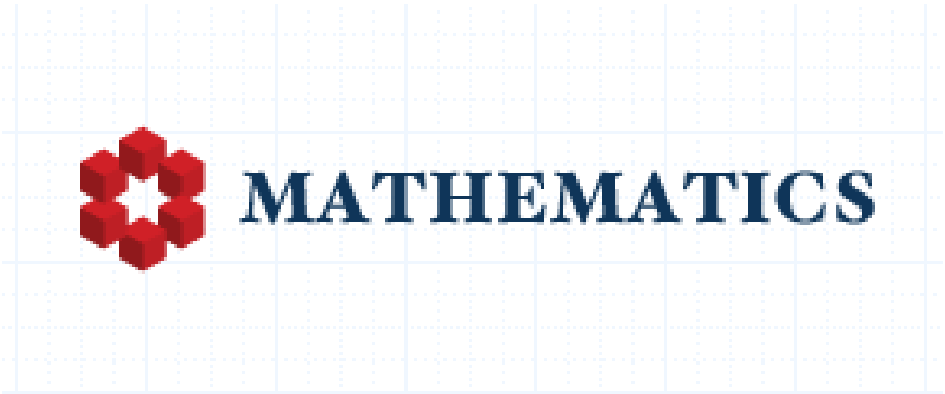
▸ Beamer ▸ Errors ▸ General Front Page

Stack Exchange - Stack Overflow

- Questions about programming in different languages.
- Great for whichever language you're required to work in.

▸ Python ▸ C++

Stack Exchange - Mathematics



- Most important of all for Mathematics majors.
- Search subjects by tags so one can look up their classes and find useful material.
- Tags exist for every course in the WPUNJ major.
- Can examine the large flow of current questions without even commenting.

Sequences and Series | Group Theory | Combinatorics | Linear Algebra | Number Theory | Main Site

Reddit

- Reddit has 234 million unique users per month.
- Seventh most visited US website.
- Founded in 2005 by two roommates at the University of Virginia: Steve Huffman and Alexis Ohanian.

Strength and Weaknesses

- WARNING - Pretty much every single user on Reddit will tell you that Reddit is a life draining colossal waste of time.
- Also, things that are quickly consumable tend to get more upvotes, so there is a tendency for memes (and cats) to rise to the top.
- Though much less serious than the stack exchange community, it does have its share of helpful and/or brilliant users, people are more tolerant of flawed questions, and sometimes easily digestible things are still insightful and worthwhile.

▸ Polygonal Sine Functions ▸ Relating Tangent to Tangent Lines ▸ More Trig Functions

▸ John Nash Recommendation Letter ▸ Mechanical Calculator Divides by Zero ▸ Newton and Leibniz

▸ Silly Textbook Exercise ▸ Affordable Textbook Comment ▸ Paranormal Distribution

▸ Scarlet Johannsen Billboard Mistake ▸ FLT News Mistake

Math Subreddits

- Main mathematical subreddit is r/math which supports discussion of mathematical questions and links.
- The r/statistics subreddit is an active group devoted to that subject.
- The subreddit r/learnmath has study tips, links to additional lectures on topics, and more for people learning various subjects.
- The subreddit r/actuary/ is for articles and links of interest to those in the actuarial profession.
- There are subreddits devoted to mathematical software such as r/mathematica, r/matlab and r/sagemath, as well as coding language for almost any language you can think of.

r/math r/statistics r/learnmath r/mathriddles r/actuary r/mathematica r/matlab r/sagemath

Encyclopedic Resources

Wikipedia

- Wikipedia is an online free-content encyclopedia of everything.
- The name comes from the Hawaiian word "Wiki" for quick together with the obvious.
- Created in 2001 by Jimmy Wales who has a Ph.D. in finance.
- Has 374 million unique monthly visitors, 5,370,474 English articles, and about 70,000 contributors.

Credibility

- In 2005 Nature did a study which found the level of accuracy to be equivalent to the Encyclopedia Brittanica, which is also not flawless.
- There is some vandalism, for example the first rule of Thermodynamics was temporarily changed to "You do not talk about Thermodynamics."
- Peer reviewed journal articles are often only gone through once by a single reviewer.
- The braid group entry on Wikipedia had the correct relations for one of my capstone students when the peer reviewed algebra journal did not.

