



# Student Tracking System Using Radio Frequency Identification

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

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

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by  
  
CASTILLO, Karlos Leo F.  
DEL ROSARIO, Aldwin Jocep C.  
JARABELO, Adrian Benjamin S.  
UY, Charleston Franklin C.

May, 2016



De La Salle University

## ORAL DEFENSE RECOMMENDATION SHEET

This thesis proposal, entitled **Student Tracking System Using Radio Frequency Identification**, prepared and submitted by thesis group, Aldwin Friends, composed of:

CASTILLO, Karlos Leo F.  
DEL ROSARIO, Aldwin Jocep C.  
JARABELO, Adrian Benjamin S.  
UY, Charleston Franklin C.

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

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**Engr. Melvin K. Cabatuan**  
*Adviser*

May 30, 2016



De La Salle University

## THESIS PROPOSAL APPROVAL SHEET

This thesis proposal entitled **Student Tracking System Using Radio Frequency Identification**, prepared and submitted by:

CASTILLO, Karlos Leo F.  
DEL ROSARIO, Aldwin Jocep C.  
JARABELO, Adrian Benjamin S.  
UY, Charleston Franklin C.

with group number Aldwin Friends in partial fulfillment of the requirements for the degree of **Bachelor of Science in Computer Engineering (CPE)** has been examined and is recommended for acceptance and approval.

### PANEL OF EXAMINERS

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**Dr. Donabel D. Abuan**  
*Chair*

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**Engr. Mark Lorenze D. Torregoza**  
*Member*

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**Engr. Argel A. Bandala**  
*Member*

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**Engr. Melvin K. Cabatuan**  
*Adviser*

Date: May 30, 2016



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2016

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## ACKNOWLEDGMENT

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Write this prior to hard binding if you have submitted all requirements and are told by your adviser that you have passed.



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## ABSTRACT

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Keep your abstract short by giving the gist/nutshell of your thesis proposal.

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*Index Terms*—Tracker, RFID, Scanner, Database.



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



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## GLOSSARY



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## Chapter 1

### INTRODUCTION

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## 1.1 Background of the Study

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## 1.2 Prior Studies

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## 1.3 Problem Statement

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## 1.4 Objectives

### 1.4.1 General Objective(s)

To ...;

### 1.4.2 Specific Objectives

1. To ...;

2. To ...;

3. To ...;

4. To ...;

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## 1.5 Significance of the Study

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## 1.6 Assumptions, Scope and Delimitations

Bulletize your scope in one group, and then bulletize the delimitations in another. Bulletize your assumptions as well.

## 1.7 Description and Methodology

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## 1.8 Overview

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



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## Chapter 2

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203 Cite and summarize here relevant and significant literature (dissertations, theses, jour-  
 204 nals, patents, notable conference papers) to prove that no one has done your work yet.

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## 2.1 Summary



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## REFERENCES

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[ISO, 2009] ISO (2009). 80000-2. *Quantities and units–Part 2: Mathematical signs and symbols to be used in the natural sciences and technology*.

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[Oetiker et al., 2014] Oetiker, T., Partl, H., Hyna, I., and Schlegl, E. (2014). *The Not So Short Introduction to L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> Or L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> in 157 minutes*. n.a.

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## Appendix A

### ANSWERS TO QUESTIONS TO THIS THESIS PROPOSAL

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## 292 **A1 How important is the problem to practice?**

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## 302 **A2 How will you know if the solution/s that you will** 303 **achieve would be better than existing ones?**

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### 313 **A2.1 How will you measure the improvement/s?**

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323 **A2.1.1 What is/are your basis/bases for the improvement/s?**

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333 **A2.1.2 Why did you choose that/those basis/bases?**

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 342 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

343 **A2.1.3 How significant are your measure/s of the improvement/s?**

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



### **A3 What is the difference of the solution/s from existing ones?**

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.

#### **A3.1 How is it different from previous and existing ones?**

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.

### **A4 What are the assumptions made (that are behind for your proposed solution to work)?**

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.



#### **A4.1 Will your proposed solution/s be sensitive to these assumptions?**

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.

#### **A4.2 Can your proposed solution/s be applied to more general cases when some of the assumptions are eliminated? If so, how?**

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.

#### **A5 What is the necessity of your approach / proposed solution/s?**

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.



