



Non-Destructive Carabao Mango Sorter and Grader based on Physical Characteristics
using Machine Learning

A Thesis Proposal
Presented to the Faculty of the
Department of Electronics and Computer Engineering
Gokongwei College of Engineering
De La Salle University

In Partial Fulfillment of the
Requirements for the Degree of
Bachelor of Science in Computer Engineering

by
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February, 2025



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ORAL DEFENSE RECOMMENDATION SHEET

This thesis proposal, entitled **Non-Destructive Carabao Mango Sorter and Grader based on Physical Characteristics using Machine Learning**, prepared and submitted by thesis group, AISL-1-2425-C5, composed of:

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in partial fulfillment of the requirements for the degree of **Bachelor of Science in Computer Engineering (BS-CPE)** has been examined and is recommended for acceptance and approval for **ORAL DEFENSE**.

Dr. Reggie C. Gustillo
Adviser

February 2, 2025



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ABSTRACT

39

Index Terms—Machine Learning, Carabao Mangoes, Sorting and Grading Mangoes, Machine Vision, Microcontroller.

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ABBREVIATIONS

143	AC	Alternating Current.....	78
144	CSS	Cascading Style Sheet	78
145	HTML	Hyper-text Markup Language	78
146	XML	eXtensible Markup Language	78



147

NOTATION

148	$ \mathcal{S} $	the number of elements in the set \mathcal{S}	80
149	\emptyset	the set with no elements	80
150	$h(t)$	impulse response	70
151	\mathcal{S}	a collection of distinct objects	80
152	\mathcal{U}	the set containing everything	80
153	$x(t)$	input signal represented in the time domain	70
154	$y(t)$	output signal represented in the time domain	70

155 Throughout this thesis proposal, mathematical notations conform to ISO 80000-2 standard,
156 e.g., variable names are printed in italics, the only exception being acronyms like, e.g., SNR,
157 which are printed in regular font. Constants are also set in regular font like j . Standard
158 functions and operators are also set in regular font, e.g., in $\sin(\cdot)$, $\max\{\cdot\}$. Commonly
159 used notations are t , f , $j = \sqrt{-1}$, n and $\exp(\cdot)$, which refer to the time variable, frequency
160 variable, imaginary unit, n th variable, and exponential function, respectively.



161

GLOSSARY

162

Functional Analysis

the branch of mathematics concerned with the study of spaces of functions

163

matrix

a concise and useful way of uniquely representing and working with linear transformations; a rectangular table of elements



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Chapter 1

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INTRODUCTION



1.1 Background of the Study

Aside from the usual text descriptions of the background, put here figures that will cast images to your audience about the context of your work.

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1.2 Prior Studies

Put here a narrative and a summary (not a duplicate) of your literature review chapter. In this section, summarize and highlight the gap(s) found in the literature review in Chapter 2. Preferably, a table showing the summary would be helpful.

Prior Studies or Literature Review¹ (expansion of the Prior Studies) is basically about competition. **Competition.**

So the suggested goals in writing the narrative of the Prior Studies in summative and highlighted forms are, in no particular order:

1. to mention the problem briefly;
2. to show the features of the existing literature in solving the problem
3. to show the weaknesses of the solutions of existing literature
4. to show how your solution is better (can be better (for proposals))

If the suggested table will be placed, please discuss it in light of the above-mentioned items.

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¹The main difference between the Prior Studies and Literature Review is that the Prior Studies is done in a concise manner. By the way, this is also an example of a footnote usage.



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 251 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
 252 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

253 1.3 Problem Statement

254 The problem statement needs to be very clear and to the point.

255 A persuasive problem statement from a contextualized and intended-audience-awareness
 256 perspective consists of:

257 1. PS1: description of the ideal scenario for your intended audience

- 258 • Describe the goals, desired state, or the values that your audience considers
 259 important and that are relevant to the problem.

260 2. PS2: reality of the situation

- 261 • Describe a condition that prevents the goal, state, or value discussed in PS1
 262 from being achieved or realized at the present time.
- 263 • It is imperative to make the audience feel the pain point.

264 3. PS3: consequences for the audience

- 265 • Using specific details, show how the situation contains a little promise of
 266 improvement unless something is done.



After the above-mentioned items, succinctly describe your solution. Please avoid describing your entire solution here since you will articulate and elucidate it by showing what you want to achieve through your objectives, and how you will make it through your methodology. A well-constructed problem statement will convince your audience that the problem is real and worth having you solve it.

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1.4 Objectives and Deliverables

Your objectives are the states that you desire to achieve in solving the problem. The general objective is the main state to be achieved whereas the specific ones are sub-states to be achieved.

1.4.1 General Objective (GO)

GO: To Morbi quis dolor. ;



1.4.2 Specific Objectives (SOs)

- SO1: To Quisque egestas wisi eget nunc. ;
- SO2: To Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. ;
- SO3: To Nullam cursus pulvinar lectus. ;
- SO4: To Morbi blandit ligula feugiat magna. ;
- SO5: To Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. ;

1.4.3 Expected Deliverables

Table 1.1 shows the outputs, products, results, achievements, gains, realizations, and/or yields of the Thesis Proposal.

TABLE 1.1 EXPECTED DELIVERABLES PER OBJECTIVE

Objectives	Expected Deliverables
GO: To Morbi quis dolor.	:

1.5 Significance of the Study

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1.5.1 Technical Benefit

- 1. First itemtext
- 2. Second itemtext
- 3. Last itemtext
- 4. First itemtext
- 5. Second itemtext

1.5.2 Social Impact

- 1. First itemtext
- 2. Second itemtext
- 3. Last itemtext
- 4. First itemtext



320 5. Second itemtext

321 **1.5.3 Environmental Welfare**

322

323 1. First itemtext

324 2. Second itemtext

325 3. Last itemtext

326 4. First itemtext

327 5. Second itemtext

328 **1.6 Assumptions, Scope, and Delimitations**

329 Bulletize your assumptions in one group, and then bulletize the scope in another, and do
330 the same for your delimitations. The assumptions to put here are those major facts or
331 statements that are *key* for your proposed solution to work. Scope refers to the space(s)
332 for the operation of your proposed solution, whereas delimitations are the limits of the
333 operation of your proposed solution.

334 **1.6.1 Assumptions**

335 1. ...;

336 2. ...;



3. ...;

1.6.2 Scope

1. ...;

2. ...;

3. ...;

1.6.3 Delimitations

1. ...;

2. ...;

3. ...;

1.7 Description and Methodology of the Thesis Proposal

A purpose of the description here is to re-steer/remind the panelist/reader again by tersely describing what your thesis is about (i.e. the problem and the main goal you want to achieve) in another way without sounding repetitive.

Your methodology is your means of achieving your stated objectives. What you put here is the summary of your methodology chapter.

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1.8 Estimated Work Schedule and Budget

The estimated work schedule can be represented as a Gantt Chart or a combination of
 Project Network Diagram, Work Breakdown Structure, and Critical Path. The budget can
 be made into a Bill of Materials, financial plan, or if your Thesis Proposal is funded and
 part of larger project, the cost, and date for reaching each milestone and/or deliverable for
 your part of the project.

For ECE Department undergraduate theses, the individual Gantt Chart or Work Break-
 down Schedule and Bill of Materials will be included in this section and be removed in the
 final document.

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378 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
379 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

380 **1.9 Overview of the Thesis Proposal**

381 Provide here a brief summary and what the reader should expect from each succeeding
382 chapter. Show how each chapter is connected with each other.



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383

Chapter 2

384

LITERATURE REVIEW



385 It is to be noted that each subsection in this chapter should discuss in narrative form
 386 each table that is presented in order to point out to the reader what the author(s) intend to
 387 convey.

388 2.1 Existing Work

389 Cite and summarize here relevant and significant literature (dissertations, theses, journals,
 390 patents, notable conference papers) through a table and descriptions to prove that no one
 391 has done your work yet and/or that your work is not a duplication of existing ones. Your
 392 focus here is what has *been done*.

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2.2 Lacking in the Approaches

You can summarize the weaknesses of existing approaches by a tabular comparison of the
 literature. Your focus here is what has *not been done*, i.e. what features were missed, what
 solutions were not considered, what the demerits are, etc. Through these items, you then
 can introduce the necessity for doing your proposed solution.

It is to be noted that the degree of novelty for undergraduate thesis is lower than those
 for graduate school. If a Ph.D. dissertation/thesis has a high degree of novelty and that for
 an undergraduate is low, then a master's thesis is somewhere between the two.

Briefly include here the following in order to remind the reader why you are highlighting
 the weaknesses of the solutions of existing literature.

- mentioning the problem
- showing how your solution is better (can be better (for proposals))

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495 **2.3 Summary**

496 Provide the gist of this chapter such that it reflects the contents and the message.



497

Chapter 3

498

THEORETICAL CONSIDERATIONS



Before starting the first section, provide an overview of the purpose of this chapter and its contents, and how they are relevant to your methodology. Discuss in this chapter the relevant theories and concepts that should support your proposed solutions.

This chapter is for providing the context to your panelist/reader. It is actually an expanded form of the Background of the Study that you have put in Chapter 1.

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Fig. 3.1 A quadrilateral image example.