▸ Correct Braid Group Relations

The Problem with Wikipedia is that it's peppered with vandalism at various times and at various locations: vandalism that remains until it's noticed by someone who knows enough and cares enough to fix it!
SOMETIMES THIS CAN TAKE A WHILE.
But!
ahem
Ladies and gentlemen: I have solved the Wikipedia Problem!
The solution is as brilliant as it is awesome: instead of vandalizing the ENTIRE encyclopedia, we all just agree to vandalize one article, leaving the other ones alone!
That article is the one about chickens. Why? It's pretty obvious. DUDES ALREADY KNOW ABOUT CHICKENS.
In conceding that one TINY article to the vandals, Wikipedia wins! Their victory: a FULLY ACCURATE encyclopedia that covers every topic in the universe, 'cept chickens.
T-Rex, this is worse than taking on the mob! Wikipedia will be HELLUVA mad at you!
No way! I am doing them a FAVOUR.
Their vandalism problem GOES AWAY, FOREVER, and all that I ask is that chickens become The Forbidden Topic. "We never talk about chickens", they can say. "DON'T ASK."
But how are you going to get people to respect this idea? Plus, IS IT NOT TRUE THAT MANY WIKIPEDIA EDITORS ARE TRULY HUMOURLESS ABOUT WIKIPEDIA??
I guess we're about to find out! I bet Fictional Jimbo Wales loves the idea.
I do love this idea, T-Rex!
Fictional Jimbo Wales! You brought cupcakes!!
(C) 2006 Ryan North
www.qwantz.com

Sample Pages

- Any topic in any class in the undergraduate curriculum will be available on Wikipedia.
- Even if you don't need help with a topic, getting a different perspective from you professor and textbook is almost always beneficial.
- The following pages correspond to different 400 level classes taught at WPUNJ, and one can often find the different topics your instructor has chosen from links on these main pages.

▸ 4110 Discrete Mathematics ▸ 4120 Time Series Analysis ▸ 4150 Topics from Applied Mathematics

▸ 4230 Real Analysis ▸ 4250 Topology ▸ 4220 Complex Analysis

Multiple Wikipedia Entries

- There are sometimes multiple Wikipedia pages for a topic.
- This generally happens when there is a extensive list of accessible examples.
- Be sure to look for good information on both pages.
- Some examples of this include the entries for Limits, Simple Groups.

- Limits
- List of Limits
- Series
- List of Series
- Polytopes
- List of Polytopes
- Johnson solid
- List of Johnson solids
- Prime Knots
- List of Prime Knots
- Perfect Number
- List Perfect Numbers
- Simple Groups
- List of Simple Groups

Mathworld

- Alternate free-content general Mathematics encyclopedia.
- Began as notes published online by Caltech Physics student Eric W. Weisstein in 1995.
- In 1999 he was hired by Wolfram Research and it has since been hosted at the company website.
- Site contains about 13,000 different entries.
- Can download wolfram notebooks for entries and run Mathematica to recreate and build off the examples shown.
- Often far less information than Wikipedia about topics.

▸ Wolfram Mathworld Main Site ▸ 15 Puzzle ▸ Tower of Hanoi ▸ Simple Groups ▸ Induction

The On-Line Encyclopedia of Integer Sequences

THE ON–LINE ENCYCLOPEDIA
OF INTEGER SEQUENCES®

founded in 1964 by N. J. A. Sloane

- An online database of important mathematical sequences.
- Started in early 1964 by Neil Sloane of Bell Labs with the first sequences written on note cards.
- Published in 1995 as a 587 page book of 5487 sequences.
- In 1996 it became part of Sloane's home page at the AT&T Labs..
- Current form began November 11, 2010 where it is maintained by Sloane and a team of 130 editors.
- Containing over 280,000 sequences, this topic deserves its own talk.

▸ OEIS Website ▸ Sample Sequence

The MacTutor History of Mathematics Archive

- Created by John J O'Connor and Edmund F Robertson at the University of St Andrews, Scotland.
- They received a laboratory of thirty Macintosh computers in 1988 and used what was called the hypercard system to create links for students to hop from topic to topic.

The MacTutor History of Mathematics Archive

- The site has over 2800 articles and 6000 pictures related to the History of Mathematics.
- Can search by name, year of birth, geographic area and other fields.
- The "Mathematicians of the Day" link allows people to search and find mathematicians who were born or died on the given date.

▸ Mathematician of the Day ▸ Search by Name ▸ Chronological Index ▸ By Location ▸ Cauchy

Group Props

- Created by Vipul Naik, a graduate student at the University of Chicago.
- Not a large site but contains useful information about various finite groups.

