

Notes on research methodology
CS2001 – fall 2003
Rami Melhem

- CS research process
- Writing a paper
- Refereeing an article
- Dissertation proposal
- Bibliographical search
- How to give a talk
- Research integrity

*) most of the material in these notes are taken from notes prepared by Bruce Buchanan for CS3001 "research methods in Computer Science", taught in the Spring of 2002.

1. CS research process

- Check research on prior work on this problem
 - Who (where, when), what, how?
 - Assess difficulties with previous methods (time, space, scope)
- Propose a new method
 - Describe in pseudo-code
 - Implement in a working program
 - Make the claim(s) explicit (better solution, first solution, proofs..)
- Gather evidence for the claim(s)
 - Face validity (discussion, argument, implementation)
 - Explain mechanisms
 - Proof correctness and complexity
 - Empirical demonstration and statistical significance

CS research process (continue)

- Analyze the new method
 - Explain why it works
 - Where is the leverage?
 - What is the good idea?
 - Assess limitations (assumption, scope, difficulties)
- Write up the project
 - Select a target audience
 - Select an appropriate conference or journal
 - Follow the guidelines
 - Write incrementally
 - Get feedback from peers
 - Submit, revise, resubmit – do until accepted.

2. Twelve steps in publishing a research paper

1. Find a subject
2. Read a general article
3. Formulate a temporary thesis and a temporary outline
4. Prepare a preliminary bibliography
5. Take notes from relevant sources
6. Categorize notes and revise working outline
7. Write a first draft
8. Revise the text; write introduction and conclusion sections
9. Fill in missing details
10. Put the paper in final form
11. Submit to conference or journal on time
12. Revise with careful attention to reviewers' comments

3. Refereeing a Technical Paper

Notes from Writing for Computer Science

By Justin Zobel

Referee Process

- Submit paper to editor of journal for publication.
- Editor sends paper to referees.
- Referees evaluate paper and return written reports.
- Editor decides, based on referee reports, whether to accept paper for publication.

“When a referee recommends acceptance of an article, the referee is assuring the accuracy of the technical content, originality, and proper credit to previous work to the best of the referee’s ability to judge these aspects.”

Referees Must Be ...

- Fair
- Objective
- Maintain confidentiality
- Avoid Conflict of Interest
- Declare limitations as reviewers
- Evaluate paper with proper diligence
- Only accept if paper is of adequate standard

Evaluating the contribution

Originality: the degree to which the ideas presented are significant, new, and interesting

- Most ideas are extensions or variations of previously published work
- Groundbreaking ideas are rare!
- View as continuum from groundbreaking to “tinkering, debugging, or survey”.

Validity: is the degree to which the ideas have been shown to be sound.

- Proof, analysis, modeling, simulation, and/or experiment usually necessary to validate science.
- Whether by theory or experiment, should be carefully described, thorough, and verifiable.
- Experiments for testing algorithms should be based on good implementation.
- Experiments based on statistical tests of subjects.
- Should use sufficiently large samples and appropriate controls
- Comparison to existing work is an important part of demonstration of validity

Questions for Evaluation

- Is there a contribution? Is it significant?
- Is the contribution of interest?
- Is the contribution timely or only of historical interest?
- Is the topic relevant to the likely audience?
- Are the results correct?
- Are the proposals and results critically analyzed?

Donald Knuth says: “the goals of a referee are to keep the quality of publication as high as possible and also to help the author to produce better papers in the future”.

More Questions

- Are appropriate conclusions drawn from the results, or are there other possible interpretations?
- Are all the technical details correct? Are they sensible?
- Could the results be verified?
- Are there any serious ambiguities or inconsistencies?
- What is missing? What would complete the presentation?
- Is any of the material unnecessary?
- How broad is the likely audience?
- Can the paper be understood? Is it clearly written? Is the presentation at an adequate standard?
- Does the content justify the length?

Critical Analysis

- Authors should correctly identify the strengths, weaknesses, and implications of their work
- Authors should not ignore problems or shortcomings
- It is easier to trust results when they are described fairly

Identify the Hypothesis

- If you can't identify the assertion or hypothesis, there is probably something wrong
- If you can, it will help you to decide whether or not the paper is pertinent to the hypothesis

Bibliography

- Quality of paper reflected in the bibliography
 - How many references?
 - Are the references from refereed sources?
 - How current are the references?
 - Is there some variety in sources?
 - Not all from same author
 - Not all from same journal or book

Referees' Reports

- Usually some combination of written comments and scores on certain criteria
- Two main criteria for determining if referee's report is well done
 - Is the case for or against the paper convincing?
 - Is there adequate guidance for the authors?
- Nitpicking
 - Spelling and syntax
 - English expression
 - Errors in bibliography
 - Definition of terms
 - Errors in formulas or mathematics
 - Inconsistency (format, naming, etc.)

