CSE215
Foundations of Computer Science

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course website

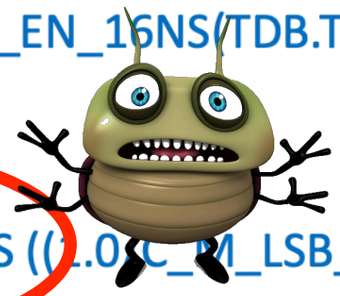
https://github.com/zhoulaifu/24_cse215_spring

Why Studying Computer Science?

French Ariane 5 Rocket, 1996

Ada code for Ariane 5 Rocket

```
if L_M_BV_32 > 32767 then
  P_M_DERIVE(T_ALG.E_BV) := 16#7FFF#;
elsif L_M_BV_32 < -32768 then
  P_M_DERIVE(T_ALG.E_BV) := 16#8000#;
else
  P_M_DERIVE(T_ALG.E_BV) := UC_16S_EN_16NS(TDB.T_ENTIER_16S(L_M_BV_32));
end if;
P_M_DERIVE(T_ALG.E_BH) :=
  UC_16S_EN_16NS (TDB.T_ENTIER_16S ((1.0/C_M_LSB_BH)*G_M_INFO_DERIVE(T_ALG.E_BH)));
```



$7 billion Software Disaster

Comparison:

SUNY Korea was awarded $0.05 billion for 10 years under an MKE grant
(Source: https://sunyk.cs.stonybrook.edu/)

From 2018 to 2020, South Korea GDP dropped $94 billion;
(Source: World bank)

- How to make reliable software?
- How to make efficient software?
- How to make energy-friendly software?
- We need to understand **deeply** how code works

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- Quiz: If Precondition holds, will Postcondition holds after executing this piece of code?

```
Precondition: x >= 0;

z = 0;
if (x != 0)
    z = x;
} else {
    z = z+1
  }
Postcondition: z > 0;
```

https://slideplayer.com/slide/14725881/

- Yes. We can **prove** it!

```
Precondition: x >= 0;

z = 0;
                          { x >= 0 && z = 0 }
if (x != 0) {
                          { x > 0 && z = 0 }
   z = x;
                       { x > 0 && z = x }
} else {
                                { x = 0 && z = 0 }
   z = z+1
                             { x = 0 && z = 1 }
  }
Postcondition: z > 0;
```

Propositional Logic

Predicate Logic

Proof

CSE215

Sequences

Sets

Functions

Relations

Expected Learning Outcomes

- An ability to check if a mathematical argument is valid
- An ability to verify the correctness of proofs of some existing theorems and prove some new theorems
- An ability to use the mathematical concepts of sequences, functions, relations, and sets in solving computing problems

Logistic matters

- Team
- Textbook
- Schedule
- Homework
- Exams and grading
- Ask for help

Meet the Instructor

- CSE215 and CSE216
- Data & Intelligent Computing Lab (C404)
- Previous Work: France, US, Denmark and Korea
- Education: École Polytechnique, France
- Personal: Happily married; like dreaming and playing with my child; no special hobbies or talents.

TA

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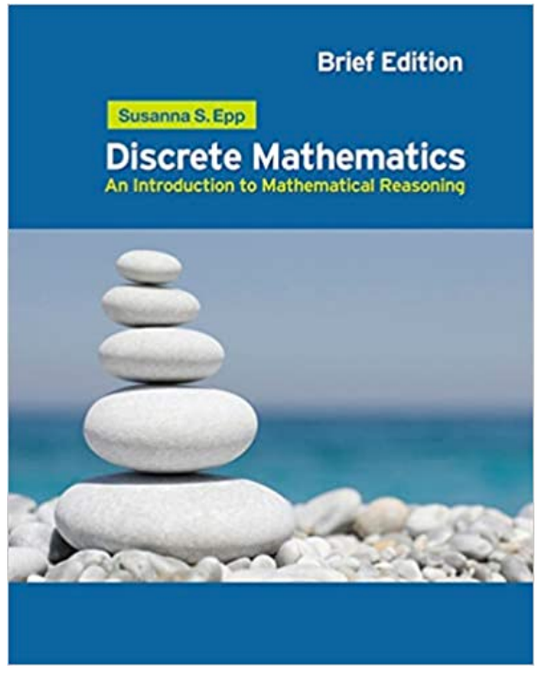
Gyujeong Park gyujeong.park@stonybrook.edu

Team

You	TA	Instructor	ChatGPT
Lectures		**Office hours**	**Not do homework**
Homework	**Office hours**	**Lectures**	**Answer questions**
Ask questions	**Answer questions**	**Grading**	
		Answer questions	

