cse541
LOGIC for COMPUTER SCIENCE

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/Users/anita/Desktop/mytv copy.jpg

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**. 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 **0pts** 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 Undregraduate 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 have some **EQuizzes** - Extra Credit Quizzes for total of **(15 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, February 13 - extra credit Q1, more to be advertised in class

Quiz 1 Thursday, February 27 - regular Q1

MIDTERM Thursday, March 13

Spring Break March 17 - 21

Quiz 2 Thursday, April 17 - regular Q2

Last Class Thursday, May 8

FINAL - during the Finals Period May 13 - May 21

GRADING COMPONENTS

2 Quizzes - 20pts each,40pts total

EQuizzes - Extra Credit Quizzes - 20 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

$$\text{IF} \quad \vdash_S A \quad \text{THEN} \quad \models_{\mathbf{M}} A$$

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

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

$$\vdash_S A \quad \text{if and only if} \quad \models_{\mathbf{M}} A$$

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**