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Guide to the 3-volume book

SOFTWARE ENGINEERING

Vol. 1: Abstraction and Modelling

Vol. 2: Specification of Systems and Languages

Vol. 3: Domains, Requirements and Software Design — in 9 Courses

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Why You Want to Lecture over This Book

- **The Texts:**
  - ⋆ Software engineering: the art, craft, discipline, logic, practice and science of developing large scale software products is in increasing need of a trustworthy, believable and professional base.
  - ⋆ This book is devoted to fill this need.
  - ⋆ The present series of strongly related volumes combine informal, engineeringly sound practices with the rigour of formal, mathematics based approaches.
  - ⋆ The three volumes, 2288 pages, are here suggested as the basis for quite a number of different undergraduate and graduate courses. In this document we outline nine (9) courses.
- **Problem Exercises and Solutions:**
  - ⋆ Each volume contains many exercises.
  - ⋆ Already now solutions can be provided to many of these exercises.
  - ⋆ Eventually all exercises will be so supported.
  - ⋆ A number of medium-to-large scale carefully annotated example — current and upcoming — specifications can serve as role models for lecturers and students alike. Helping lecturers to conduct semester projects and students to carry out such projects.
- **249 Lecture Topics and 2884 Slides:**
  - ⋆ The three volumes cover a great many carefully related topics.
  - ⋆ Each topic is supported by may lecture slides.
  - ⋆ These can — as well – be provided to lecturers.
  - ⋆ The present guide hints at combinations of topics into courses.
  - ⋆ Slide texts form a proper subset of volume and chapter texts.
  - ⋆ The following documents list topics and slide numbers:
    - · **Vol. 1: 71 Topics and 1790 Slides:**
      http://www.imm.dtu.dk/~db/Software_Engineering/ts1.pdf
    - · **Vol. 2: 95 Topics and 1531 Slides:**
      http://www.imm.dtu.dk/~db/Software_Engineering/ts2.pdf
    - · **Vol. 3: 83 Topics and 2563 Slides:**
      http://www.imm.dtu.dk/~db/Software_Engineering/ts3.pdf

- **More URLs:**
  - ⋆ **Software Engineering Book Home Page:**
    http://www.imm.dtu.dk/~db/Software_Engineering
  - ⋆ **Home Page for This Guide:**
    http://www.imm.dtu.dk/~db/Software_Engineering/se-guide.pdf
  - ⋆ **Vol. 1 Table of Contents:**
    http://www.imm.dtu.dk/~db/Software_Engineering/vol1/toc1.pdf
  - ⋆ **Vol. 2 Table of Contents:**
    http://www.imm.dtu.dk/~db/Software_Engineering/vol2/toc2.pdf
  - ⋆ **Vol. 3 Table of Contents:**
    http://www.imm.dtu.dk/~db/Software_Engineering/vol3/toc3.pdf
  - ⋆ **Springer's Vol. 1 URL:**
    http://www.springeronline.com/uk/3-540-21149-7
  - ⋆ **Springer's Vol. 2 URL:**
    http://www.springeronline.com/uk/3-540-21150-0
  - ⋆ **Springer's Vol. 3 URL:**
    http://www.springeronline.com/uk/3-540-21151-9

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1

Background

1.1 A Three-Volume Textbook on Software Engineering

Chapter 4 lists three table of contents for this series of texts and handbooks on software engineering. From these the reader can see that together these volumes span 2284 pages.

1. Abstraction and Modelling	xxxvii + 711 pages
2. Specification of Systems and Languages	xxiv + 753 pages
3. Domains, Requirements and Software Design	xxx + 723 pages

1.1.1 Volume 1: Abstraction and Modelling

Volume 1 covers the basic principles and techniques of abstraction and modeling.

First Vol. 1 provides a sound, but simple basis of insight into discrete mathematics: numbers, sets, Cartesians, types, functions, the λ-calculus, algebras and mathematical logic.

Then Vol. 1 goes on to teach and train its readers in basic property- and model-oriented specification principles and techniques.

The model-oriented concepts that are common to such specification languages as B, VDM-SL, and Z will be propagated here through he use of the RAISE specification language RSL.

Finally Vol. 1 covers basic principles of functional, imperative and parallel specification programming — the latter based on the use of CSP, Hoare's language of communicating sequential processes.

1.1.2 Volume 2: Specification of Systems and Languages

Volume 2 covers the basic principles and techniques of specifying systems and languages.

First Vol. 2 teaches and trains its readers in advanced modelling principles and techniques: hierarchical versus compositional abstraction, denotational versus computational abstraction, and configurational abstraction, that is, abstracting and modeling contexts and states.