549 3.1 Summary

550 Provide the gist of this chapter such that it reflects the contents and the message.



De La Salle University

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Chapter 4

552

DESIGN CONSIDERATIONS



Before starting the first section, provide an overview of the purpose of this chapter and its contents, and how they are relevant to your methodology.

Your primary goal in the Design Considerations chapter is to describe to your panelist/readers the key topics that fall further under Theoretical Considerations, but should be placed here instead since they are geared towards your Methodology. These key topics are those that you have directly adopted in making your solution/methodology. You can think of the connection of the Design Considerations chapter to the Theoretical Considerations chapter in this way: if your Theoretical Considerations chapter serves as the main foundation of a building, then the Design Considerations chapter functions as the columns.

The Design Considerations chapter is an avenue for explaining why you considered the topics here for your proposed methodology. This chapter is different from your methodology, because topics you discuss here are already accepted as part of the body of knowledge, and may have not been developed by you.

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4.1 Standards

Standards are essential for successful projects and impactful research. They provide a common framework and ensure consistency, quality, and safety across various disciplines. By adhering to established standards, your work becomes more reliable, interoperable, and valuable in real-world applications. Standards also demonstrate your understanding of industry best practices and enhance the credibility of your research.

To effectively integrate standards into your project, begin by identifying relevant standards related to your specific field. Thoroughly research and understand the requirements and guidelines outlined within these standards. Align your project objectives and methodologies to meet or exceed these standards. Document your use of standards in this section, including how and why specific standards were chosen. Finally, evaluate your results against the established standards, justifying any deviations from the norm with sound



623 reasoning and evidence.

624 **4.2 Summary**

625 Provide the gist of this chapter such that it reflects the contents and message.



De La Salle University

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Chapter 5

627

METHODOLOGY



Put an overview of the contents of chapter. Mention here your methodology flow through a figure and provide an overview of it and how your methodology achieves your objectives. How your methodology achieves each of your specific objectives is what your panelists/examiners will be looking for. Specify how your methodology achieves your general objective and specific objectives. A point-by-point comparison how your methodology achieves each of your specific objectives is expected in the final Thesis Proposal.

Also make sure that you refer clearly to the chapters on the Literature Review, Theoretical Considerations, and Design Considerations showing how your methodology ties with those that you have discussed in those chapters.

Make an overview of the contents of the chapter. Put here your methodology flow through a figure and provide an overview of it.

In summative form, Table 5.1 indicates the approaches, designs, modes, processes, programs, techniques, and/or ways that the Thesis Proposal reaches the objectives.

TABLE 5.1 SUMMARY OF METHODS FOR REACHING THE OBJECTIVES

Objectives	Methods	Locations
GO: To Morbi quis dolor.	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext	Sec. 5.1 on p. 31

Continued on next page



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Objectives	Methods	Locations
SO1: To Quisque egestas wisi eget nunc.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31
SO2: To Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31
SO3: To Nullam cursus pulvinar lectus.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31
SO4: To Morbi blandit ligula feugiat magna.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31

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Objectives	Methods	Locations
SO5: To Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31

5.1 Implementation

Summarize the process used to create/set-up the work with an explanation of such process, instruments, and materials that you used if any. If the description is lengthy, use condensed bullet points.

Rule of thumb: Implementation is how you made your work; (keywords: implemented, created, made, soldered, programmed, etc.).

If you wrote a program or made a simulation, you must state how the program or simulation functions in this section. An algorithm or a pseudocode as shown in Table E.2 is a good example.

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696 5.2 Evaluation

697 Describe the procedures for evaluating the correct behavior and outcome of your work,
 698 including what information you need to gather and how you will obtain or measure it.

699 *Rule of thumb:* Evaluation is how you tested your work; (keywords: measured, tested,
 700 compared, simulated, etc.).

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5.3 Summary

Provide the gist of this chapter such that it reflects the contents and the message.



748

Chapter 6

749

RESULTS AND DISCUSSIONS



750 Show in this chapter proofs why your proposed solution works. However, presenting
 751 results ("It worked") without an appropriate explanation does not show thorough under-
 752 standing. Aside from the data and results that you have obtained, and their explanation,
 753 the discussion includes why components of your proposed solution work did or did not
 754 work in accordance to what you described in the evaluation process, and how the proposed
 755 solution performed and faired. Interpret the results and the reasons why they were obtained.
 756 If your results are incorrect, apparent discrepancies from theory should be pointed out and
 757 explained. In essence, what do the results mean? Citing existing publication can help you
 758 compare your results and your explanations.

759 The next items below is not related to the description of this results and discussions
 760 chapter, but serves as an opener for the L^AT_EX portion of this template.

761 Here is an example of a citation for ISO 80000-2 standard [?]. Another one is [?]
 762 and [?].

763 In using this template, the user is expected to have a working knowledge of L^AT_EX. A
 764 good introduction is in [?]. Its latest version can be accessed at <http://www.ctan.org/tex-archive/info/lshort>. See the Appendix of document_guide.pdf for examples.

766 In aggregate form, Table 6.1 shows the outcomes and completions in applying the
 767 methodology of the Thesis Proposalper objective.

TABLE 6.1 SUMMARY OF RESULTS FOR ACHIEVING THE OBJECTIVES

Objectives	Results	Locations
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Continued on next page



Continued from previous page

Objectives	Results	Locations
GO: To Morbi quis dolor.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31
SO1: To Quisque eget wisi eget nunc.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31
SO2: To Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31
SO3: To Nullam cursus pulvinar lectus.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31

Continued on next page



Continued from previous page

Objectives	Results	Locations
SO4: To Morbi blandit ligula feugiat magna.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31
SO5: To Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam.	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	Sec. 5.1 on p. 31

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6.1 Summary

Provide the gist of this chapter such that it reflects the contents and the message.



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Chapter 7

816

CONCLUSIONS, RECOMMENDATIONS, AND

817

FUTURE DIRECTIVES



818 7.1 Concluding Remarks

819 In this Thesis Proposal, ...

820 Put here the main points that should be known and learned about the work topic.
821 Summarize or give the gist of the essential principles and inferences drawn from your
822 results.

823 7.2 Contributions

824 The interrelated contributions and supplements that have been developed by the author(s)
825 in this Thesis Proposal are listed as follows. Only those that are unique to the authors' work
826 are included.

- 827 • the ;
- 828 • the ;
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830 7.3 Recommendations

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7. Conclusions, Recommendations, and Future Directives



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876 7.4 Future Prospects

877 There are several prospects that may be extended for further studies. . . . So the suggested
 878 topics are listed in the following.

879 1. the

880 2. the

881 3. the

7. Conclusions, Recommendations, and Future Directives



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882 Note that for ECE undergraduate theses, as per the directions of the thesis adviser,
883 Recommendations and Future Directives will be removed for the hardbound copy but will
884 be retained for database storage.



885 \LaTeX -comment this and the following texts after you have implemented them. See the
 886 following references for helpful guides for the bibliography and script editing in general.
 887 Note that the links might be unavailable, but the names can be searched in the Web.

- 888 1. IEEE Citation Reference: www.ieee.org/documents/ieeecitationref.pdf
- 889 2. IEEE Editorial Style manual: www.ieee.org/documents/style_manual.pdf
- 890 3. IEEE Abbreviations for Transactions, Journals, Letters, and Magazines: www.ieee.org/documents/trans_journal_names.pdf
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892 Also in your BibTeX file, enclose letters or words that should all be in uppercase in curly
 893 brackets. Example: IBM, Philippines, eXtensible Markup Language.



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Appendix A

STUDENT RESEARCH ETHICS CLEARANCE



897

RESEARCH ETHICS CLEARANCE FORM¹
For Thesis Proposals

Names of Student Researcher(s):

Dela Cruz, Juan Z.

College: **Gokongwei College of Engineering**Department: **Electronics and Communications Engineering**Course: **PhD-ECE**Expected Duration of the Project: from: **April 2015**to: **April 2017**

Ethical considerations

None

(The [Ethics Checklists](#) may be used as guides in determining areas for ethical concern/consideration)

To the best of my knowledge, the ethical issues listed above have been addressed in the research.

Dr. Francisco D. Baltasar

Name and Signature of Adviser/Mentor:

Date: **April 8, 2017**

Noted by:

Dr. Rafael W. Sison

Name and Signature of the Department Chairperson:

Date: **April 8, 2017**

¹ The same form can be used for the reports of completed projects. The appropriate heading need only be used.



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Appendix B
ANSWERS TO QUESTIONS TO THIS THESIS
PROPOSAL



B1 How important is the problem to practice?

A possible answer to this question is the summary of your Significance of the Study, and that portion of the Problem Statement where you describe the ideal scenario for your intended audience.

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B2 How will you know if the solution/s that you will achieve would be better than existing ones?

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B2.1 How will you measure the improvement/s?

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935 **B2.1.1 What is/are your basis/bases for the improvement/s?**

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945 **B2.1.2 Why did you choose that/those basis/bases?**

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955 **B2.1.3 How significant are your measure/s of the improvement/s?**

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963 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
964 amet ipsum. Nunc quis urna dictum turpis accumsan semper.



B3 What is the difference of the solution/s from existing ones?

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B3.1 How is it different from previous and existing ones?

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B4 What are the assumptions made (that are behind for your proposed solution to work)?

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B4.1 Will your proposed solution/s be sensitive to these assumptions?

