



A Microcontroller-based System Used to Measure Different Weather Parameters Such As
Temperature, Humidity, and Amount of Rainfall

A Thesis
Presented to the Faculty of the
Department of Electronics and Communications 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

CHEONG, Junlae
NIHALANI, Rohit P.
PAULINO, Noel B.
PO, Ryback Tyrone G.

May, 2016



De La Salle University

ORAL DEFENSE RECOMMENDATION SHEET

This thesis, entitled **A Microcontroller-based System Used to Measure Different Weather Parameters Such As Temperature, Humidity, and Amount of Rainfall**, prepared and submitted by thesis group, ESG-04, composed of:

CHEONG, Junlae
NIHALANI, Rohit P.
PAULINO, Noel B.
PO, Ryback Tyrone G.

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**.

Engr. Donabel D. Abuan
Adviser

May 27, 2016



De La Salle University

THESIS APPROVAL SHEET

This thesis entitled **A Microcontroller-based System Used to Measure Different Weather Parameters Such As Temperature, Humidity, and Amount of Rainfall**, prepared and submitted by:

CHEONG, Junlae
NIHALANI, Rohit P.
PAULINO, Noel B.
PO, Ryback Tyrone G.

with group number ESG-04 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.

PANEL OF EXAMINERS

Engr. Julius P. Bancud
Chair

Engr. Blanca I. Bucao
Member

Dr. Rionel B. Caldo
Member

Engr. Donabel D. Abuan
Adviser

Date: May 27, 2016



De La Salle University

60
61
62
63

2016

All Rights Reserved. No part of this publication may be reproduced, stored in an information retrieval system, or transmitted, in any form or by any means, electronic, mechanical, by photocopying, scanning, recording, or otherwise, except under the terms of the applicable law.



De La Salle University

64

ACKNOWLEDGMENT

65

66

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



67

ABSTRACT

68

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

69

Index Terms—alloy system, characterization, InP, InGaAs.



70

TABLE OF CONTENTS

71

Oral Defense Recommendation Sheet **ii**

72

Thesis Approval Sheet **iii**

73

Acknowledgment **v**

74

Abstract **vi**

75

Table of Contents **vii**

76

List of Figures **x**

77

List of Tables **xi**

78

Abbreviations **xii**

79

Notation **xiii**

80

Glossary **xiv**

81

Listings **xv**

82

Chapter 1 INTRODUCTION **1**

83

1.1 Background of the Study 2

84

1.2 Prior Studies 4

85

1.3 Problem Statement 4

86

1.4 Objectives 5

87

1.4.1 General Objective(s) 5

88

1.4.2 Specific Objectives 5

89

1.5 Significance of the Study 5

90

1.6 Assumptions, Scope and Delimitations 6

91

1.7 Description and Methodology 6

92

1.8 Overview 6

93

Chapter 2 LITERATURE REVIEW **7**

94

2.1 Summary 10



95	Chapter 3 THEORETICAL CONSIDERATIONS	11
96	3.1 Summary	13
97	Chapter 4 DESIGN CONSIDERATIONS	15
98	4.1 Summary	17
99	Chapter 5 METHODOLOGY	18
100	5.1 Implementation	19
101	5.2 Evaluation	21
102	5.3 Summary	23
103	Chapter 6 RESULTS AND DISCUSSION	24
104	6.1 Summary	26
105	Chapter 7 CONCLUSIONS, RECOMMENDATIONS, AND FUTURE DIREC-	
106	TIVES	27
107	7.1 Concluding Remarks	28
108	7.2 Contributions	28
109	7.3 Recommendations	28
110	7.4 Future Prospects	30
111	References	31
112	Appendix A ANSWERS TO QUESTIONS TO THIS THESIS	32
113	A1 How important is the problem to practice?	33
114	A2 How will you know if the solution/s that you will achieve would be better	
115	than existing ones?	33
116	A2.1 How will you measure the improvement/s?	33
117	A2.1.1 What is/are your basis/bases for the improvement/s? . .	34
118	A2.1.2 Why did you choose that/those basis/bases?	34
119	A2.1.3 How significant are your measure/s of the improvement/s? .	34
120	A3 What is the difference of the solution/s from existing ones?	35
121	A3.1 How is it different from previous and existing ones?	35
122	A4 What are the assumptions made (that are behind for your proposed solution	
123	to work)?	35
124	A4.1 Will your proposed solution/s be sensitive to these assumptions? .	36
125	A4.2 Can your proposed solution/s be applied to more general cases	
126	when some of the assumptions are eliminated? If so, how?	36
127	A5 What is the necessity of your approach / proposed solution/s?	36
128	A5.1 What will be the limits of applicability of your proposed solution/s?	37



