Pursuing Research: *Why* and *How*?

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Research?

- What is it?
- Should you be doing it
- How do you do it?

- Think about the word ‘Research’ – what thoughts come to your mind?

Research = Passion

"Your work is going to fill a large part of your life, and the only way to be truly satisfied is to do what you believe is great work. And the only way to do great work is to love what you do. If you haven't found it yet, keep looking. Don't settle."

- Steve Jobs (CEO, Apple Inc.)

What is Research?

Degree	Expertise
Bachelor's	General Education
Master's	Specialization in advanced knowledge
Doctorate	License to teach and guide others

- Transition from undergraduate education to becoming an independent researcher
  - Homework problems v/s Ill-defined problems
- Passion for discovering new things
  - making the world a better place

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English (US)

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Experiments

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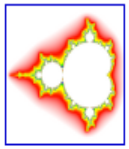
Google Swiffy (SWF to HTML5)
Swiffy converts Flash SWF files to HTML5, allowing you to reuse Flash content on devices without a Flash player (such as iPhones and iPads).
June 28, 2011 ★★★★½ 301 Ratings Details and feedback »

Google Scribe
Write high-quality documents quickly. Supports text completion, correction, automatic link text and faster formatting features. See Help for details.
March 31, 2011 ★★★★½ 954 Ratings Details and feedback »



Julia Map
Julia meets HTML 5. Browse the Julia fractals like Google Maps.
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Google Correlate
Google Correlate finds search patterns which correspond with real-world trends.
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Art Project powered by Google
Explore museums from around the world, discover and view hundreds of artworks at incredible zoom levels, and even create and share your own collection of masterpieces.
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Google Body
Google Body is a detailed 3D model of the human body. You can peel back anatomical layers, zoom in, and navigate to parts that interest you. Click to identify anatomy, or search for muscles, organs, bones and more.
December 16, 2010 ★★★★½ 1007 Ratings Details and feedback »

Page Speed Online
Analyzes web pages and provides specific suggestions to make them faster

Other experiments at Google

Calendar Labs
Latest ideas from the Calendar team

Gmail Labs
Dozens of Gmail experiments

Google Code Labs
Experimental developer products

Google Maps Labs
Experimental Maps features

Search Experiments
Alternate search views and more

Toolbar Labs (IE only)
Language and location-based experiments

YouTube TestTube
YouTube's ideas incubator

Meet the engineers

Leon Palm
Worked on Google Goggles. If it's an AI or computer vision problem, Leon has probably tried solving it. In ten different ways.

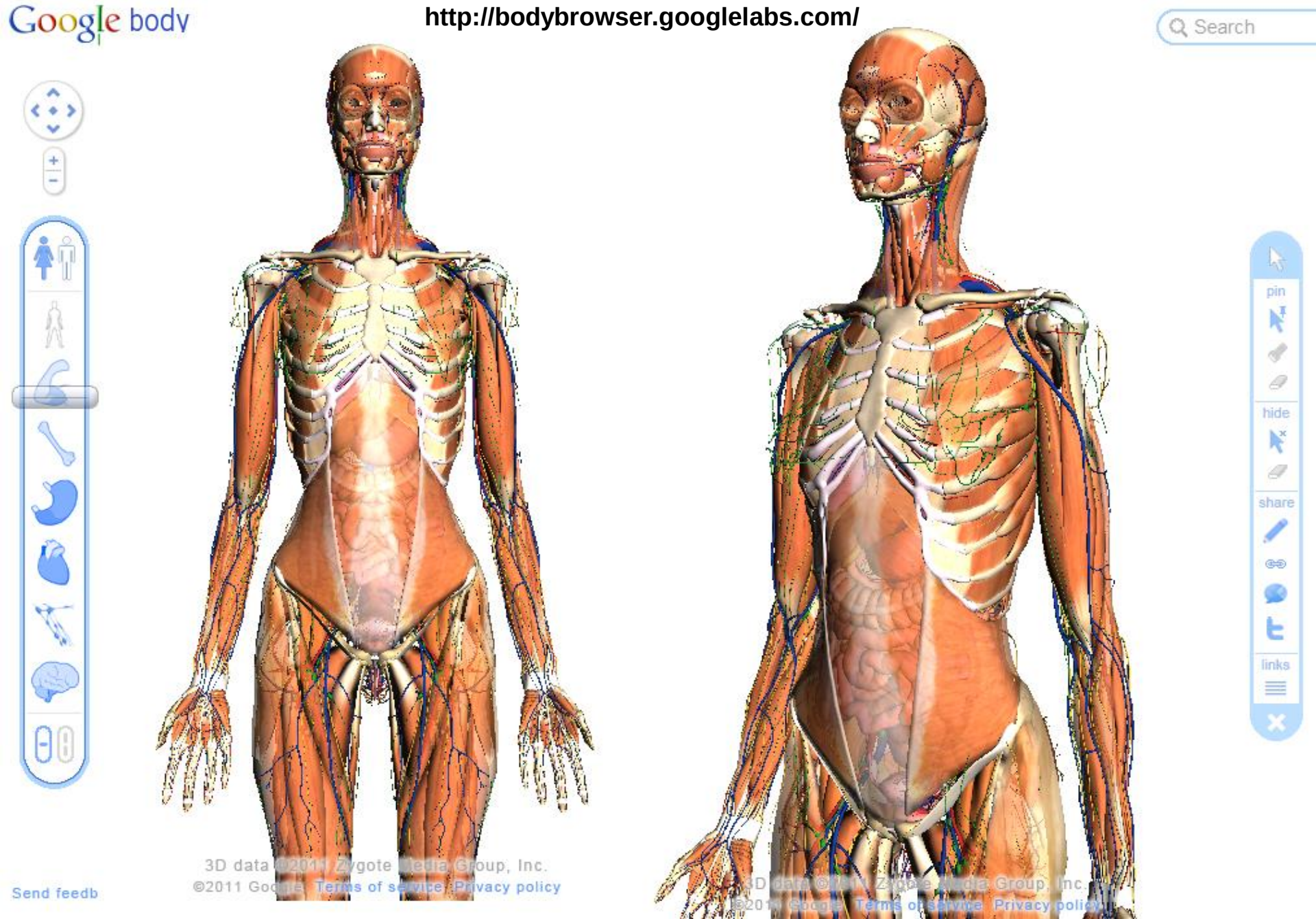
Yushi Jing
Worked on Image Swirl. Yushi hates outliers.