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B4.2 Can your proposed solution/s be applied to more general cases when some assumptions are eliminated? If so, how?

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B5 What is the necessity of your approach / proposed solution/s?

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B5.1 What will be the limits of applicability of your proposed solution/s?

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B5.2 What will be the message of the proposed solution to technical people? How about to non-technical managers and business people?

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B6 How will you know if your proposed solution/s is/are correct?

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B6.1 Will your results warrant the level of mathematics used (i.e., will the end justify the means)?

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B7 Is/are there an/_ alternative way/s to get to the same solution/s?

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B7.1 Can you come up with illustrating examples, or even better, counterexamples to your proposed solution/s?

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B7.2 Is there an approximation that can arrive at essentially the same proposed solution/s more easily?

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B8 If you were the examiner of your Thesis Proposal, how would you present the Thesis Proposal in another way? Give your remarks, especially for your methodology and the results and discussions.

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B8.1 What are the weaknesses of your Thesis Proposal, specifically your methodology and the results and discussions?

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1126 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.
1127 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla
1128 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue
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1130 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
1131 amet ipsum. Nunc quis urna dictum turpis accumsan semper.



De La Salle University

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Appendix C

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REVISIONS TO THE PROPOSAL



Make a table with the following columns for showing the summary of revisions to the proposal based on the comments of the panel of examiners.

1. Examiner

2. Comment

3. Summary of how the comment was addressed

4. Locations in the document where the changes have been reflected

TABLE C.1 SUMMARY OF REVISIONS TO THE PROPOSAL

Examiner	Comment	Summary of how the comment was addressed	Locations
Dr. Reggie C. Gustillo	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p>	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p> <p>First itemtext</p> <p>Second itemtext</p> <p>Last itemtext</p> <p>First itemtext</p> <p>Second itemtext</p>	<p>Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22</p>

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Examiner	Comment	Summary of how the comment was addressed	Locations
Dr. Donable de Veas Abuan	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p>	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p> <p>First itemtext</p> <p>Second itemtext</p> <p>Last itemtext</p> <p>First itemtext</p> <p>Second itemtext</p>	<p>Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22</p>

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Examiner	Comment	Summary of how the comment was addressed	Locations
Engr. Jose Martin Maningo	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p>	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p> <ul style="list-style-type: none"> • First itemtext • Second itemtext • Last itemtext • First itemtext • Second itemtext 	<p>Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22</p>

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Examiner	Comment	Summary of how the comment was addressed	Locations
Dr. Alexander Co Abad	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p>	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p> <ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	<p>Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22</p>

Continued on next page



Continued from previous page

Examiner	Comment	Summary of how the comment was addressed	Locations
Dr. Rafael W. Sison	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p>	<p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.</p>	<p>Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22</p>



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Appendix D

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REVISIONS TO THE FINAL



Make a table with the following columns for showing the summary of revisions to the proposal based on the comments of the panel of examiners.

1. Examiner
2. Comment
3. Summary of how the comment has been addressed
4. Locations in the document where the changes have been reflected

TABLE D.1 SUMMARY OF REVISIONS TO THE THESIS PROPOSAL

Examiner	Comment	Summary of how the comment has been addressed	Locations
Dr. Reggie C. Gustillo	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext 	<ol style="list-style-type: none"> 1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext <p>First itemtext</p> <p>Second itemtext</p> <p>Last itemtext</p> <p>First itemtext</p> <p>Second itemtext</p>	<p>Sec. 5.1 on p. 31,</p> <p>Sec. 5.2 on p. 33,</p> <p>Fig. 3.1 on p. 22</p>

Continued on next page



Continued from previous page

Examiner	Comment	Summary of how the comment has been addressed	Locations
Dr. Donable de Veas Abuan	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext First itemtext Second itemtext Last itemtext First itemtext Second itemtext	Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22
Engr. Jose Martin Maningo	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext • First itemtext • Second itemtext • Last itemtext • First itemtext • Second itemtext	Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22

Continued on next page



Continued from previous page

Examiner	Comment	Summary of how the comment has been addressed	Locations
Dr. Alexander Co Abad	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext	Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22
Dr. Rafael W. Sison	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext	1. First itemtext 2. Second itemtext 3. Last itemtext 4. First itemtext 5. Second itemtext	Sec. 5.1 on p. 31, Sec. 5.2 on p. 33, Fig. 3.1 on p. 22



De La Salle University

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Appendix E

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USAGE EXAMPLES



The user is expected to have a working knowledge of \LaTeX . A good introduction is in [?]. Its latest version can be accessed at <http://www.ctan.org/tex-archive/info/lshort>.

E1 Equations

The following examples show how to typeset equations in \LaTeX . This section also shows examples of the use of `\gls{ }` commands in conjunction with the items that are in the `notation.tex` file. **Please make sure that the entries in `notation.tex` are those that are referenced in the \LaTeX document files used by this Thesis Proposal. Please comment out unused notations and be careful with the commas and brackets in `notation.tex`.**

In (E.1), the output signal $y(t)$ is the result of the convolution of the input signal $x(t)$ and the impulse response $h(t)$.

$$y(t) = h(t) * x(t) = \int_{-\infty}^{+\infty} h(t - \tau) x(\tau) d\tau \quad (\text{E.1})$$

Other example equations are as follows.

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ I_2 \end{bmatrix} \quad (\text{E.2})$$

$$\frac{1}{2} < \left[\text{mod} \left(\left\lfloor \frac{y}{17} \right\rfloor 2^{-17\lfloor x \rfloor - \text{mod}(\lfloor y \rfloor, 17)}, 2 \right) \right], \quad (\text{E.3})$$

$$|\zeta(x)^3 \zeta(x + iy)^4 \zeta(x + 2iy)| = \exp \sum_{n,p} \frac{3 + 4 \cos(ny \log p) + \cos(2ny \log p)}{np^{nx}} \geq 1 \quad (\text{E.4})$$



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The verbatim \LaTeX code of Sec. E1 is in List. E.1.Listing E.1: Sample \LaTeX code for equations and notations usage

```

1 The following examples show how to typeset equations in \LaTeX. This
  section also shows examples of the use of \verb| \gls{ } | commands
  in conjunction with the items that are in the \verb| notation.tex |
  file. \textbf{Please make sure that the entries in} \verb| notation.
  tex |\textbf{ are those that are referenced in the \LaTeX \
  document files used by this \documentType. Please comment out
  unused notations and be careful with the commas and brackets in} \
  \verb| notation.tex |.

2
3 In~\eqref{eq:conv}, the output signal \gls{not:output_sigt} is the
  result of the convolution of the input signal \gls{not:input_sigt}
  and the impulse response \gls{not:ir}.

4
5 \begin{eqnarray}
6   y\left( t \right) = h\left( t \right) * x\left( t \right)=\int_{-\infty}^{+\infty}h\left( t-\tau \right)x\left( \tau \right) \mathrm{d}\tau
7   \label{eq:conv}
8 \end{eqnarray}
9
10 Other example equations are as follows.
11
12 \begin{eqnarray}
13   \left[ \begin{matrix} V_{1} \\ I_{1} \end{matrix} \right] =
14   \begin{matrix} A & B \\ C & D \end{matrix}
15   \begin{matrix} V_{2} \\ I_{2} \end{matrix}
16   \label{eq:ABCD}
17 \end{eqnarray}
18
19 \begin{eqnarray}
20   \left[ \begin{matrix} V_{1} \\ I_{1} \end{matrix} \right] =
21   \left[ \begin{matrix} A & B \\ C & D \end{matrix} \right]
22   \left[ \begin{matrix} V_{2} \\ I_{2} \end{matrix} \right]
23   \label{eq:ABCD}
24 \end{eqnarray}
25
26 \begin{eqnarray}
27   \left| \zeta(x)^3 \zeta(x + iy)^4 \zeta(x + 2iy) \right| =
28   \exp\sum_{n,p} \frac{3 + 4 \cos( ny \log p) + \cos(2ny \log p)}{n^p}
29   \geq 1
30 \end{eqnarray}

```



E2 Notations

In order to use the standardized notation, the user is highly suggested to see the ISO 80000-2 standard [?].

See https://en.wikipedia.org/wiki/Help:Displaying_a_formula and https://en.wikipedia.org/wiki/List_of_mathematical_symbols for L^AT_EX maths and other notations, respectively.

The following were taken from `isomath-test.tex`.

E2.1 Math alphabets

If there are other symbols in place of Greek letters in a math alphabet, it uses T1 or OT1 font encoding instead of OML.

<code>mathnormal</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$
<code>mathit</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \text{ff}, \text{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<code>mathrm</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \text{ff}, \text{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<code>mathbf</code>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \mathbf{ff}, \mathbf{fi}, \mathbf{\beta}, ^\circ, !, v, w, 0, 1, 9$
<code>mathsf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \text{ff}, \text{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<code>mathtt</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \uparrow, \downarrow, \beta, ^\circ, !, v, w, 0, 1, 9$

New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-italic.

<code>mathbfit</code>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$
<code>mathsf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$
<code>mathsfbit</code>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$

Do the math alphabets match?