129	A5.2	What will be the message of the proposed solution to technical people? How about to non-technical managers and business men?	37
130			
131	A6	How will you know if your proposed solution/s is/are correct?	37
132	A6.1	Will your results warrant the level of mathematics used (i.e., will the end justify the means)?	38
133			
134	A7	Is/are there an/_ alternative way/s to get to the same solution/s?	38
135	A7.1	Can you come up with illustrating examples, or even better, counter examples to your proposed solution/s?	38
136			
137	A7.2	Is there an approximation that can arrive at the essentially the same proposed solution/s more easily?	39
138			
139	A8	If you were the examiner of your proposal, how would you present the proposal in another way?	39
140			
141	A8.1	What are the weaknesses of your proposal?	39
142			
143	Appendix B	USAGE EXAMPLES	41
144	B1	Equations	42
145	B2	Notations	44
146	B3	Abbreviation	50
147	B4	Glossary	52
148	B5	Figure	53
149	B6	Table	59
150	B7	Algorithm or Pseudocode Listing	63
151	B8	Program/Code Listing	65
152	B9	Referencing	67
153	B9.1	A subsection	68
154	B9.1.1	A sub-subsection	69
155	B10	Index	70
156	B11	Adding Relevant PDF Pages (e.g. Standards, Datasheets, Specification Sheets, Application Notes, etc.)	71
157	Appendix C	PUBLICATION LIST AND AWARD	75
158	Appendix D	VITA	77
159	Index		79



160

LIST OF FIGURES

161

3.1 A quadrilateral image example. 14

162

B.1 A quadrilateral image example. 53

163

B.2 Figures on top of each other. See List. B.6 for the corresponding \LaTeX code. 55

164

B.3 Four figures in each corner. See List. B.7 for the corresponding \LaTeX code. . 57



165

LIST OF TABLES

166

B.1 Feasible triples for highly variable grid 59

167

B.2 Calculation of $y = x^n$ 63



168

ABBREVIATIONS

169	AC	Alternating Current.....	50
170	HTML	Hyper-text Markup Language	50
171	CSS	Cascading Style Sheet	50
172	XML	eXtensible Markup Language	50



173

NOTATION

174	\mathcal{S}	a collection of distinct objects	52
175	\mathcal{U}	the set containing everything	52
176	\emptyset	the set with no elements	52
177	$ \mathcal{S} $	the number of elements in the set \mathcal{S}	52
178	$h(t)$	impulse response	42
179	$x(t)$	input signal represented in the time domain	42
180	$y(t)$	output signal represented in the time domain	42

181 Throughout this thesis, mathematical notations conform to ISO 80000-2 standard, e.g.
182 variable names are printed in italics, the only exception being acronyms like e.g. SNR,
183 which are printed in regular font. Constants are also set in regular font like j . Functions are
184 also set in regular font, e.g. in $\sin(\cdot)$. Commonly used notations are t , f , $j = \sqrt{-1}$, n and
185 $\exp(\cdot)$, which refer to the time variable, frequency variable, imaginary unit, n th variable,
186 and exponential function, respectively.



187

GLOSSARY

188

matrix a concise and useful way of uniquely representing and working with linear transformations; a rectangular table of elements 52



189

LISTINGS

190	B.1 Sample \LaTeX code for equations and notations usage	43
191	B.2 Sample \LaTeX code for notations usage	47
192	B.3 Sample \LaTeX code for abbreviations usage	51
193	B.4 Sample \LaTeX code for glossary and notations usage	52
194	B.5 Sample \LaTeX code for a single figure	54
195	B.6 Sample \LaTeX code for three figures on top of each other	56
196	B.7 Sample \LaTeX code for the four figures	58
197	B.8 Sample \LaTeX code for making typical table environment	61
198	B.9 Sample \LaTeX code for algorithm or pseudocode listing usage	64
199	B.10 Computing Fibonacci numbers	65
200	B.11 Sample \LaTeX code for program listing	66
201	B.12 Sample \LaTeX code for referencing sections	67
202	B.13 Sample \LaTeX code for referencing subsections	68
203	B.14 Sample \LaTeX code for referencing sub-subsections	69
204	B.15 Sample \LaTeX code for Index usage	70
205	B.16 Sample \LaTeX code for including PDF pages	71



Chapter 1

INTRODUCTION

Contents

1.1	Background of the Study	2
1.2	Prior Studies	4
1.3	Problem Statement	4
1.4	Objectives	5
1.4.1	General Objective(s)	5
1.4.2	Specific Objectives	5
1.5	Significance of the Study	5
1.6	Assumptions, Scope and Delimitations	6
1.7	Description and Methodology	6
1.8	Overview	6



221 1.1 Background of the Study

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

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

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



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

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

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



1.2 Prior Studies

Put here a summary of your literature review. Preferably, a table showing the summary would be helpful. 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.