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

419 **A5.1 What will be the limits of applicability of your proposed so-**  
420 **lution/s?**

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

430 **A5.2 What will be the message of the proposed solution to**  
431 **technical people? How about to non-technical managers**  
432 **and business men?**

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

442 **A6 How will you know if your proposed solution/s**  
443 **is/are correct?**

444 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.  
445 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec  
446 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus  
447 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.  
448 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla



449 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue  
450 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.  
451 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit  
452 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

453 **A6.1 Will your results warrant the level of mathematics used**  
454 **(i.e., will the end justify the means)?**

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

464 **A7 Is/are there an/\_ alternative way/s to get to the**  
465 **same solution/s?**

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

475 **A7.1 Can you come up with illustrating examples, or even bet-**  
476 **ter, counter examples to your proposed solution/s?**

477 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.  
478 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec  
479 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus  
480 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.





481 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla  
 482 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue  
 483 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.  
 484 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit  
 485 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

## 486 **A7.2 Is there an approximation that can arrive at the essen-** 487 **tially the same proposed solution/s more easily?**

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

## 497 **A8 If you were the examiner of your proposal, how** 498 **would you present the proposal in another way?**

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

## 508 **A8.1 What are the weaknesses of your proposal?**

509 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.  
 510 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec  
 511 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus  
 512 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.





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513 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla  
514 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue  
515 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.  
516 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit  
517 amet ipsum. Nunc quis urna dictum turpis accumsan semper.



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## **Appendix B**

### **USAGE EXAMPLES**



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

## B1 Equations

The following examples show how to typeset equations in  $\text{\LaTeX}$ . 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  $\text{\LaTeX}$  document files used by this Thesis Proposal. Please comment out unused notations and be careful with the commas and brackets in `notation.tex`.**

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

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

Other example equations are as follows.

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

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

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



532

The verbatim L<sup>A</sup>T<sub>E</sub>X code of Sec. ?? is in List. ??.Listing B.1: Sample L<sup>A</sup>T<sub>E</sub>X code for equations and notations usage

```

1 The following examples show how to typeset equations in \LaTeX.
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[ \dfrac{V_{1}}{I_{1}} \right] =
14   \begin{bmatrix}
15     A & B \\
16     C & D
17   \end{bmatrix}
18   \left[ \dfrac{V_{2}}{I_{2}} \right]
19   \label{eq:ABCD}
20 \end{eqnarray}
21
22 \begin{eqnarray}
23   {1\over 2} < \left\lfloor \mathrm{mod}\right\left(\left\lfloor {y \over 17} \right\rfloor 2^{-17} \lfloor x \rfloor - \mathrm{mod}(\lfloor y \rfloor, 17)\right)\right\rfloor, 2\right)\right\rfloor,
24 \end{eqnarray}
25
26 \begin{eqnarray}
27   | \zeta(x)^3 \zeta(x+iy)^4 \zeta(x+2iy) | =
28   \exp\sum_{n,p}\frac{3+4\cos(ny\log p) +\cos(2ny\log p)}{np^{nx}}\geq 1
29 \end{eqnarray}

```



## B2 Notations

In order to use the standardized notation, the user is highly suggested to see the ISO 80000-2 standard [?]. The following were taken from `isomath-test.tex`.

### 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>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \textit{ff}, \textit{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<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>	$\mathbf{A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \text{ff}, \text{fi}, \beta, ^\circ, !, v, w, 0, 1, 9}$
<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>	$\mathbf{A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9}$
<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>mathsfbfit</code>	$\mathbf{A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9}$

Do the math alphabets match?

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

### 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,  $a + 0 = a$ .

### Matrix symbols

Symbols for matrices are boldface italic, too:<sup>1</sup>  $A = E \cdot A$ .

<sup>1</sup>However, matrix symbols are usually capital letters whereas vectors are small ones. Exceptions are physical quantities like the force vector  $F$  or the electrical field  $E$ .

