GENERAL INFORMATION
Course Web Page
www3.cs.stonybrook.edu/~cse371

The course Webpage contains:

COURSE Lectures Slides with material we cover during the semester

BOOK Chapters Slides

Collection of Past Quizzes and Tests
Course Text Book

Anita Wasilewska

Logics for Computer Science: Classical and Non-Classical
Springer 2018

You can get the book in Hard cover, or in Electronic form
Springer also has an option of providing you with chapters of your choice
Course Goal

The goal of the course is to make students understand the need for, and to learn the formality of logic as a scientific field.

I will progress relatively slowly, making sure that the pace is appropriate for students in the class.

The book is written with students on my mind so that they can read and learn by themselves, even before coming to class.
Course Goal

The main goal of the course is to teach **intuitive** and **formal** understanding of the **classical logic** and some **non-classical logics**

Moreover, the **goal** of course is also to teach the modern **formal logic** as a **scientific subject**

You will learn **Formal Logic** basic notions and definitions, Main Theorems, similarities, differences and problems characteristic to **different logics; classical** and **non-classical**
Workload

There will be two Quizzes, one Midterm and a Final

Each quiz will consist of 3 - 4 questions

None of the grades will be curved.
Workload

Quizzes and Tests problems may be taken from exercises and problems solved in the Book.

They will be very similar to Homework Assignments located at the end of the chapters of the BOOK.

Our actual Quizzes and Tests may have a different form and cover different material depending on what we actually cover in class.

There also will be some challenge problems given as extra credit.
Final grade computation

You can earn up to 200 points + x extra points = 200+x points during the semester.

The grade will be determined in the following way:
# of earned points divided by 2 = % grade

The % grade is translated into a letter grade in a standard way as described in the course Syllabus.
Final grade computation

The % grade is translated into a letter grade in a standard way i.e.

100 – 95 % is A
94 – 90 is A–
89 – 86% is B+, 85 – 83 % is B, 82 – 80 % is B–
79 – 76 % is C+, 75 – 73 % is C, 72 – 70 % is C–
69 – 60 % is D range and
F is below 60%
General Goals and Tasks of the Book
The General Goal of the Book

The **General Goal** of the book is to make readers understand the need of, and existence of **Logic** as a **scientific** field.

The **book** teaches not only **intuitive** understanding of different logics, but also teaches modern **symbolic logic** as a **scientific** subject.

The **book progresses** relatively **slowly**, making sure that the pace is appropriate for a reader with only **cursory knowledge** of logic.

**Readers** can learn introductory chapters by themselves, and then gradually **progress** to more **advanced** chapters and other, more **advanced books**.
Main Tasks of the Book

First Task when one builds a symbolic logic, or foundations of mathematics, or foundations of computer science, is to define formally a proper symbolic language.

We distinguish and define two kind of languages: propositional and predicate.

They are also called also zero and first order languages, respectively.
Main Tasks of the Book

Second Task is to define formally what does it mean that formulas of a symbolic language are considered to be true, and always true i.e. we have to define a notion of a tautology.

It means that we define what is called a semantics for a given language.

The same languages can have different semantics.

For example, the languages for classical and intuitionistic logics can be the same, but their semantics are different.
Main Tasks of the Book

Third Task is to define a syntactical notion of a proof in a proof system based on a given language.

It allows us to find out what can, or cannot be proved if certain axioms and rules of inference are assumed.

This part of syntax is also called a proof theory.
Main Tasks of the Book

Fourth Task is to investigate the relationship between a syntactical notion of a proof system based on a given language and a semantics for that language.

It means we establish formal relationship between the syntax and a semantics for a given language.

This relationship is established by providing answers to the following two questions.
Main Tasks of the Book

Fourth Task is to pose and answer the following questions

Q1:  Is everything one proves in a given proof system tautology under a given semantics?

The positive answer to the question Q1 is called Soundness Theorem for a given proof system and a given semantics proof system.

Such proof system is called a sound proof system.
Main Tasks of the Book

We write the **Soundness Theorem** symbolically as follows

**Soundness Theorem** (with respect to a semantics $M$)
Let $S$ be a proof system and $A$ any formula of its language, then the following holds

$$\text{IF } \vdash_S A \text{ THEN } \models_M A$$
Main Tasks of the Book

Q2: Is it also possible to guarantee a provability in a sound proof system of everything we know to be a tautology under a given semantics?

The positive answer to the question Q2 is called Completeness Theorem for a proof system under a given semantics.

Such proof system is called complete proof system with respect to the given semantics.
Main Tasks of the Book

We write the Completeness Theorem symbolically as follows

CompletenessTheorem (with respect to a semantics $M$)
Let $S$ be a proof system and $A$ any formula of its language, then the following holds

$$\vdash_S A \quad \text{if and only if} \quad \models_M A$$
Main Tasks of the Book

**Fifth Task** is to develop proof systems in which a process of finding proofs can be carried fully automatically.

These are **automated theorem proving** systems.

The book presents various **Gentzen Type automated theorem proving systems**.

It also discusses various methods of proving the **Completeness Theorem** for them.

The book also provides an introduction to the **Resolution based automated theorem proving systems**.
Main Goals of the Book

The first set of Main Goals of the book is to formally define and develop the above FIVE TASKS in case of Classical Propositional and Predicate Logic.

The second set of Main Goals is to develop and discuss the FIVE TASKS for some Non-Classical Propositional Logics, namely for some extensional Many Valued logics, for the Intuitionistic logic, and Modal S4, S5 logics.
Main Goals of the Book

The third set of Main Goals of the book is to formally define and develop the notion of a formal theory based on a given proof system for a first order logic.

It discusses notions of a model of a theory, its semantical and syntactical consistency and completeness.

The book presents some Formal Theories based on classical predicate logic. In particular presents the Peano Arithmetic of Natural Numbers PA and discusses and proves the Gödel Incompleteness Theorems.