Then Vol. 2 goes on to teach and train its readers basic principles and techniques of modeling the semiotics: pragmatics, semantics and syntax of systems and languages.

An important part of Vol. 2 covers principles and techniques of modeling spatial and simple temporal phenomena.

A major part of Vol. 2 is devoted to such specialised topics as: modularity (incl. UML's class diagrams); Petri nets, message and live sequence charts, statecharts and temporal logics — including the duration calculus.

This part epitomises the adage: we "UML"-lise formal techniques. Thus the reader is brought, on a firm, precise, formal basis, on to the (trustworthy, believable and) professional use of such ideas as are the mainstay of UML — albeit the latter in informal, less precise disguises.

Finally Vol. 2 presents principles and techniques for developing the basis for sound and efficient interpreter and compiler development of functional, imperative, modular and parallel programming languages.

Volume 2 has Vol. 1 as prerequisite text.

1.1.3 Volume 3: Domains, Requirements and Software Design

Volume 3 covers the basic principles and techniques of overall software development: from domains via requirements to software designs.

Thus Vol. 3 advocates a novel approach to software engineering based on the adage: before requirements can be formulated one must understand the application domain.

Volume 3 therefore structured as follows: from (i) the principles and techniques for the development of domain descriptions, via (ii) principles and techniques for the derivation of requirements prescriptions from domain models, to (iii) principles and techniques for the refinement of requirements into software designs: architectures and component design.

Emphasis in the coverage of domain and requirements engineering is on "what goes into a proper domain description", respectively "requirements prescription", and on "how does one acquire and analyse the domain knowledge", respectively "the requirements expectations", and "how does one validate and verify domain and requirements models".

Volume 3 is structured so as to be targetable for two rather different audiences: in one clearly marked structure — focusing only on the informal parts — Vol. 3 is targeted at undergraduate students in a second semester course on software engineering, as well as at college lecturers in that field. In another – for the full version of Vol. 3 — it is targeted at advanced students, lecturers and researchers.

This is a novel feature for textbooks.

As such Vol. 3 — in the first, simple version — has no prerequisite texts. In the full version Vol. 3 has Vol. 2 as prerequisite text.

1.2 Lecturers' and Students' Course Material

In addition to the three-volume book, there is extensive course material:

- **Assignments/Exercises:** Most chapters contain assignments, typically 5–6 per chapter.
- **Problem Solutions:** The published volumes do not contain solutions to these problems. As times go by the author may post solutions to an increasing number of problem assignments on the Internet.
- **249 Lecture Topics Covering 5884 Slides:** Each chapter is the direct source of topic lecture slides. For each volume the numbers of separate topics and slides are:
  - ⋆ **Vol. 1: 71 topics, for a total of 1790 slides**
    http://www.imm.dtu.dk/~db/Software_Engineering/ts1.pdf
  - ⋆ **Vol. 2: 95 topics, for a total of 1531 slides**
    http://www.imm.dtu.dk/~db/Software_Engineering/ts2.pdf
  - ⋆ **Vol. 3: 83 topics, for a total of 2563 slides**
    http://www.imm.dtu.dk/~db/Software_Engineering/ts3.pdf

  Course lecturers will be able by means of, for example, `ghostview` to edit slides into any subsets suitable for individual lecture. All slides will be made available to bona fide course lecturers.

1.3 Conclusion

Given the extent of the course material already worked out in quite some detail, it was thought expedient to suggest how the volumes could be used in some nine courses. This is done next.

2

Course Proposals

The nine courses outlined below are typically thought of as one semester, typically 12–14 week courses with typically two lectures a week (of two times 45 minutes). Some courses are centered around solving exercises posed in respective volume chapters — ending with a written three to four hour examination. Such courses, except the examination, can be "patterned" by readers self-studying these volumes. Other courses are more project-oriented: groups of from three to eight students work throughout the semester on a set of related exercises which together "make up" a "single", comprehensive exercise. Appendix A of Vol. 1 and Sect. 1.7.1 of Vol. 3 contain outlines of three (3), respectively fifteen (15) "single", comprehensive project exercises. Chapter exercises in respective volumes then poses specific questions with reference to these 3+15 projects. Chapters 6–9 of Vol. 2 similarly poses a exercises which together form one comprehensive problem — which can, again, be subject to group projects. We refer to Sect. 2.3 for more details.

2.1 Undergraduate Courses

2.1.1 Two Courses in Software Engineering (SE I, SE II)

Volume 3 can be read and taught in basically two ways. The text of Vol. 3 is organised so that it is made syntactically very clear that some material can be skipped in a first reading. That "skippable" material constitutes the "formal stuff" of Vol. 3. Hence:

- **SE I + SE II, Vol. 3 Informally:** See Sects. 2.1.1.1 and 2.1.1.2.
  These two standard module courses, or one double module course, uses only the informal material of Vol. 3.
- **SE I + SE II, Vol. 3 Formally:** See Sect. 2.2.4 on page 13.
  This course may need the informal version of SE I + SE II as prerequisite course(s), depending on the maturity of the students.