$\alpha x \alpha \omega \mathbf{a} x \alpha \omega \mathbf{a} x \alpha \omega \quad T C \Theta \Gamma T C \Theta \Gamma T C \Theta \Gamma$

E2.2 Vector symbols

Alphabetic symbols for vectors are boldface italic, $\lambda = e_1 \cdot \mathbf{a}$, while numeric ones (e.g. the zero vector) are bold upright, $\mathbf{a} + \mathbf{0} = \mathbf{a}$.

E2.3 Matrix symbols

Symbols for matrices are boldface italic, too:¹ $\mathbf{A} = \mathbf{E} \cdot \mathbf{A}$.

¹However, matrix symbols are usually capital letters whereas vectors are small ones. Exceptions are physical quantities like the force vector \mathbf{F} or the electrical field \mathbf{E} .



1180

E2.4 Tensor symbols

1181

Symbols for tensors are sans-serif bold italic,

$$\boldsymbol{\alpha} = \boldsymbol{e} \cdot \boldsymbol{a} \quad \Longleftrightarrow \quad \alpha_{ijl} = e_{ijk} \cdot a_{kl}.$$

1182

The permittivity tensor describes the coupling of electric field and displacement:

$$\boldsymbol{D} = \epsilon_0 \boldsymbol{\epsilon}_r \boldsymbol{E}$$



E2.5 Bold math version

The “bold” math version is selected with the commands `\boldmath` or `\mathversion{bold}`

<code>mathnormal</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$
<code>mathit</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \mathfrak{f}, \mathfrak{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<code>mathrm</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \mathfrak{f}, \mathfrak{fi}, \mathfrak{B}, ^\circ, !, v, w, 0, 1, 9$
<code>mathbf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \mathfrak{f}, \mathfrak{fi}, \mathfrak{B}, ^\circ, !, v, w, 0, 1, 9$
<code>mathsf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \mathfrak{f}, \mathfrak{fi}, \mathfrak{B}, ^\circ, !, v, w, 0, 1, 9$
<code>mathtt</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \uparrow, \downarrow, \mathfrak{B}, ^\circ, !, v, w, 0, 1, 9$

New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-italic.

<code>mathbf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$
<code>mathsf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$
<code>mathsfbf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$

Do the math alphabets match?

$\alpha x \alpha \omega \alpha x \alpha \omega \alpha x \alpha \omega \quad TC\Theta\Gamma TC\Theta\Gamma TC\Theta\Gamma$

E2.5.1 Vector symbols

Alphabetic symbols for vectors are boldface italic, $\lambda = e_1 \cdot a$, while numeric ones (e.g. the zero vector) are bold upright, $a + 0 = a$.

E2.5.2 Matrix symbols

Symbols for matrices are boldface italic, too:² $\Lambda = E \cdot A$.

E2.5.3 Tensor symbols

Symbols for tensors are sans-serif bold italic,

$$\alpha = e \cdot a \quad \Longleftrightarrow \quad \alpha_{ijl} = e_{ijk} \cdot a_{kl}.$$

The permittivity tensor describes the coupling of electric field and displacement:

$$D = \epsilon_0 \epsilon_r E$$

²However, matrix symbols are usually capital letters whereas vectors are small ones. Exceptions are physical quantities like the force vector F or the electrical field E .



1196 The verbatim \LaTeX code of Sec. E2 is in List. E.2.

Listing E.2: Sample \LaTeX code for notations usage

```

1197 1 % A teststring with Latin and Greek letters::
1198 2 \newcommand{\teststring}{%
1199 3 % capital Latin letters
1200 4 % A,B,C,
1201 5 A,B,
1202 6 % capital Greek letters
1203 7 %\Gamma,\Delta,\Theta,\Lambda,\Xi,\Pi,\Sigma,\Upsilon,\Phi,\Psi,
1204 8 \Gamma,\Delta,\Theta,\Lambda,\Xi,\Pi,\Sigma,\Phi,\Psi,\Omega,
1205 9 % small Greek letters
1206 10 \alpha,\beta,\pi,\nu,\omega,
1207 11 % small Latin letters:
1208 12 % compare \nu, \omega, v, and w
1209 13 v,w,
1210 14 % digits
1211 15 0,1,9
1212 16 }
1213 17
1214 18
1215 19 \subsection{Math alphabets}
1216 20
1217 21 If there are other symbols in place of Greek letters in a math
1218 22 alphabet, it uses T1 or OT1 font encoding instead of OML.
1219 23
1220 24 \begin{eqnarray*}
1221 25 \mbox{\mathnormal} & & \mbox{\teststring} \\
1222 26 \mbox{\mathit} & & \mbox{\mathit{\teststring}} \\
1223 27 \mbox{\mathrm} & & \mbox{\mathrm{\teststring}} \\
1224 28 \mbox{\mathbf} & & \mbox{\mathbf{\teststring}} \\
1225 29 \mbox{\mathsf} & & \mbox{\mathsf{\teststring}} \\
1226 30 \mbox{\mathtt} & & \mbox{\mathtt{\teststring}} \\
1227 31 \end{eqnarray*}
1228 32 New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-
1229 33 italic.
1230 34 \begin{eqnarray*}
1231 35 \mbox{\mathbfit} & & \mbox{\mathbfit{\teststring}} \\
1232 36 \mbox{\mathsfit} & & \mbox{\mathsfit{\teststring}} \\
1233 37 \mbox{\mathsfbfit} & & \mbox{\mathsfbfit{\teststring}} \\
1234 38 \end{eqnarray*}
1235 39 %
1236 40 Do the math alphabets match?
1237 41 $
1238 42 \mathnormal {a x \alpha \omega}
1239 43 \mathbfit {a x \alpha \omega}
1240 44 \mathsfbfit{a x \alpha \omega}
1241 45 \quad
1242 46 \mathsfbfit{T C \Theta \Gamma}
1243 47 \mathbfit {T C \Theta \Gamma}
1244 48 \mathnormal {T C \Theta \Gamma}
1245 49 $
1246 50
1247 51 \subsection{Vector symbols}
1248 52
1249
1250

```



```

1251 53 Alphabetic symbols for vectors are boldface italic,
1252 54  $\vec{\lambda} = \vec{e}_1 \cdot \vec{a}$ ,
1253 55 while numeric ones (e.g. the zero vector) are bold upright,
1254 56  $\vec{a} + \vec{0} = \vec{a}$ .
1255 57
1256 58 \subsection{Matrix symbols}
1257 59
1258 60 Symbols for matrices are boldface italic, too:%
1259 61 \footnote{However, matrix symbols are usually capital letters whereas
1260 62 vectors
1261 62 are small ones. Exceptions are physical quantities like the force
1262 63 vector  $\vec{F}$  or the electrical field  $\vec{E}$ .%
1263 64 }
1264 65  $\Lambda = E \cdot A$ .
1265 66
1266 67
1267 68 \subsection{Tensor symbols}
1268 69
1269 70 Symbols for tensors are sans-serif bold italic,
1270 71
1271 72 \[
1272 73 \quad \text{\textit{\textbf{tensorsym{\alpha}}}} = \text{\textit{\textbf{tensorsym{e}}}} \cdot \text{\textit{\textbf{tensorsym{a}}}}
1273 74 \quad \quad \quad \Longleftrightarrow \quad \quad \quad
1274 75 \quad \text{\textit{\textbf{\alpha}_{ijl}}} = \text{\textit{\textbf{e}_{ijk}}} \cdot \text{\textit{\textbf{a}_{kl}}}.
1275 76 \]
1276 77
1277 78
1278 79 The permittivity tensor describes the coupling of electric field and
1279 80 displacement: \[
1280 81 \text{\textit{\textbf{D}}} = \text{\textit{\textbf{\epsilon}_0}} \text{\textit{\textbf{tensorsym{\epsilon}}}}_{\text{\textit{\textbf{r}}}} \text{\textit{\textbf{E}}} \]
1281 82
1282 83
1283 84
1284 85 \newpage
1285 86 \subsection{Bold math version}
1286 87
1287 88 The ‘‘bold’’ math version is selected with the commands
1288 89 \verb+\boldmath+ or \verb+\mathversion{bold}+
1289 90
1290 91 {\boldmath
1291 92 \begin{eqnarray*}
1292 93 \quad \text{\textit{\textbf{mbox{mathnormal}}}} & & \text{\textit{\textbf{teststring}}} \\
1293 94 \quad \text{\textit{\textbf{mathit}}}} & & \text{\textit{\textbf{mathit{teststring}}}} \\
1294 95 \quad \text{\textit{\textbf{mathrm}}}} & & \text{\textit{\textbf{mathrm{teststring}}}} \\
1295 96 \quad \text{\textit{\textbf{mathbf}}}} & & \text{\textit{\textbf{mathbf{teststring}}}} \\
1296 97 \quad \text{\textit{\textbf{mathsf}}}} & & \text{\textit{\textbf{mathsf{teststring}}}} \\
1297 98 \quad \text{\textit{\textbf{mathtt}}}} & & \text{\textit{\textbf{mathtt{teststring}}}} \\
1298 99 \end{eqnarray*}
1299 100 \quad \text{New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-}
1300 101 \quad \text{italic.}
1301 102 \begin{eqnarray*}
1302 102 \quad \text{\textit{\textbf{mathbfit}}}} & & \text{\textit{\textbf{mathbfit{teststring}}}} \\
1303 103 \quad \text{\textit{\textbf{mathsfif}}}} & & \text{\textit{\textbf{mathsfif{teststring}}}} \\
1304 104 \quad \text{\textit{\textbf{mathsfbfit}}}} & & \text{\textit{\textbf{mathsfbfit{teststring}}}} \\
1305 105 \end{eqnarray*}
1306 106 \%
1307 107 Do the math alphabets match?