Textbook



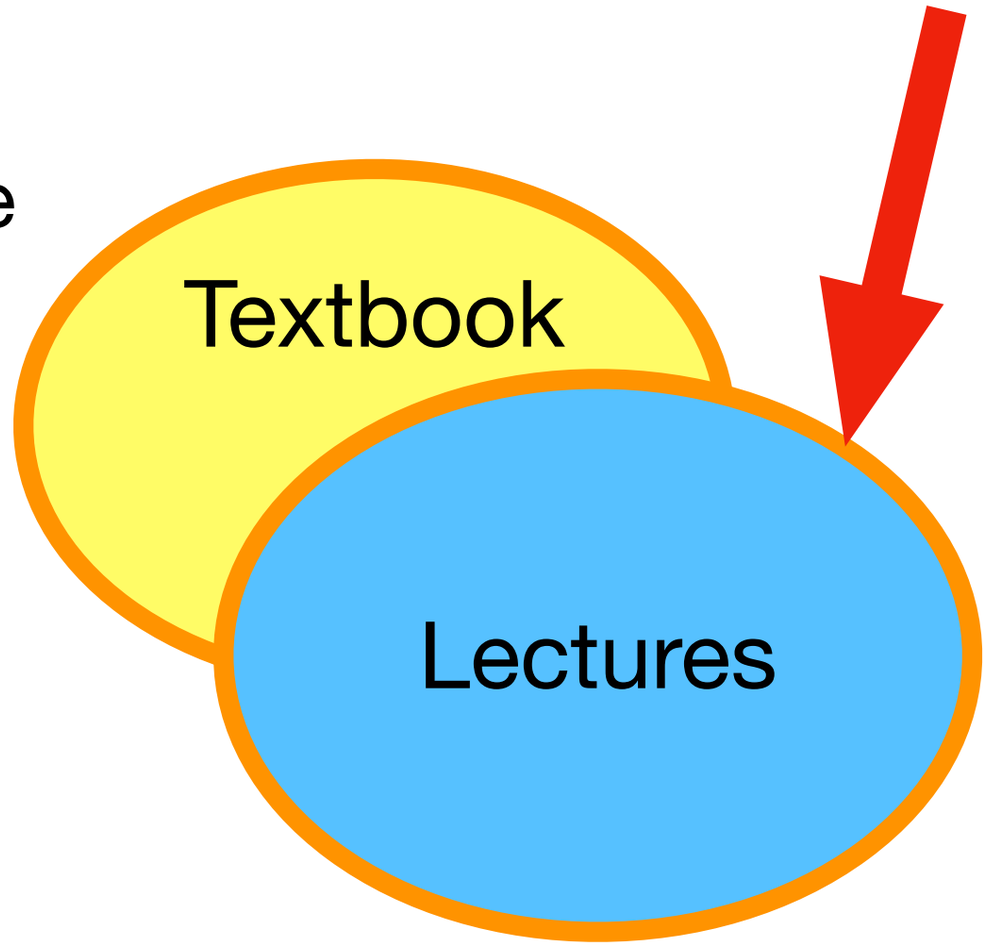
- Our course relates to Chapters 2-7

- Very helpful, but optional

- Suggestion: Skim the related chapter before the lecture; read deeper after the lecture

- Textbook may not cover everything in the exams; lectures do

Exam



Schedule

- Lectures: M, W 9:00 - 10:30, at C107
- Recitation: M 12:30 - 13:25, at B207
- Homework is announced on Wednesday, and due time is next Wednesda 23:59 KST (included)
- Office hours: M 13:30 - 14:30, TH 15:30 - 16:30 at B424
- TA Office hours: TBA

Numerical Grading

- Homeworks: 30%
- Midterm1: 20%
- Midterm2: 20%
- Final: 30%
- Students who consistently participate or provide constructive feedback will receive a bonus of 0.5% or 1%. However, any student with three or more class absences will not be eligible for this bonus.
-

Letter Grade

- Absolute grading

Recipe for Success in CSE215

- Attend lectures
- Ask questions
- **Do homework (VITAL)**

Quiz

- Where to find official course info? Is ChatGPT allowed?
- Homework due time?
- How to ask for help?

Questions so far?

Course overview

A personal story

- Once upon a time, I worked for a project involving financial calculation
- I needed to sum up a number of floating-point values like
  - 0.1 + 0.2 + 0.3 + 0.7 + 0.9 + 1.2 + 3.5…
- There were billion of numbers like this, so performance was a key for the project's success
- We decided to use the state-of-the-art multi-core, parallel computing
- Parallel computing works like a divide-and-conquer:
  - (0.1 + 0.2) + (0.3 + 0.7) + (0.9 + 1.2 + 3.5) + …
- Now, let us think why it looks reasonable le to use parallel computing for this task??
- The reason is associative law. (a + b) + c = a + (b + c)

A problem

We get different results for each round, if we put parentheses differently each time.

- (0.1 + 0.2) + (0.3 + 0.7) + (0.9 + 1.2 + 3.5) + …
- becomes different from
- (0.1 + 0.2 + 0.3) + (0.7+ 0.9)+ (1.2 + 3.5) + …

Demo:

https://www.pythonanywhere.com/try-ipython/

Why?

- We made this assumption:
  - for any numbers a, b, c, (a + b) + c = a + (b+ c)
- This is a statement that can be assigned with true or false value, we call it a **proposition**
- The inner part has variables, and can be denoted as a statement with parameters (a, b, c). We call it a **predicate**.
- Many CS work involves determining if a proposition is true or false. To show the truth is called **to prove**.
- The reason for the problem is that the proposition above is false.

Summary for the story

The whole is called a proposition,
to which we can assign a truth value

$$\forall a, b, c \in I, (a + b) + c = a + (b + c)$$

quantifier

variables

set

Predicate

Summary

- The ultimate goal of this course is to learn fundamentals for understanding why our digital world works or fails.

- We will study logic (propositions, and predicates), proof, and math structures like sets as a language to reason about computer science

- Our next classes will be about propositions.