1.3 Problem Statement

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.



288 1.4 Objectives

289 1.4.1 General Objective(s)

290 To ...;

291 1.4.2 Specific Objectives

292 1. To ...;

293 2. To ...;

294 3. To ...;

295 4. To ...;

296 5. To ...;

297 1.5 Significance of the Study

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



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

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.

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.



323

Chapter 2

324

LITERATURE REVIEW

325

Contents

326

327

328

2.1	Summary	10
-----	-------------------	----



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

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

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

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



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

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

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



376

2.1 Summary



377

Chapter 3

378

THEORETICAL CONSIDERATIONS

379

Contents

380

381

382

3.1 Summary	13
-----------------------	----



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

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

401 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.
 402 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec
 403 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus
 404 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.
 405 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla
 406 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue



407 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.
 408 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
 409 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

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

428 3.1 Summary

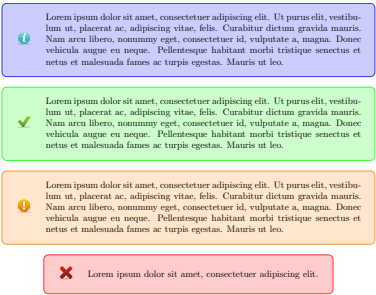


Fig. 3.1 A quadrilateral image example.



429

Chapter 4

430

DESIGN CONSIDERATIONS

431

Contents

432

433

434

4.1 Summary	17
-----------------------	----



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

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 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.
 454 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec
 455 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus
 456 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.
 457 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla
 458 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue



459 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.
 460 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
 461 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

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

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

480 4.1 Summary



481

Chapter 5

482

METHODOLOGY

483

Contents

484

485

486

487

488

5.1	Implementation	19
5.2	Evaluation	21
5.3	Summary	23



489 5.1 Implementation

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

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



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

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

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



5.2 Evaluation

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.

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.

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.



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

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

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



581

5.3 Summary



582

Chapter 6

583

RESULTS AND DISCUSSION

584

Contents

585

586

587

6.1 Summary	26
-----------------------	----



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

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

606 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.
 607 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec
 608 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus
 609 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.
 610 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla
 611 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue



612 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.
 613 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
 614 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

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

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

633 6.1 Summary



634

Chapter 7

635

CONCLUSIONS, RECOMMENDATIONS,

636

AND FUTURE DIRECTIVES

637

Contents

638

639

7.1	Concluding Remarks	28
-----	------------------------------	----

640

7.2	Contributions	28
-----	-------------------------	----

641

7.3	Recommendations	28
-----	---------------------------	----

642

7.4	Future Prospects	30
-----	----------------------------	----

643



644 **7.1 Concluding Remarks**

645 In this Thesis, . . .

646 **7.2 Contributions**

647 The interrelated contributions and supplements that have been developed in this Thesis are
648 listed as follows.

- 649 • the ;
- 650 • the ;
- 651 • the ;

652 **7.3 Recommendations**

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



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

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

680 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.
 681 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec
 682 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus
 683 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.
 684 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla
 685 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue



686 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.
 687 Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit
 688 amet ipsum. Nunc quis urna dictum turpis accumsan semper.

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

698 7.4 Future Prospects

699 There are several prospect related in this research that may be extended for further studies.
 700 ... So the suggested topics are listed in the following.

701 1. the

702 2. the

703 3. the



REFERENCES

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

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



Appendix A ANSWERS TO QUESTIONS TO THIS THESIS

Contents

A1	How important is the problem to practice?	33
A2	How will you know if the solution/s that you will achieve would be better than existing ones?	33
A2.1	How will you measure the improvement/s?	33
A2.1.1	What is/are your basis/bases for the improvement/s? . .	34
A2.1.2	Why did you choose that/those basis/bases?	34
A2.1.3	How significant are your measure/s of the improvement/s? .	34
A3	What is the difference of the solution/s from existing ones?	35
A3.1	How is it different from previous and existing ones?	35
A4	What are the assumptions made (that are behind for your proposed solution to work)?	35
A4.1	Will your proposed solution/s be sensitive to these assumptions? .	36
A4.2	Can your proposed solution/s be applied to more general cases when some of the assumptions are eliminated? If so, how?	36
A5	What is the necessity of your approach / proposed solution/s?	36
A5.1	What will be the limits of applicability of your proposed solution/s? .	37
A5.2	What will be the message of the proposed solution to technical people? How about to non-technical managers and business men? .	37
A6	How will you know if your proposed solution/s is/are correct?	37
A6.1	Will your results warrant the level of mathematics used (i.e., will the end justify the means)?	38
A7	Is/are there an/_ alternative way/s to get to the same solution/s?	38
A7.1	Can you come up with illustrating examples, or even better, counter examples to your proposed solution/s?	38
A7.2	Is there an approximation that can arrive at the essentially the same proposed solution/s more easily?	39
A8	If you were the examiner of your proposal, how would you present the proposal in another way?	39
A8.1	What are the weaknesses of your proposal?	39



745

A1 How important is the problem to practice?

