00: Introduction
January 6, 2012
10,000 hours!

- 5 years of 40h/week doing research (estimate)
- May not include
  - Classes
  - Recreation
  - Distractions...

A common theme that appears throughout *Outliers* is the "10,000-Hour Rule", based on a study by Anders Ericsson. Gladwell claims that greatness requires enormous time, using the source of The Beatles' musical talents and Gates' computer savvy as examples.\(^3\) The Beatles performed live in Hamburg, Germany over 1,200 times from 1960 to 1964, amassing more than 10,000 hours of playing time, therefore meeting the 10,000-Hour Rule. Gladwell asserts that all of the time The Beatles spent performing shaped their talent, "so by the time they returned to England from Hamburg, Germany, 'they sounded like no one else. It was the making of them.'"\(^3\) Gates met the 10,000-Hour Rule when he gained access to a high school computer in 1968 at the age of 13, and spent 10,000 hours programming on it.\(^3\)

“but there is no instruction manual”
http://jobmob.co.il/blog/funny-ikea-job-interview-cartoon/
I Brought You Here to Be... Candidates.

Ph.D. Candidates.

Secrets Revealed!
Ph.D. program milestones

1. RESEARCH
2. COURSES (GCCs)
3. Candidacy (RFE + 18 credits at UM)
4. Dissertation proposal exam (w/committee, timing flexible)

RFE (Y2-Fall) = “prelim”

Thesis defense!

=4-5 years
The RFE

- Research
- Fundamentals
- Exam

- “15 minute presentation + 30 minute Q+A”
  → a 45 minute discussion

- Abstract submitted ahead of time
- Used to select the examiners ...they may read it before the exam
RFE – evaluation criteria (as of F10)

- **Synthesis of Course Material in Research Problem Context:** The student is able to connect his/her research problem to undergrad material from engineering, math, physics, chemistry, biology, etc.

- **Input to Research Project:** Student has read and understands the state of the art, has identified a need for original knowledge development, and understands what technical subjects need to be learned.

- **Research Conduct and Methodology:** Student has presented a valid research objective, can apply a rigorous research process, and can draw appropriate inferences from analysis or data collection. The student shows indications of appropriate problem solving and technical skills applicable to the research problem presented. The work must clearly be that of the student and not the work of others from the research group.
RFE – evaluation criteria (as of F10)

- **Research Outcomes:** The student is able to draw conclusions from the work where appropriate; the student understands the limitations of what s/he has done so far; and the student provides evidence of being able to think about the next steps that should be taken (independent of where student is in the research process).

- **Communication:** Student is an effective oral and written communicator of research concepts.

→ These criteria are weighted equally, and scored by each examiner.
ME Ph.D. program milestones

- **RESEARCH**
- **COURSES**
- **(GCCs)**

RFE (Y2-Fall) = “prelim”

Dissertation proposal exam (w/committee, timing flexible)

Candidacy (RFE + 18 non-research credits at UM)

Thesis defense!

=4-5 years
Themes

- Defining research and identifying your interests
- Searching literature and choosing a research topic
- Planning and doing research
- Communicating research (written, visual, and verbal)
- Beyond the Ph.D. program

How will we learn?

- Readings and assignments (step-by-step)
- Open dialogue and peer review
- Practicing and refining our thought process

Everyone has different interests, background, perspective

- your **individual** Ph.D. program
## Schedule (subject to change)

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Theme</th>
<th>Pre-class task</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Jan/6</td>
<td>Course overview; recap of ME RFE/candidacy process</td>
<td>(Thurs 2pm)</td>
<td>(Fri 2pm)</td>
</tr>
<tr>
<td>1</td>
<td>Jan/13</td>
<td>Defining “research”</td>
<td>Research words</td>
<td></td>
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<tr>
<td>2</td>
<td>Jan/20</td>
<td>Searching and analyzing the literature</td>
<td>Research theme</td>
<td></td>
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<tr>
<td>3</td>
<td>Jan/27</td>
<td>Creativity and impact; choosing a research topic</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>Feb/3</td>
<td>Planning and time management</td>
<td>Literature search</td>
<td></td>
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<tr>
<td>5</td>
<td>Feb/10</td>
<td>Advisor-student relations; mentorship and collaboration</td>
<td>Discussion topics</td>
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<tr>
<td>6</td>
<td>Feb/17</td>
<td>Responsible conduct of research</td>
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<td></td>
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<tr>
<td></td>
<td>Feb/24</td>
<td>No class</td>
<td></td>
<td>Background report</td>
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<tr>
<td></td>
<td>Mar/2</td>
<td>No class (spring break)</td>
<td></td>
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<tr>
<td>7</td>
<td>Mar/9</td>
<td>Formulating and writing a proposal</td>
<td>Proposal exercise</td>
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<tr>
<td>8</td>
<td>Mar/16</td>
<td>Evaluating proposals</td>
<td>Proposal aims</td>
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<tr>
<td>9</td>
<td>Mar/23</td>
<td>Graphics and visual aids</td>
<td>Proposal</td>
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<tr>
<td>10</td>
<td>Mar/30</td>
<td>Giving and evaluating presentations</td>
<td>Proposal peer-review</td>
<td></td>
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<tr>
<td>11</td>
<td>Apr/6</td>
<td>Research administration and commercialization</td>
<td>Discussion topics</td>
<td></td>
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<tr>
<td>12</td>
<td>Apr/13</td>
<td>Student presentations (extended session)</td>
<td>Presentation</td>
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### Assignments

