

Cleveland State University

EEC 414/503

Writing in Electrical and Computer Engineering

Lecture 1 – Introduction

Dan Simon

The Importance of Communication

- 96% of employers say that employees must have good communication skills [Markel]
- 80% of Fortune 400 companies identify writing skills as their greatest weakness [Markel]
- “Without communication there is no engineering.” [Gunn]
- A professional engineer spends up to 80% of the time communicating with others [Oatheimer]
- “If you cannot communicate, you are less valuable; if you can, you are more valuable.” [Markel]

The Importance of Communication

How do you objectively identify senior engineering qualities? [Lee]

- Instinct and intuition
- Foresight and planning
- Result oriented
- **Communication skills**
- Time management

How can we improve our communication skills?

Types of Engineering Communication

- Memos, emails, letters
- Instructions, manuals
- Proposals
- Reports
- Oral presentations
- Web sites
- Articles
- Master's and doctoral theses

Characteristics of Good Communication

1. Address your particular audience
2. Use both words and graphics
3. Write clearly
4. Write accurately
5. Write comprehensively
6. Write accessibly (i.e., be organized)
7. Write concisely
8. Write professionally

1. Address your particular audience

- What is your audience's level of knowledge?
Avoid being overly simple or overly complex.
 - Example: A technical proposal to NASA or the NSF should not include an overview of fuzzy logic
 - Example: An overview of fuzzy logic to management should not include defuzzification equations

1. Address your particular audience

- Address your particular audience. What is your audience's interest?
 - Example: An academic research paper should not include a cost/benefit analysis, but it could be included in a thesis
 - Example: A proposal to management for a new control approach should not include a stability proof

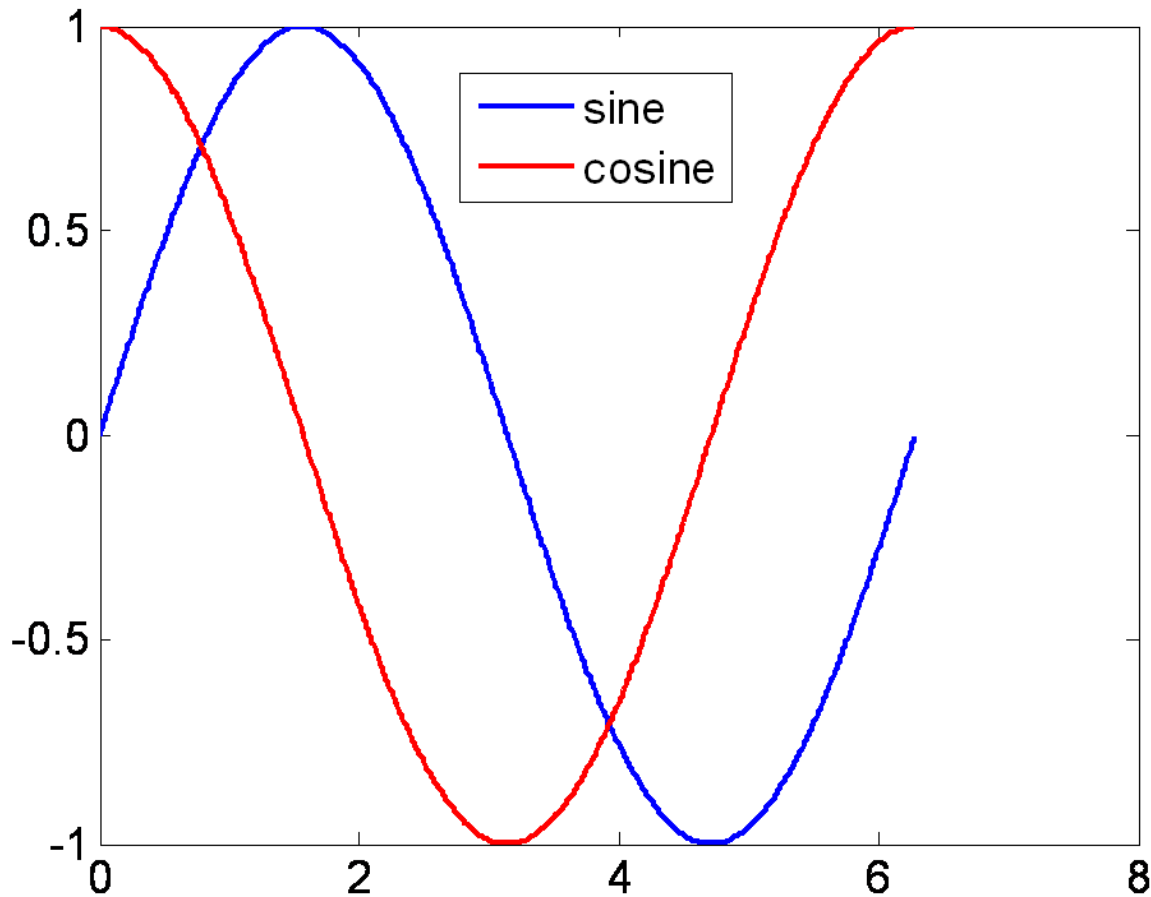
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2. Use both words and graphics