Sharon Perl
Worked on App Inventor for Android. Non-programmers have great app ideas, and she wants to make them real.

Jack Hebert
Worked on Fast Flip. Jack won't rest until

Google Body Browser

http://bodybrowser.googlelabs.com/

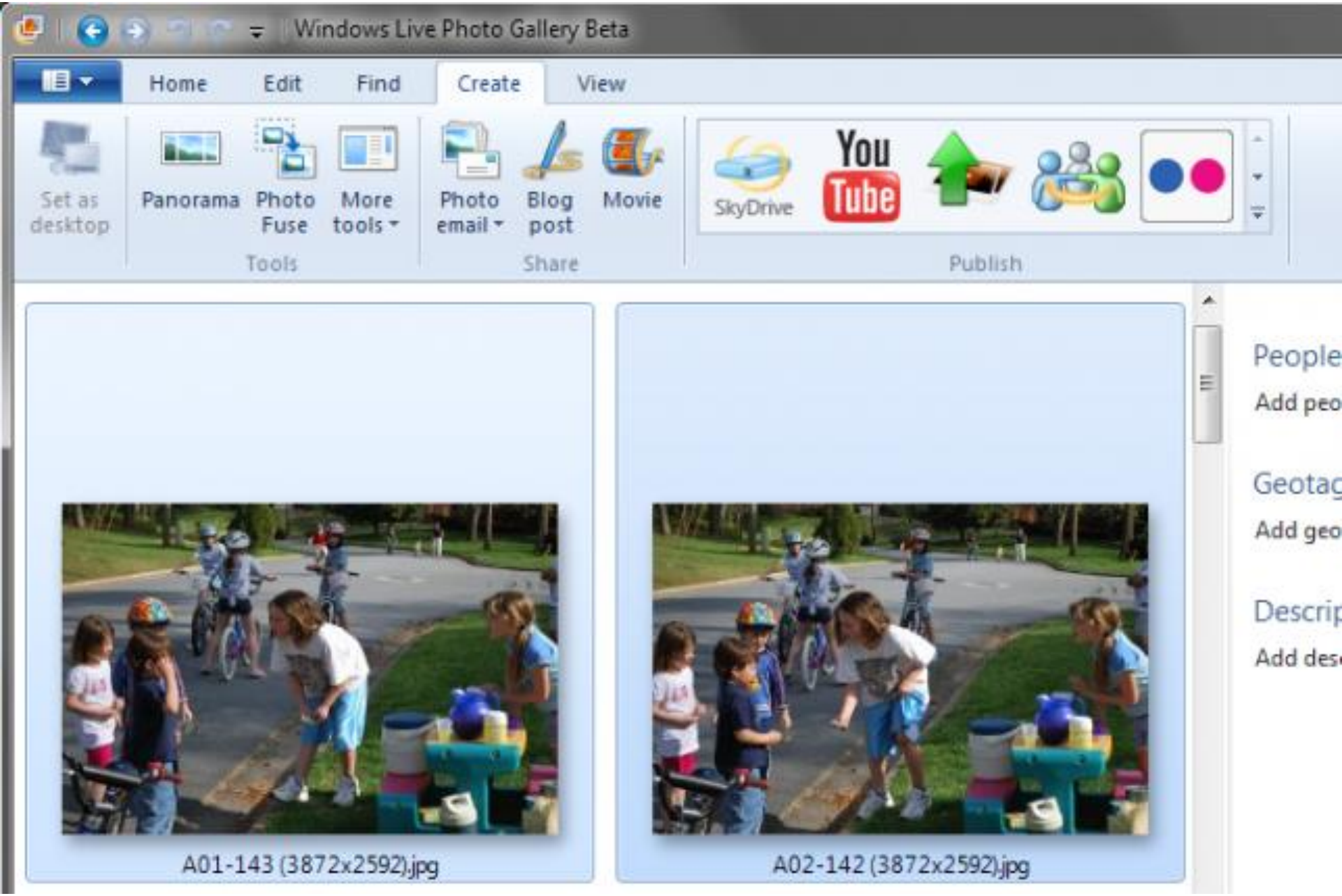


Microsoft Windows Live Photo Gallery – Photo Fuse

Microsoft®
Research

Photo Fuse

Microsoft Windows Live Photo Gallery – Photo Fuse



Microsoft Windows Live Photo Gallery – Photo Fuse

Microsoft Windows Live Photo Gallery – Photo Fuse

What is Research? (contd.)