746

747

748

749

750

751

752

753

754

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.

755

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

756

757

758

759

760

761

762

763

764

765

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.

766

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

767

768

769

770

771

772

773

774

775

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.



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

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

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

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

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

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



806

807

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

808

809

810

811

812

813

814

815

816

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.

817

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

818

819

820

821

822

823

824

825

826

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.

827

828

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

829

830

831

832

833

834

835

836

837

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.



838 **A4.1 Will your proposed solution/s be sensitive to these as-**
839 **sumptions?**

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

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

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

861 **A5 What is the necessity of your approach / pro-**
862 **posed solution/s?**

863 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem.
864 Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec
865 ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus
866 placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.
867 Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla
868 tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue
869 a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris.



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

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

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

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

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

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

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



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

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

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

917 **A7 Is/are there an/_ alternative way/s to get to the**
918 **same solution/s?**

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

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

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



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

939 **A7.2 Is there an approximation that can arrive at the essen-** 940 **tially the same proposed solution/s more easily?**

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

950 **A8 If you were the examiner of your proposal, how** 951 **would you present the proposal in another way?**

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

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

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



De La Salle University

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



De La Salle University

971

972

Appendix B

USAGE EXAMPLES



The user is expected to have a working knowledge of \LaTeX . A good introduction is in [Oetiker et al., 2014]. 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 \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. Please comment out unused notations and be careful with the commas and brackets in `notation.tex`.**

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

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

Other example equations are as follows.

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

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

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



986

The verbatim L^AT_EX code of Sec. B1 is in List. B.1.

Listing B.1: Sample L^AT_EX 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 [ISO, 2009]. 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>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \mathbf{ff}, \mathbf{fi}, \mathbf{\beta}, ^\circ, !, \mathbf{v}, \mathbf{w}, \mathbf{0}, \mathbf{1}, \mathbf{9}$
<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>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \mathbf{\alpha}, \mathbf{\beta}, \mathbf{\pi}, \mathbf{\nu}, \mathbf{\omega}, \mathbf{v}, \mathbf{w}, \mathbf{0}, \mathbf{1}, \mathbf{9}$
<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>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \mathbf{\alpha}, \mathbf{\beta}, \mathbf{\pi}, \mathbf{\nu}, \mathbf{\omega}, \mathbf{v}, \mathbf{w}, \mathbf{0}, \mathbf{1}, \mathbf{9}$

Do the math alphabets match?

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

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, $\mathbf{a} + \mathbf{0} = \mathbf{a}$.

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} .

1001 **Tensor symbols**

1002 Symbols for tensors are sans-serif bold italic,

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

1003 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>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \textit{ff}, \textit{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<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>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \text{ff}, \text{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<code>mathsf</code>	$\mathbf{A}, \mathbf{B}, \mathbf{\Gamma}, \mathbf{\Delta}, \mathbf{\Theta}, \mathbf{\Lambda}, \mathbf{\Xi}, \mathbf{\Pi}, \mathbf{\Sigma}, \mathbf{\Phi}, \mathbf{\Psi}, \mathbf{\Omega}, \text{ff}, \text{fi}, \beta, ^\circ, !, v, w, 0, 1, 9$
<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>	$A, B, \Gamma, \Delta, \Theta, \Lambda, \Xi, \Pi, \Sigma, \Phi, \Psi, \Omega, \alpha, \beta, \pi, \nu, \omega, v, w, 0, 1, 9$
<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:² $\Lambda = E \cdot A$.

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:

$$D = \epsilon_0 \epsilon_r E$$

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 .



