

Having a Grand Project: Advice for Graduate Students

Mark Tomforde

University of Houston

February 10, 2012

Some Questions:

- Why are you here in graduate school?
- What should you accomplish in your years in the graduate program?
- What is expected of you after you earn your degree?

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- The practice must be *Deliberate Practice*, pushing yourself out of your comfort zone to become better at doing the things that are hard for you, and using rigorous assessment and feedback to improve your performance.
- Skills fade with non-use. Becoming an expert requires you to practice *regularly* to keep your skills honed.
- Implicit in this rule: Hard work is more important than talent.

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A quotation from the February 2012 AMS Notices

“The purpose of doctoral education, taken broadly, is to educate and prepare those to whom we can entrust the vigor, quality, and integrity of the field . . . Someone who will creatively generate new knowledge, critically conserve valuable and useful ideas, and responsibly transform those understandings through writing, teaching, and application. We call such a person a ‘steward of the discipline’.”

— *Chris M. Golde, Carnegie Foundation for the Advancement of Teaching*

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- Stewardship is an ethic that embodies responsibility and care.
- You are expected to not only maintain the community of mathematics, but to contribute to it.
- You contribute through writing, teaching, application.
- Contributions should involve efforts to make the community better.

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Examples:

- Experiments with unexpected results
- Wikipedia vs. Encarta
- Linux
- 20% time at many companies

Some Questions

How can you become an **Expert** and a **Steward**?

How can you find time to pursue deliberate practice to become an **Expert** when you're feeling tired or burnt out?

How can you find a way to contribute and become a **Steward**?

How can you cultivate **Autonomy**, **Mastery**, and **Purpose**?

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This is something special that you choose to work on to make a personal connection with and contribution to mathematics.

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A Grand Project can help you to practice your skills and also contribute to the community around you.

What kind of characteristics should a Grand Project have?

- It should have something to do with mathematics or being a mathematician (in a very broad sense).
- It should be something you're interested in and consider fun.
- It should be something that provides a service or helps others.
- It should set you apart and be something unique to you and your interests
- It should help you practice skills that complement your Ph.D. work (e.g., skills in writing, skills in teaching, skills communicating, skills in creating, applying, or sharing mathematics)

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I want to tell you three stories about Grand Projects I've seen. After the stories, I'd like to analyze them, and discuss how you can go about creating your own Grand Project.

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Learned about Eneström numbers, got data from members of Euler Society.

Story 1: The Euler Archive, Continued

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It has moved from the server in the Dartmouth Math Department to the MAA website.

Euler Archive Website at Dartmouth

The Euler Archive



Main Page
Quick Start
Archive Tour
FAQs

Search archive by:

Subject
Date
Publication
Index Number
Keyword Search
What's Available

Historical Information:

18th Century Europe
The Life of Euler
Contemporaries
Important Locations

Archive features:

Translations
Correspondence
Further Reading

Documents Needed
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Archive Staff

The works of Leonhard Euler online

The Euler Archive is an online resource for Leonhard Euler's original works and modern Euler scholarship. This dynamic library and database provides access to publications, and references to available translations and current research.

The Archive is built around "E-pages." There is one of these pages for each of work written by Leonhard Euler (all 866 of them!). Each page includes:

- The title of the work (and an English translation of the title)
- A summary of the work
- A description of where the work was originally published
- A description of where the work is published in the **Opera Omnia**
- A scanned pdf version of Euler's original publication
- A brief list of modern research papers which discuss or cite the work

(Click here if links do not appear to the left)



Be sure to visit the website for **The Leonhard Euler Tercentenary - Basel 2007!**

The Euler Archive would like to thank the following institutions for their support:



PRS - Presence
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House for
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State Secretariat
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The Euler Society



Dartmouth College

Euler Archive Website at the MAA

The Euler Archive

A digital library dedicated to the work and life of Leonhard Euler



Navigation

- Main Page
- Navigation Help

Search archive by:

- Subject
- Date
- Publication
- Index Number

Historical Information:

- 18th Century Europe
- The Life of Euler
- Contemporaries
- Important Locations

Archive Features:

- Translations
- Correspondence
- Further Reading

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The Archive is centered around individual webpages corresponding to (and containing information about) each work written by Leonhard Euler (more than 850 of them!). Most pages also contain copies of the original publications of these works. You can access these pages various ways using the navigation links on the left sidebar. In addition, the Archive contains historical information concerning the life and times of Leonhard Euler, as well as a significant percentage of Euler's correspondence.