```




```

1308 108
1309 109 $
1310 110 \mathnormal {a x \alpha \omega}
1311 111 \mathbfit {a x \alpha \omega}
1312 112 \mathsfbfit{a x \alpha \omega}
1313 113 \quad
1314 114 \mathsfbfit{T C \Theta \Gamma}
1315 115 \mathbfit {T C \Theta \Gamma}
1316 116 \mathnormal {T C \Theta \Gamma}
1317 117 $
1318 118
1319 119 \subsection{Vector symbols}
1320 120
1321 121 Alphabetic symbols for vectors are boldface italic,
1322 122 $\vec{\lambda}=\vec{e}_{1}\cdot\vec{a}$,
1323 123 while numeric ones (e.g. the zero vector) are bold upright,
1324 124 $\vec{a} + \vec{0} = \vec{a}$.
1325 125
1326 126
1327 127
1328 128
1329 129 \subsection{Matrix symbols}
1330 130
1331 131 Symbols for matrices are boldface italic, too:%
1332 132 \footnote{However, matrix symbols are usually capital letters whereas
1333 133 vectors
1334 133 are small ones. Exceptions are physical quantities like the force
1335 134 vector $\vec{F}$ or the electrical field $\vec{E}$.%
1336 135 }
1337 136 $\matrixsym{\Lambda}=\matrixsym{E}\cdot\matrixsym{A}$.
1338 137
1339 138
1340 139 \subsection{Tensor symbols}
1341 140
1342 141 Symbols for tensors are sans-serif bold italic,
1343 142
1344 143 \[
1345 144 \tensorsym{\alpha} = \tensorsym{e}\cdot\tensorsym{a}
1346 145 \quad \Longleftarrow \quad
1347 146 \alpha_{ijl} = e_{ijk}\cdot a_{kl}.
1348 147 \]
1349 148
1350 149 The permittivity tensor describes the coupling of electric field and
1351 150 displacement: \[
1352 151 \vec{D}=\epsilon_{0}\tensorsym{\epsilon}_{\mathrm{r}}\vec{E}\]
1353 152 }

```



E3 Abbreviation

This section shows examples of the use of \LaTeX commands in conjunction with the items that are in the `abbreviation.tex` and in the `glossary.tex` files. Please see List. E.3. **To lessen the \LaTeX parsing time, it is suggested that you use `\acr{ }` only for the first occurrence of the word to be abbreviated.**

Again please see List. E.3. Here is an example of first use: alternating current (ac). Next use: ac. Full: alternating current (ac). Here's an acronym referenced using `\acr` : hyper-text markup language (html). And here it is again: html. If you are used to the glossaries package, note the difference in using `\gls` : hyper-text markup language (html). And again (no difference): hyper-text markup language (html). For plural use `\glspl` . Here are some more entries:

- extensible markup language (xml) and cascading style sheet (css).
- Next use: xml and css.
- Full form: extensible markup language (xml) and cascading style sheet (css).
- Reset again.
- Start with a capital. Hyper-text markup language (html).
- Next: Html. Full: Hyper-text markup language (html).
- Prefer capitals? Extensible markup language (XML). Next: XML. Full: extensible markup language (XML).
- Prefer small-caps? Cascading style sheet (CSS). Next: CSS. Full: cascading style sheet (CSS).
- Resetting all acronyms.
- Here are the acronyms again:
- Hyper-text markup language (HTML), extensible markup language (XML) and cascading style sheet (CSS).
- Next use: HTML, XML and CSS.
- Full form: Hyper-text markup language (HTML), extensible markup language (XML) and cascading style sheet (CSS).



- 1384 • Provide your own link text: style sheet.

1385 The verbatim \LaTeX code of Sec. E3 is in List. E.3.

Listing E.3: Sample \LaTeX code for abbreviations usage

```

1 Again please see List.~\ref{lst:abbrv}. Here is an example of first use:
  \acr{ac}. Next use: \acr{ac}. Full: \gls{ac}. Here's an acronym
  referenced using \verb| \acr |: \acr{html}. And here it is again: \
  acr{html}. If you are used to the \texttt{glossaries} package, note
  the difference in using \verb| \gls |: \gls{html}. And again (no
  difference): \gls{html}. Here are some more entries:
2
3 \begin{itemize}
4
5   \item \acr{xml} and \acr{css}.
6
7   \item Next use: \acr{xml} and \acr{css}.
8
9   \item Full form: \gls{xml} and \gls{css}.
10
11  \item Reset again. \glsresetall{abbreviation}
12
13  \item Start with a capital. \Acr{html}.
14
15  \item Next: \Acr{html}. Full: \Gls{html}.
16
17  \item Prefer capitals? \renewcommand{\acronymfont}[1]{\
    MakeTextUppercase{#1}} \Acr{xml}. Next: \acr{xml}. Full: \gls{xml}
    }.
18
19  \item Prefer small-caps? \renewcommand{\acronymfont}[1]{\textsc{#1}}
    \Acr{css}. Next: \acr{css}. Full: \gls{css}.
20
21  \item Resetting all acronyms.\glsresetall{abbreviation}
22
23  \item Here are the acronyms again:
24
25  \item \Acr{html}, \acr{xml} and \acr{css}.
26
27  \item Next use: \Acr{html}, \acr{xml} and \acr{css}.
28
29  \item Full form: \Gls{html}, \gls{xml} and \gls{css}.
30
31  \item Provide your own link text: \glslink{[textbf]css}{style}
32
33 \end{itemize}

```



E4 Glossary

This section shows examples of the use of `\gls{ }` commands in conjunction with the items that are in the `glossary.tex` and `notation.tex` files. Note that entries in `notation.tex` are prefixed with “not:” label (see List. E.4).

Please make sure that the entries in `notation.tex` are those that are referenced in the \LaTeX document files used by this Thesis Proposal. Please comment out unused notations and be careful with the commas and brackets in `notation.tex` .

- Matrices are usually denoted by a bold capital letter, such as \mathbf{A} . The matrix’s (i, j) th element is usually denoted a_{ij} . Matrix \mathbf{I} is the identity matrix.
- A set, denoted as \mathcal{S} , is a collection of objects.
- The universal set, denoted as \mathcal{U} , is the set of everything.
- The empty set, denoted as \emptyset , contains no elements.
- Functional Analysis is seen as the study of complete normed vector spaces, i.e., Banach spaces.
- The cardinality of a set, denoted as $|\mathcal{S}|$, is the number of elements in the set.

The verbatim \LaTeX code for the part of Sec. E4 is in List. E.4.

Listing E.4: Sample \LaTeX code for glossary and notations usage

```

1 \begin{itemize}
2
3   \item \Glspl{matrix} are usually denoted by a bold capital letter,
      such as  $\mathbf{A}$ . The  $\mathbf{A}$ 's  $(i,j)$ th element is
      usually denoted  $a_{ij}$ .  $\mathbf{I}$  is the
      identity  $\mathbf{I}$ .
4
5   \item A set, denoted as  $\mathbf{S}$ , is a collection of objects.
6
7   \item The universal set, denoted as  $\mathbf{U}$ , is the
      set of everything.
8
9   \item The empty set, denoted as  $\emptyset$ , contains no
      elements.
10
11  \item  $\mathbf{FA}$  is seen as the study of complete
      normed vector spaces, i.e., Banach spaces.
12
13  \item The cardinality of a set, denoted as  $\mathbf{C}$ , is
      the number of elements in the set.
14
15 \end{itemize}

```



E5 Figure

This section shows several ways of placing figures. PDFL^AT_EX compatible files are PDF, PNG, and JPG. Please see the `figure` subdirectory.

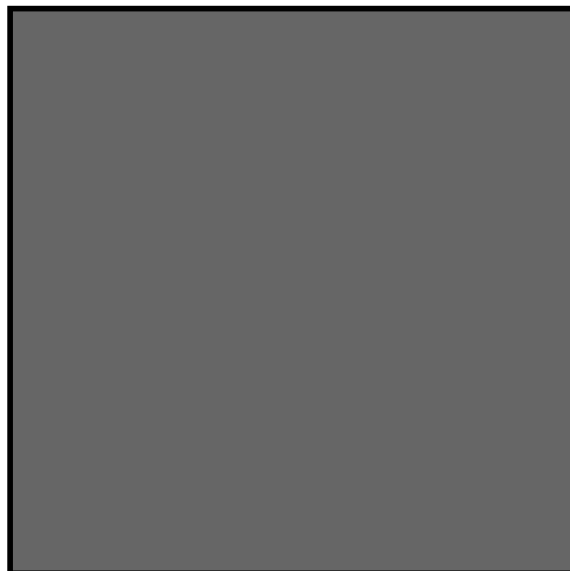


Fig. E.1 A quadrilateral image example.