547 **Tensor symbols**

548 Symbols for tensors are sans-serif bold italic,

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

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

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



## 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>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \textit{ff}, \textit{fi}, \beta, \textsuperscript{\circ}, !, v, w, 0, 1, 9$
<code>mathrm</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \text{ff}, \text{fi}, \beta, \textsuperscript{\circ}, !, v, w, 0, 1, 9$
<code>mathbf</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \text{ff}, \text{fi}, \beta, \textsuperscript{\circ}, !, v, w, 0, 1, 9$
<code>mathsf</code>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \text{ff}, \text{fi}, \beta, \textsuperscript{\circ}, !, v, w, 0, 1, 9$
<code>mathtt</code>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \uparrow, \downarrow, \beta, \textsuperscript{\circ}, !, v, w, 0, 1, 9$

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

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

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

## 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,  $a + 0 = a$ .

## Matrix symbols

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

## Tensor symbols

Symbols for tensors are sans-serif bold italic,

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

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

$$D = \epsilon_0 \epsilon_r E$$

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



564 The verbatim  $\text{\LaTeX}$  code of Sec. ?? is in List. ??.

Listing B.2: Sample  $\text{\LaTeX}$  code for notations usage

```

565 1 % A teststring with Latin and Greek letters::
566 2 \newcommand{\teststring}{%
567 3 % capital Latin letters
568 4 % A,B,C,
569 5 A,B,
570 6 % capital Greek letters
571 7 %\Gamma,\Delta,\Theta,\Lambda,\Xi,\Pi,\Sigma,\Upsilon,\Phi,\Psi,
572 8 \Gamma,\Delta,\Theta,\Lambda,\Xi,\Pi,\Sigma,\Phi,\Psi,\Omega,
573 9 % small Greek letters
574 10 \alpha,\beta,\pi,\nu,\omega,
575 11 % small Latin letters:
576 12 % compare \nu, \omega, v, and w
577 13 v,w,
578 14 % digits
579 15 0,1,9
580 16 }
581 17
582 18
583 19 \subsection*{Math alphabets}
584 20
585 21 If there are other symbols in place of Greek letters in a math
586 22 alphabet, it uses T1 or OT1 font encoding instead of OML.
587 23
588 24 \begin{eqnarray*}
589 25 \mbox{\mathnormal} & & \mbox{\teststring} \\
590 26 \mbox{\mathit} & & \mbox{\mathit{\teststring}} \\
591 27 \mbox{\mathrm} & & \mbox{\mathrm{\teststring}} \\
592 28 \mbox{\mathbf} & & \mbox{\mathbf{\teststring}} \\
593 29 \mbox{\mathsf} & & \mbox{\mathsf{\teststring}} \\
594 30 \mbox{\mathtt} & & \mbox{\mathtt{\teststring}} \\
595 31 \end{eqnarray*}
596 32 New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-
597 33 italic.
598 34 \begin{eqnarray*}
599 35 \mbox{\mathbfit} & & \mbox{\mathbfit{\teststring}} \\
600 36 \mbox{\mathsf fit} & & \mbox{\mathsf fit{\teststring}} \\
601 37 \mbox{\mathsf bfit} & & \mbox{\mathsf bfit{\teststring}} \\
602 38 \end{eqnarray*}
603 39 %
604 40 Do the math alphabets match?
605 41 $
606 42 \mathnormal {a x \alpha \omega}
607 43 \mathbfit {a x \alpha \omega}
608 44 \mathsf bfit {a x \alpha \omega}
609 45 \quad
610 46 \mathsf bfit {T C \Theta \Gamma}
611 47 \mathbfit {T C \Theta \Gamma}
612 48 \mathnormal {T C \Theta \Gamma}
613 49 $
614 50
615 51 \subsection*{Vector symbols}
616 52