- Why use graphics?
 - A picture is worth a thousand words
 - Make your writing more interesting and appealing
 - Communicate difficult concepts
 - Communicate large amounts of data
- Use flowcharts and algorithm listings
- Make sure you *explain* your figures and tables
- Use color as appropriate

2. Use both words and graphics



The figure looks fine in color, but not in black and white.

Do not rely on color unless you are sure that it will always be available.

2. Use both words and graphics

The price of soybeans is \$1.45 per pound in Zambia and \$1.67 in Sweden. The price of rice is \$0.65 per pound in Zambia and \$0.63 in Sweden. We see that soybeans are more expensive in Sweden, but rice is more expensive in Zambia.

	Soybeans	Rice
Zambia	\$1.45	\$0.65
Sweden	\$1.67	\$0.63

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3. Write clearly



It is necessary for technical reasons that these warheads be stored upside down, that is, with the top at the bottom and the bottom at the top. In order that there be no doubt as to which is the bottom and which is the top, for storage purposes, it will be seen that the bottom of each warhead has been labeled 'TOP'.

British navy instructions [Markel]

3. Write clearly

- **Unclear:** Such preparations shall be made as will completely obscure all Federal buildings and non-Federal buildings occupied by the Federal government during an air raid for any period of time from visibility by reason of internal or external illumination. [Zinsser]
- **Clear:** In buildings where you have to keep the work going, put something across the windows.

3. Write clearly

- Make sure antecedents are well defined
 - John built the experimental setup. Elmer and Fred conducted the experiment. They destroyed the lab and should be fired.

 - John built the experimental setup. Elmer and Fred conducted the experiment. Elmer and Fred destroyed the lab and should be fired.


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4. Write accurately

- Inaccuracy confuses and annoys readers
- Accuracy is an ethical consideration
- Inaccuracy casts doubt on your entire document

4. Write accurately

- Accuracy includes completeness
- Two types of deceit
 - Commission
 - Omission

Example: A new controller tracks to within 1% of the setpoint, while PID tracks to within 10%. But what were the tuning parameters?
- Avoid spin; we are not salespersons

4. Write accurately

- Accuracy includes correct spelling.
- Accuracy, includes correct punctuation.
- Accuracy include correct grammar.
- accuracy Includes correct Capitalization.
- Accuracy includes correct spacing.

4. Write accurately

- Technical writing should be objective and unbiased. It should not be sales literature.
 - **Ugly:** Our new optimization algorithm far outperforms all other methods and is clearly the best algorithm that has ever been invented.
 - **Bad:** Our new optimization algorithm outperforms differential evolution.
 - **Good:** Our new algorithm outperforms differential evolution in terms of convergence speed for the benchmarks that we investigated and the tuning parameters that we used.

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5. Write comprehensively

- Provide background
 - Technology background
 - Define acronyms (within reason)
 - Experiment background
- Provide detail
- Clearly refer to supporting materials
- Allow (even encourage) the reader to reproduce your results

5. Write comprehensively



This paper discusses various experiments with FCs, including tradeoffs related to materials and tolerances.



Flux capacitors (FCs) are a new ...
Initial research was reported in ...

This paper discusses various experiments with FCs, including tradeoffs related to materials and tolerances.

5. Write comprehensively



Genetic algorithm results are shown in Fig. 3.



The genetic algorithm was run with a mutation rate of 0.01, a crossover rate of 0.9, a population size of 50, an elitism parameter of 4, and roulette wheel selection. Results are shown in Fig. 3. These results can be duplicated with the PIC assembly code that is available at www.micropicga.com.