1405 Fig. E.1 is a gray box enclosed by a dark border. List. E.5 shows the corresponding
1406 \LaTeX code.

Listing E.5: Sample \LaTeX code for a single figure

```
1 \begin{figure}[!htbp]
2   \centering
3   \includegraphics[width=0.5\textwidth]{example}
4   \caption{A quadrilateral image example.}
5   \label{fig:example}
6 \end{figure}
7 \cleardoublepage
8
9 Fig.~\ref{fig:example} is a gray box enclosed by a dark border. List.~\ref{lst:onefig} shows the corresponding  $\text{\LaTeX}$  \ code.
10 \end{figure}
```



(a) A sub-figure in the top row.



(b) A sub-figure in the middle row.



(c) A sub-figure in the bottom row.

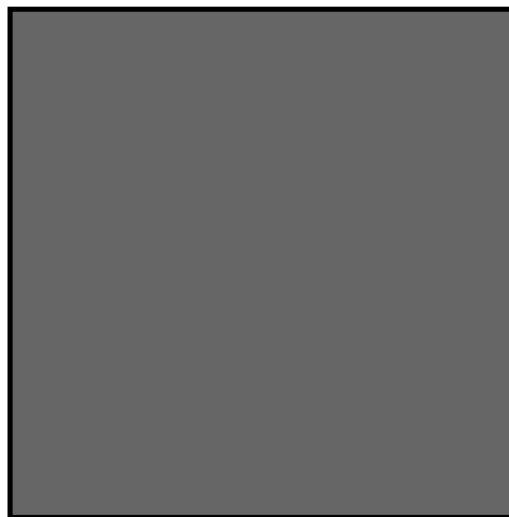
Fig. E.2 Figures on top of each other. See List. E.6 for the corresponding \LaTeX code.

Listing E.6: Sample L^AT_EX code for three figures on top of each other

```
1 \begin{figure}[!htbp]
2 \centering
3 \subbottom[A sub-figure in the top row.]{
4 \includegraphics[width=0.35\textwidth]{example_gray_box}
5 \label{fig:top}
6 }
7 \vfill
8 \subbottom[A sub-figure in the middle row.]{
9 \includegraphics[width=0.35\textwidth]{example_gray_box}
10 \label{fig:mid}
11 }
12 \vfill
13 \subbottom[A sub-figure in the bottom row.]{
14 \includegraphics[width=0.35\textwidth]{example_gray_box}
15 \label{fig:botm}
16 }
17 \caption{Figures on top of each other}
18 \label{fig:tmb}
19 \end{figure}
```



(a) A sub-figure in the upper-left corner.



(b) A sub-figure in the upper-right corner.



(c) A sub-figure in the lower-left corner.



(d) A sub-figure in the lower-right corner.

Fig. E.3 Four figures in each corner. See List. E.7 for the corresponding \LaTeX code.

Listing E.7: Sample \LaTeX code for the four figures

```

1 \begin{figure}[!htbp]
2 \centering
3 \subbottom[A sub-figure in the upper-left corner.]{
4 \includegraphics[width=0.45\textwidth]{example_gray_box}
5 \label{fig:upprleft}
6 }
7 \hfill
8 \subbottom[A sub-figure in the upper-right corner.]{
9 \includegraphics[width=0.45\textwidth]{example_gray_box}
10 \label{fig:uppright}
11 }
12 \vfill
13 \subbottom[A sub-figure in the lower-left corner.]{
14 \includegraphics[width=0.45\textwidth]{example_gray_box}
15 \label{fig:lowerleft}
16 }
17 \hfill
18 \subbottom[A sub-figure in the lower-right corner]{
19 \includegraphics[width=0.45\textwidth]{example_gray_box}
20 \label{fig:lowright}
21 }
22 \caption{Four figures in each corner. See List.\ref{lst:fourfigs} for
23 the corresponding \LaTeX \ code.}
24 \label{fig:fourfig}
25 \end{figure}

```



E6 Table

This section shows an example of placing a table (a long one). Table E.1 are the triples.

TABLE E.1 FEASIBLE TRIPLES FOR HIGHLY VARIABLE GRID

Time (s)	Triple chosen	Other feasible triples
0	(1, 11, 13725)	(1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0)
2745	(1, 12, 10980)	(1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0)
5490	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
8235	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
10980	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
13725	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
16470	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
19215	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
21960	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
24705	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
27450	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
30195	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
32940	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
35685	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
38430	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
41175	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
43920	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
46665	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
49410	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
52155	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
54900	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
57645	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
60390	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
63135	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
65880	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
68625	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
71370	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
74115	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
76860	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
79605	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
82350	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
85095	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
87840	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
90585	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
93330	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
96075	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
98820	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
101565	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
104310	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
107055	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
109800	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
112545	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
115290	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
118035	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
120780	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
123525	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)

Continued on next page



Continued from previous page

Time (s)	Triple chosen	Other feasible triples
126270	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
129015	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
131760	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
134505	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
137250	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
139995	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
142740	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
145485	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
148230	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
150975	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
153720	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
156465	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
159210	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
161955	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
164700	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)



1410 List. E.8 shows the corresponding \LaTeX code.

Listing E.8: Sample \LaTeX code for making typical table environment

```

1411 1 \begin{center}
1412 2 {\scriptsize
1413 3 \begin{tabularx}{\textwidth}{p{0.1\textwidth}|p{0.2\textwidth}|p{0.5\textwidth}}
1414 4 \caption{Feasible triples for highly variable grid} \label{tab:triple_
1415 5 grid} \\
1416 6 \hline
1417 7 \hline
1418 8 \textbf{Time (s)} &
1419 9 \textbf{Triple chosen} &
1420 10 \textbf{Other feasible triples} \\
1421 11 \hline
1422 12 \endfirsthead
1423 13 \multicolumn{3}{c}{\textit{Continued from previous page}} \\
1424 14 \hline
1425 15 \hline
1426 16 \textbf{Time (s)} &
1427 17 \textbf{Triple chosen} &
1428 18 \textbf{Other feasible triples} \\
1429 19 \hline
1430 20 \endhead
1431 21 \hline
1432 22 \multicolumn{3}{r}{\textit{Continued on next page}} \\
1433 23 \endfoot
1434 24 \hline
1435 25 \endlastfoot
1436 26 \hline
1437 27
1438 28 0 & (1, 11, 13725) & (1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0) \\
1439 29 & \\
1440 30 2745 & (1, 12, 10980) & (1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0) \\
1441 31 & \\
1442 32 5490 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1443 33 8235 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1444 34 10980 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1445 35 13725 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1446 36 16470 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1447 37 19215 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1448 38 21960 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1449 39 24705 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1450 40 27450 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1451 41 30195 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1452 42 32940 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1453 43 35685 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1454 44 38430 & (1, 13, 10980) & (2, 2, 2745), (2, 3, 0), (3, 1, 0)

```



```

1465 43 41175 & (1, 12, 13725) & (1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1,
1466      0) \\
1467 44 43920 & (1, 13, 10980) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1468 45 46665 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1469 46 49410 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1470 47 52155 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1,
1471      0) \\
1472 48 54900 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1473 49 57645 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1474 50 60390 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1475 51 63135 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1476 52 65880 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1477 53 68625 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1478 54 71370 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1479 55 74115 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1480 56 76860 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1481 57 79605 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1482 58 82350 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1483 59 85095 & (1, 12, 13725) & (1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1,
1484      0) \\
1485 60 87840 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1486 61 90585 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1487 62 93330 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1488 63 96075 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1489 64 98820 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1490 65 101565 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1491 66 104310 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1492 67 107055 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1493 68 109800 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1494 69 112545 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
1495      1, 0) \\
1496 70 115290 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1497 71 118035 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1498 72 120780 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1499 73 123525 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1500 74 126270 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
1501      1, 0) \\
1502 75 129015 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1503 76 131760 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1504 77 134505 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1505 78 137250 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1506 79 139995 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1507 80 142740 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1508 81 145485 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
1509      1, 0) \\
1510 82 148230 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1511 83 150975 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1512 84 153720 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1513 85 156465 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1514 86 159210 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1515 87 161955 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1516 88 164700 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1517 89 \end{tabularx}
1518 90 }
1519 91 \end{center}

```



1521

E7 Algorithm or Pseudocode Listing

1522

Table E.2 shows an example pseudocode. Note that if the pseudocode exceeds one page, it can mean that its implementation is not modular. List. E.9 shows the corresponding L^AT_EX code.