2.1.1.1 Software Engineering, SE I

- **Aim:** To cover basic principles and techniques of domain and requirements engineering.
- **Objectives:** To set the reader free to engage with others in domain and requirements engineering, and to enable the reader to follow SE II.

This course is suggested to cover the following Vol. 3 material:

- Vol. 3: Chap. 1, Sects. 1.1, 1.2: The TripTych SE Paradigm
- Vol. 3: Chap. 2. Documentation
- Vol. 3: Chap. 5. Phenomena an Concepts
- Vol. 3: Chap. 8. Overview of Domain Engineering

- Vol. 3: Chap. 9. Domain Stake Holders
- Vol. 3: Chap. 11. Domain Facets
- Vol. 3: Chap. 16. The Domain Engineering Process Model
- Vol. 3: Chap. 17. Overview of Requirements Engineering
- Vol. 3: Chap. 19. Requirements Facets
- Vol. 3: Chap. 24. The Requirements Engineering Process Model

We refer to Sect. 2.3.3 on page 14.

2.1.1.2 Software Engineering, SE II

- **Aim:** To cover advanced principles and techniques of domain and requirements engineering, and to cover basic principles and techniques of software architecture and components design.
- **Objectives:** To set the reader free to lead other software engineers in software development.

This course is suggested to cover the following “intervening” Vol. 3 material:

- Vol. 3: Chap. 1, Sects. 1.3, 1.4, 1.5: The TripTych SE Paradigm
- Vol. 3: Chap. 3. Methods and Methodology
- Vol. 3: Chap. 4. Models and Modelling
- Vol. 3: Chap. 6. On Defining and on Definitions
- Vol. 3: Chap. 7. Jackson’s Description Principles
- Vol. 3: Chap. 10. Domain Attributes
- Vol. 3: Chap. 12. Domain Acquisition
- Vol. 3: Chap. 13. Domain Analysis and Concept Formation
- Vol. 3: Chap. 14. Domain Validation and Verification
- Vol. 3: Chap. 18. Requirements Stake Holders
- Vol. 3: Chap. 20. Requirements Acquisition
- Vol. 3: Chap. 21. Requirements Analysis and Concept Formation
- Vol. 3: Chap. 22. Requirements Validation and Verification
- Vol. 3: Chap. 23. Requirements Satisfiability and Feasibility
- Vol. 3: Chap. 25. Hardware/Software Co-Design
- Vol. 3: Chap. 26. Software Architecture Design
- Vol. 3: Chap. 27. A Case Study in Component Design

We refer to Sect. 2.3.3 on page 14.

2.1.2 A Course in Discrete Mathematics for Software Engineering (DM)

- **Aim:** To cover basic concepts of numbers, sets, Cartesians, types, functions, λ-calculus, algebras and mathematical logic.
- **Objectives:** To enable the reader to follow courses in and to self-study material on formal techniques in software engineering. That is, the remaining material on Vols. 1 and 2 as well as the formal parts of Vol. 3 (A&M, LD&I, SE/“UML”, SS&L and SE III (A or B)).

This course is suggested to cover the following (approximately 200-page) Vol. 1 chapters if not already taught in some other undergraduate course:

- Vol. 1: Chap. 1. Overview part of the Introduction
- Vol. 1: Chap. 2. Numbers
- Vol. 1: Chap. 3. Sets
- Vol. 1: Chap. 4. Cartesians
- Vol. 1: Chap. 5. Types
- Vol. 1: Chap. 6. Functions
- Vol. 1: Chap. 7. A λ–calculus
- Vol. 1: Chap. 8. Algebras
- Vol. 1: Chap. 9. Mathematical Logic

2.1.3 A Course in Abstraction and Modelling (A&M)

- **Aim:** To cover basic principles and techniques of abstraction and modelling (using the formal specification tool of the `RAISE` Specification Language, `RSL`).
- **Objectives:** To enable the reader to master basic concepts of and practical skills with respect to abstraction and modelling, and to serve as a prerequisite for courses LS&I, SS&L and SE/“UML”.