▸ Main Page ▸ Particular Groups

Prime Pages

- Created and maintained by Chris Caldwell a professor at the University of Tennessee at Martin.
- Website is devoted not to all of Number Theory, but specifically the primes themselves.
- Contains current information about largest primes and research involving the computation involved in finding them.
- Contains many "fun facts" about primes and other numbers.

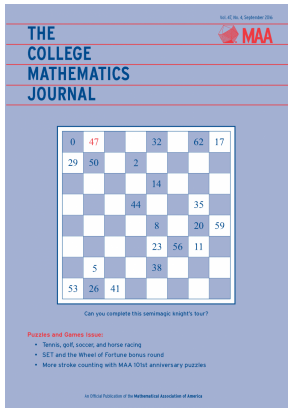
▸ Prime Pages Main Link ▸ Prime Curios ▸ 101

Accessible Journals

Don't Be Afraid of Math Journals

- The vast majority of math journals are specifically aimed at mathematics researchers who have gone into one particular field.
- This can make them quite impenetrable and downright scary.
- There are, however, journals out there designed to be accessible to the undergraduate mathematics major.

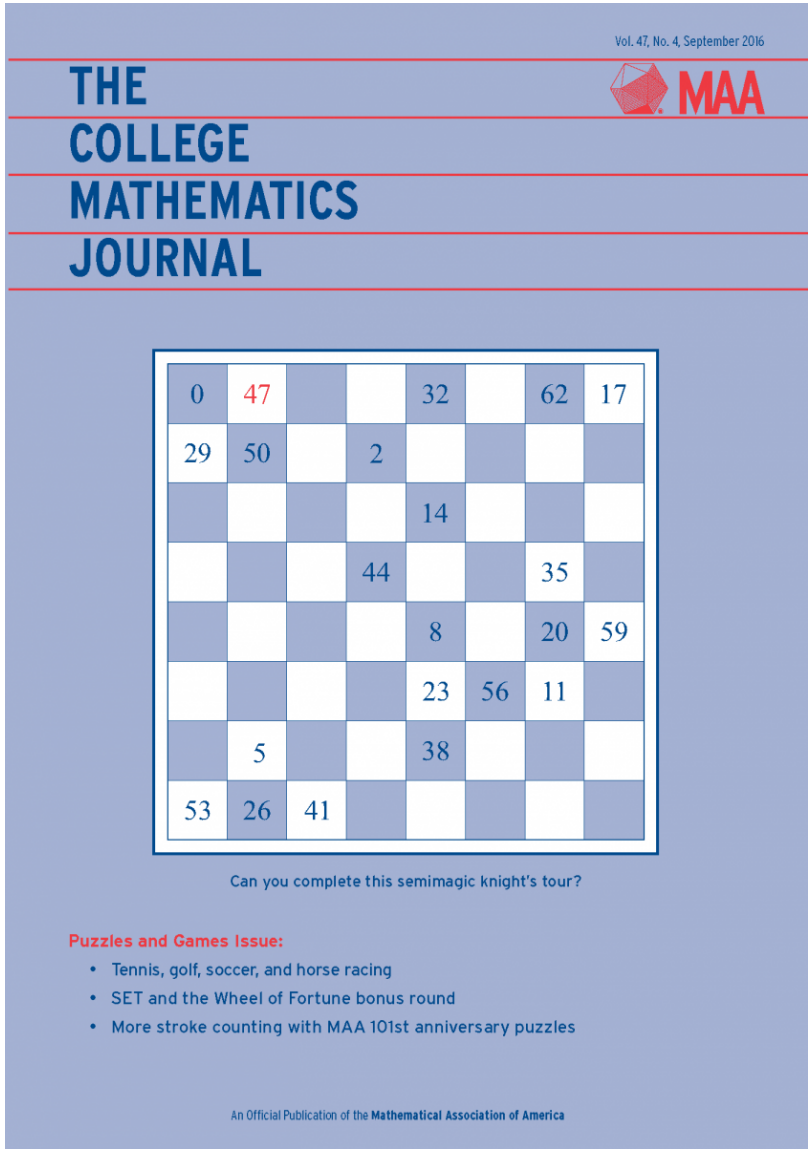
The College Mathematics Journal



- Started in 1970, they release five issues per year.
- Article are aimed at the college mathematics curriculum with emphasis on topics taught in the first two years.
- Maintains a problem solving contest at the end of every issue.
- Available through JSTOR at WPUNJ or through deeply discounted student MAA membership.