1523

1524

TABLE E.2 CALCULATION OF $y = x^n$

Input(s):	
n	: n th power; $n \in \mathbb{Z}^+$
x	: base value; $x \in \mathbb{R}^+$
Output(s):	
y	: result; $y \in \mathbb{R}^+$

Require: $n \geq 0 \vee x \neq 0$
Ensure: $y = x^n$

```
1:  $y \leftarrow 1$ 
2: if  $n < 0$  then
3:    $X \leftarrow 1/x$ 
4:    $N \leftarrow -n$ 
5: else
6:    $X \leftarrow x$ 
7:    $N \leftarrow n$ 
8: end if
9: while  $N \neq 0$  do
10:  if  $N$  is even then
11:     $X \leftarrow X \times X$ 
12:     $N \leftarrow N/2$ 
13:  else { $N$  is odd}
14:     $y \leftarrow y \times X$ 
15:     $N \leftarrow N - 1$ 
16:  end if
17: end while
```


Listing E.9: Sample L^AT_EX code for algorithm or pseudocode listing usage

```

1 \begin{table}[!htbp]
2   \caption{Calculation of  $y = x^n$ }
3   \label{tab:calcxn}
4   {\footnotesize
5     \begin{tabular}{lll}
6       \hline
7       \hline
8       {\bfseries Input(s):} & & \\
9       $n$ & : & $n$th power; $n$ \in \mathbb{Z}^{+}$ \\
10      $x$ & : & base value; $x$ \in \mathbb{R}^{+}$ \\
11      \hline
12      {\bfseries Output(s):} & & \\
13      $y$ & : & result; $y$ \in \mathbb{R}^{+}$ \\
14      \hline
15      \hline
16      \\
17    \end{tabular}
18  }
19  \begin{algorithmic}[1]
20    {\footnotesize
21      \REQUIRE $n \geq 0$ \vee $x \neq 0$
22      \ENSURE $y = x^n$
23      \STATE $y \leftarrow 1$
24      \IF{$n < 0$}
25        \STATE $X \leftarrow 1 / x$
26        \STATE $N \leftarrow -n$
27      \ELSE
28        \STATE $X \leftarrow x$
29        \STATE $N \leftarrow n$
30      \ENDIF
31      \WHILE{$N \neq 0$}
32        \IF{$N$ is even}
33          \STATE $X \leftarrow X \times X$
34          \STATE $N \leftarrow N / 2$
35        \ELSE[$N$ is odd]
36          \STATE $y \leftarrow y \times X$
37          \STATE $N \leftarrow N - 1$
38        \ENDIF
39      \ENDWHILE
40    }
41  \end{algorithmic}
42 \end{table}

```



E8 Program/Code Listing

List. E.10 is a program listing of a C code for computing Fibonacci numbers by calling the actual code. Please see the `code` subdirectory.

Listing E.10: Computing Fibonacci numbers in C (`./code/fibo.c`)

```

1  /* fibo.c -- It prints out the first N Fibonacci
2  *              numbers.
3  */
4
5  #include <stdio.h>
6
7  int main(void) {
8      int n;          /* Number of fibonacci numbers we will print */
9      int i;          /* Index of fibonacci number to be printed next */
10     int current;     /* Value of the (i)th fibonacci number */
11     int next;        /* Value of the (i+1)th fibonacci number */
12     int twoaway;     /* Value of the (i+2)th fibonacci number */
13
14     printf("How many Fibonacci numbers do you want to compute? ");
15     scanf("%d", &n);
16     if (n<=0)
17         printf("The number should be positive.\n");
18     else {
19         printf("\n\n\tI\t\tFibonacci(I)\t\n\t=====\n");
20         next = current = 1;
21         for (i=1; i<=n; i++) {
22             printf("\t%d\t\t\t%d\n", i, current);
23             twoaway = current+next;
24             current = next;
25             next = twoaway;
26         }
27     }
28 }
29
30 /* The output from a run of this program was:
31
32 How many Fibonacci numbers do you want to compute? 9
33
34     I      Fibonacci(I)
35     =====
36     1      1
37     2      1
38     3      2
39     4      3
40     5      5
41     6      8
42     7     13
43     8     21
44     9     34
45
46 */

```



1528

List. E.11 shows the corresponding \LaTeX code.

Listing E.11: Sample \LaTeX code for program listing

```
1 List.~\ref{lst:fib_c} is a program listing of a C code for computing  
   Fibonacci numbers by calling the actual code. Please see the \verb|  
   code | subdirectory.
```



E9 Referencing

Referencing chapters: This appendix is in Appendix E, which is about examples in using various \LaTeX commands.

Referencing sections: This section is Sec. E9, which shows how to refer to the locations of various labels that have been placed in the \LaTeX files. List. E.12 shows the corresponding \LaTeX code.

Listing E.12: Sample \LaTeX code for referencing sections

```
1 Referencing sections: This section is Sec.~\ref{sec:ref}, which shows
   how to refer to the locations of various labels that have been
   placed in the \LaTeX \ files. List.~\ref{lst:refsec} shows the
   corresponding \LaTeX \ code.
```

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E9.1 A subsection

Referencing subsections: This section is Sec. E9.1, which shows how to refer to a subsection. List. E.13 shows the corresponding \LaTeX code.

Listing E.13: Sample \LaTeX code for referencing subsections

```
1 Referencing subsections: This section is Sec.~\ref{sec:subsec}, which
  shows how to refer to a subsection. List.~\ref{lst:refsub} shows the
  corresponding \LaTeX \ code.
```

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E9.1.1 A sub-subsection

Referencing sub-subsections: This section is Sec. E9.1.1, which shows how to refer to a sub-subsection. List. E.14 shows the corresponding \LaTeX code.

Listing E.14: Sample \LaTeX code for referencing sub-subsections

```
1 Referencing sub-subsections: This section is Sec.\ref{sec:subsubsec},
   which shows how to refer to a sub-subsection. List.\ref{lst:
   refsubsub} shows the corresponding \LaTeX \ code.
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.



E10 Citing

Citing bibliography content is done using BibTeX. It requires the creation of a BibTeX file (.bib extension name), and then added in the argument of `\bibliography{ }`. For each .bib file, separate them by a comma in the argument of `\bibliography{ }` without the extension name. Building your BibTeX file (references.bib) can be done easily with a tool called JabRef (www.jabref.org).

The following subsections are examples of citations.

E10.1 Books

- [?]

- [?]

- [?]

- [?]

- [?]

- [?]

- [?]

- [?]

- [?]

- [?]

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**E10.2 Booklets**

- [?]

E10.3 Proceedings

- [?]

E10.4 In books

- [?]

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1651 **E10.5 In proceedings**

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1659 **E10.6 Journals**

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1695 **E10.7 Theses/dissertations**

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1703 **E10.8 Technical Reports and Others**

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1719 **E10.9 Miscellaneous**

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1731 • [?]

1732 • [?]



E11 Index

For key words or topics that are expected (or the user would like) to appear in the Index, use `\index{key}`, where `key` is an example keyword to appear in the Index. For example, Fredholm integral and Fourier operator of the following paragraph are in the Index.

If we make a very large matrix with complex exponentials in the rows (i.e., cosine real parts and sine imaginary parts), and increase the resolution without bound, we approach the kernel of the Fredholm integral equation of the 2nd kind, namely the Fourier operator that defines the continuous Fourier transform.

List. E.15 is a program listing of the above-mentioned paragraph.

Listing E.15: Sample \LaTeX code for Index usage

```
1 If we make a very large matrix with complex exponentials in the rows (i.
  e., cosine real parts and sine imaginary parts), and increase the
  resolution without bound, we approach the kernel of the \index{
    Fredholm integral} Fredholm integral equation of the 2nd kind,
  namely the \index{Fourier} Fourier operator that defines the
  continuous Fourier transform.
```



1742

E12 Adding Relevant PDF Pages

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1744

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Examples of such PDF pages are Standards, Datasheets, Specification Sheets, Application Notes, etc. Selected PDF pages can be added (see List. E.16), but note that the options must be tweaked. See the manual of `pdftpages` for other options.

Listing E.16: Sample \LaTeX code for including PDF pages