- You will like research if you like innovations and you look beyond what is in the textbook or the problem at hand
- Research is time-consuming
- Generally our thinking tends to be Re-productive, i.e. based on similar problems encountered in the past, or taught to solve. But, we must do Productive thinking, i.e. generate as many alternative approaches as possible

Benefits of pursuing Research

- Developing your professional skills, knowledge and expertise is critical in today's work culture
- Build your research and publications profile
  - Get peer recognition
  - Reputation in academics
- Increase the depth of your area of expertise
- Broaden your areas of specialization
- Ability to guide students more effectively with state-of-the-art knowledge
- Demonstrate practical applications of the syllabus in a more tangible way

PhD: The road to your future

- PhD is the highest research-oriented degree: demonstrate mastery of a particular field, done through intensive research
- Some questions to ponder before embarking on PhD:
  - Are you passionate about a particular area of study?
  - Are you eager to discover new things?
  - Do you wish to become more intellectually engaged in a certain field?
  - Are you goal-oriented and self-motivated?
  - Do you have determination?
  - Does your career goal require an advanced degree?
- Getting a PhD requires **Passion**, **Desire**, and **Determination**

Group Brain-storming

1) Your HOD asks you to get involved in research activity and publish papers. How would you proceed?

Contribute at least 3 points per group

2) Should students be engaged in research? How can you involve them?

Motivating Students for Research

- *Why* should the students be involved in research?
  - Meet the demands of the evolving job market
  - Enhances the ability to communicate technical information
  - Improve a sense of community and group dynamics
  - Helps to clarify career paths; very crucial for Masters, PhD
- When is the *ideal time* for students to pursue research?
- What *topics* can a student select?
  - Look back and forward at the different subjects and decide based on a) which subject interested them the most, and b) which subject they did the best in

Motivating Students for Research

- Enhances the reputation of the college through real contributions to various fields
- Role of Faculty in guiding students
  - Promote student engagement through final year projects
  - Provide research facilities for students in labs
- Publications: the desired outcome

How to do Research?

- **Step 1**: Define the problem (scope, area,…)
  - Literature survey
- **Step 2**: Formulate the problem (into a homework problem)
  - Introduce assumptions to *simplify* the problem
- **Step 3**: Solve the problem (~ solve a homework problem)
  - Validate with experiments
- **Step 4**: Interpret the solution
  - Go back to the original problem: new insights, new methods,…
- **Step 5**: Disseminate the results
  - Papers, presentations, patents,…

Literature Survey

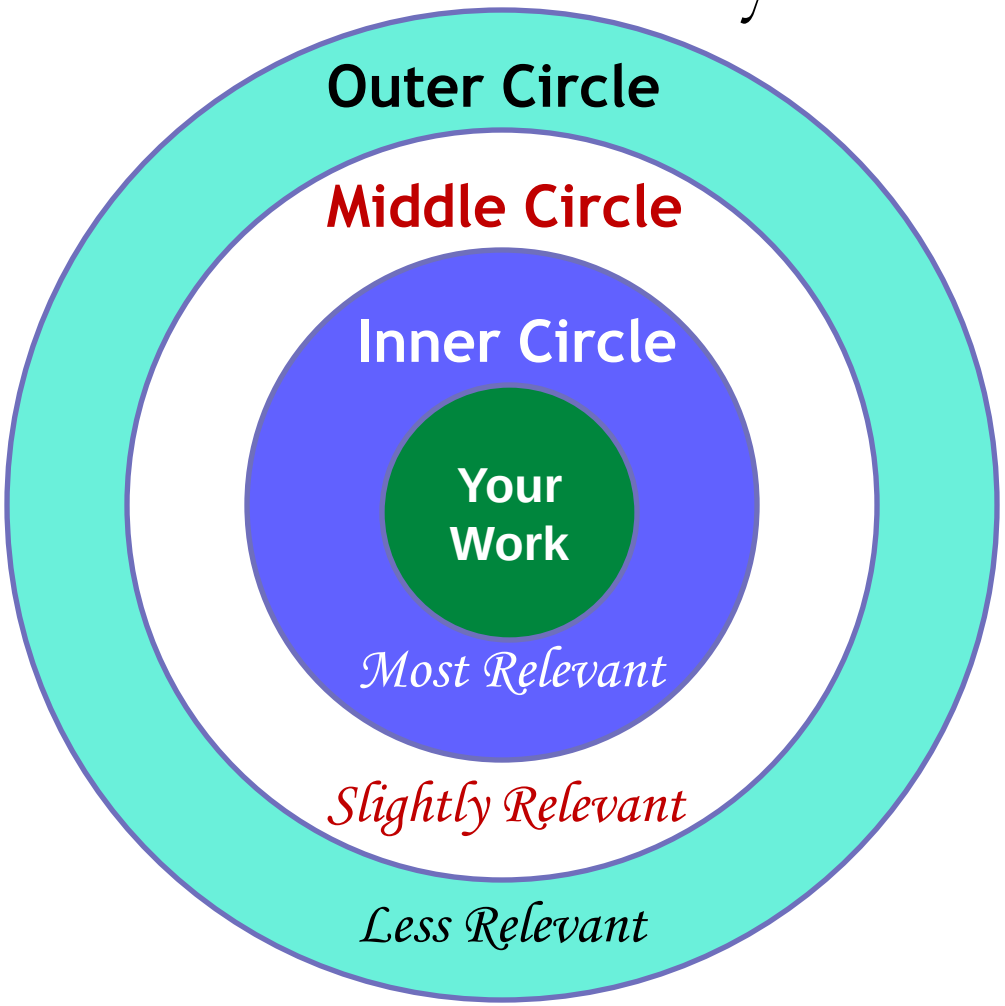
- A literature survey is meant to uncover previously published information in a specific area
- Most research papers contain literature survey as one of its parts
- Can be used as a foundation and support for a new insight that you contribute
- Many modern techniques to solve problems can only be found in research papers
- Helps ***you*** to demonstrate skills in two areas:
  - Seeking Information
  - Critical Appraisal