<table>
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<tr>
<th>Assignment</th>
<th>Points</th>
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<tr>
<td>In-class participation</td>
<td>10</td>
</tr>
<tr>
<td>Pre-class tasks and peer review</td>
<td>10</td>
</tr>
<tr>
<td>Literature search</td>
<td>5</td>
</tr>
<tr>
<td>Background report</td>
<td>30</td>
</tr>
<tr>
<td>Research proposal</td>
<td>30</td>
</tr>
<tr>
<td>Presentation</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

1. Will be graded on a 1-10 scale overall for the semester. Everyone can get 10/10.
2. Will be graded 0/50/100% in each instance. 0 = nothing or late; 50 = partially complete or did not follow instructions; 100 = complete.
What is research?
Noun

- **S:** (n) research (systematic investigation to establish facts)
- **S:** (n) inquiry, enquiry, research (a search for knowledge) "their pottery deserves more research than it has received"

Verb

- **S:** (v) research (attempt to find out in a systematically and scientific manner) "The student researched the history of that word"
- **S:** (v) research, search, explore (inquire into) "the students had to research the history of the Second World War for their history project"; "He searched for information on his relatives on the web"; "Scientists are exploring the nature of consciousness"
“Research is fundamentally a state of mind involving continual reexamination of doctrines and axioms upon which current thought and action are based. It is, therefore, critical of existing practices”

-Theobald Smith (1859-1934)
[considered to be America’s first world-renowned medical research scientist]
How do you think and learn?

John’s approach to Digital Literature Management (DLM)

RSS aggregator
http://www.google.com/reader

Journal
http://www.sciencemag.org
Published articles (in print)

“Express” articles
(online only; advance of print)

Literature database
http://apps.isiknowledge.com/

Search results
au = smalley and ts = fuller*

Email alert
Email

Saved searches

Export

Reference management
http://www.myendnoteweb.com

Your document
(e.g., Word, LaTeX)

Your groups

Shared groups (you or others)
Choosing a problem

Problems can be ranked in terms of ease and interest

Large gain in knowledge

Small gain in knowledge

Choice of problems along the Pareto front moves with life stages of scientist

Large gain in knowledge

Small gain in knowledge

Hard

Easy

Figure 1. The Feasibility-Interest Diagram for Choosing a Project

Two axes for choosing scientific problems: feasibility and interest.
Loehle, “A guide to increased creativity in research – inspiration or perspiration?”

Most people can learn to be far more creative than they are. Our school system emphasizes single correct answers and provides few opportunities for exploratory learning, problem solving, or innovation. Suddenly, when one becomes a graduate student, however, it is expected that one is automatically an independent thinker and a creative problem solver.
Research output vs. time?
Research freedom vs. time?
Time management

```
“stuff”

In-basket

What is it?

Is it actionable?  no

Projects (planning)

Project plans (review for actions)

Will it take less than 2 minutes?

yes

Do it

Delegate it

Defer it

yes

Waiting (for someone else to do)

Calendar (to do at a specific time)

Next actions (to do as soon as I can)

Someday/maybe (ticker file; hold for review)

Reference (retrievable when required)

Trash
```
“It’s a waste of time and energy to keep thinking about something that you make no progress on”

-David Allen
Advisor-student relations, teamwork

“Optimally interacting minds” by Behrami et al., *Science* 329, 2010; perspective by Ernst.
Responsible conduct of research?

- **HONESTY** — conveying information truthfully and honoring commitments,

- **ACCURACY** — reporting findings precisely and taking care to avoid errors,

- **EFFICIENCY** — using resources wisely and avoiding waste, and

- **OBJECTIVITY** — letting the facts speak for themselves and avoiding improper bias.
Structuring a proposal (just like choosing a research problem)

- **Feasibility**: “whether a problem is hard or easy, in units such as the expected time to complete a project”. [Alon]

- **Importance**: how important is the topic within the research community and beyond?

- **Interest**: both internal and external...