1018

The verbatim L^AT_EX code of Sec. B2 is in List. B.2.Listing B.2: Sample L^AT_EX code for notations usage

1019

1020

1021

1022

1023

1024

1025

1026

1027

1028

1029

1030

1031

1032

1033

1034

1035

1036

1037

1038

1039

1040

1041

1042

1043

1044

1045

1046

1047

1048

1049

1050

1051

1052

1053

1054

1055

1056

1057

1058

1059

1060

1061

1062

1063

1064

1065

1066

1067

1068

1069

1070

1071

1072

```

1  % A teststring with Latin and Greek letters::
2  \newcommand{\teststring}{%
3  % capital Latin letters
4  % A,B,C,
5  A,B,
6  % capital Greek letters
7  %\Gamma,\Delta,\Theta,\Lambda,\Xi,\Pi,\Sigma,\Upsilon,\Phi,\Psi,
8  \Gamma,\Delta,\Theta,\Lambda,\Xi,\Pi,\Sigma,\Phi,\Psi,\Omega,
9  % small Greek letters
10 \alpha,\beta,\pi,\nu,\omega,
11 % small Latin letters:
12 % compare \nu, \omega, v, and w
13 v,w,
14 % digits
15 0,1,9
16 }
17
18
19 \subsection*{Math alphabets}
20
21 If there are other symbols in place of Greek letters in a math
22 alphabet, it uses T1 or OT1 font encoding instead of OML.
23
24 \begin{eqnarray*}
25 \mbox{\mathnormal} & & \mbox{\teststring} \\
26 \mbox{\mathit} & & \mbox{\mathit{\teststring}} \\
27 \mbox{\mathrm} & & \mbox{\mathrm{\teststring}} \\
28 \mbox{\mathbf} & & \mbox{\mathbf{\teststring}} \\
29 \mbox{\mathsf} & & \mbox{\mathsf{\teststring}} \\
30 \mbox{\mathtt} & & \mbox{\mathtt{\teststring}} \\
31 \end{eqnarray*}
32 New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-
33   italic.
34 \begin{eqnarray*}
35 \mbox{\mathbfit} & & \mbox{\mathbfit{\teststring}} \\
36 \mbox{\mathsf} & & \mbox{\mathsf{\teststring}} \\
37 \mbox{\mathsfbfit} & & \mbox{\mathsfbfit{\teststring}} \\
38 \end{eqnarray*}
39 %
40 Do the math alphabets match?
41 $
42 \mathnormal {a x \alpha \omega}
43 \mathbfit {a x \alpha \omega}
44 \mathsfbfit {a x \alpha \omega}
45 \quad
46 \mathsfbfit {T C \Theta \Gamma}
47 \mathbfit {T C \Theta \Gamma}
48 \mathnormal {T C \Theta \Gamma}
49 $
50
51 \subsection*{Vector symbols}
52

```



```

53 Alphabetic symbols for vectors are boldface italic,
54  $\vec{\lambda} = \vec{e}_1 \cdot \vec{a}$ ,
55 while numeric ones (e.g. the zero vector) are bold upright,
56  $\vec{a} + \vec{0} = \vec{a}$ .
57
58 \subsection*{Matrix symbols}
59
60 Symbols for matrices are boldface italic, too:%
61 \footnote{However, matrix symbols are usually capital letters whereas
62 vectors
63 are small ones. Exceptions are physical quantities like the force
64 vector  $\vec{F}$  or the electrical field  $\vec{E}$ .%
65 }
66  $\Lambda = E \cdot A$ .
67
68 \subsection*{Tensor symbols}
69
70 Symbols for tensors are sans-serif bold italic,
71
72 \[
73 \quad \text{\texttt{\textbf{\textit{tensorsym{\alpha}}}}} = \text{\texttt{\textbf{\textit{tensorsym{e}}}}} \cdot \text{\texttt{\textbf{\textit{tensorsym{a}}}}}
74 \quad \Longleftrightarrow
75 \quad \text{\texttt{\textbf{\textit{\alpha_{ijl}}}}} = \text{\texttt{\textbf{\textit{e_{ijk}}}}} \cdot \text{\texttt{\textbf{\textit{a_{kl}}}}}.
76 \]
77
78
79 The permittivity tensor describes the coupling of electric field and
80 displacement: \[
81 \vec{D} = \epsilon_0 \text{\texttt{\textbf{\textit{tensorsym{\epsilon}}}}} \text{\texttt{\textbf{\textit{r}}}} \vec{E} \]
82
83
84
85 \newpage
86 \subsection*{Bold math version}
87
88 The ‘‘bold’’ math version is selected with the commands
89 \verb+\boldmath+ or \verb+\mathversion{bold}+
90
91 {\boldmath
92 \begin{eqnarray*}
93 \quad \text{\texttt{\textbf{\textit{mbox{\mathnormal}}}}} & & \text{\texttt{\textbf{\textit{teststring}}}} \\
94 \quad \text{\texttt{\textbf{\textit{mbox{\mathit}}}}} & & \text{\texttt{\textbf{\textit{\mathit{teststring}}}}} \\
95 \quad \text{\texttt{\textbf{\textit{mbox{\mathrm}}}}} & & \text{\texttt{\textbf{\textit{\mathrm{teststring}}}}} \\
96 \quad \text{\texttt{\textbf{\textit{mbox{\mathbf}}}}} & & \text{\texttt{\textbf{\textit{\mathbf{teststring}}}}} \\
97 \quad \text{\texttt{\textbf{\textit{mbox{\mathsf}}}}} & & \text{\texttt{\textbf{\textit{\mathsf{teststring}}}}} \\
98 \quad \text{\texttt{\textbf{\textit{mbox{\mathtt}}}}} & & \text{\texttt{\textbf{\textit{\mathtt{teststring}}}}} \\
99 \end{eqnarray*}
100 \quad \text{New alphabets bold-italic, sans-serif-italic, and sans-serif-bold-}
101 \quad \text{italic.}
102 \begin{eqnarray*}
103 \quad \text{\texttt{\textbf{\textit{mbox{\mathbf fit}}}}} & & \text{\texttt{\textbf{\textit{\mathbf fit{teststring}}}}} \\
104 \quad \text{\texttt{\textbf{\textit{mbox{\mathsf fit}}}}} & & \text{\texttt{\textbf{\textit{\mathsf fit{teststring}}}}} \\
105 \quad \text{\texttt{\textbf{\textit{mbox{\mathsf bfit}}}}} & & \text{\texttt{\textbf{\textit{\mathsf bfit{teststring}}}}} \\
106 \end{eqnarray*}
107 \%
108 Do the math alphabets match?