Art of Reading Papers

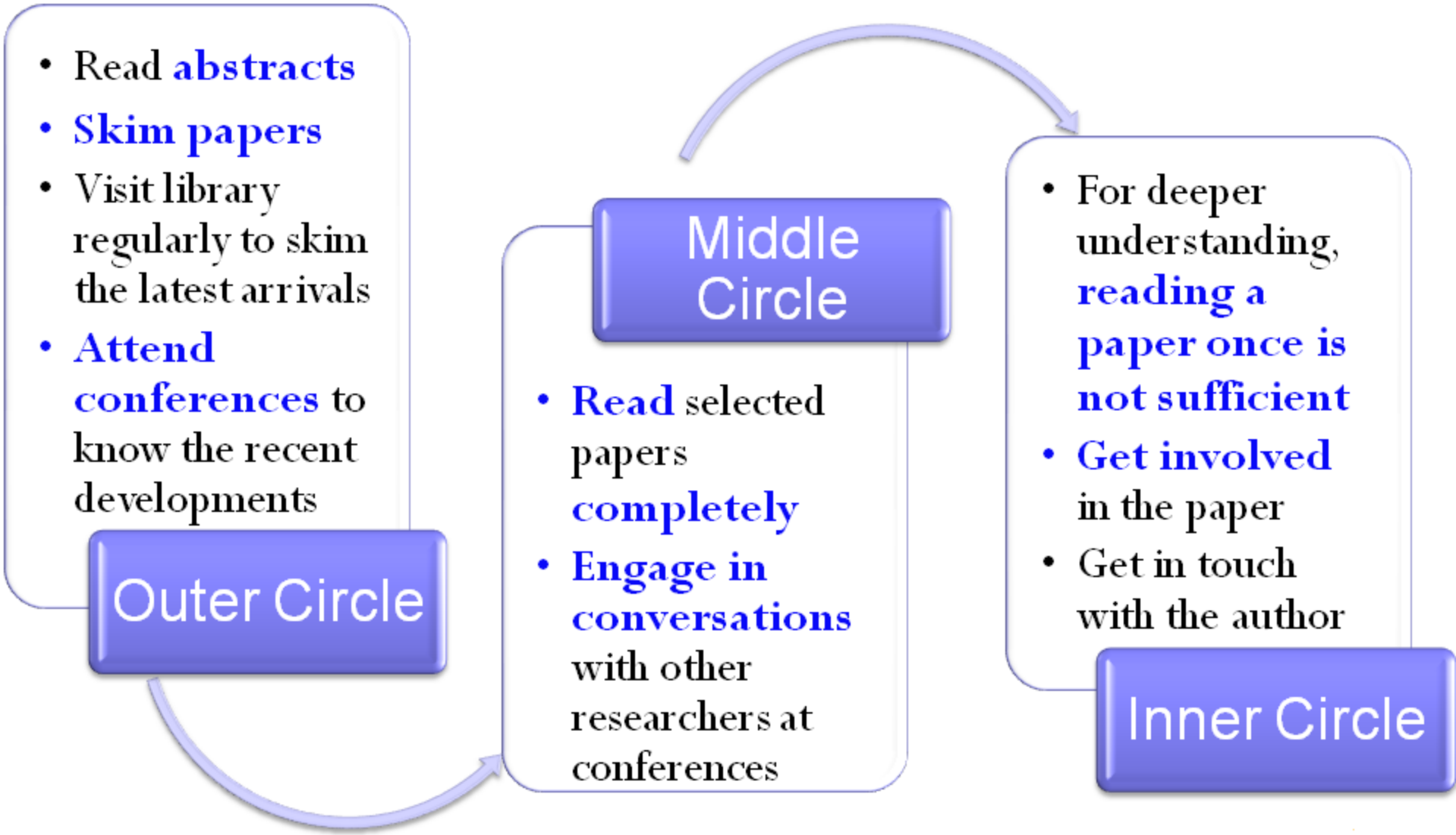
- Develop the art of speed reading/skimming
  - Read the title and abstract, look at the pictures and tables. If you find anything interesting, then look for the specific point in the paper.
- What to read?
  - **Avoid** most prestigious journals to begin with
  - **Begin** with conference proceedings, magazines etc.
  - Then move on to international journal papers of repute (IEEE, ACM, Springer, etc.)

Art of Reading Papers (contd.)

Think of the work of others as arranged in concentric circles around your own



Art of Reading Papers (contd.)