- **Competence**: why are you qualified? Do you have an advantage (secret weapon)?
Dividing the big idea: objectives/aims
Presentations: communicating what you did

- Planning the presentation
- Building the content (slides)
- Preparing the narrative and practicing
- Delivering the presentation

![Diagram showing the relationship between science, doing, communicating, substance, and style.](Image)
Visuals

Research administration and commercialization

**Figure 1: Research Expenditures by Major Sponsor Group, FY2001-2010**

- **Total Federal Government**: $750,937,613 (65.9%)
- **Total Non-Federal Sponsors**: $106,762,901 (9.4%)
  - **Industry (direct)**: $39,269,613 (3.4%)
  - **Industry (indirect)**: $18,321,297 (3.4%)
  - **Foundations**: $24,881,157 (2.2%)
  - **State of Michigan/Counties/Cities**: $3,792,924 (0.3%)
- **Total U-M Funds**: $281,793,811 (24.7%)
- **Total Research Expenditures**: $1,139,493,986

**Table 1: U-M Research Expenditures by Major Sponsor Group, FY2010**

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- **Total Research Expenditures**: $1,139,493,986

**Note:** subcontracts from industry included under federal government as the prime sponsor; see also Table 3.
ME department only

ANNUAL RESEARCH EXPENDITURES

<table>
<thead>
<tr>
<th>Year</th>
<th>NIH</th>
<th>DoE</th>
<th>NSF</th>
<th>DoD</th>
<th>All Other</th>
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<td>07-08</td>
<td>1,232,517</td>
<td>1,885,113</td>
<td>3,099,414</td>
<td>6,030,570</td>
<td>12,076,860</td>
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<tr>
<td>08-09</td>
<td>1,403,643</td>
<td>1,773,858</td>
<td>2,460,177</td>
<td>10,195,017</td>
<td>14,608,221</td>
<td><strong>$30,440,916</strong></td>
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<tr>
<td>09-10</td>
<td>1,996,237</td>
<td>2,390,860</td>
<td>2,701,330</td>
<td>10,992,316</td>
<td>13,792,756</td>
<td><strong>$31,873,499</strong></td>
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Assistant

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<tr>
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<th>FA08</th>
<th>FA09</th>
<th>FA10</th>
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<tbody>
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<td>11</td>
<td>12</td>
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Associate

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<th>FA09</th>
<th>FA10</th>
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<tr>
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<td>35</td>
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</table>

Professor

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<th>Faculty</th>
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<th>FA09</th>
<th>FA10</th>
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<tbody>
<tr>
<td>Total</td>
<td>57</td>
<td>58</td>
<td>60</td>
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</tbody>
</table>
Figure O-24
Value added of knowledge-intensive and high-technology industries as share of region’s/country’s GDP: 1995–2007

EU = European Union; GDP = gross domestic product

NOTE: Knowledge intensive services and high technology manufacturing industries as defined by Organisation for Economic Co-operation and Development. See glossary for countries included in Asia-9. China includes Hong Kong. EU excludes Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta, and Slovenia.


Science and Engineering Indicators 2010

What is the goal of a Ph.D. program?
What do you want to gain from your Ph.D.?
What is success?

“Success is peace of mind which is a direct result of self-satisfaction in knowing you made the effort to become the best of which you are capable.”

“Focus on running the race rather than winning it ... Don’t lose sleep worrying about the competition. Let the competition lose sleep worrying about you.”

-John Wooden (1910-2010)

[hall of fame basketball player and coach, 7 consecutive national championships at UCLA]
Focus!

you

goal

observers

Focus! 

Serengeti National Park, Tanzania, August 2008

A.J. Hart | 38
and balance, relax...
“It is not so much the talents we possess so much as the use we make of them that counts in the progress of the world.”

-Brailsford Robinson

[?]
Homework

- Readings for **lecture 1** (on ctools)

  **Choose 2 of 3**
  - Beveridge, “Scientists”, excerpt from *The Art of Scientific Investigation*
  - Desjardins, “How to Succeed in Graduate School: A Guide for Students and Advisors”
  - Hamming, “You and Your Research”

- Research words, see next slide – **due 2pm Thu Jan/12**
- Send comments on course content to **ajohnh@umich.edu**
Research words assignment

Due Jan 12, 2012 2:00 pm
Status Not Started
Grade Scale: Checkmark

Assignment Instructions
Come up with 5 words representing each of the themes below.

a. The practice of doing good research, e.g., “doing good research is…”
b. Good research when you evaluate it, e.g., “his/her research is good because it is…”
c. Attributes of a good researcher, e.g., “you’re/I’m a good researcher because…”

Put your words in the attached template file (researchwords.xls)
Add your last name to the filename:
lastname-researchwords.xls (example: hart-researchwords.xlsx)

Additional resources for assignment

researchwords.xls (24 KB)

Submission
This assignment allows submissions by attaching documents only. Use the Add Attachments button below to attach 1 or more documents.

Attachments
No attachments yet