▸ CMJ Website

Sample College Mathematics Journal Puzzle and Cover



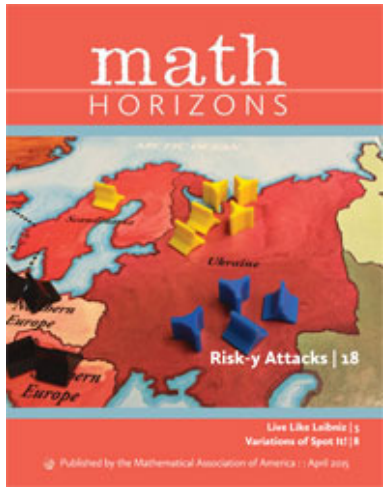
Mathematics Magazine

- A continuation of Mathematics News Letter which began in 1926, they release six issues per year.
- Article are aimed at teachers of college mathematics and their students, with an emphasis on mathematics at the junior and senior level.
- This is a great place to look for capstone projects.
- Maintains a problem solving contest at the end of every issue.
- Also available through JSTOR or student MAA membership.

▸ Mathematics Magazine Website

Sample Mathematics Magazine Journal Puzzle and Cover

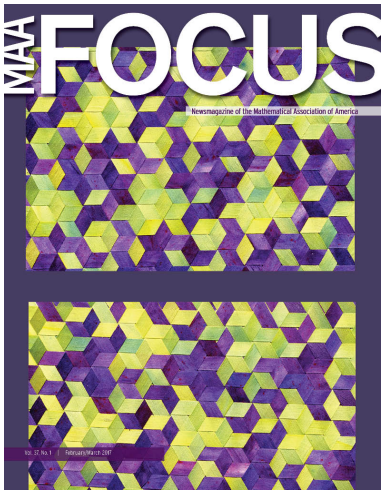
Math Horizons



- Actually a magazine instead of a journal.
- Released four times a year fully in color.
- Aimed mostly at undergraduates interested in mathematics, not necessarily math majors.
- Has math puzzles and games every issue with solutions included.
- Free through JSTOR login.

▸ Math Horizons Website

MAA Focus



- Even father from a journal, this is the newsmagazine of the MAA.
- Released six times a year fully in color.
- Contains news article about math in America.
- Fully free at the MAA website, with no login required.

▸ MAA Focus Website

Covergence

Figure: A Mesopotamian Table of Square Roots

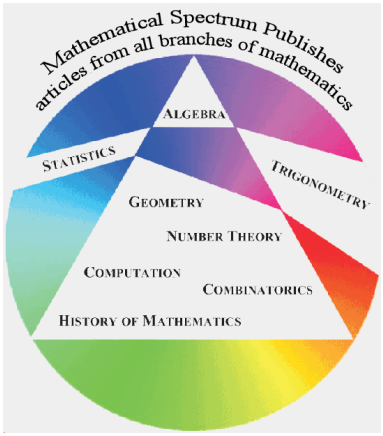
- An online History of Mathematics journal.
- Articles are compiled together once a year.
- Fully free at the MAA website, with no login required.

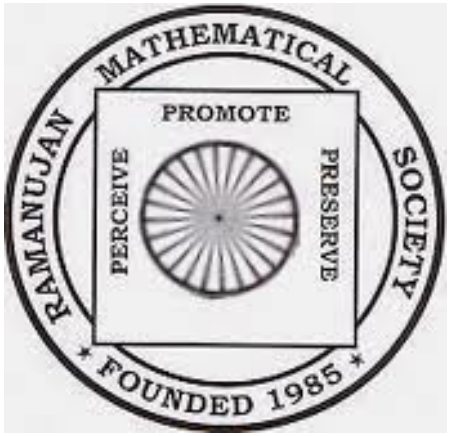
Journal of Integer Sequences

- An fully open-access journal, specializing in research papers about integer sequences.
- Founded in 1998 by Neil Sloane.
- One volume is released each year with as many articles as deemed worthy by peer review.
- Papers are of varying degrees of difficulty, some being extremely accessible.