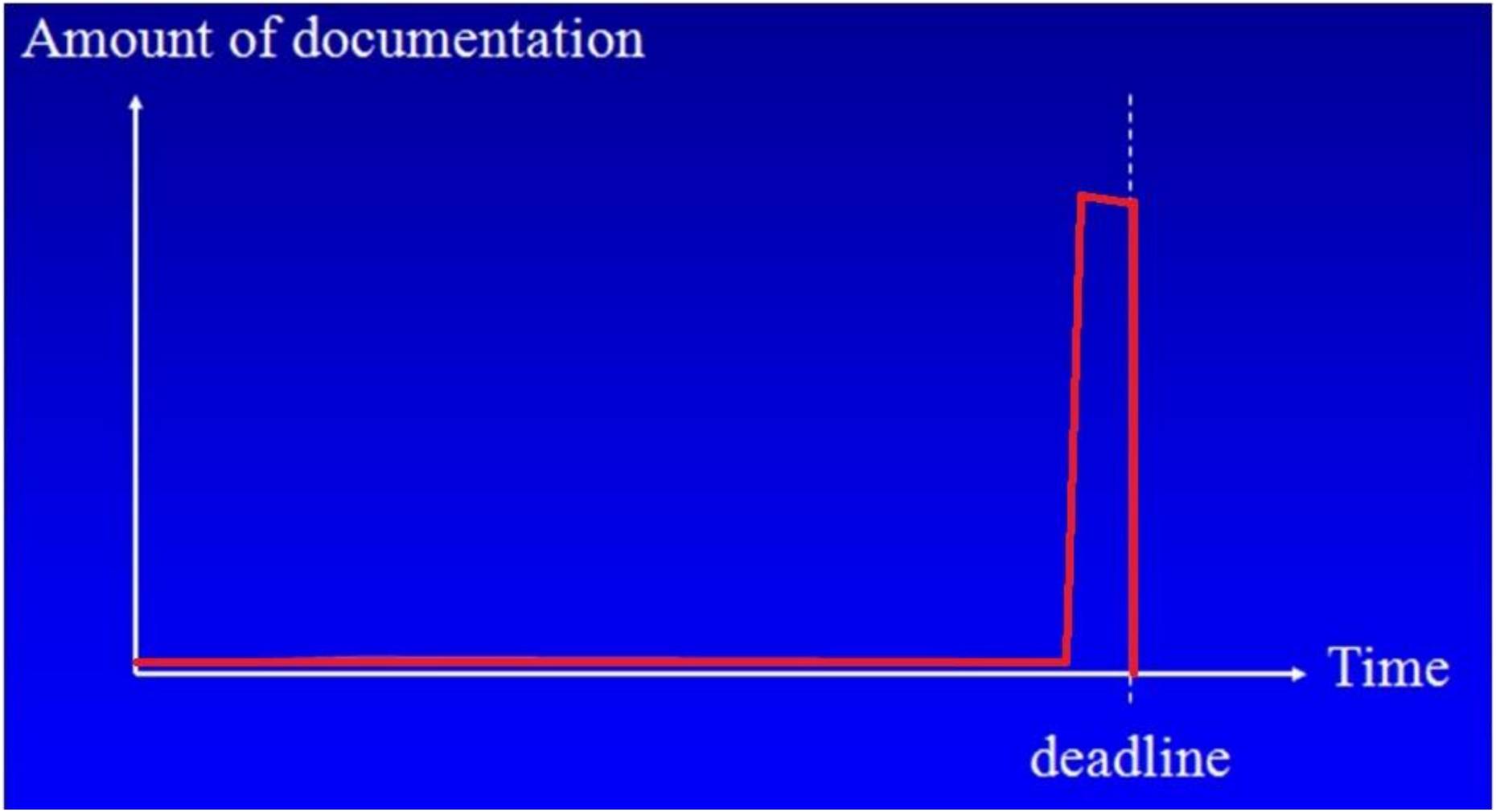
Implementation

- Required to show evidence that your theory or contribution is actually valid
- Know the prerequisites before starting the development
- Use appropriate hardware and/or software simulation tools
- Often need to implement previously published work for comparison with your work
  - Contact authors for questions on their paper