This course is suggested to cover selected parts of the following Vol. 1:

- Vol. 1: Chap. 1. Introduction
- Vol. 1: Chap. 10. Atomic Types and Values in `RSL`
- Vol. 1: Chap. 11. Function Definitions in `RSL`
- Vol. 1: Chap. 12. Property and Model Oriented Abstraction
- Vol. 1: Chap. 13. Sets in `RSL`
- Vol. 1: Chap. 14. Cartesians in `RSL`
- Vol. 1: Chap. 15. Lists in `RSL`
- Vol. 1: Chap. 16. Maps in `RSL`
- Vol. 1: Chap. 17. Higher-order Functions in `RSL`
- Vol. 1: Chap. 18. Types in `RSL`
- Vol. 1: Chap. 19. Applicative Specification Programming (lightly)
- Vol. 1: Chap. 20. Imperative Specification Programming (lightly)
- Vol. 1: Chap. 21. Parallel Specification Programming (lightly)
- Vol. 1: Chap. 22. Etcetera!

We refer to Sect. 2.3.1 on page 13.

2.2 Graduate Courses

2.2.1 A Course in Language Design and Implementation (LD&I)

This course has A&M as a prerequisite course. This course could (and should) precede a course on compiler development based on, for example, [1, 11]. The LD&I course could also be given jointly with a course on formal semantics using either of the books [2, 3, 9, 7, 8, 10, 12].

- **Aim:** To introduce the candidate to basic principles and techniques of semiotics: pragmatics, semantics and syntax, to cover basic abstraction and modelling principles and techniques of denotational (including continuation) and computational (i.e., mechanical) semantics, and to cover basic principles and techniques of designing typed, functional, imperative, modular and parallel programming languages.
- **Objectives:** To enable the reader to design reasonably advanced, yet simple and elegant programming languages, and to develop precise requirements for their interpretation and compilation.

This course is suggested to cover (selected parts of) the following Vol. 1 and Vol. 2 chapters:

- Vol. 2: Chap. 1. Introduction
- Vol. 1: Chap. 19. Applicative Specification Programming
- Vol. 1: Chap. 20. Imperative Specification Programming
- Vol. 1: Chap. 21. Parallel Specification Programming
- Vol. 2: Chap. 6. Pragmatics
- Vol. 2: Chap. 7. Semantics
- Vol. 2: Chap. 8. Syntax
- Vol. 2: Chap. 9. Semiotics
- Vol. 2: Chap. 16. Simple Applicative Language

- Vol. 2: Chap. 17. SIL: Simple Imperative Language
- Vol. 2: Chap. 18. SMIL: Simple Modular, Imperative Language
- Vol. 2: Chap. 19. SPIL: Simple Parallel, Imperative Language

We refer to Sect. 2.3.2 on the facing page.

2.2.2 A Course in "UML"-ised Formal SE Techniques (SE/"UML")

This course has course (a study of) A&M as a prerequisite course (study).

- **Aim:** To introduce the reader to basic diagrammatic specification principles and techniques of software development such as the latter (the diagrammatic) are found, albeit less precisely, in, for example, `UML`.
- **Objectives:** To enable the reader to master principles and techniques of Petri nets, message and live sequence charts and statecharts — and thus, as a beneficial side effect, to more professionally use `UML` critically and effectively.

This course is suggested to cover (selected parts of) the following Vol. 2 chapters:

- Vol. 2: Chap. 1. Introduction
- Vol. 2: Chap. 10. Modularisation, Class Diagrams
- Vol. 2: Chap. 11. State Automata and Machines
- Vol. 2: Chap. 12. Petri Nets
- Vol. 2: Chap. 13. Message and Live Sequence Charts
- Vol. 2: Chap. 14. Statecharts

• • •

The above course, SE/"UML", is a brief version of the next course, SS&L. For both courses the Vol. 2, Chap. 12 coverage of Petri nets is adequate. But a deeper, more satisfying study of Petri nets can be advised. We recommend [5, 4, 6]. Vol. 2, Chap. 12 is short on challenging exercises. Such can be found in [5, 4, 6].

2.2.3 A Course in Specification of Systems and Languages (SS&L)

This course has course (a study of) A&M as a prerequisite course (study).

- **Aim:** To introduce the reader to advanced abstraction and modelling principles and techniques for the development of complex systems including real-time embedded systems.
- **Objectives:** To enable the reader to tackle, with confidence, the specification of sophisticated computing systems.

This course is suggested to cover selected parts of the following Vol. 2 chapters:

- Vol. 2: Chap. 1. Introduction
- Vol. 2: Chap. 2. Hierarchies & Compositions
- Vol. 2: Chap. 3. Denotations & Computations
- Vol. 2: Chap. 4. Configurations: Contexts and States
- Vol. 2: Chap. 5. Time, Space and Space/Time
- Vol. 2: Chap. 10. Modularisation, Class Diagrams
- Vol. 2: Chap. 11. State Automata and Machines
- Vol. 2: Chap. 12. Petri Nets
- Vol. 2: Chap. 13. Message and Live Sequence Charts
- Vol. 2: Chap. 14. Statecharts
- Vol. 2: Chap. 15. Quantitative Models of Time

2.2.4 Two Advanced Courses in Software Engineering (SE III A or B)

This course is basically the formal version of courses SE I + SE II, see Sects.2.1.1.1 and 2.1.1.2.

