Types of Papers

Papers in this class are generally fall into one of three categories

1. **New Methodology**: papers that propose a new methodology to solve a specific problem
   - Development of a new algorithm

2. **New Application**: papers that apply existing methodology to a new application, typically with the purpose of developing a new application
   - Prediction
   - Estimation

3. **Scientific Paper**: papers that apply the scientific method to create new knowledge
   - Do people with Parkinson’s disease have associated cognitive impairments?
   - These papers typically include the application of one or more hypothesis tests

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Types of Papers: What Not to Do

- You should NOT write a paper that tries to do more than one of these tasks
- Such a paper should be divided into separate papers
Algorithm Design

- This section is only included in papers that propose a new algorithm
- Typically this section completely describes the algorithm
- If the algorithm is especially complicated, mathematical proofs and other lengthy details are sometimes included in an appendix
- The goal of this section is to completely and clearly describe the new algorithm
- Do not describe components of your algorithm elsewhere

Methodology: Scientific Papers

- This section describes how the experiment was conducted to test the hypothesis
- Includes
  - How the data was collected
  - How the data was analyzed
  - What type of hypothesis test was used
  - The level of significance
- Essentially, all of the details of what you did to collect and analyze the data belong in this section
Methodology: New Algorithm, Application

- This section describes how you assessed the performance of your algorithm or new application
- Assessment often doesn’t receive sufficient attention
- Must think carefully about how to demonstrate your algorithm works better than one of the following:
  - Previous techniques published by others
  - The best current practice
- Whenever possible, the assessment should be prospective
  - Use new data to measure performance
  - Reduces favorable bias

Results

- Typically, this section is also full of detail stating the results of your work
- For this class, results will often be plots, tables, or the results of hypothesis tests

Discussion

- The objectives of this section are
  - To interpret the results
  - To discuss possible explanations for any anomalies in the results
  - To speculate about the impact of the results
- In scientific papers, this section is also used to compare the results with those of other studies and suggest possible explanations (hypotheses) for any discrepancies

Conclusion/Summary

- This section should concisely summarize the final results of the paper
- For scientific paper, typically one or more conclusions can be drawn
- For new methodologies, a summary section may be more appropriate that summarizes
  - What was proposed
  - How well it performed
  - What other advantages & good features it has
Literature Search

- You should conduct a literature search for your project
- Purpose: to determine what other people have written about your topic
- Literature only includes PUBLISHED papers
- It does not usually include web pages or textbooks
- You cannot conduct a literature search with Google or any other web search engine
- The PSU library has web access to several literature databases that you can use to find papers on your topic
- Probably the best ones for this class are
  - Web of Science (http://isi4.isiknowledge.com)
  - Compendex via Engineering Village 2 (http://www.engineeringvillage2.org)
  - IEEE Xplore (http://ieeexplore.ieee.org/Xplore)

Abstract

- The abstract should be a concise summary of the entire paper
- It is not an introduction
- Should include a statement of the problem, summary of the methods and key results, and the conclusions that you made
- This is usually easy to write once you have written the rest of the paper

Organization

- Required: Abstract, Introduction, Results, Conclusions, & References (if any)
- Optional: Acknowledgments and Appendices
- Prohibited: Source code and raw data in printed form

General Tips

- Readership
  - Should be written for someone that understands the key concepts and methods covered in this class
  - You may assume the reader is a first year graduate student in an engineering program
  - In general, try to avoid passive sentence construction
    - If you don’t like using first person pronouns (“I”), you can often use “this paper” or “this report” as the subject
    - For example, “This paper describes an analysis of…”
    - Not “An analysis of … is described” or “I describe an analysis of…”
  - Try to use simple declarative sentences, “The model achieved an MSE=3.27 (1.75–8.83 with 95% confidence).”
General Tips Continued

- Figures
  - Label your axes.
  - Describe the figures in words using a caption below the figure
  - Be sure to use the IEEE format for the caption.

- Tables
  - Remember to use units
  - The captions go above the tables

- Citations
  - Include relevant citations
  - Use review articles to avoid a lengthy literature search
  - Each reference number should be enclosed in square brackets
  - Do not begin a sentence with a reference number