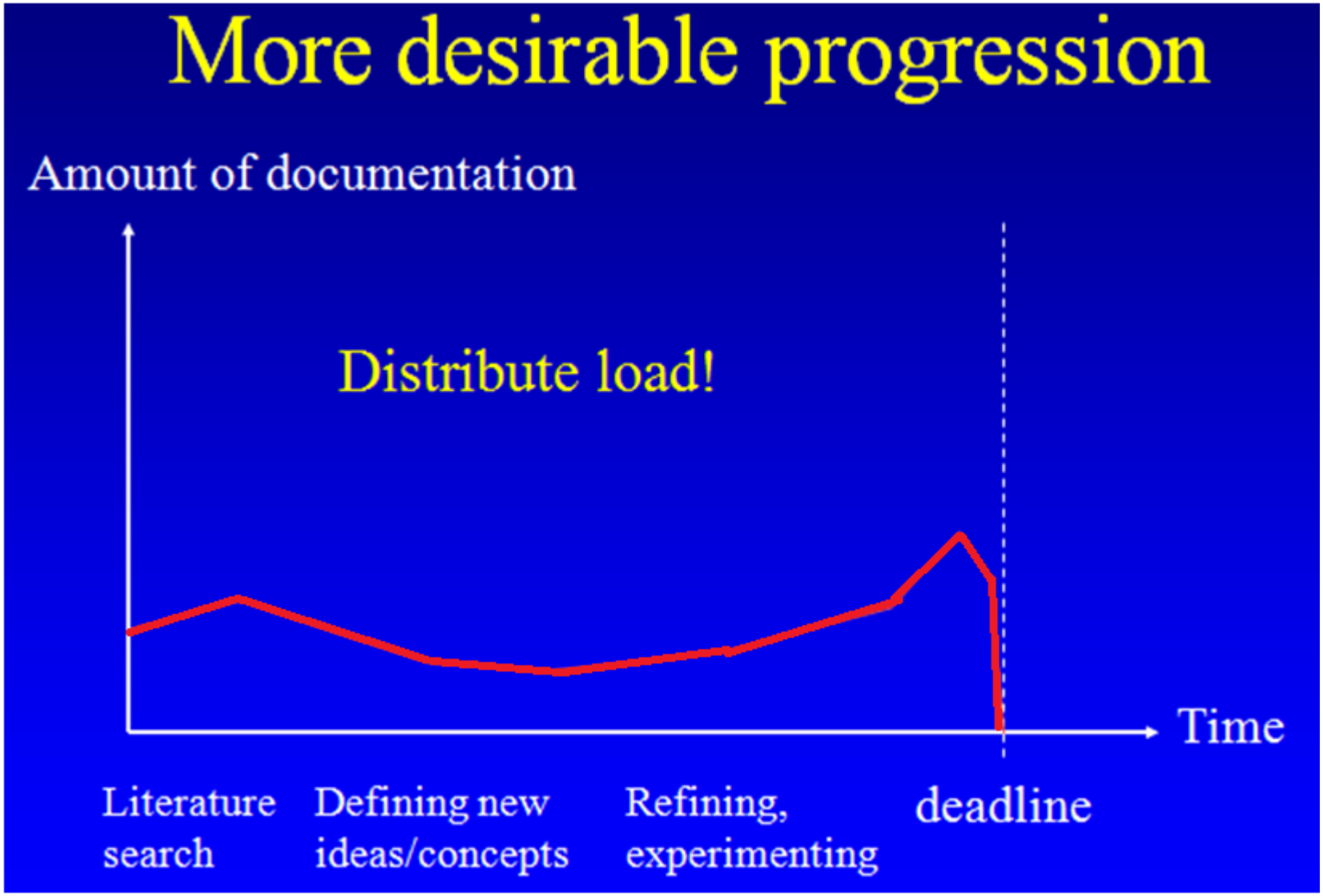
Results and Documentation

- Document your results
  - Publish paper(s) in conferences/journals
  - Conference presentations
- It takes time to write a good paper
  - What if someone says your paper is trash?

Documentation: Observed Trend



Documentation: Desirable Trend



Pitfalls in pursuing Research

- Solving the World
  - Don't pick research goals which are far too ambitious
- Ideas will just come to me!
- The Development Trap
- Not great at programming ☹
- Ivory Tower
  - Dedication to chosen topic is good, but do not shut out the rest of the world completely
- Ambition Paralysis
- Mental Attitude
- Dealing with Criticism

Publishing Papers

The greatest ideas are worthless if you keep them to yourself

Benefits of Publishing Papers

- Research papers are the major research products of any department
- One of the yardsticks by which an individual and department success is measured
- Helps you to grow intellectually in your specialized area
- Earn reputation for being an expert in your specialized area

How to Write Research Papers

- Approaches:

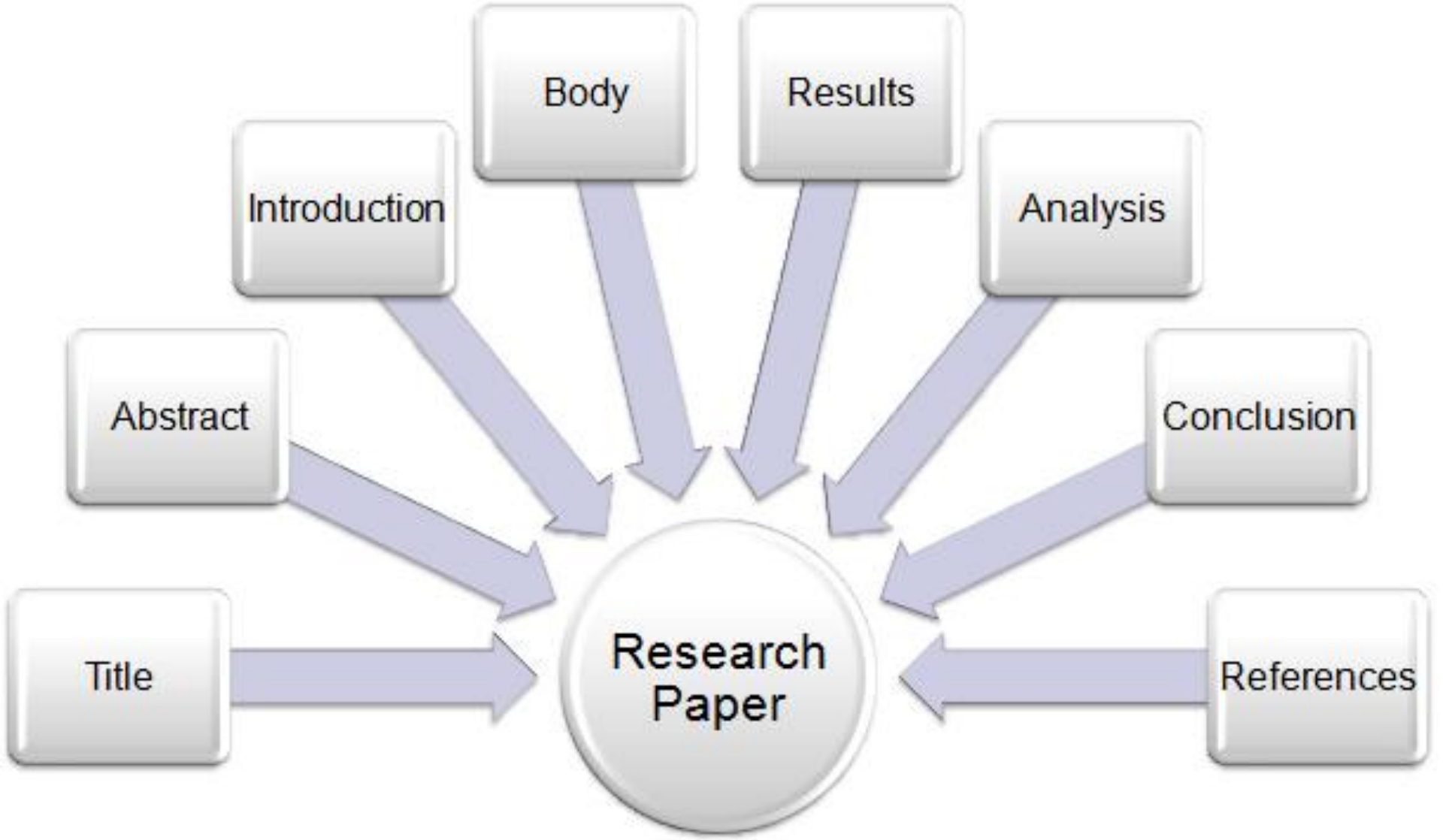
1) Top-down (skeleton, then fill the details)
2) Bottom-up (write details, then reorganize)
3) Linear (progressing from beginning to end)
4) Any combination of the above