```



B. Usage Examples

De La Salle University

```
1130 108 $
1131 109 \mathnormal {a x \alpha \omega}
1132 110 \mathbf{it}{a x \alpha \omega}
1133 111 \mathsf{fbfit}{a x \alpha \omega}
1134 112 \quad
1135 113 \mathsf{fbfit}{T C \Theta \Gamma}
1136 114 \mathbf{it}{T C \Theta \Gamma}
1137 115 \mathnormal {T C \Theta \Gamma}
1138 116 $
1139 117
1140 118 \subsection*{Vector symbols}
1141 119
1142 120 Alphabetic symbols for vectors are boldface italic,
1143 121 $\vec{\lambda}=\vec{e}_1\cdot\vec{a}$,
1144 122 while numeric ones (e.g. the zero vector) are bold upright,
1145 123 $\vec{a} + \vec{0} = \vec{a}$.
1146 124
1147 125
1148 126
1149 127
1150 128 \subsection*{Matrix symbols}
1151 129
1152 130 Symbols for matrices are boldface italic, too:%
1153 131 \footnote[However, matrix symbols are usually capital letters whereas
1154 132 vectors
1155 133 are small ones. Exceptions are physical quantities like the force
1156 134 vector $\vec{F}$ or the electrical field $\vec{E}$.%
1157 135 }
1158 136 $\Lambda=\mathbf{E}\cdot\mathbf{A}$.
1159 137
1160 138
1161 139 \subsection*{Tensor symbols}
1162 140
1163 141 Symbols for tensors are sans-serif bold italic,
1164 142
1165 143 \[
1166 144 \quad \text{\textbf{\textit{\scriptsize tensorsym{\alpha}}}} = \text{\textbf{\textit{\scriptsize tensorsym{e}}}}\cdot\text{\textbf{\textit{\scriptsize tensorsym{a}}}}
1167 145 \quad \Longleftarrow \quad
1168 146 \quad \text{\textbf{\textit{\scriptsize alpha_{ijl}}}}} = \text{\textbf{\textit{\scriptsize e_{ijk}}}}\cdot\text{\textbf{\textit{\scriptsize a_{kl}}}}.
1169 147 \]
1170 148
1171 149 The permittivity tensor describes the coupling of electric field and
1172 150 displacement: \[
1173 151 \vec{D}=\epsilon_0\text{\textbf{\textit{\scriptsize tensorsym{\epsilon}}}}_{\mathrm{r}}\vec{E}\]
1174 152 }
```




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. B.3. **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. B.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). 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).



- 1206 • Provide your own link text: style sheet.

1207 The verbatim \LaTeX code of Sec. B3 is in List. B.3.

Listing B.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}

```



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. B.4).

Please make sure that the entries in `notation.tex` are those that are referenced in the \LaTeX document files used by this Thesis. 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. B4 is in List. B.4.

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}
```



1222

B5 Figure

1223

1224

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

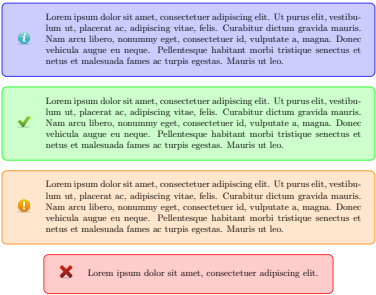


Fig. B.1 A quadrilateral image example.