```
1 \includepdf[pages={8-10},%  
2 offset=3.5mm -10mm,%  
3 scale=0.73,%  
4 frame,%  
5 pagecommand={},]  
6 {./reference/Xilinx2015-UltraScale-Architecture-Overview.pdf}
```



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Virtex UltraScale FPGA Feature Summary

Table 6: Virtex UltraScale FPGA Feature Summary

	VU065	VU080	VU095	VU125	VU160	VU190	VU440
Logic Cells	626,640	780,000	940,800	1,253,280	1,621,200	1,879,920	4,432,680
CLB Flip-Flops	716,160	891,424	1,075,200	1,432,320	1,852,800	2,148,480	5,065,920
CLB LUTs	358,080	445,712	537,600	716,160	926,400	1,074,240	2,532,960
Maximum Distributed RAM (Mb)	4.8	3.9	4.8	9.7	12.7	14.5	28.7
Block RAM/FIFO w/ECC (36Kb each)	1,260	1,421	1,728	2,520	3,276	3,780	2,520
Total Block RAM (Mb)	44.3	50.0	60.8	88.6	115.2	132.9	88.6
CMT (1 MMCM, 2 PLLs)	10	16	16	20	30	30	30
I/O DLLs	40	64	64	80	120	120	120
Fractional PLLs	5	8	8	10	15	15	0
Maximum HP I/Os ⁽¹⁾	468	780	780	780	650	650	1,404
Maximum HR I/Os ⁽²⁾	52	52	52	104	52	52	52
DSP Slices	600	672	768	1,200	1,560	1,800	2,880
System Monitor	1	1	1	2	3	3	3
PCIe Gen3 x8	2	4	4	4	5	6	6
150G Interlaken	3	6	6	6	8	9	0
100G Ethernet	3	4	4	6	9	9	3
GTH 16.3Gb/s Transceivers	20	32	32	40	52	60	48
GTY 30.5Gb/s Transceivers	20	32	32	40	52	60	0

Notes:

1. HP = High-performance I/O with support for I/O voltage from 1.0V to 1.8V.
2. HR = High-range I/O with support for I/O voltage from 1.2V to 3.3V.



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UltraScale Architecture and Product Overview

Virtex UltraScale Device-Package Combinations and Maximum I/Os

Table 7: Virtex UltraScale Device-Package Combinations and Maximum I/Os

Package ⁽¹⁾⁽²⁾⁽³⁾	Package Dimensions (mm)	VU065	VU080	VU095	VU125	VU160	VU190	VU440
		HR, HP GTH, GTY	HR, HP GTH, GTY	HR, HP GTH, GTY	HR, HP GTH, GTY	HR, HP GTH, GTY	HR, HP GTH, GTY	HR, HP GTH, GTY
FFVC1517	40x40	52, 468 20, 20	52, 468 20, 20	52, 468 20, 20				
FFVD1517	40x40		52, 286 32, 32	52, 286 32, 32				
FLVD1517	40x40				52, 286 40, 32			
FFVB1760	42.5x42.5		52, 650 32, 16	52, 650 32, 16				
FLVB1760	42.5x42.5				52, 650 36, 16			
FFVA2104	47.5x47.5		52, 780 28, 24	52, 780 28, 24				
FLVA2104	47.5x47.5				52, 780 28, 24			
FFVB2104	47.5x47.5		52, 650 32, 32	52, 650 32, 32				
FLVB2104	47.5x47.5				52, 650 40, 36			
FLGB2104	47.5x47.5					52, 650 40, 36	52, 650 40, 36	
FFVC2104	47.5x47.5			52, 364 32, 32				
FLVC2104	47.5x47.5				52, 364 40, 40			
FLGC2104	47.5x47.5					52, 364 52, 52	52, 364 52, 52	
FLGB2377	50x50							52, 1248 36, 0
FLGA2577	52.5x52.5						0, 448 60, 60	
FLGA2892	55x55							52, 1404 48, 0

Notes:

1. Go to [Ordering Information](#) for package designation details.
2. All packages have 1.0mm ball pitch.
3. Packages with the same last letter and number sequence, e.g., A2104, are footprint compatible with all other UltraScale architecture-based devices with the same sequence. The footprint compatible devices within this family are outlined. See the [UltraScale Architecture Product Selection Guide](#) for details on inter-family migration.



1748



Virtex UltraScale+ FPGA Feature Summary

Table 8: Virtex UltraScale+ FPGA Feature Summary

	VU3P	VU5P	VU7P	VU9P	VU11P	VU13P
Logic Cells	689,640	1,051,010	1,379,280	2,068,920	2,147,040	2,862,720
CLB Flip-Flops	788,160	1,201,154	1,576,320	2,364,480	2,453,760	3,271,680
CLB LUTs	394,080	600,577	788,160	1,182,240	1,226,880	1,635,840
Max. Distributed RAM (Mb)	12.0	18.3	24.1	36.1	34.8	46.4
Block RAM/FIFO w/ECC (36Kb each)	720	1,024	1,440	2,160	2,016	2,688
Block RAM (Mb)	25.3	36.0	50.6	75.9	70.9	94.5
UltraRAM Blocks	320	470	640	960	1,152	1,536
UltraRAM (Mb)	90.0	132.2	180.0	270.0	324.0	432.0
CMTs (1 MMCM and 2 PLLs)	10	20	20	30	12	16
Max. HP I/O ⁽¹⁾	520	832	832	832	624	832
DSP Slices	2,280	3,474	4,560	6,840	8,928	11,904
System Monitor	1	2	2	3	3	4
GTY Transceivers 32.75Gb/s	40	80	80	120	96	128
PCIe Gen3 x16 and Gen4 x8	2	4	4	6	3	4
150G Interlaken	3	4	6	9	9	12
100G Ethernet w/RS-FEC	3	4	6	9	6	8

Notes:

1. HP = High-performance I/O with support for I/O voltage from 1.0V to 1.8V.

Virtex UltraScale+ Device-Package Combinations and Maximum I/Os

Table 9: Virtex UltraScale+ Device-Package Combinations and Maximum I/Os

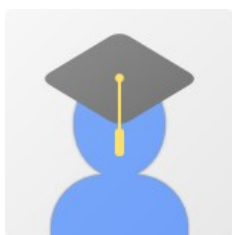
Package (1)(2)(3)	Package Dimensions (mm)	VU3P	VU5P	VU7P	VU9P	VU11P	VU13P
		HP, GTY	HP, GTY	HP, GTY	HP, GTY	HP, GTY	HP, GTY
FFVC1517	40x40	520, 40					
FLVF1924	45x45					624, 64	
FLVA2104	47.5x47.5		832, 52	832, 52	832, 52		
FHVA2104	52.5x52.5 ⁽⁴⁾						832, 52
FLVB2104	47.5x47.5		702, 76	702, 76	702, 76	624, 76	
FHVB2104	52.5x52.5 ⁽⁴⁾						702, 76
FLVC2104	47.5x47.5		416, 80	416, 80	416, 104	416, 96	
FHVC2104	52.5x52.5 ⁽⁴⁾						416, 104
FLVA2577	52.5x52.5				448, 120	448, 96	448, 128

Notes:

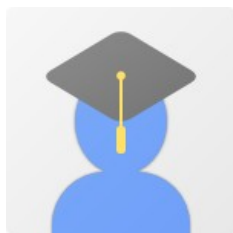
- Go to [Ordering Information](#) for package designation details.
- All packages have 1.0mm ball pitch.
- Packages with the same last letter and number sequence, e.g., A2104, are footprint compatible with all other UltraScale devices with the same sequence. The footprint compatible devices within this family are outlined.
- These 52.5x52.5mm overhang packages have the same PCB ball footprint as the corresponding 47.5x47.5mm packages (i.e., the same last letter and number sequence) and are footprint compatible.



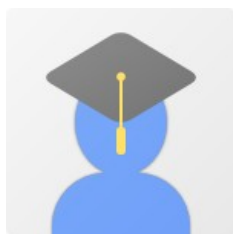
Appendix F VITA



Kenan A. Banal received the B.Sc., M.Sc., and Ph.D. degrees in chemistry all from the Pamantasan ng Pilipinas, San Juan, Metro Manila, Philippines, in 2020, 2022 and 2025 respectively. He is currently taking up his B.Sc. Computer Engineering studies. He has developed several high-speed packet-switched network systems and node modules. His research interests include high-speed packet-switched networks, high speed radio interface design, discrete simulation and statistical models for packet switches.



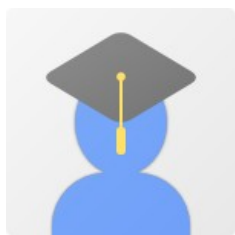
Francis Robert Miguel F. BAUTISTA received the B.Sc., M.Sc., and Ph.D. degrees in chemistry all from the Pamantasan ng Pilipinas, San Juan, Metro Manila, Philippines, in 2020, 2022 and 2025 respectively. He is currently taking up his B.Sc. Computer Engineering studies. He has developed several high-speed packet-switched network systems and node modules. His research interests include high-speed packet-switched networks, high speed radio interface design, discrete simulation and statistical models for packet switches.



Don Humphrey L. HERMOSURA received the B.Sc., M.Sc., and Ph.D. degrees in chemistry all from the Pamantasan ng Pilipinas, San Juan, Metro Manila, Philippines, in 2020, 2022 and 2025 respectively. He is currently taking up his B.Sc. Computer Engineering studies. He has developed several high-speed packet-switched



1769 network systems and node modules. His research interests include high-speed packet-
1770 switched networks, high speed radio interface design, discrete simulation and statistical
1771 models for packet switches.



1772 Daniel G. SALAZAR received the B.Sc., M.Sc., and Ph.D. degrees
1773 in chemistry all from the Pamantasan ng Pilipinas, San Juan, Metro Manila, Philippines,
1774 in 2020, 2022 and 2025 respectively. He is currently taking up his B.Sc. Computer
1775 Engineering studies. He has developed several high-speed packet-switched network systems
1776 and node modules. His research interests include high-speed packet-switched networks,
1777 high speed radio interface design, discrete simulation and statistical models for packet
1778 switches.



De La Salle University

1779

Appendix G

1780

ARTICLE PAPER(S)

Article/Forum Paper Format (IEEE LaTeX format)

Michael Shell, *Member, IEEE*, John Doe, *Fellow, OSA*, and Jane Doe, *Life Fellow, IEEE*

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Abstract—The abstract goes here. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

Index Terms—Computer Society, IEEE, IEEEtran, journal, LaTeX, paper, template.

I. INTRODUCTION

THIS demo file is intended to serve as a “starter file” for IEEE article papers produced under LaTeX using IEEEtran.cls version 1.8b and later. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

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M. Shell was with the Department of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA, 30332.

E-mail: see <http://www.michaelshell.org/contact.html>

J. Doe and J. Doe are with Anonymous University.



Fig. 1. Simulation results for the network.

TABLE I
AN EXAMPLE OF A TABLE

One	Two
Three	Four

Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

1) Subsubsection Heading Here: Subsubsection text here.

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II. CONCLUSION

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(a) Case I



(b) Case II

Fig. 2. Simulation results for the network.

a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

APPENDIX A

PROOF OF THE FIRST ZONKLAR EQUATION

Appendix one text goes here.

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APPENDIX B

Appendix two text goes here. [1].

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- [1] T. Oetiker, H. Partl, I. Hyna, and E. Schlegl, *The Not So Short Introduction to L^AT_EX 2_ε Or L^AT_EX 2_ε in 157 minutes.* n.a., 2014.