- Keep records: notes of ideas you have, notes of papers you read, etc.
  - Serves several purposes: an aid to memory, vehicle for clarification, and a starting point for your paper

Title of the Research Paper

- A good title should be
  - Short
  - Descriptive
- Examples: (good or bad?)
  - Should violence on TV be banned?
  - The Social Impact of Television Violence
  - A New Routing Algorithm
  - Dynamic Routing in Hypercubic Optical Networks

Typical Research Paper



Where to Publish Papers

- Select a publishing source that is most appropriate for your research problem
- International Journals
  - tougher reviews
  - expect significant new contribution with detailed analysis
- International Conferences - often concise (≤ 5 pages)
- National Journals and National Conferences are the next preferred options
- Check the 'Advisory Committee' of the specific Journal/Conference before choosing to publish your paper

Rules for Writing Papers

- Your paper should have a clear message
- Writing paper so that it can be understood is not enough, you must write it so that it cannot be misunderstood!
- Say what you are going to say, say it, and then say what you just said
- Basic framework: what is the problem, how did you tackle it, what results followed
- Use **LaTeX** for writing papers

LaTeX

- Type-setting system instead of WYSIWYG

$$f(x)=a_1x^2+a_2x+a_3$$

```
$$f(x)=a_1x^2+a_2x+a_3$$
```

$$f(x)=\frac{x+1}{x-1}$$

```
$$f(x)=\frac{x+1}{x-1}$$
```

$$\ln x=\int_1^x\frac{1}{t}\,dt \qquad (1)$$

$\ln x=\int_1^x\frac{1}{t}\,dt$

```
\begin{equation}\label{eq:1}
\ln x=\int_1^x\frac{1}{t}\,dt
\end{equation}
```

The Hilbert matrix in this case is

$$H=\begin{pmatrix} 1 & 1/2 & 1/3 \\ 1/2 & 1/3 & 1/4 \\ 1/3 & 1/4 & 1/5 \end{pmatrix}$$

```
The Hilbert matrix in this case is
$$H=\begin{pmatrix}
1   & 1/2 & 1/3\\
1/2 & 1/3 & 1/4\\
1/3 & 1/4 & 1/5
\end{pmatrix}.$$
```