The Euler Archive is directed by Dominic Klyve (Central Washington University), Lee Stemkoski (Adelphi University), and Erik Tou (Carthage College), and is hosted by the Mathematical Association of America.

To celebrate the relaunch of the Euler Archive, the Mathematical Association of America will be offering a special discount on the five books produced for the Euler tercentennial: each book will be on sale for \$20 each (plus shipping and handling), beginning April 15, 2011. Below are links to the MAA online bookstore, where you can read more about each book and place orders.



The Early Mathematics of Leonhard Euler
C. Edward Sandifer



The Genius of Euler: Reflections on his Life and Work
William Dunham, editor

Mark Tomforde (University of Houston)

Having a Grand Project

February 10, 2012

11 / 40

Building the Euler Archive An Interview with the Founders

By Don Albers

In 2001 Dominic Klyve and Lee Stemkoski began their graduate studies at Dartmouth. By the fall of 2002, they started building the Euler Archive, an online resource on the works of Leonhard Euler, currently at <http://www.math.dartmouth.edu/~euler/>. It has grown rapidly, and is now the largest online collection of Euler's papers and books in the world. The fascinating story of how these two enterprising students accomplished the construction of the Euler Archive with meager financial assistance is told in the interview that follows. No doubt Euler himself would have been greatly pleased by the creation of the Euler Archive, and very likely would have found very useful in his own work.

Lee completed his doctorate under Dorothy Wallace in the spring of 2006; he is now an assistant professor at Adelphi University. Dominic will finish his doctoral studies, under Carl Pomerance, in the spring of 2007.

Don: Today I'm talking with Dominic and Lee, founders of the Euler Archive. You two entered Dartmouth at the same



Dominic Klyve

a 200-year long history and lots of false starts. We eventually put together a little paper (see below) about it and went to the Euler Society's first annual conference that was held in August 2002.

Don: So you two guys had struck up a productive friendship during your first year.

Dominic: Yes, pretty early on. We have a good synergistic relationship. We got



Lee Stemkoski

Dominic: That's right, and from my conversations with him, it's going to be fantastic. There are several reasons a biography hasn't been written already. One is that Euler did so much that no single person is able to read and understand everything Euler did (except Euler himself, of course). Even the Euler Society as a whole has studied only a fraction of Euler's works over the last five years.

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When he started a tenure-track job, Doug started collaborating with an economist at his school to use economics and math to describe a problem from baseball: *“Someone insured against risk is more likely to engage in risky behavior; a pitcher who has a designated hitter batting in his stead is more likely to risk plunking an opposing player.”*

Story 2: Sports and Math, Continued

Using a computer program, they mined eight years of detailed play-by-play data on major-league games. They published three papers on the topic. A reporter at the New York Times picked up on it, and a New York Times article was written on their research.

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He started a fantasy baseball league online, which has been very popular. He started making money off it, couldn’t handle all the programming, and brought in some friends to help. Last I heard, he was thinking about quitting his professor job to do this full time.

December 12, 2004

Designated Hitter as Moral Hazard, The

By DANIEL H. PINK

Baseball purists have long argued that the designated hitter is a moral outrage. Now an economist and a mathematician have found that the D.H. is also a moral hazard. In economics, "moral hazard" is the term for the idea that someone insured against risk is more likely to engage in risky behavior. Just as a homeowner who has fire insurance is more likely to risk smoking in bed, these scholars argue, so, too, a pitcher who has a designated hitter batting in his stead is more likely to risk plunking an opposing player.

Since the American League instituted the designated hitter in 1973, A.L. pitchers haven't been required to bat. In the National League, which never adopted the D.H., pitchers still must step up to the plate. As a result, A.L. pitchers who hit a batter with a pitch never have to face retaliation in the form of a 95-mile-an-hour fastball to the ribs. But N.L. pitchers who bean an opponent must step into the batter's box later in the game and stand 60 feet, 6 inches away from a snarling Randy Johnson, bent on exacting revenge. John-Charles Bradbury and Doug Drinen of the University of the South in Seawane, Tenn., realized that this rule difference "created ideal conditions to test for the existence of moral hazard in a controlled setting."