```





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```

619 53 Alphabetic symbols for vectors are boldface italic,
620 54  $\vec{\lambda} = \vec{e}_1 \cdot \vec{a}$ ,
621 55 while numeric ones (e.g. the zero vector) are bold upright,
622 56  $\vec{a} + \vec{0} = \vec{a}$ .
623 57
624 58 \subsection*{Matrix symbols}
625 59
626 60 Symbols for matrices are boldface italic, too:%
627 61 \footnote{However, matrix symbols are usually capital letters whereas
628 62 vectors
629 62 are small ones. Exceptions are physical quantities like the force
630 63 vector  $\vec{F}$  or the electrical field  $\vec{E}$ .%
631 64 }
632 65  $\text{\matrixsym{\Lambda}} = \text{\matrixsym{E}} \cdot \text{\matrixsym{A}}$ .
633 66
634 67
635 68 \subsection*{Tensor symbols}
636 69
637 70 Symbols for tensors are sans-serif bold italic,
638 71
639 72 \[
640 73 \text{\tensorsym{\alpha}} = \text{\tensorsym{e}} \cdot \text{\tensorsym{a}}
641 74 \quad \Longleftrightarrow \quad
642 75 \alpha_{ijl} = e_{ijk} \cdot a_{kl}.
643 76 \]
644 77
645 78
646 79 The permittivity tensor describes the coupling of electric field and
647 80 displacement: \[
648 81 \vec{D} = \epsilon_0 \text{\tensorsym{\epsilon}}_{\text{\mathrm{r}}} \vec{E} \]
649 82
650 83
651 84
652 85 \newpage
653 86 \subsection*{Bold math version}
654 87
655 88 The ‘‘bold’’ math version is selected with the commands
656 89 \verb+ \boldmath+ or \verb+ \mathversion{bold}+
657 90
658 91 { \boldmath
659 92 \begin{eqnarray*}
660 93 \text{\mbox{\mathnormal}} & & \text{\teststring} \\
661 94 \text{\mbox{\mathit}} & & \text{\mathit{\teststring}} \\
662 95 \text{\mbox{\mathrm}} & & \text{\mathrm{\teststring}} \\
663 96 \text{\mbox{\mathbf}} & & \text{\mathbf{\teststring}} \\
664 97 \text{\mbox{\mathsf}} & & \text{\mathsf{\teststring}} \\
665 98 \text{\mbox{\mathtt}} & & \text{\mathtt{\teststring}} \\
666 99 \end{eqnarray*}
667 100 New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-
668 101 italic.
669 102 \begin{eqnarray*}
670 103 \text{\mbox{\mathbfit}} & & \text{\mathbfit{\teststring}} \\
671 104 \text{\mbox{\mathsf fit}} & & \text{\mathsf fit{\teststring}} \\
672 105 \text{\mbox{\mathsf bfit}} & & \text{\mathsf bfit{\teststring}} \\
673 106 \end{eqnarray*}
674 107 %
675 108 Do the math alphabets match?

```



```

676 108 $
677 109 $
678 110 \mathnormal {a x \alpha \omega}
679 111 \mathbf{fit}{a x \alpha \omega}
680 112 \mathsf{fbfit}{a x \alpha \omega}
681 113 \quad
682 114 \mathsf{fbfit}{T C \Theta \Gamma}
683 115 \mathbf{fit}{T C \Theta \Gamma}
684 116 \mathnormal {T C \Theta \Gamma}
685 117 $
686 118
687 119 \subsection*{Vector symbols}
688 120
689 121 Alphabetic symbols for vectors are boldface italic,
690 122 $\vec{\lambda}=\vec{e}_1\cdot\vec{a}$,
691 123 while numeric ones (e.g. the zero vector) are bold upright,
692 124 $\vec{a} + \vec{0} = \vec{a}$.
693 125
694 126
695 127
696 128
697 129 \subsection*{Matrix symbols}
698 130
699 131 Symbols for matrices are boldface italic, too:%
700 132 \footnote{However, matrix symbols are usually capital letters whereas
701 133 vectors
702 134 are small ones. Exceptions are physical quantities like the force
703 135 vector $\vec{F}$ or the electrical field $\vec{E}$.%
704 136 }
705 137 $\matrixsym{\Lambda}=\matrixsym{E}\cdot\matrixsym{A}.$
706 138
707 139
708 140 \subsection*{Tensor symbols}
709 141
710 142 Symbols for tensors are sans-serif bold italic,
711 143
712 144 \[
713 145 \tensorsym{\alpha} = \tensorsym{e}\cdot\tensorsym{a}
714 146 \quad \Longleftrightarrow \quad
715 147 \alpha_{ijl} = e_{ijk}\cdot a_{kl}.
716 148 \]
717 149
718 150 The permittivity tensor describes the coupling of electric field and
719 151 displacement: \[
720 152 \vec{D}=\epsilon_0\tensorsym{\epsilon}_{\mathrm{r}}\vec{E}\]
721 153 }

```



## B3 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. ??.

**To lessen the  $\LaTeX$  compilation time, it is suggested that you use `\acr{ }` only for the first occurrence of the word to be abbreviated.**

Again please see List. ??.

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). 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).



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

753 The verbatim  $\text{\LaTeX}$  code of Sec. ?? is in List. ??.

### Listing B.3: Sample $\text{\LaTeX}$ 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}

```



## B4 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. ??).

**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  $A$ . The matrix’s  $(i, j)$ th element is usually denoted  $a_{ij}$ . Matrix  $I$  is the identity matrix.
- A set, denoted as  $S$ , 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.
- The cardinality of a set, denoted as  $|S|$ , is the number of elements in the set.