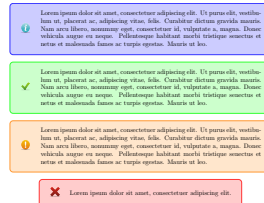
1225 Fig. B.1 is a gray box enclosed by a dark border. List. B.5 shows the corresponding
1226 \LaTeX code.

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

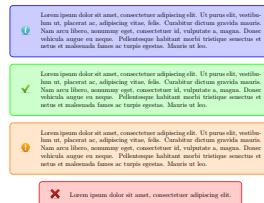
```
1 \begin{figure}[!htbp]
2   \centering
3   \includegraphics[width=0.5\textwidth]{example}
4   \caption{A quadrilateral image example.}
5   \label{fig:example}
6 \end{figure}
7 \cleardoublepage
8
9 Fig.~\ref{fig:example} is a gray box enclosed by a dark border. List.~\ref{lst:onefig} shows the corresponding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



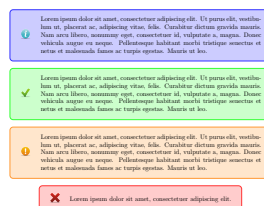
De La Salle University



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



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



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

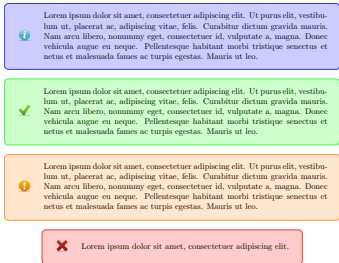
Listing B.6: Sample L^AT_EX code for three figures on top of each other

```
1 \begin{figure}[!htbp]
2 \centering
3 \subbottom[A sub-figure in the top row.]{
4 \includegraphics[width=0.35\textwidth]{example}
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



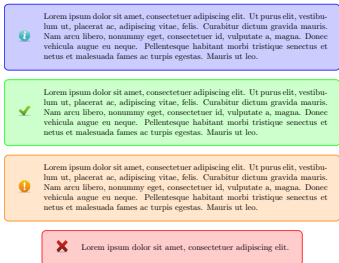
(a) A sub-figure in the upper-left corner.



(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. B.7 for the corresponding L^AT_EX code.

Listing B.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}
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}

```



B6 Table

This section shows an example of placing a table (a long one). Table B.1 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)



1230

List. B.8 shows the corresponding \LaTeX code.Listing B.8: Sample \LaTeX code for making typical table environment

```

1231 1 \begin{center}
1232 2 {\scriptsize
1233 3 \begin{tabularx}{\textwidth}{p{0.1\textwidth}|p{0.2\textwidth}|p{0.5\textwidth}}
1234 4 \caption{Feasible triples for highly variable grid} \label{tab:triple_
1235 5 grid} \\
1236 6 \hline
1237 7 \textbf{Time (s)} &
1238 8 \textbf{Triple chosen} &
1239 9 \textbf{Other feasible triples} \\
1240 10 \hline
1241 11 \endfirsthead
1242 12 \multicolumn{3}{c}{\textit{Continued from previous page}} \\
1243 13 \hline
1244 14 \hline
1245 15 \textbf{Time (s)} &
1246 16 \textbf{Triple chosen} &
1247 17 \textbf{Other feasible triples} \\
1248 18 \hline
1249 19 \endhead
1250 20 \hline
1251 21 \multicolumn{3}{r}{\textit{Continued on next page}} \\
1252 22 \endfoot
1253 23 \hline
1254 24 \endlastfoot
1255 25 \hline
1256 26
1257 27
1258 28 0 & (1, 11, 13725) & (1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0) \\
1259 29 & \\
1260 30 2745 & (1, 12, 10980) & (1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0) \\
1261 31 & \\
1262 32 5490 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1263 33 8235 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1264 34 10980 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1265 35 13725 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1266 36 16470 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1267 37 19215 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1268 38 21960 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1269 39 24705 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1270 40 27450 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1271 41 30195 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1272 42 32940 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1273 43 35685 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1274 44 38430 & (1, 13, 10980) & (2, 2, 2745), (2, 3, 0), (3, 1, 0)

```