▸ Journal of Integer Sequences Website ▸ A Sample Article

Acessible Journals from Outside the US





- Mathematical Spectrum (UK)
- Ramanujan Mathematical Society Newsletter (India)
- Recreational Mathematics Magazine (Portugal)

▸ Mathematical Spectrum Website ▸ A Sample Spectrum Abstract

▸ Ramanujan Mathematical Society Newsletter Website ▸ Recreational Mathematics Magazine Website

YouTube Channels

Credibility

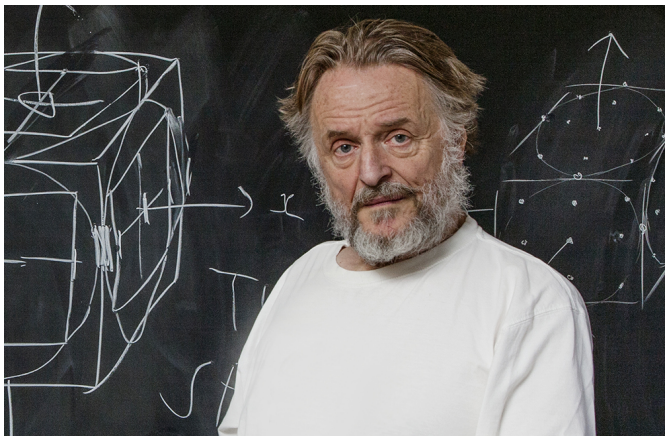
- As anyone with a camera on their computer, laptop or cellphone can make videos, credibility is a serious issue.
- We wish to avoid outright false information, ambiguous information, imformation that is being made harder than necessary, and information provided in a boring way.

Numberphile

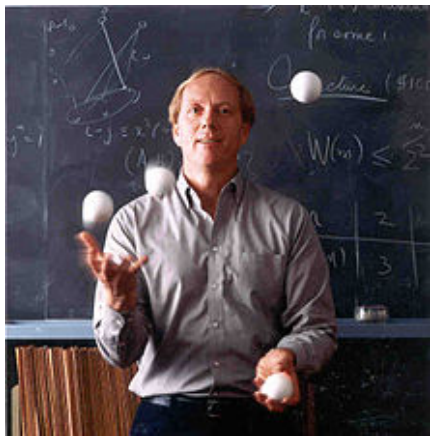
- Creation of an Austrailian filmmaker named Brian Haran.
- Started on Halloween of 2011.
- Funded by the MSRI, the Mathematical Sciences Research Institute in Berkeley, California.
- Youtube channel has 2,010,416 subscribers.

numberphile.com | Numberphile on Youtube | Numberphile on Twitter

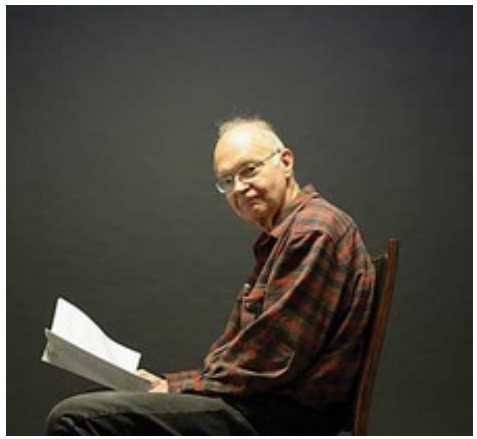
Numberphile Guests



(a) Conway



(b) Graham



(c) Knuth

- Numberphile videos are each hosted by great mathematicians or well known promoters of Mathematics.
- Some of the famous guests are Elwyn Berlekamp, John Conway, Persi Diaconis, Ron Graham, Don Knuth and Tom Scott.

Numberphile Strengths and Weaknesses

- Everything at Numberphile is both presented and checked by great researchers in the field.
- They only choose entertaining and/or famous presenters.
- Content is aimed at a general audience so material will be quite accessible to Mathematics majors.
- Updated extremely regularly compared to most other Mathematics channels.
- My only nitpick is that their most popular video, the $-\frac{1}{12}$ one, uses techniques that are different than that of the normal calculus sequence, thus possible creating confusion.

Some Videos

Choosing the ten best Numberphile videos is too hard, so here are simply ten truly great videos everyone should watch.