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6. Write accessibly

Make your writing clear and organized

- Abstract: 100—200 word summary of results
- Introduction, including overview of paper
- Sections
 - Subsections
 - Paragraphs
- Conclusion
 - Summary
 - Future work
- References
- Appendices

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7. Write concisely




Eliminate and eradicate words and terms which, due to their repetitiveness and redundancy, do not serve a useful or functional purpose, and that do not add to the intended meaning.



Eliminate unnecessary words.

7. Write concisely

- Use short words

 – The proposed **methodology** **endeavors** to **facilitate** the **utilization** of the assembler.

 – The proposed **method** **makes it easier** to **use** the assembler.

7. Write concisely

- Replace phrases with words



– Our students' excellence is **due to the fact that** professors are hired **for the purpose of** teaching, **with the possible exception of** Dr. Einstein.



– Our students' excellence is **because** professors are hired **for** teaching, **except** Dr. Einstein.

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8. Write professionally

- Your writing is a reflection of your ability
- Use consistent formatting
 - Margins
 - Font
 - Capitalization
 - Reference formatting

8. Write professionally

Ugly example of bad formatting:

This is an approach for finding the closest correlation matrix of a user-specified rank to a given matrix, where some elements of the matrix are constrained to be zero. This is the first time that this particular problem has been studied. If there are no constraints then our method reduces to that proposed in [1] and convergence is guaranteed. If constraints are specified in the problem then we cannot guarantee convergence, or even feasibility, depending on the constraints and the rank of the matrix.

8. Write professionally

Ugly example of inconsistent section headings:

1. INTRODUCTION
2. Constrained Correlation
3. Feasibility and convergence
4. CONCLUSION

What is the correct format?

8. Write professionally

- Use consistent reference formatting, **regardless** of the format of the original reference
- Include **enough information** in the reference so that the reader can find the reference

8. Write professionally

Ugly example of inconsistent reference formatting:

1. Chen M, Linkens D. – A Systematic Neuro-Fuzzy Modelling Framework, IEEE Transactions on System, Man, and Cybernetics, 31, 5, 781–790 , 2001.
2. M. Dische, “Observations on the morphological changes of the developing heart”, Cardiovascular Clinics, Vol. 4 (3), pp. 175 -191,1972
3. Jim Johnson and Nigel Flowers. Diagnostic accuracy of the ECG, *Cardiovascular Clinics*, volume 8(3) 25-40, 1977
4. Macfarlane P W – Is electrocardiography still useful in the diagnosis of cardiac chamber hypertrophy and dilatation?, *Cardiology Clinics* **24**, number 3, p.401-411, March 2006

8. Write professionally:

How do we reference technical sources?

Journal Paper:

- [1] B. Igel'nik and D. Simon, "The eigenvalues of a tridiagonal matrix in biogeography," *Applied Mathematics and Computing*, vol. 218, no. 1, pp. 195–201, September 2011.

Conference Paper:

- [2] H. Ma and D. Simon, "Biogeography-based optimization with blended migration for constrained optimization," *Genetic and Evolutionary Computation Conference*, Portland, Oregon, pp. 417–418, July 2010.

Book Chapter:

- [3] P. Lozovyy, G. Thomas, and D. Simon, "Biogeography-based optimization for robot controller tuning," in: *Computational Modeling and Simulation of Intellect* (B. Igel'nik, editor) IGI Global, pp. 162–181, 2011.

Book:

- [4] D. Simon, *Optimal State Estimation*, John Wiley & Sons, 2006.

Conclusion:

The Simplicity of Communication

“... a great many people who pass in society as being polished, refined and educated use less [than 2,000 words] ... The greatest scholar alive hasn't more than four thousand different words at his command, and he never has occasion to use half the number.” [Devlin]

References

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- C. Gunn, Engineering graduate students as evaluators of communication skills. *Proc. ASEE Annual Conf., Washington, DC, USA, 287-290*, 1995
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- M. Markel, *Technical Communication*, Chapter 1, Appendix D, “Guidelines for Multilingual Writers (ESL)”
- M. Oatheimer and E. White, Portfolio assessment in an American engineering college. *Assessing Writing*, 10, 61-73, 2005
- W. Zinsser, *On Writing Well*, 2006