```

1285 43 41175 & (1, 12, 13725) & (1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1,
1286      0) \\
1287 44 43920 & (1, 13, 10980) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1288 45 46665 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1289 46 49410 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1290 47 52155 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1,
1291      0) \\
1292 48 54900 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1293 49 57645 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1294 50 60390 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1295 51 63135 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1296 52 65880 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1297 53 68625 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1298 54 71370 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1299 55 74115 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1300 56 76860 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1301 57 79605 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1302 58 82350 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1303 59 85095 & (1, 12, 13725) & (1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1,
1304      0) \\
1305 60 87840 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1306 61 90585 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1307 62 93330 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1308 63 96075 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1309 64 98820 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1310 65 101565 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1311 66 104310 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1312 67 107055 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1313 68 109800 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1314 69 112545 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
1315      1, 0) \\
1316 70 115290 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1317 71 118035 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1318 72 120780 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1319 73 123525 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1320 74 126270 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
1321      1, 0) \\
1322 75 129015 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1323 76 131760 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1324 77 134505 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1325 78 137250 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1326 79 139995 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1327 80 142740 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1328 81 145485 & (1, 12, 16470) & (1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3,
1329      1, 0) \\
1330 82 148230 & (2, 2, 2745) & (2, 3, 0), (3, 1, 0) \\
1331 83 150975 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1332 84 153720 & (1, 12, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1333 85 156465 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1334 86 159210 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1335 87 161955 & (1, 13, 16470) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1336 88 164700 & (1, 13, 13725) & (2, 2, 2745), (2, 3, 0), (3, 1, 0) \\
1337 89 \end{tabularx}
1338 90 }
1339 91 \end{center}

```



1341

B7 Algorithm or Pseudocode Listing

1342

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

1343

1344

TABLE B.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 B.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}

```



1345

1346

1347

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

```

1  /* fibo.c -- It prints out the first N Fibonacci
2  *
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 */

```




1348

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

Listing B.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.
```



B9 Referencing

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

Referencing sections: This section is Sec. B9, which shows how to refer to the locations of various labels that have been placed in the \LaTeX files. List. B.12 shows the corresponding \LaTeX code.

Listing B.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.
```

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.



B9.1 A subsection

Referencing subsections: This section is Sec. B9.1, which shows how to refer to a subsection. List. B.13 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.
```

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.



B9.1.1 A sub-subsection

Referencing sub-subsections: This section is Sec. B9.1.1, which shows how to refer to a sub-subsection. List. B.14 shows the corresponding \LaTeX code.

Listing B.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.



B10 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. B.15 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. B.16), but note that the options must be tweaked. See the manual of `pdfpages` for other options.

Listing B.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 {./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 ⁽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.



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.



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:

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.



Appendix C

PUBLICATION LIST AND AWARD

Journal

1. ...

2. ...

Conference

1. ...

2. ...



De La Salle University

1413

Others

1414

1. ...

1415

2. ...

1416

Award

1417

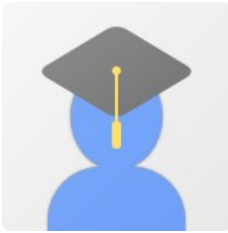
1. ...

1418

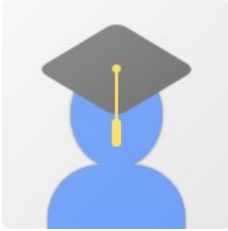
2. ...



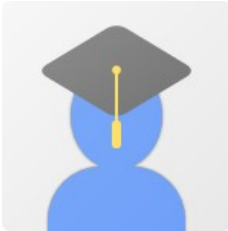
Appendix D VITA



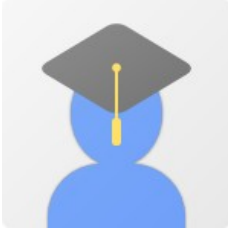
Junlae Cheong is a sixth year student at De La Salle University. He is currently taking up his B.Sc. Computer Engineering studies. His strengths in the field are electronics circuit design and configuration. His fields of interest are electronics hardware and computer microprocessor.



Rohit P. Nihalani is a third year student at De La Salle University. He is currently taking up his B.Sc. Computer Engineering studies. He has designed communication systems which covers basic AM radios. His fields of interest are digital communications and computer networks.



Noel B. Paulino is a third year student at De La Salle University. He is currently taking up his B.Sc. Computer Engineering studies. His strengths in the field are microcontroller program design and advanced electronics.



Ryback Tyrone G. Po is a fourth year student at De La Salle University. He is currently taking up his B.Sc. Computer Engineering studies. He has designed and



1434

1435

programmed electronic circuits that includes microcontrollers. His strengths in the field are microcontroller simulation and programming.



INDEX

1436	contributions, 28
1437	Fourier operator, 70
1438	Fredholm integral, 70
1439	summary, 4