Hints

- First impressions of papers can be misleading.
- Positives are as important as negatives.
- Every paper should have some aspect that can be commended.
- Referees should offer obvious references that have been overlooked.
- Referees should be reasonably polite – not patronizing, sarcastic, or insulting.

Summary

When you accept a paper, you should

- Convince yourself that it has no serious defects.
- Convince the editor that it is of an acceptable standard by explaining why it is original, valid, and clear.
- List the changes, major and minor, that should be made before it appears in print - and what to change it to.
- Take care to check details (grammar, mathematics, bibliography)

When you reject a paper, you should

- Give a clear explanation of the faults and how they might be rectified.
- Indicate which parts of work to keep and which parts to pitch.
- Check the paper at a reasonable level of detail.

4. Dissertation proposals

The main purpose of the proposal is to

- Get you started,
- Give your advisor and committee evidence that you will succeed.

Proposal outline

- Introduction: overall goal and specific aims
- Background and significance
- Preliminary results
- Research design and methods
- Literature cited

The proposal should answer the following

- **What problems** are you working on? What is your claim?
- **Why** is the problem important? (“so what?”) Give examples.
- **Who** has worked in this area and what did they do?
- **How** will you approach the problem? How is your approach different from previous ones?
- **What evidence** do you have that your approach will work? Part of proof? A program?
- **What open problems** remain? How will you approach them?
What are your milestones?
- **When** will you accomplish which milestone? What is your time table?

5. Bibliographical search

- IEEE explorer (from Pitt library system)
- Other Pittcat resources
- Citeseer (<http://citeseer.nj.nec.com/cs>)
- Google.com

Homework:

- 1) select a paper or a number of related papers to present in class
- 2) email or give me a hard copy of the paper with its citation
- 3) do an extensive bibliographical search (using at least two search programs) to find the work related the paper(s). Give me a printout of your search and identify the most active (most cited?) researchers in the area.

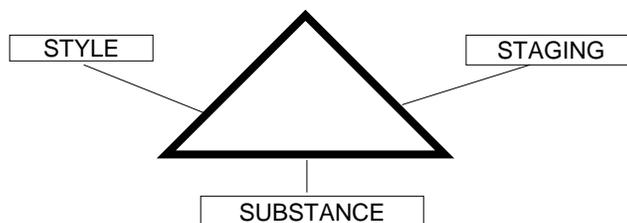
6. How to give a talk

KSL RETREAT

Asilomar

September 23-25, 1992

Three keys to presentation excellence



SUBSTANCE

Core Message
Key Points
Evidence
Humor
Stories
Applications
Openings/Closings

STYLE

Eye Interaction
Pause
Voice
Gestures
Movement
Stance
Dress

STAGING

Lighting
Room Arrangement
Visual Aids
Props/Handouts
Audience Involvement
Handling Q & A
Audience Control

Staging

SUCCESS WITH OVERHEADS

- Design – *Keep it Big*
 - Horizontal format
 - One idea per slide
 - No more than ten lines per slide
 - No more than ten words per line
 - Use upper and lower case large fonts
 - Use colors
 - Use diagrams, cartoons or other graphics
- Preparation – *Attend To Details*
 - Arrive early to get familiar with equipment
 - Adjust projector: distance to screen; focus; image position
 - Place first transparency on projector
 - Put slides in order

Staging (cont.)

- Delivery – *Take Charge*
 - Rehearse the delivery incorporating visuals
 - Talk to audience before showing transparencies
 - Walk in front of the screen
 - Stand flush with the screen
 - Point with hand closest to the screen
 - Point to screen, not to transparency
 - Turn off projector when not in use
 - Do not cover part of the slide to control audience's attention
 - Talk to audience, not to screen
 - Turn off projector before conclusion

Staging (cont.)

OVERHEAD RESEARCH

- **Effects of Overhead Use in Business Meetings:**
(Wharton Study, The Wharton Applied Research Center, U. of Pennsylvania, 1981)
 - Shorter meetings (reduced length by 28%)
 - Faster group decisions
 - Perception of a more professional, credible presenter
 - Increase in understanding by participants (50% better retention rate)
 - More decisions made at meetings
- **Effects of Visuals** (University of Minnesota/3M Study, 1985)
 - Presentations with visuals 43% more persuasive
 - Color more persuasive than black and white
 - 35mm slides heighten sense of professionalism
 - Overhead transparencies heighten interest of the presenter
 - Visuals add clarity, interest

Substance

PRESENTATION PLAN

- 1. Attention Getting Opening:** (Question, story, startling statement, quote, anecdote, humor)
- 2. Transition with Core Message:** "Tell them what you're going to tell them."
(Big picture: goals, objectives, point of view)
Transition: "Today I'm going to talk about..."
Core Message (one sentence):
- 3. Body:** "Tell them."
Key Point 1 Evidence

Core Message
Key Point 2 Evidence
- 4. Conclusion with Core Message and Call to Action:**
Summary: "Tell them what you told them."
Action Statement (think, feel, act):

Types of Evidence

Analytical (left brain)

- data and statistics
- graphs and charts
- research
- surveys

Narrative (right brain)

- stories and anecdotes
- metaphors and analogies
- illustrations
- applications

Substance

Organizing Technical Presentations

- **Know Your Audience**
 - How much background information do they need?
 - What level of detail do they want?