The verbatim  $\LaTeX$  code for the part of Sec. ?? is in List. ??.

Listing B.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  $\gls{matrix}$ ’s  $(i, j)$ th element is
      usually denoted  $a_{ij}$ .  $\Gls{matrix}$   $\mathbf{I}$  is the
      identity  $\gls{matrix}$ .
4
5   \item A set, denoted as  $\gls{not:set}$ , is a collection of objects.
6
7   \item The universal set, denoted as  $\gls{not:universalSet}$ , is the
      set of everything.
8
9   \item The empty set, denoted as  $\gls{not:emptySet}$ , contains no
      elements.
10
11   \item The cardinality of a set, denoted as  $\gls{not:cardinality}$ , is
      the number of elements in the set.
12
13 \end{itemize}

```



768 **B5 Figure**

769 This section shows several ways of placing figures. PDFL<sup>A</sup>T<sub>E</sub>X compatible files are PDF,  
770 PNG, and JPG. Please see the `figure` subdirectory.

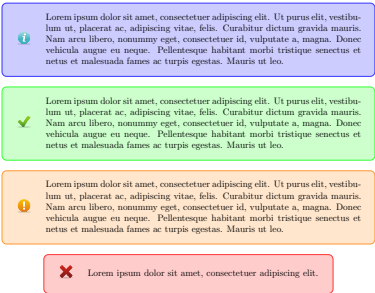


Fig. B.1 A quadrilateral image example.





771 Fig. ?? is a gray box enclosed by a dark border. List. ?? shows the corresponding L<sup>A</sup>T<sub>E</sub>X  
772 code.


Listing B.5: Sample L<sup>A</sup>T<sub>E</sub>X 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 \LaTeX \ code.
10 \end{figure}
```




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


 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut porta elit, vestibulum ut, placerat ac, adipiscing vitae, fido. Quamlibet dictum gravida maecenas. Nam arcu libero, nuncius eget, consectetur id, vulputate a, maugis. Donec vehicula augue eu tunc. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Maecenas ut leo.


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

 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut porta elit, vestibulum ut, placerat ac, adipiscing vitae, fido. Quamlibet dictum gravida maecenas. Nam arcu libero, nuncius eget, consectetur id, vulputate a, maugis. Donec vehicula augue eu tunc. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Maecenas ut leo.

 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut porta elit, vestibulum ut, placerat ac, adipiscing vitae, fido. Quamlibet dictum gravida maecenas. Nam arcu libero, nuncius eget, consectetur id, vulputate a, maugis. Donec vehicula augue eu tunc. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Maecenas ut leo.

 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut porta elit, vestibulum ut, placerat ac, adipiscing vitae, fido. Quamlibet dictum gravida maecenas. Nam arcu libero, nuncius eget, consectetur id, vulputate a, maugis. Donec vehicula augue eu tunc. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Maecenas ut leo.

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(c) A sub figure in the bottom row



Listing B.6: Sample L<sup>A</sup>T<sub>E</sub>X 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}
5 \label{fig:top}
6 }
7 \vfill
8 \subbottom[A sub-figure in the middle row.]{
9 \includegraphics[width=0.35\textwidth]{example}
10 \label{fig:mid}
11 }
12 \vfill
13 \subbottom[A sub-figure in the bottom row.]{
14 \includegraphics[width=0.35\textwidth]{example}
15 \label{fig:botm}
16 }
17 \caption{Figures on top of each other}
18 \label{fig:tmb}
19 \end{figure}
```

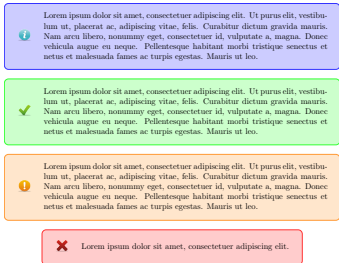
B. Usage Examples



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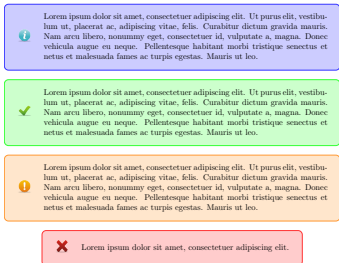
(a) A sub-figure in the upper-left corner.



(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. B.3 Four figures in each corner. See List. ?? for the corresponding L<sup>A</sup>T<sub>E</sub>X code.

Listing B.7: Sample  $\text{\LaTeX}$  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}
5 \label{fig:upprleft}
6 }
7 \hfill
8 \subbottom[A sub-figure in the upper-right corner.]{
9 \includegraphics[width=0.45\textwidth]{example}
10 \label{fig:uppright}
11 }
12 \vfill
13 \subbottom[A sub-figure in the lower-left corner.]{
14 \includegraphics[width=0.45\textwidth]{example}
15 \label{fig:lowerleft}
16 }
17 \hfill
18 \subbottom[A sub-figure in the lower-right corner]{
19 \includegraphics[width=0.45\textwidth]{example}
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}