SE III will cover the same chapters as courses SE I and SE II, but now emphasising the formal material.

There are two versions of this course:

- **SE III A:** A short, having the informal version of SE I and SE II as prerequisite.
  - ⋆ **Aim:** To introduce the reader to principles and techniques of formal software engineering: modelling domains, requirements and software design. The course contents follow that of course SE I, but present this material formally.
  - ⋆ **Objectives:**
- **SE III B:** A long, which does not have SE I + SE II as prerequisite — but instead covers the chapters mentioned in Sect. 2.1.1 on page 9 and 2.1.1 on page 10.
  - ⋆ **Aim:** To introduce the reader to principles and techniques of formal software engineering: modelling domains, requirements and software design, and additionally covers principles and techniques of acquisition, analysis, verification, verifications as well as other topics. The course contents follow that of courses SE I + SE II, but present this material formally.
  - ⋆ **Objectives:** To enable the reader to lead formal development of large software systems.

Course SE III A has courses (a study of) LD&I or SS&L as a prerequisite course (study). Course SE III B has both LD&I or SS&L as prerequisites.

2.3 "Single" Project Exercises

In the introduction to this chapter we briefly mentioned a notion of "single", comprehensive group project exercises. We repeat from there:

> *Appendix A of Vol. 1 and Sect. 1.7.1 of Vol. 3 contain outlines of three (3), respectively fifteen (15) "single", comprehensive project exercises. Chapter exercises in respective volumes then poses specific questions with reference to these 3+15 projects. Chapters 6–9 of Vol. 2 similarly poses a exercises which together form one comprehensive problem — which can, again, be subject to group projects.*

2.3.1 Vol. 1 Project Exercises

The three exercise clusters of Vol. 1 are:

1. Transportation Nets
2. Container Logistics
3. Financial Service Industry

Exercises section of chapters 2–5, 8–16, 18–21 then poses a total of nineteen (19) assignments for each of these three application areas.

2.3.2 Vol. 2 Project Exercises

Exercises sections of chapters 6–9 poses fourteen (14) assignments related to the pragmatics, semantics and syntax of an evolving set of programming languages: first (Chaps. 6–9), `STIL`, a simply typed imperative language, then (Chap. 9) three extensions to `STIL`, extensions that should result in a complete definition of an imperative programming language which allows the programmer to define types with dimensions and units (like length, respective either millimeter, centimeter, meter, kilometer, etc.). On the basis of Chaps. 16-19 of Vol. 2, the course lecturer can extend thus language design project into an interpreter and compiler development project.

2.3.3 Vol. 3 Project Exercises

The fifteen exercise clusters of Vol. 3 center around domain, requirements and software design engineering answers (including software related) to the following questions

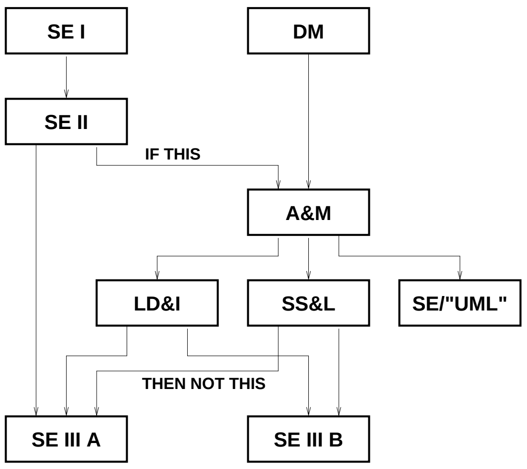
1. *What is administrative forms processing?*
2. *What is an airport?*
3. *What is air traffic?*
4. *What is a container harbour?*
5. *What is a document system?*
6. *What is a financial service system?*
7. *What is freight logistics?*
8. *What is a hospital?*
9. *What is a manufacturing company?*
10. *What is the market?*
11. *What is a metropolitan area tourism industry?*
12. *What is a railway system?*
13. *What is a university?*
14. *What is public administration?*
15. *What is a ministry of finance?*

Almost all exercise sections of Vol. 3 chapters contain almost 70 specific assignments related to any one of the above specific project clusters.

3 Course and Volume Diagrams

3.1 Course Diagram

The following diagram hints at possible prerequisite "arrangements" of the up towards nine different courses:



3.2 Brief Guide to Studies of Volume 1

Figure 3.1 abstracts a precedence relation between chapters. It is one that approximates suggested sequences of studying this volume.

