LECTURE 0
GENERAL INFORMATION
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
The BOOK Goal

I wrote the Book with students on my mind so that they can read and learn by themselves, even before coming to class.

For sure, it is also essential to study after the class.

The Book and hence the course progresses slowly, making sure that the pace is appropriate for somebody without previous knowledge of formal logic.

The Book contains hundreds of examples and problems with detailed solutions to facilitate understanding of material.
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**.
The course Webpage contains:

**Lecture SLIDES** for each chapter of the BOOK

Collection of previous **Tests**

We will not cover all of the chapters of the BOOK in detail. I made Lectures for all of them **accessible** for students’ reading and future use.
The course [Webpage](www3.cs.stonybrook.edu/~cse371) contains two kind of Lectures: Class Lectures and VIDEO Lectures. Class Lectures are very detailed and contain more examples and problems with carefully written detailed solutions than the VIDEO Lectures. Class Lectures were developed for each Chapter of the Book with 2 - 5 Class Lectures for one Chapter.
The **Video Lectures** are created especially for the Logic Youtube Channel.

The **VIDEO Lectures** correspond, chapter by chapter to the slides used in the Texbook Chapters **VIDEOS**.

You can use the **VIDEO Lectures** slides to follow the Chapters **VIDEOS** as they are exactly the same as slides used in the **VIDEOS**.
Logic Youtube Channel

LOGIC, Theory of Computation CHANNEL
https://www.youtube.com/channel/UCLZp06JC9yit6M_YW3Xuvlw
First 4 VIDEOS are for the Theory of Computation, the
LOGIC VIDEOS follow
Workload

There will be a Midterm, a Practice Final, and a Final

The consistency of your efforts and work is the most important for this course.

None of the grades will be curved.

Records of students points are kept on BRIGHTSPACE

Contact TAs. for information about grading, grades changes, etc....
TESTING

TESTS cover material that was presented in class before the dates of respective tests. Consult Weekly STUDY PLAN posted on the course Webpage. PRELIMINARY schedule is posted on the course webpage. Changes will be posted on Brightspace.

WE DO NOT GIVE MAKE-UP TESTS
Tests

**Midterm (100ts)**
Midterm will covers material presented in class before the week of the Midterm

**Practice Final (15 extra pts)**
Practice Final will have Problems only from material covered after Midterm

We will correct only one problem and post solutions for you to study and prepare for the Final
Tests

Final (100pts)

Final will cover mainly class material covered after the Midterm, including material from the Practice Final

There will be 1-2 questions from the material covered in the Midterm

Extra Credit  I may give some extra credit problems on Tests.
This is a PRELIMINARY schedule. Changes, if any, will be posted on BRIGHTSPACE and course Webpage.

**MIDTERM** - Tuesday, **March 5**

Spring Break  March 11 - March 17

**Practice Final**  Tuesday, **April 30**

Last Class  Thursday, **May 2**

**FINAL** - during the Finals Period **May 6 - 15**
Tests

Tests problems will be similar to exercises and problems solved in the Book. They also can be similar to problems included in the Class Lectures, to problems in previous Quizzes, and Tests as published on the Webpage. Our actual Tests will have a different content and cover different material depending on what we actually cover in class. There also may be some challenge problems given as extra credit.
Final grade computation

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

The grade will be determined in the following way:

$\frac{\# \text{ of earned points}}{2} = \% \text{ grade}$

The $\% \text{ grade}$ 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 Course
The Goals of the Course

The **Main Goals** of course is to make students understand the need of, and the existence of **Logic** as a **scientific** field, to teach not only **intuitive** understanding of different logics, but also to present **symbolic logic** as a **scientific** field.

The course progresses **slowly** with the pace is appropriate for students with only **cursory knowledge** of logic.

Students will learn first **introductory chapters** of the book and then gradually **progress** to more **advanced** chapters and to 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 the 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 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

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

$$\vdash_S A \text{ if and only if } \models_M A$$
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.