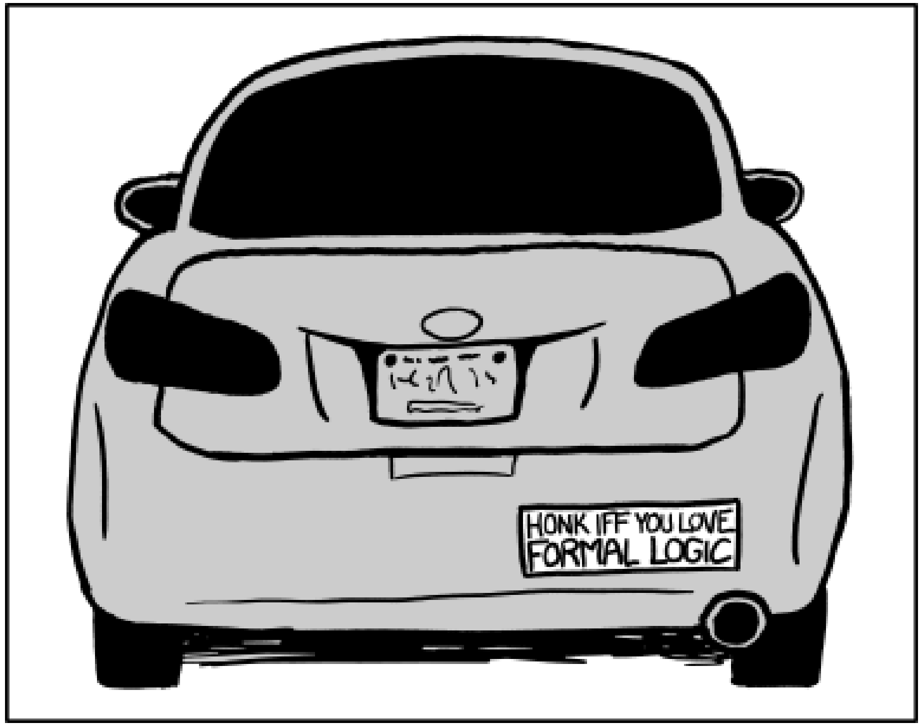


Logistics and Propositional Logic

CSE 311: Foundations of Computing I
Lecture 1

Course Logistics

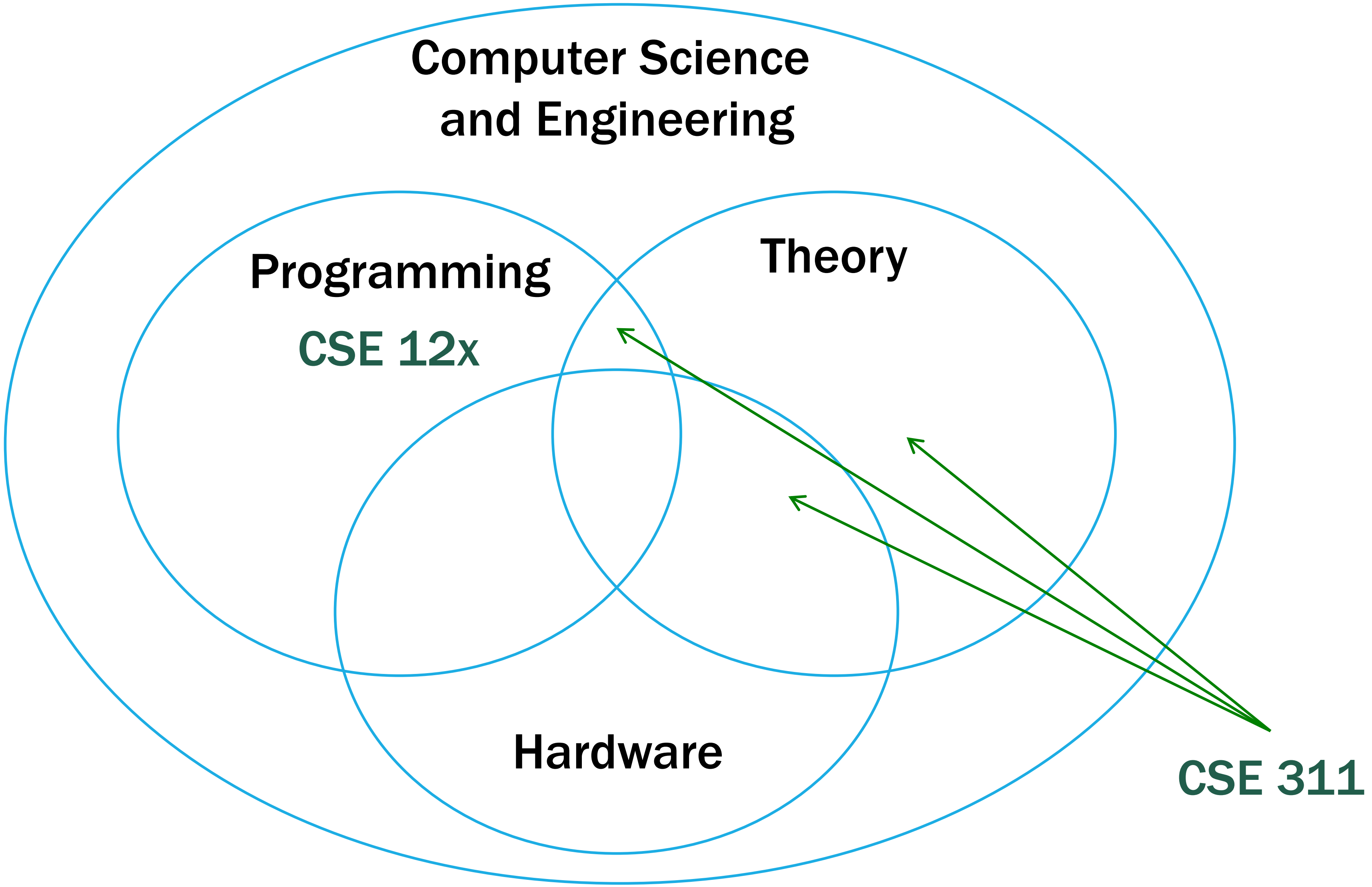
Course Staff

Anjali Agarwal (she / her)
Instructor

Cade Dillon (he / him)
TA

Robert Stevens (he / him)
TA

Perspective



Course Goals

1. Learn to make & clearly communicate rigorous formal arguments
   - Mathematical Proofs
2. Understand mathematical objects that are widely used in CS
   - Number Theory, Set Theory, Recursively-Defined Functions
3. Explore and analyze models of computation
   - Regular Expressions, Context-Free Grammars
4. Develop a toolkit for approaching computational problems
   - Programmer → Computer Scientist

Lectures & Sections

Lectures

- Monday, Wednesday, Friday. Recorded.

Sections

- TA-led sections meet on Thursdays
- Opportunity to practice and ask questions
- Materials are posted, but sections aren’t recorded
- Participation is part of the course grade
- Can make-up absence from a couple of sections

Homework

- 7 written assignments (no programming)
- Posted Wednesday evenings, due the follow Wednesday at 11:59 pm
  - HW 1 released tonight, shorter
- Start early & consider typesetting

Exams

- In-class midterm on July 28th
- In-class final on August 17th and 18th

Getting Help

Office Hours

- Schedule posted on course website
- Begin this Monday

Ed Discussion

- Post any content or logistical questions

Study Groups

- 311 is *different* than programming

Textbook

- **Optional**: Discrete Mathematics and its Applications
  Kenneth Rosen, 6^{th} or 7^{th} edition
- Helpful practice problems

Course Grades

55% Homework

15% Midterm Exam

25% Final Exam

5% Section Participation

Late Policy

- You have 4 late days for the quarter
- You can use a late day to turn in an assignment up to 24 hours late with no penalty
- You can use at most 2 late days per assignment
- In the case of extenuating circumstances, please reach out

Collaboration Policy

- Collaboration with others is **encouraged**
  - Do help other students learn
  - Do not help other students *avoid* learning
- Policy:
  - List all names of those you worked with
  - Don’t take away pictures or notes from discussions
  - Write up the final solutions on your own

Course Tools

Course Website
(assignments, calendar)

gradescope

Gradescope
(submissions, feedback)

ed

Ed Discussion
(discussion board)

Canvas
(lecture recordings)

Poll Everywhere
(lecture polling)

Propositional Logic

What is logic?