```



773

**B6 Table**

774

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

TABLE B.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)



776 List. ?? shows the corresponding  $\text{\LaTeX}$  code.

Listing B.8: Sample  $\text{\LaTeX}$  code for making typical table environment

```

777 1 \begin{center}
778 2 {\scriptsize
779 3 \begin{tabularx}{\textwidth}{p{0.1\textwidth}|p{0.2\textwidth}|p{0.5\textwidth}}
780 4 \caption{Feasible triples for highly variable grid} \label{tab:triple_
781 5 grid} \\
782 6 \hline
783 7 \textbf{Time (s)} &
784 8 \textbf{Triple chosen} &
785 9 \textbf{Other feasible triples} \\
786 10 \hline
787 11 \endfirsthead
788 12 \multicolumn{3}{c}{\textit{Continued from previous page}} \\
789 13 \hline
790 14 \hline
791 15 \textbf{Time (s)} &
792 16 \textbf{Triple chosen} &
793 17 \textbf{Other feasible triples} \\
794 18 \hline
795 19 \endhead
796 20 \hline
797 21 \multicolumn{3}{r}{\textit{Continued on next page}} \\
798 22 \endfoot
799 23 \hline
800 24 \endlastfoot
801 25 \hline
802 26
803 27
804 28 0 & (1, 11, 13725) & (1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0) \\
805 29 & & \\
806 30 2745 & (1, 12, 10980) & (1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0) \\
807 31 & & \\
808 32 5490 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
809 33 8235 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
810 34 10980 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
811 35 13725 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
812 36 16470 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
813 37 19215 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
814 38 21960 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
815 39 24705 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
816 40 27450 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
817 41 30195 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
818 42 32940 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
819 43 35685 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
820 44 38430 & (1, 13, 10980) & (2, 2, 2745), (2, 3, 0), (3, 1, 0)

```



```

831 43 41175 & (1, 12, 13725) & (1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1,
832 0) \\
833 44 43920 & (1, 13, 10980) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
834 45 46665 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
835 46 49410 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
836 47 52155 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1,
837 0) \\
838 48 54900 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
839 49 57645 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
840 50 60390 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
841 51 63135 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
842 52 65880 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
843 53 68625 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
844 54 71370 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
845 55 74115 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
846 56 76860 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
847 57 79605 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
848 58 82350 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
849 59 85095 & (1, 12, 13725) & (1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1,
850 0) \\
851 60 87840 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
852 61 90585 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
853 62 93330 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
854 63 96075 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
855 64 98820 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
856 65 101565 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
857 66 104310 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
858 67 107055 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
859 68 109800 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
860 69 112545 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
861 1, 0) \\
862 70 115290 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
863 71 118035 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
864 72 120780 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
865 73 123525 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
866 74 126270 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
867 1, 0) \\
868 75 129015 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
869 76 131760 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
870 77 134505 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
871 78 137250 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
872 79 139995 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
873 80 142740 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
874 81 145485 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
875 1, 0) \\
876 82 148230 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
877 83 150975 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
878 84 153720 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
879 85 156465 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
880 86 159210 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
881 87 161955 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
882 88 164700 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
883 89 \end{tabularx}
884 90 }
885 91 \end{center}

```



887

**B7 Algorithm or Pseudocode Listing**

888

Table ?? shows an example pseudocode. Note that if the pseudocode exceeds one page, it can mean that its implementation is not modular. List. ?? shows the corresponding L<sup>A</sup>T<sub>E</sub>X code.