- Chapter 1 is considered a prerequisite for the study of any chapter.
- Chapters 2–4 may be skipped by readers with some schooling in discrete mathematics.
- Chapters 5–6 may be skipped by readers with a bit more schooling in discrete mathematics.
- Chapters 7–9 can only be skipped by readers who have a reasonably firm grip on the topics mentioned.
- Chapters 10–16 from the core of Vol. 1.
- If, after Chap. 1, you continue with Chap. 2, then you should study all of Chaps. 2–9.
- If, after Chap. 1, you continue with Chap. 5, then you should study all of Chaps. 5–9.
- If, after Chap. 1, you continue with Chap. 7, then you should study all of Chaps. 7–9.
- You can skip Chaps. 17 and/or 18 before continuing with Chaps. 19–21.
- You can exit your study of this volume after any of Chaps. 16–21.
- It is no harm to study Chap. 22.

Within most chapters many sections can be skipped. Typically those with larger examples or towards the end of the chapters.

In this way a teacher or a reader can compose a number of suitable courses and studies.

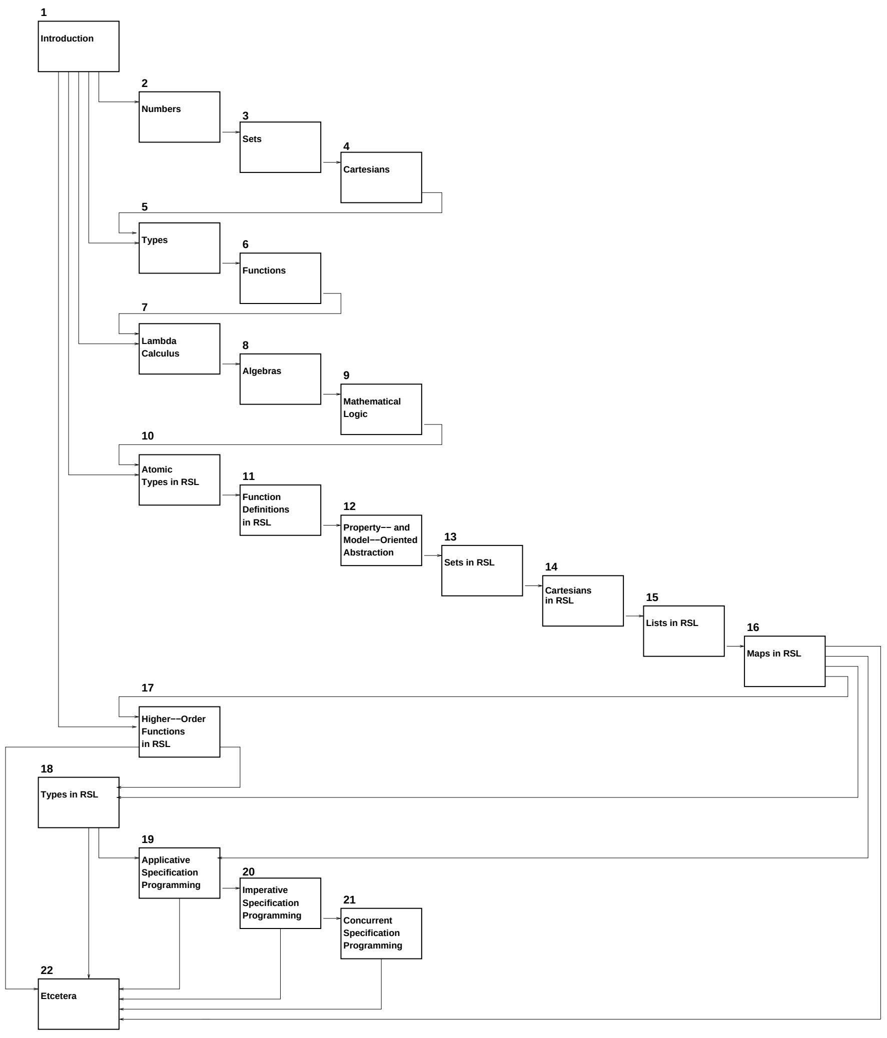

1 Introduction
2 Numbers
3 Sets
4 Cartesians
5 Types
6 Functions
7 Lambda Calculus
8 Algebras
9 Mathematical Logic
10 Atomic Types in RSL
11 Function Definitions in RSL
12 Property-- and Model--Oriented Abstraction
13 Sets in RSL
14 Cartesians in RSL
15 Lists in RSL
16 Maps in RSL
17 Higher--Order Functions in RSL
18 Types in RSL
19 Applicative Specification Programming
20 Imperative Specification Programming
21 Concurrent Specification Programming
22 Etcetera

