Lecturer:

* Petra LE ROUX

Module Name:

* Formal Program Verification

Prescribed book:

* Program Construction: Calculating Implementations from Specifications

Recommended book:

* The Spine of Software: Designing Provably Correct Software - Theory and Practice. John Wiley & Sons, Chichester, 1987.

Lecture of the module is specified in the myUnisa

Assessment plan:

* The prescribed book (i.e. Backhouse or RB) consists of 16 chapters which are covered in this module.
  + **Motivation**: Chapters 1 and 2 set the scene for why reasoning about algorithms is important.
  + **Arithmetic preliminaries:** Chapters 3, 6, 8, 11 and 12 cover various aspects often needed in the verification of programs. Assignments 01 and 02 cover this part.
  + **Logic**: Chapters 5, 7 and 11 deal with logical reasoning including a thorough treatment of equivalence. These three chapters do not form part of the curriculum, although it is recommended that you read through them.
  + **Implementation**: Chapter 4 is a short chapter and shows how to correctly implement some algorithms in Java.
  + **Verification principles:** Chapters 9, 10 and 13 in RB as well as Chapter 3 in Baber develop the theory needed to 9 reason about familiar program constructs, e.g. assignments, if-then-else, sequences of statements, loops, etc. Assignment 02 covers this part.
  + **Practice**: Chapters 14, 15 and 16 look at a variety of concrete examples. Assignment 03 covers this part.

**Assignments due dates**:

* Assignments to be done are 3.

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| Assignment no | Chapters |
| 1 | RB Chapters 1 - 8 |
| 2 | RB Chapters 9 - 13 Baber Chapter 3 |
| 3 | RB Chapters 14 - 16 |

**Year Mark and final examinations**:

* The weight for Assignment 01 is 0.30 i.e. 30% of your year mark; the weight for Assignment 02 is 0.40 (40%) and the weight for Assignment 03 is 0.30 (30%).
* Year mark counts towards 20% of your final mark.

Assignment opens: **15 April 2024**.

Assignment closes: **14 May 2024**

**Lessons:**

**Lesson 1:**

**Study Material:**

* Backhouse Chapters 1 and 2

**Overview:**

* Chapters 1 and 2 set the scene for why reasoning about algorithms is important.

**Specific Outcomes:**

* Reason about algorithms.
* Identify and discuss drawbacks of debugging.
* Illustrate the testing of a correct and incorrect program.
* Examine the main elements of program construction.

Chapter 3: Calculation Proof:

After completion of Chapter 3, you will be able to:

* discriminate between formal (syntactic) and informal (semantic) proofs
* illustrate and discuss the nature of proving the correctness of programs
* discriminate between construction and the verification of proofs
* format a calculation
* construct simple calculational proofs

Discriminate between formal (syntactic) and informal (semantic) proofs:

**Informal Proof**:

* Consist of a mixture of **natural language** (e.g. English), and **mathematical calculations**.
  + English part **outlines the main steps in the proof**.
  + Mathematical calculations **fill in some of the details**.
* Informal proofs place a large burden on the reader because the reader is expected to have good understanding of problem domain and the meaning of natural language statements, as well as the language of mathematics.
* Because they rely on meaning, we can say they are **semantic proofs**.

**Formal Proof**:

* Is conducted **entirely in the language of mathematics**.
* Is a sequence of steps, each of which is a well-established fact or which follows from earlier statements by a process so simple that is deemed to be self-evident.
* It is also known as **Syntactic proof**.