889

890

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

<b>Input(s):</b>	
$n$	: $n$ th power; $n \in \mathbb{Z}^+$
$x$	: base value; $x \in \mathbb{R}^+$
<b>Output(s):</b>	
$y$	: 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 B.9: Sample L<sup>A</sup>T<sub>E</sub>X 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}

```



## B8 Program/Code Listing

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

Listing B.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 */

```



894

List. ?? shows the corresponding  $\text{\LaTeX}$  code.

Listing B.11: Sample  $\text{\LaTeX}$  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.
```



## B9 Referencing

Referencing chapters: This appendix is in Appendix ??, which is about examples in using various L<sup>A</sup>T<sub>E</sub>X commands.

Referencing sections: This section is Sec. ??, which shows how to refer to the locations of various labels that have been placed in the L<sup>A</sup>T<sub>E</sub>X files. List. ?? shows the corresponding L<sup>A</sup>T<sub>E</sub>X code.

Listing B.12: Sample L<sup>A</sup>T<sub>E</sub>X 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.
```

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.



## 910 B9.1 A subsection

911 Referencing subsections: This section is Sec. ??, which shows how to refer to a subsection.  
 912 List. ?? shows the corresponding  $\LaTeX$  code.

### Listing B.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.
```

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



### 922 **B9.1.1 A sub-subsection**

923 Referencing sub-subsections: This section is Sec. ??, which shows how to refer to a  
 924 sub-subsection. List. ?? shows the corresponding L<sup>A</sup>T<sub>E</sub>X code.

#### Listing B.14: Sample L<sup>A</sup>T<sub>E</sub>X 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.
```

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



934

## B10 Index

935

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.

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938

939

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942

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. ?? is a program listing of the above-mentioned paragraph.

### Listing B.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.
```



## B11 Adding Relevant PDF Pages (e.g. Standards, Datasheets, Specification Sheets, Application Notes, etc.)

Selected PDF pages can be added (see List. ??), but note that the options must be tweaked. See the manual of `pdfpages` for other options.

Listing B.16: Sample  $\text{\LaTeX}$  code for including PDF pages

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





## 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 <sup>(1)</sup>	468	780	780	780	650	650	1,404
Maximum HR I/Os <sup>(2)</sup>	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.



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

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

Package <sup>(1)(2)(3)</sup>	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.



## 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 <sup>(1)</sup>	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 <sup>(4)</sup>						832, 52
FLVB2104	47.5x47.5		702, 76	702, 76	702, 76	624, 76	
FHVB2104	52.5x52.5 <sup>(4)</sup>						702, 76
FLVC2104	47.5x47.5		416, 80	416, 80	416, 104	416, 96	
FHVC2104	52.5x52.5 <sup>(4)</sup>						416, 104
FLVA2577	52.5x52.5				448, 120	448, 96	448, 128

**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 devices with the same sequence. The footprint compatible devices within this family are outlined.
4. 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.



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## Appendix C

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## PUBLICATION LIST AND AWARD

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### Journal

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1. ...

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2. ...

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### Conference

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1. ...

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2. ...



# De La Salle University

**Others**

1. ...

2. ...

**Award**

1. ...

2. ...



## Appendix D VITA



Karlos Leo F. Castillo is currently studying B. S. Computer Engineering in De La Salle University, Malate, Manila, Philippines. He is a senior member of the Electrical Team of the DLSU Eco Car Team, which is composed of students who apply their knowledge in their respective fields to be able to create innovative energy efficient vehicles and to spread awareness on green technology. He has an experience in various programming languages such as C, Java, and Android and has developed projects that involved the use of the PIC microcontroller, which is his major research interest.



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Adrian Benjamin S. Jarabelo is a 4th year Computer Engineering student is De La Salle University Manila - Manila, Malate, Manila, Philippines. Has knowledge on in C++, JAVA, MS OFFICE, microcontroller programming and PCB fabrication. A member of the organization ACCESS holding the position of internal Vice President which is an organization for Computer Engineering students.



# De La Salle University



984 Charleston Franklin C. Uy is a fourth year engineering student and  
985 currently taking up Bachelor of Science in Computer Engineering at De La Salle  
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987 languages such as C, CSS, Java, HTML, MySQL, PHP and Verilog, and has developed  
988 several electronic circuits that utilizes the PIC microcontroller. His research interest  
989 includes automation, environment friendly technologies and radio frequency identification  
990 technologies.



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