

cse371 math371 LOGIC

Professor Anita Wasilewska

LECTURE 0

COURSE SYLLABUS and GOALS

COURSE SYLLABUS

Course Text Book

Anita Wasilewska

Logics for Computer Science: Classical and Non-Classical

Springer 2018

ISBN 978-3-319-92590-5 ISBN 978-3-319-92591-2 (e-book)

Please **download** a **pdf copy** of the **Text Book** from the course webpage; www3.cs.stonybrook.edu/~cse371

Print, read and **study** the **relevant chapters** before and after the **Lectures**. Study **Examples** and **Problems Solutions**.

You need to know them for your **Tests** and **Quizzes**.

You can get the book in **Hard cover**, or in **Electronic form**

<https://www.springer.com/us/book/9783319925905>

The BOOK GOALS

I wrote the **Book** with students on my mind so that they can **read** and **study** 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 and study for **Tests**

COURSE GOAL

The **main goal** of the course is to teach **intuitive** and **formal** understanding of **classical** and some of **non- classical logics** by teaching **Symbolic Logic** as a **scientific** subject.

Students will learn the **Symbolic Logic** basic **notions**, **definitions**, and the role of its the most important **Theorems** by exploring problems, similarities, and differences characteristic to **different logics**; **classical** and **non-classical**.

VIDEO LECTURES

We have a **Youtube Channel**: **Logic, Theory of Computation**. The first 4 Lectures are for Theory of Computation, **Logic Lectures** follow.



It contains set of VIDEOS filmed in **Stony Brook TV Studio**. We cover only **Chapters 1 -7**, **Video Lectures** cover **Chapters 1 - 11**. Please use them as a **suplement** to **course Lectures** when you study at home.

COURSE WEBPAGE

Course Webpage contains Class and Video Lectures

L1.

Class Lectures are more detailed and contain many examples and problems solutions you need to **study** for the tests

There are 3 - 5 Class Lectures for one **Chapter** of the book

i. e. for one Video Lecture

L2. Video Lectures are created especially for Chapters Videos. Students can follow the Video Lectures, chapter by chapter, with exactly the same slides in hand that were used in the Chapters Videos

TESTS PRINCIPLES

TESTS are "closed book" - no cell phones, no computers, clean desks, no extra papers, no any form of communication with other students.

Professor supervises all TESTS together with the course **TAs**
Anybody **violating** these rules will have to immediately **submit** the TEST to the **Professor** and **leave the class**

Student then will get **Opts** for the TEST and will be reported, if needed, to the **Academic Judiciary** as **stated** and **explained** the the University Academic Integrity Statement included in the **Syllabus**

Make -up Exams Policy

The **Course Policy** on **make-up exams**, is consistent with university policy as defined in the Undergraduate Bulletin
<https://www.stonybrook.edu/sb/bulletin/current/>

Make-up exams will be given only in **extenuating circumstances**. For example doctor's note stating that student is ill and unfit to take the exam

Specific arrangements will be made on a **case-by-case basis**

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

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**

WORKLOAD

There will **2 Quizzes, Midterm**, and a **Final** examinations

We will also 2 **EQuizzes** - **Extra Credit Quizzes** for
total of **(10 extra points)** with dates advertised as they come

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

Records of students points are kept on BrightSpace

Contact course **TAs** for information about grading, grades
changes, etc....

PRELIMINARY TESTS SCHEDULE

This is a **preliminary** schedule. Changes, if any, will be posted on Brightspace and the course Webpage

EQuiz 1 Thursday, **September 18** - extra credit EQ1

Quiz 1 Thursday, **October 6** - regular Q1

Fall Break **October 13-14**

MIDTERM Thursday, **October 23**

EQuiz 2 Thursday, **November 6** - extra credit EQ2

Quiz 2 Thursday, **November 20** - regular Q2

Last Class Thursday, **December 8**

FINAL - during the Finals Period **December 10-18**

GRADING COMPONENTS

2 Quizzes - 20pts each, 40pts total

2 EQuizzes - Extra Credit Quizzes - 10 extra points total

Midterm - (80pts)

Final - (80pts)]

Midterm will cover material from all Lectures given in class before Midterm.

Final will cover mainly material Lectured after Midterm but there will be 1-2 questions from Midterm material.

None of grades will be curved

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%

COURSE GOALS and TASKS

Main Goals

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

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

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

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

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

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

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

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

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

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

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

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**