- Dots and Boxes
- Knights Tours
- Eight Queen Problem
- Why Secret Santa is Horrible
- Josephus Problem
- Hating the Game of Life
- Shortest Ever Papers
- Graham's Number
- Surreal Numbers
- Terry Tao

Vi Hart

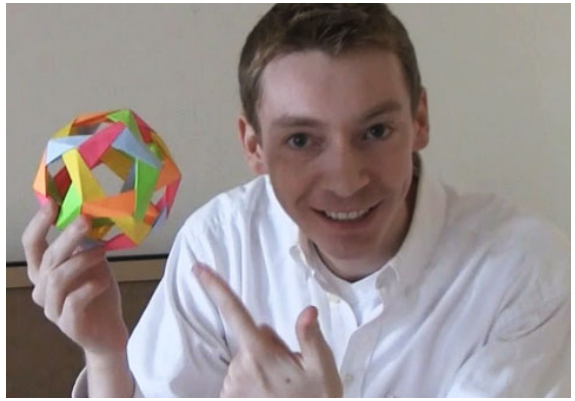
- Daughter of the famous mathematical sculptor George Hart who also happens to have a great YouTube channel.
- Vi is a mathematician and doodler, born in 1988 who earned her Ph.D. at Stonybrook University.
- Her own research in on Computational Geometry.

Some Videos

Also not a top ten list, these are ten of her videos all majors should watch:

- Anti-Pi Rant
- Anti-Pi Day Rant
- Types of Infinity
- Logarithms
- Point Nine Repeating
- Transcendental Darts
- Reverse Cantor
- Infinite Trees
- Sick Number Games
- Dragons

James Grime



- Received his Ph.D. from the University of York in 2007.
- Featured multiple times on Numberphile and other shows.
- Has over 200 YouTube videos on Mathematical tricks and problems.
- Took a job at Cambridge University popularizing Mathematics to high school students and the general public as part of the Enigma Project.

singingbanana

Museum of Mathematics

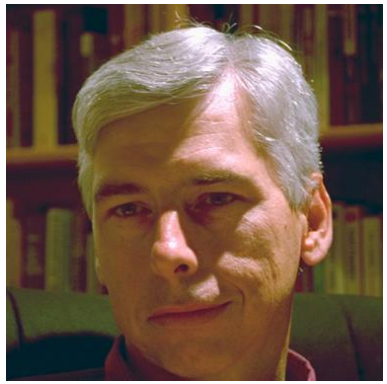
- On December 15, 2012 museum dedicated only to Mathematics opened in Manhattan.
- Called MOMATH it is the only Mathematics museum in North America.
- Their YouTube channel is designed to help with their mission to "enhance public understanding and perception of mathematics."
- In particular, their Math Encounters videos are both long and accessible.

▸ Main Link ▸ Bob Bosch Talk ▸ Conway Talk ▸ Berlecamp Talk ▸ Richard Guy

Math Blogs

THE WILLIAM PATERSON UNIVERSITY OF NEW JERSEY
COMMITMENT TO EXCELLENCE
1855
WAYNE

bit-player



- Author and columnist who popularizes ideas in Mathematics and Computer Scientist.
- Published regular columns in Scientific American and American Scientist.
- Maintains a very accessible blog at bit-player.org devoted to math and computing.

▸ bit-player Website ▸ KenKen Friendly Numbers ▸ Gauss Fable

Tanya Khovanova's Math Blog

- Tanya Khovanova is a freelance Mathematician at MIT.
- All entries of her blog are accessible to undergraduates, with a focus on recreational problems.

▸ Website

Wolfram Blog

- Most entries are about explorations with Mathematica.
- Since Mathematica is free for students here in our labs and used in some classes, it might be useful to keep track of its uses.
- Due to the diversity of Mathematica, there are entries in all areas of Mathematics.

▸ Wolfram Blog ▸ Gardening Entry ▸ Coin Flipping

Software

THE WILLIAM PATERSON UNIVERSITY OF NEW JERSEY
COMMITMENT TO EXCELLENCE
1855
WAYNE

Free Software

- TOR can display LaTeX formulas in blogs.
- Python deserves its own talk, though I'll mention that even just as a calculator, the command prompt beats the Microsoft windows calculator for speed.
- This talk, along with everything I write, was created using LaTeX.
- The compiler used was TexMaker, one of several free choices.

▸ The Old Reader ▸ Python ▸ LaTeX ▸ TexMaker

Free Software

- Available free, yEd can make all sorts of graphs and diagrams.
- Mathematica is a powerful computational engine free at WPU.
- Sage, free for all, is a powerful Python based computational engine.

▸ yEd ▸ Mathematica ▸ Sage

Final Thoughts

- As a WPU Mathematics major, your time is extremely precious.
- You are struggling with the constraints that come from all the different courses you need to take as a major.
- Many of you also have other constraints due to work, family, and other pressures.
- Hopefully, some of these resources can help you save time, some of these can help you for your future career in teaching, research or industry, and others can replace other forms of entertainment.

Thank You

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