In a paper presented at the Joint Mathematics Meeting in January, Bradbury, the economist, and Drinen, the mathematician, noted that the rate of hit batsmen is 15 percent higher in the American League than in the National. Using a computer program written by Drinen, a former college baseball player, the two young scholars mined eight years of detailed play-by-play data on major-league games. After they controlled for pitcher quality, batter quality, game situation and other factors that also contribute to hit batters, they found that the designated-hitter rule itself "increases the likelihood that any batter will be hit during a plate appearance between 11 and 17 percent." And in a study of interleague play that they plan to publish next year, the pattern held: in interleague games in which both sides used a D.H., National League pitchers were more likely than usual to hit batters; in games in which pitchers had to bat, American League throwers were less likely to hit opponents with a pitch. In baseball, it seems, the laws of economics govern the diamond as well as the front office.

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Coonce received no support from his university. He retired from Mankato State in 1999, and continued to work on the project there. In 2002 the university said they wanted him out because his project “had no academic value”.

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Reached out to David Eisenbud, who was director of MSRI and became a great supporter. MSRI offered Coonce a one-month membership, which allowed him to publicize the project.

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It has over 150,000 entries, and catalogs dissertation titles and mathematical genealogy from the past 500 years.



Mathematics Genealogy Project

Home

Search

Extrema

About MGP

Links

FAQs

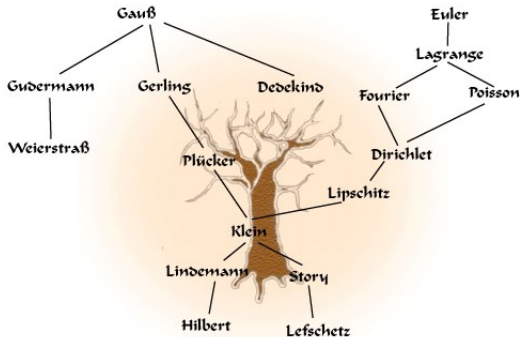
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158253 records as of 5 February 2012

View the [growth](#) of the genealogy project

Patterns in these Stories of Grand Projects

- (1) Started with interests/hobbies.
- (2) Others told them it wouldn't work, but they persisted anyway (often with limited resources).
- (3) Joined up with others in a community.
- (4) Worked consistently and regularly on the projects, and kept expanding their projects over time.

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How can you emulate this?

I'd like to talk about ideas for projects, and discuss each of the items above.

Some Ideas for Grand Projects

- List of errata in math books
<http://www.math.mcmaster.ca/~ohagans/errata.php>
- Write up solutions to all exercises in a particular book
- Websites for asking and answering questions
(e.g., Math Stack Exchange, MathOverflow)
- Personal Blogs
(e.g., Terence Tao's Blog <http://terrytao.wordpress.com/>
Vi Hart's Blog <http://vihart.com/>)
- Mathematical or Academic Blogs
(e.g., *N-Category Cafe*, <http://golem.ph.utexas.edu/category>
Study Hacks by Cal Newport <http://calnewport.com/blog/>)
- Preliminary Exam Preparation Book with problems and solutions
- I wrote a Guide for Graduate Students, and maintain a list of grad student resources on my website
<http://www.math.uh.edu/~tomforde/gradstudents.html>
- A Virtual Math Library
<http://home.adelphi.edu/~stemkoski/freebook.html>

Some Ideas for Grand Projects

- Start a Math Circle
- Write a Guide for Incoming Grad Students
- Start a Department Newsletter
- Organize a regular Department Picnic or other Social Activities
- Organize a series of talks or a Professional Development Seminar

Many of these involve: Writing, Teaching, Applications

. . . as well as sharing ideas, communicating, making math accessible.

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A: No. Pick one thing, and then work on it. Identify a need, and find an aspect you'd enjoy working on.

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A: No. Pick one thing, and then work on it. Identify a need, and find an aspect you'd enjoy working on.

Q: Should I pick a project that looks like it will turn into something very successful?

