ECE 470: How to Write your Final Report (Spring 2019)

List of Group members with NetIDs

Your Team Name

Link to GitHub with your codebase

Link to YouTube video demonstrating your final project

1 Abstract

Provide 150- to 250-word summary of your project that provides the reader with an overview of your project. Tell us what the problem statement is, why your robot is important / has potential impact, what your key solutions were, and summarize your results with a quantitative metric of success as well as a qualitative assessment. Give a brief conclusion what you learned and what future steps might be.

2 Introduction

The purpose of this report is to describe all the hard work you've put into the project this semester, and show your understanding of the material and to practice expressing your ideas in a formal way. This document will help you format and structure your final report correctly. N**ote that this is heavily based off the lab manual guide, but there are some changes. Please read this carefully!**

3 Sections

The final report is like a journal paper in that it typically has the following sections:

- Abstract
  - See guidance above!
- Introduction
  - Explain the objective or goal of the project, and provide a motivating application or potential applications of your robot
  - Provide a summary of background / literature review that you conducted to figure out how to best solve your proposed task. Reference at least five technical articles or texts.
- Method
  - Explain your design process and create a block diagram of your robotic system
  - Describe each of the modules you designed for your robot and explain how they worked. No need to regurgitate all equations from class, but convey how you

formalized the problem and connected each piece to something you learned in class.
    - Did you use existing or other folks' code for your project? If so, give credit where credit is due! Describe in detail how those functions worked, and why you chose to use it.
- Experimental Setup
    - Create a description and diagram that explains what your robot setup and task is
    - Describe how you simulated your system, what variables you tuned, and what experiments you ran to collect the results
    - To get results for the next section, run a few trials and tests to get a representative sample of your robot performance. What changes in each trial?
- Data and Results
    - How do you define success? What metrics are you using to show performance?
    - Analyze the data you collected, providing quantitative metrics (e.g., success rates, error analysis, etc), and qualitative examples of success and/or failures you encountered
    - What parameters did you vary to get things to work? What are the tradeoffs made in your design?
    - Provide at least one plot illustrating your robot's performance
    - Include an error analysis and discussion of sources of error. Characterize under what conditions your system performs well, and under what conditions your robot fails.
- Conclusion
    - Summarize what you did and the results of your data
    - Discuss what you learned from the project
    - Tell us what you would do differently if you were to attempt this project again and/or had more time
- References
    - List of references
- Appendix
    - Additional information if needed

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You are free to combine, split or rename these sections as needed or desired, as long as the final structure is clear and well organized. The reader should still be able to find all this information easily. You may adjust the sections as needed – be as concise as possible, while still convincing us that you understand and successfully implemented all components.

4 Style and Formatting

Consistent and clear style and formatting are necessary for effective communication. This document tries to present a simple but effective style. There are many official style guidelines such as ALA, MLA and IEEE. This guide does not specifically follow any of them, but they can be a good resource if you are not sure how to handle some situation.

4.1 Style

Your report should be written in formal language and be clearly and concisely written in full sentences in paragraph form and not as a series of bullet points. Bullet points are fine for clarity, but not for organizing and structuring your entire report. You are free to write in the active or passive voice, as long as you are consistent. No one will be grading you on your English grammar, punctuation and usage, but excessive problems will inhibit clear communication.

4.2 Formatting

Your report must be typed, but you are free to use Microsoft Word, Latex or any similar program. Ensure that your report is formatted to be easy to read. This typically means 12-pt Times New Roman font on a page with 1" margins. We do not count pages, so there is no reason to adjust this. Do **not** include a cover page, but include the following on the top of the first page:

- List of Group members with NetIDs
- Your Team Name
- Link to github with your codebase
- Link to youtube video demonstrating your final project

As reports will be submitted electronically, make appropriate use of color to make your figures, tables, etc. as clear as possible. However, your report should not be a rainbow explosion. Sections and sub-sections should be clearly marked and numbered. The format of this document is one such method. In Microsoft Word, this is done using the Styles tools – Heading 1, Heading 2, etc. This document is an excellent template for writing your report and Latex template can be found here.

4.3 Figures, Equations, Tables, Etc.

Figures, equations, tables, etc. are a key part of any lab report. It is important to properly format your figures, equations and tables. This document includes some guidance on how to do this in Microsoft Word. Please read through it carefully so you fully understand the requirements.

4.3.1 Figures

Figures should be photos or drawings made on a computer. You may use the drawing tools of Microsoft Word or any drawing software to create your figures. Do not use hand drawn figures – note that this includes drawings made with tablet and stylus. Figures should be center-aligned and captions should appear below them. The captions should also be center-aligned. **All figures must**

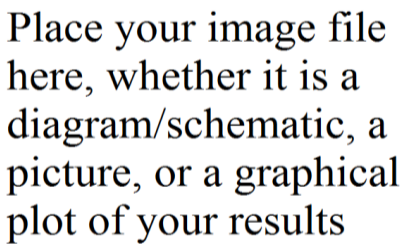

Figure 1. If a text box is used for both the figure and its caption, they will never be separated by a page break.

be described in the body of the report by text that (a) references the figure by number and (b) explains the content of the figure. In Microsoft Word, it is advisable to place each figure and its caption inside a simple borderless text box or picture box, as in Figure 1. By clicking on the text of the Figure 1 caption, the text box will become visible. After inserting the text or picture box, click on its border and select a layout option with "top and bottom" text wrapping. Then, insert the figure image file into the box and write the caption below it. The figure can easily be moved by clicking the border of the box and dragging it where it fits best in the document. Make sure to reference each figure included in the body of the report. Don't add figures without explaining them in the report text.