- **Set Clear Goals**
 - Explain your objectives
 - Don't try to cover too much

- **Use A Logical Outline Sequence**
 - Present information in easy-to-follow sequence
 - Develop complex points logically

- **Use Visual Aids**
 - Keep visuals simple
 - Use visuals only to support key points

Substance

Organizing Technical Presentations

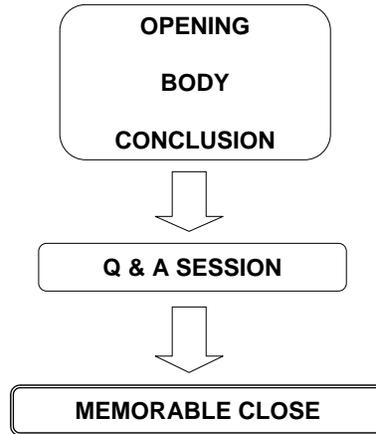
- **Use Analogies**
 - Compare major concepts to familiar objects or experiences
 - Use simple analogies to help non-technical audiences grasp technical content

- **Use Examples**
 - Describe applications in specific terms
 - Explain unfamiliar technical terms
 - Point out exceptions

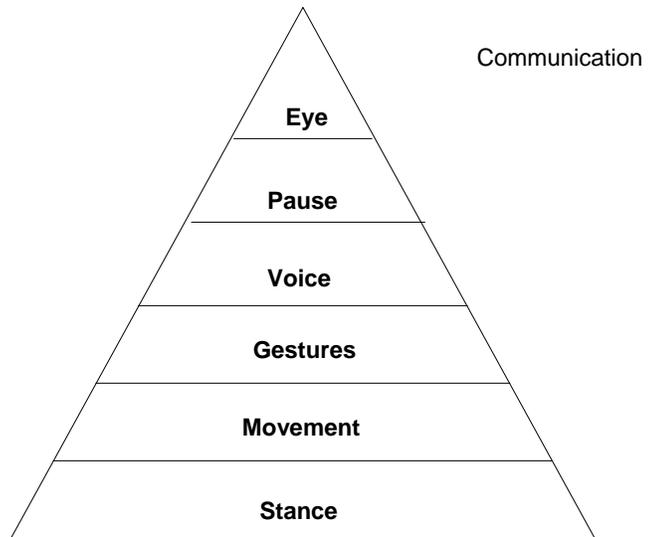
- **Anticipate Questions**
 - Review content for areas of possible confusion

Substance

STRUCTURAL OVERVIEW



Style Hierarchy



Style

STYLE REVIEW

- **Eye Interaction**
 - *Look people in the eye*
 - *Completion of entire thoughts (3 – 5 seconds)*
 - *Connect with people randomly around the room*
- **Pause**
 - *Use for emphasis*
 - *Use to increase attention and retention*
 - *Try 1- 3 second pauses*
- **Voice**
 - *Vary the pitch and pace*
 - *Project voice with confidence*
 - *Articulate clearly*

Style

STYLE REVIEW (cont.)

- **Gestures**
 - *Make them big, bold, expressive*
 - *Use varied gestures (asymmetrical)*
 - *Get them up and out*
- **Movement**
 - *Move with purpose*
 - *Move at transitions*
 - *Use the entire stage*
- **Stance**
 - *Plant feet*
 - *Hip width apart*
 - *Weight evenly distributed*

7. Research integrity Responsible conduct

- Maintain the integrity of the research record
- Prohibit purposeful interferences with research
- Protect intellectual property rights of researchers
- Mentor young colleagues in a nurturing atmosphere
- Avoid conflicts of interest affecting research objectivity
- Assign credit for authorship rationally and fairly

Authorship

- As a first rule, the first author should be the person who wrote the paper or made the largest contribution in writing it.
- Co-authors should be listed in order of decreasing contribution
- May list authors in alphabetical order, indicating this in a footnote.
- It is a good idea to negotiate the author list before the paper is actually written.

Plagiarism

Adapted from E. White (chronicle of higher education – Feb 93)

Stealing ideas and passing them as your own. It shows up when you fail to acknowledge the source of a direct quotation or idea the you restate

- By mistake (don't know what it means to be honest)
 - Develop your own ideas
 - Use sources written by others to support your ideas, with proper credit. Even if you agree you should say why.
 - Proper credit = a footnote, a reference, or a quotation in the text
- By intent
 - You deliberately copy words or ideas with the intent of deceiving someone into believing that they are yours.
- In either case, you cheat yourself
 - Learning how to think for yourself is one reason why you are in college
 - You have an opportunity to learn something – use it.