Presenting Papers

General Outline of Presentation

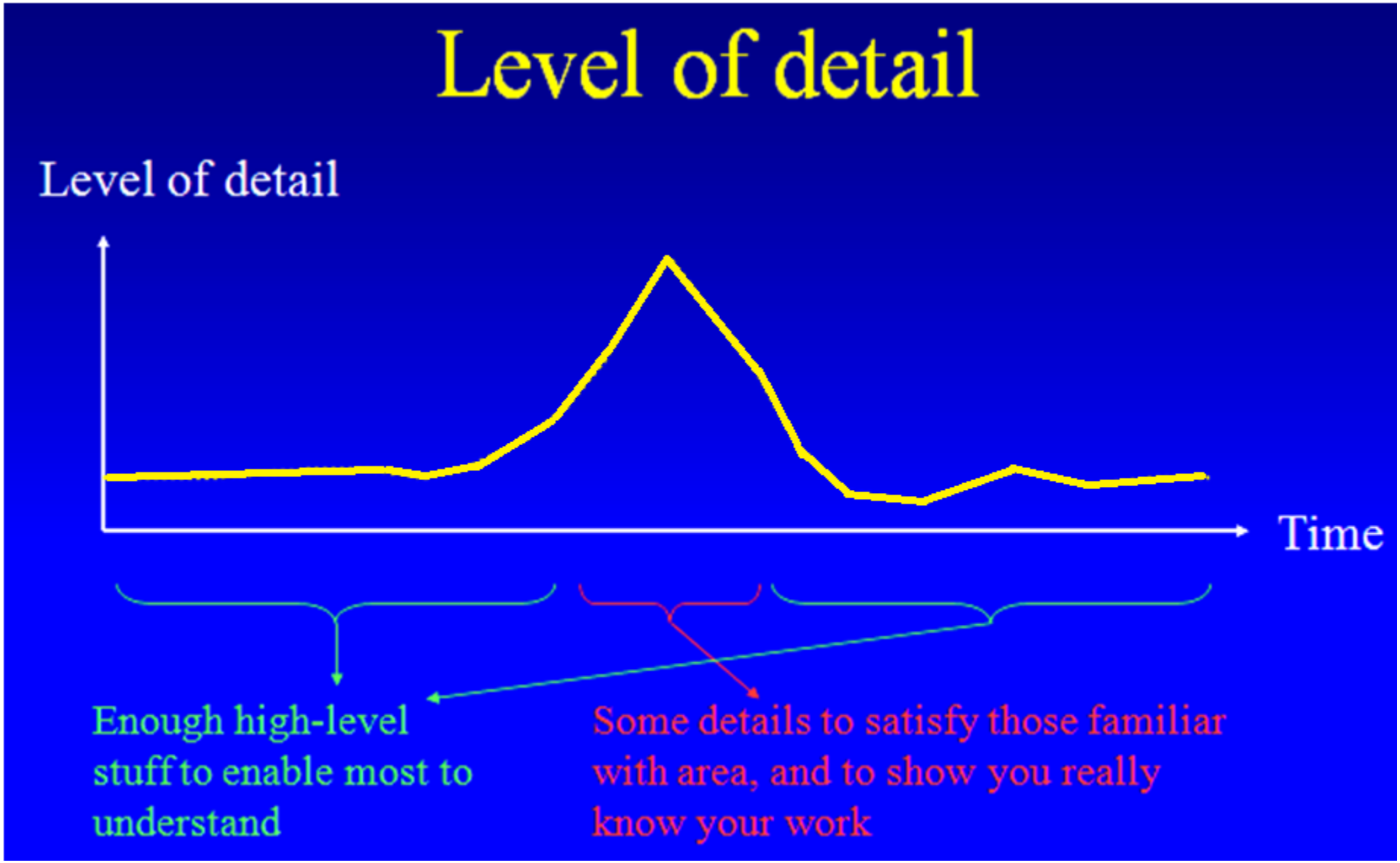
- Title/Author/Affiliation (1 slide)
- Abstract (1 slide)
- Outline (1 slide) (depends)
- Background
  - Motivation and Problem Statement (1-2 slides)
  - Related Work (0-1 slide)
- Results (4-6 slides)
- Summary (1 slide)

Connect with the Audience

- Your most potent weapon is

- Show that you are passionate about your work
- Keep eye contact with audience
- Relax: People want you to succeed

How much to speak?



Use of Color

Use color

very very very very very very very

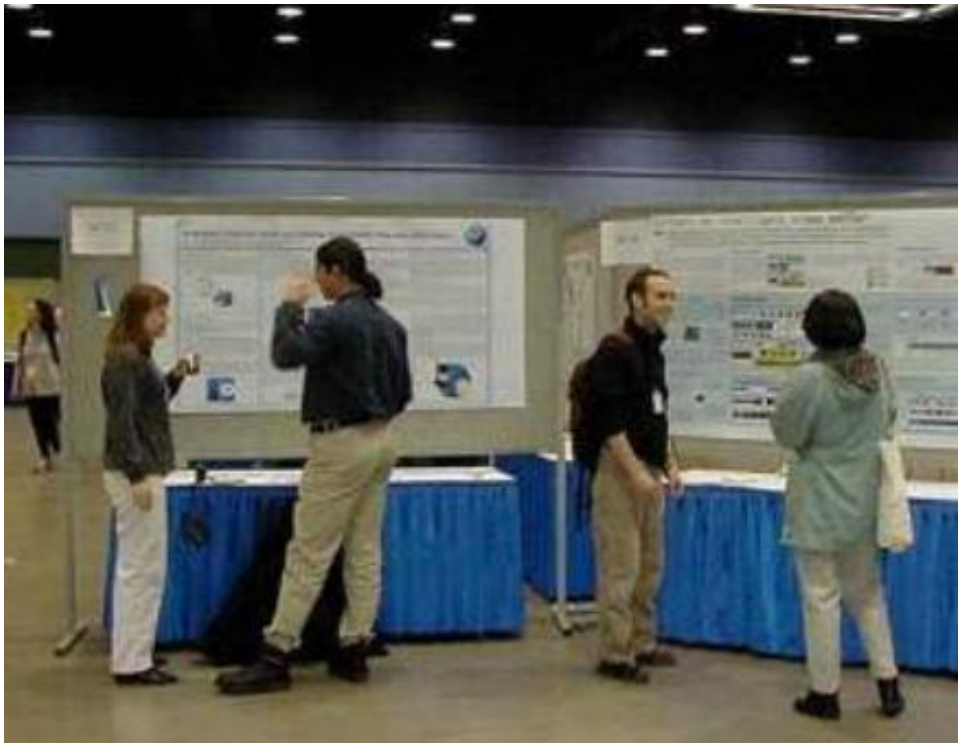
sparingly

Secrets for Effective Presentations

1) Anybody can learn to give a good talk
2) Don't give a talk *unless* you are passionate
3) Use simple and clear words
4) Modulate your voice to focus on key points
5) Silence is a great tool
6) Tell them what you are going to say. Say it. Tell them what you said.

Conferences

1) Communicate with others working on related area
2) Share ideas and possibly collaborate for next project!
3) Conversations are more valuable than the sessions
4) Notice how others deliver presentations



Thank You ☺