4.3.2 Variables, Numbers, and Equations

When using Microsoft Word, you can use a 3×1 table with no borders to format an equation. The table should be as wide as the paragraph text (6.5"), left and right cells in the table should each be approximately 0.5" wide, leaving plenty of space for the equation in the middle cell. The

left cell should contain no text and the right cell should contain the equation number in parentheses, aligned to the right side of the cell. Use centered alignment for the equation in the middle cell. Remember to use appropriate punctuation after the equation, if necessary. Be aware that Microsoft Word automatically capitalizes the first word in the next line, which often is not appropriate when introducing equations. For example, the bipolar coordinate system is defined by:

$$x = (a \sin\ v)/(\cosh\ v - \cos\ u) \tag{1}$$

and

$$y = (a \sinh\ u)/(\cosh\ v - \cos\ u), \tag{2}$$

where *a* gives one-half of the distance between poles. Note that a comma is necessary after Eq. 2 but not after Eq. 1 and that the words "and' and "where" are not (and should not be) capitalized.

4.3.3 Tables

Tables can be very useful for introducing parameters to be tested, comparing small amounts of data, and summarizing findings. There are many ways to organize data in a table but it is vital that you ensure the data presented in the table is easy to understand. One way that tables differ from figures is that the caption should **appear above the table**, as shown in Table 1. Just like figures, any table included should be referenced and discussed in the text.

Table 1. Comparison of characters according to roundness

	Round	Both Straight and Round	Straight
Vowels	O	U	A, E, I
Consonants	C, Q, S	B, D, G, J, P, R	F, H, K, L, M, N, T, V, W, X, Y, Z
Numerals	0, 3, 6, 9	2, 5, 8	1, 4

4.3.4 Code Snippets

Code snippets are very useful for explaining how you accomplished a given task. They are part of the text and should be short in length. Line numbers are not needed because we are not

concerned about how the code snippet fits in the broader code. If you are concerned about how the code fits in the full program, you should include the full text of the code in an appendix and reference it by line number.

```
# Python program to display the Fibonacci sequence up to n-th term
using recursive functions

def recur_fibo(n):
   """Recursive function to
   print Fibonacci sequence"""
   if n <= 1:
       return n
   else:
       return(recur_fibo(n-1) + recur_fibo(n-2))

# Change this value for a different result
nterms = 10

# uncomment to take input from the user
# nterms = int(input("How many terms? "))

# check if the number of terms is valid
if nterms <= 0:
   print("Plese enter a positive integer")
else:
   print("Fibonacci sequence:")
   for i in range(nterms):
       print(recur_fibo(i))
```

https://www.programiz.com/python-programming/examples/fibonacci-recursion

There are a number of ways to include well formatted code in Microsoft Word. One example is an Add-In called Easy Code Formatter. It can be added via **Insert->Add-ins->Get Add-ins** on Office 365. Copy and paste in the required code, then select Easy Code Formatter from the menu bar and Format Text As Code. After formatting, indent the code by 0.5" for clarity. Line numbers can be toggled on and off in the options. Do not use screenshots from a text editor, as they often appear blurry in the final PDF and are difficult to scale consistently.

4.4 References and Citations

When you make use of someone else's work, it is necessary to acknowledge it. When writing your list of references, you may use any common methodology that you like (e.g. APA, MLA, and IEEE). There are many online resources available to help you format these correctly. Inline citation should be a set of square brackets around a number that refers to the item in the list of references – i.e. [12]. Place the citation at the end of the final sentence associated with that reference. You do not need to cite the lab manual, text book or any provided notes from the professor or TA. You

must cite everything else. This includes sources for images that you did not create. Remember that the list of references should be in alphabetical order.

5 Submission and Grading

When you are done with the project report, please save it as a PDF file and submit it online at GradeScope. *The final report will be due on **May 15th at midnight**.* Points for the report will be allotted as follows:

Item	Points	Purpose
GitHub link	5	Is the codebase well documented and easy to follow?
YouTube link	5	Does the video effectively demonstrate the outcomes of the project?
Style and Formatting	5	Is the report consistent with the lab report guidelines?
Abstract	5	Is the abstract well written and concise?
Introduction, Background, and References	10	Did you effectively convey why your project is interesting? Did you do some background research to figure out how to solve your problem? Did you provide at least five references?
Methods	20	Did you visualize the block diagram and are the modules well described? Is the course material connected to the project and did you convey understanding of the topics? Did you give people credit for inspiration and/or code used?
Experimental Setup	15	Did you effectively describe your task and experimental protocol? Did you explain what variables were tuned? Did you explain how you were testing your system?
Data and Results	25	Did you have a good quantitative measure of performance? Did you provide an insightful qualitative example (of success and/or failure)? Did you analyze your systems failure cases? What tradeoffs are you making in your robot design? Did

		you provide a plot / visualization of your robot's performance?
Conclusions	10	Did you effectively summarize your project? Did you provide a thoughtful reflection of the project?
TOTAL	**100**	

6 Conclusion

This document should help you create clear and concise reports. Please ask the TA if you have any questions about writing a good report and always remember: clear, concise, and consistent!

7 Thank you

Thank you to whomever wrote the report guidelines for MechSE design courses, upon which this is based.

Additional Resources

https://writersworkshop.illinois.edu/ - UIUC's own writing support center. It has many online resources and you can also meet one-on-one to discuss your writing concerns.

https://owl.purdue.edu/owl/purdue_owl.html - This has lots of good information about writing all kinds of papers – including lab reports. It is often linked to by other universities and is a top hit on google.

https://www.engineering.uiowa.edu/current-students/undergradute-students/academic-support-and-tutoring/hanson-center-technical-3 - More engineering specific advice.