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Three things that will help you find time to work on your project:

- (1) Be Organized
- (2) Focus
- (3) Innovate

Be Organized

Underschedule

- This doesn't mean do less. It means do fewer things, and spend more time on those things.
- Distinguish between the Urgent vs. Important. Have blocks of time to work on the Important Things.
- Avoid Pseudowork.
- Use free time to explore, cultivate a reading habit, or practice writing.

Make your Grand Project part of your relaxation

- Pick something you consider fun — something you love and enjoy.
- Are you really enjoying the things you do to take breaks?
- Get rid of video games, surfing the web, facebook, TV (or at least make a conscious decision when you do these things)

Separate Work Time and Free Time

- Have a start and stop time for work.
- Avoid work pileups, start things long before they are due.
- Get proper sleep/food/exercise.

Being Organized and Underscheduling leads to **Autonomy**. It allows you to decide what you work on. It allows you to control your schedule rather than your schedule controlling you.

Focus

- We think we will miss out on something if we don't try everything — the truth is you'll miss out on everything if you don't focus on a few things.
- Pick a few thing to work on and do them well.
- You don't need to match interests with “natural talents” or “the perfect project” .
 - Work on it, you'll become an expert.
 - Work on it, you'll grow to love it and develop passion as you gain mastery.
- The Myth of Multitasking: We are most productive when we focus on a very small number of projects on which we can devote a large amount of attention.
- Einstein at the patent office. (Free time to focus on a problem.)
- Become obsessive about your work.

Focus leads to **Mastery**.

It also gives you the time to perform the deliberate practice necessary to become an **Expert**.

Innovate

- Find a need and fill it.
- Seek out those who have gone before you. Look at senior students, alumni, professors. See what kind of things they have done.
- Take chances, and don't be afraid to fail.
- Work within your restrictions, and make use of the resources that you have.

“Creativity comes from limits, not freedom.” — Jon Stewart

- Start small, and identify the “next step”.
- Do something you believe in.

Innovation leads to Purpose.

It also helps you to use your skills to contribute and become a Steward.

- (1) Started with interests/hobbies.
- (2) Others told them it wouldn't work, but they persisted anyway (often with limited resources).
- (3) Joined up with others in a community.
- (4) Worked consistently and regularly on the projects, and kept expanding their projects over time.

Persist and Work With Limited Resources

- Don't be afraid of failure. Expect to fail.
- When something doesn't work out, learn from it and try again.
- Persist, even if others don't believe in your vision.
- You don't need large grants or numerous resources to undertake projects. You can accomplish a lot with hard work and passion.
- Work in groups. Enlist the help of others.

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Join up with others in a community.

- Find out about existing communities.
- Pay your dues to be allowed to enter “closed communities” .
- Join forces with like-minded individuals, eventually start your own community.
- Inspire others to contribute to your project.
- Go to interesting places, meet with interesting people, stay in touch with them.
- Share resources.
- View your project as an act of service. (This helps to give a sense of Purpose, and to make you a Steward.)

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Work Consistently and Regularly, and Expand the Project

- Set aside time to work on it. (E.g., Saturday morning project, or an hour first thing in the morning or before bed.) This helps you meet the 10,000 hours to become an **Expert** when you're tired of your regular work.
- Keep pushing yourself. This helps with *Deliberate Practice* to gain **Mastery** and become an **Expert**.
- Push yourself. Once it becomes easy, make it harder.
- Ignore the urge to start working on other projects at the same time.
- Focus: whittle down your ambitions to a needle-thin point. Otherwise you'll dilute your efforts.
- Have clear ambitions, and as I said before: always ask "What is the next step?"
- Leverage. Start small, handle what you can, learn from small manageable projects, and then move to larger more ambitious ones

Some Other Benefits of Grand Projects

Grand Projects can give an outlet for self-expression, whether it is writing, blogging, teaching, etc. This creative self-expression carries over into your work and provides fuel that drives you while doing other parts of your job.

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Some Grand Projects can grow into accomplishments that look very impressive.

Failed-Simulation Effect: If I don't know how to do it, then it must be hard and require talent most people don't have.

“We act as though comfort and luxury were the chief requirements of life, when all that we need to make us happy is something to be enthusiastic about.”

— Albert Einstein

Thank you!

My Resources for Graduate Students

<http://www.math.uh.edu/~tomforde/gradstudents.html>