Fig. 3.1. Volume 1 chapter precedence graph

3.3 Brief Guide to Studies of Volume 2

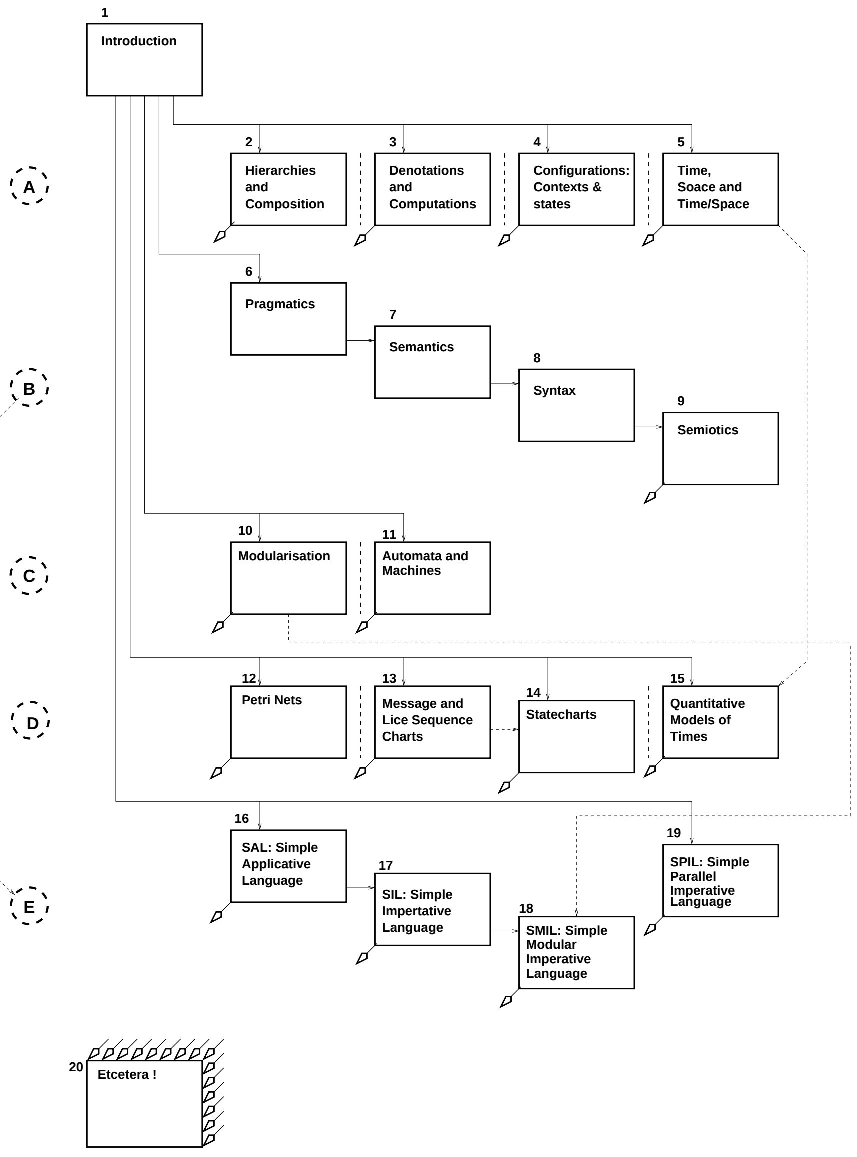
Figure 3.2 abstracts a precedence relation between chapters. It is one that approximates suggested sequences of studying this volume.

- Chapter 1 is considered a prerequisite for the study of any chapter.
- We group some parts into the dash-circled groups $A - E$.
- Group A consists of Chaps. 2–5 that can be studied in any order.
- Group B consists of Chaps. 6–9 that should be studied in order 6, 7, 8 and 9.
- Group C consists of Chaps. 10–11 that can be studied in any order.
- Group D consists of Chaps. 12–15 that can be studied in almost any order. Chaps. 14 does contain an example which requires having studied Chap. 13 first.

- Group E consists of Chaps. 16–19 that should be studied in order 16, 17 and 18. Chap. 19 can be studied in-between, before, or after. Preferably after.
- Groups $A - E$ can be studied in any order. But it might be useful to have studied Chap. 5 before Chap. 15, and Chap. 10 before Chap. 18, and to have studied Group B before Group E.
- It is no harm to study Chap. 20.

Within most chapters many sections can be skipped. Typically those with larger examples or towards the end of the chapters.

In this way a teacher or a reader can compose a number of suitable courses and studies.