Logic is a language, like English or Java, with its own:

- Syntax: ____
- Semantics: ____

Why not use English?

English can be ambiguous or imprecise.

- Turn right here.

  Does “right” mean the direction, or “right now”?

- We saw her duck.

  Does “duck” mean the animal, or duck down?

- Buffalo buffalo Buffalo buffalo buffalo buffalo Buffalo buffalo.

  This means “Bison from Buffalo, that bison from Buffalo bully, themselves bully bison from Buffalo”

Benefits of formal logic

- We can state sentences precisely
- We can state sentences concisely
- The meaning of our sentences is unambiguous

Propositions: building blocks of logic

Definition:

A proposition is a ____

Examples:

All cats are mammals

All mammals are cats

Analogy

Boolean (true / false) variables in Java

Are these Propositions?

$2 + 2 = 5$

$x + 2 = 5$

Akjsdf!

Who are you?

There is life on Mars.

There is an infinite number of primes.

Proposition Notation

- We'll use variables to talk about arbitrary propositions
- Propositional variables: $p, q, r, s \ldots$
- Truth Values:

  $\mathbf{T}$ for true

  $\mathbf{F}$ for false

Atomic and Compound Propositions

Definitions:

An atomic proposition is ____.

A compound proposition is ____________________________________.

A logical connective ____.

Compound Proposition Example

It is raining in Seattle and it's June.

Atomic Propositions:

____

____

Logical Connectives:

____

Translation into Logic:

____

Analogy

Boolean variables p, q

Java and connective &&

All Logical Connectives

Name	Logical Symbol	Java Symbol
Not	$\neg p$	
And	$p \land q$	
Or	$p \lor q$	
XOR	$p \oplus q$	
Implication	$p \rightarrow q$	
Biconditional	$p \leftrightarrow q$	

Not (¬)

$\neg p$ is true when p is false, and is false otherwise

A **truth table** is a table of all truth values of an expression

p	$\neg p$

And (∧)

$p \wedge q$ is true when p, q are both true, and is false otherwise

p	q	$p \wedge q$

Or (∨)

$p \vee q$ is true when **at least one** of p, q are true, and is false otherwise

p	q	$p \vee q$

Exclusive Or / XOR ($\oplus$)

$p \oplus q$ is true when **exactly one** of p, q are true, and is false otherwise

p	q	$p \oplus q$

Or vs. XOR

Identify the atomic propositions & translate the following English sentences into logic:

You may either redeem the $10 off coupon or the 20% off coupon.

A degree in Computer Science or Data Science is required.

Implication (→)

$p \rightarrow q$ means "if p, then q"

E.g. "If it's Wednesday, we wear pink."

Why is this a proposition?

Implication (→)

$p \rightarrow q$ means "if p, then q"

E.g. "If it's Wednesday, we wear pink."

	p	q	$p \rightarrow q$
It's Wednesday and we are wearing pink →	T	T	
It's Wednesday and we are not wearing pink →	T	F	
It's not Wednesday and we are wearing pink →	F	T	
It's not Wednesday and we are not wearing pink →	F	F	

Implication (→)

$p \to q$ means "if p, then q"

E.g. "If the Earth is flat, then all numbers are odd."

p	q	$p \to q$
T	T	T
T	F	F
F	T	T
F	F	T

Vacuous Truth (last two rows: p = F)

$p \rightarrow q$ vs. $q \rightarrow p$

These are different implications.

If it is raining, I have my umbrella.

	It's raining	It's not raining
I have my umbrella		
I do not have my umbrella		

If I have my umbrella, it is raining.

	It's raining	It's not raining
I have my umbrella		
I do not have my umbrella		

Translating Implications

Whenever I am hungry, I eat a sandwich.

It is necessary to have internet connection to be able to use Zoom.

You may register for CSE 311 only if you have taken Math 126.

Translating Implications

Implication:

p implies *q*

whenever *p* is true *q* must be true

if *p* then *q*

q if *p*

p is sufficient for *q*

p only if *q*

q is necessary for p

p	q	$p \rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

Section Tomorrow

Practice with translating and writing truth tables!

If it is raining or snowing, Red Square is slippery.

p: It is raining $(p \vee q) \rightarrow r$

q: It is snowing

r: Red Square is slippery