1 Introduction
A
2 Hierarchies and Composition
3 Denotations and Computations
4 Configurations: Contexts & states
5 Time, Soace and Time/Space
6 Pragmatics
7 Semantics
8 Syntax
9 Semiotics
B
C
10 Modularisation
11 Automata and Machines
D
12 Petri Nets
13 Message and Lice Sequence Charts
14 Statecharts
15 Quantitative Models of Times
E
16 SAL: Simple Applicative Language
17 SIL: Simple Impertative Language
18 SMIL: Simple Modular Imperative Language
19 SPIL: Simple Parallel Imperative Language
20 Etcetera !

Fig. 3.2. Volume 2 chapter precedence graph

3.4 Brief Guide to Studies of Volume 3

Volume 3 can be studied in a number of ways. Any path — through chapters (i.e., nodes) — from the input node, labelled 1, to the output node, labelled 32, can form a course. Let us elaborate briefly on that:

Base Course in SE: A minimum course covers Chaps. 1, 2, 5, 8, 11, 16, 17, 19, 24–26, 30–32. That is, all the left column chapters!
Domain Engineering: A course focusing on domain engineering would additionally cover Chaps. 9, 10 and 12–15.
Requirements Engineering: A course focusing, instead, on requirements engineering would in addition to the base course cover Chaps. 18 and 20–23.
Software Design: A course focusing on software design would in addition to the base course cover Chaps. 17–29.

Any of the four courses outlined above can be given in either of two ways:

Informal: In this way of studying this volume the reader can skip the formalisation bits and focus just on the informal material. That is, one can study this volume, in principle and in reality, without first having studied Vol. 1 or Vols. 1 and 2.
Formal: In this way of studying this volume the reader cover all the informal material as well as the formal material — and thus a study of at least Vol. 1 is a prerequisite for studying the present volume.

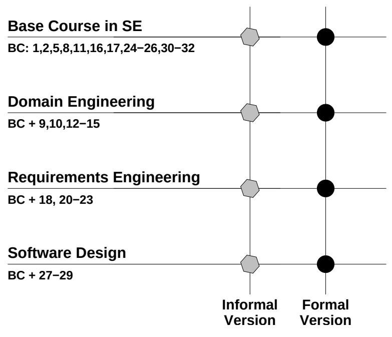
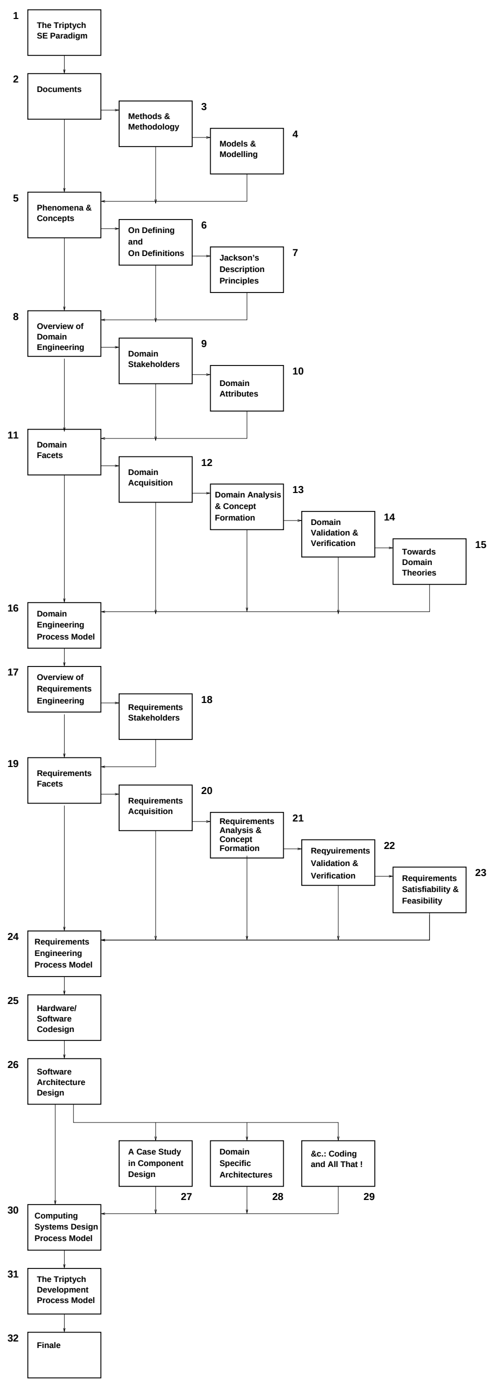


Fig. 3.3. Course alternatives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8 Overview of Domain Engineering
9 Domain Stakeholders
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28 Domain Specific Architectures
29 &c.: Coding and All That !
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31 The Triptych Development Process Model
32 Finale

Fig. 3.4. Volume 3 chapter precedence graph

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