CSE215, Foundations of Computer Science Course Information

Summer 2020

Stony Brook University

Instructor: Dr. Paul Fodor

http://www.cs.stonybrook.edu/~cse215

Course Description

- "*Introduction to the logical and mathematical foundations of computer science. Topics include functions, relations, and sets; recursion and functional programming; elementary logic; and mathematical induction and other proof techniques.*"
- This IS NOT a course in computer programming, BUT on fundamental concepts of computing.
- We will stress **mathematical** problem solving skills and the use of **formal** concepts as tools for computer science.
- Prerequisites: AMS 151 or MAT 125 or MAT 131.

Course Outcomes

- The following are the official course goals agreed upon by the faculty for this course:
  - An ability to define and use discrete structures such as functions, relations, and sets.
  - An ability to compute with recursion as a basic paradigm.
  - An ability to use logic and basic proof techniques, such as mathematical induction.

What is Computer Science?

- Why do we study mathematics and problem solving in a major course in Computer Science?
  - Computer Science is NOT computer programming - although programming is part of it.
  - Computer Science is a **mathematical science** we study the capabilities and limitations of computers and how people can use them effectively.
  - Computer programming requires that the exact sequence of steps to perform a task must be specified completely and precisely
    - difficult and requires careful reasoning about **abstract entities**
  - **Mathematics has developed over thousands of years as a method of abstract reasoning.**

Why Isn't CS "Just Programming"?

- Programs of only a few hundred lines are easy for one person to build with little training.
- BUT:
  - Real-world software systems are **large**
    - Developing and understanding such complicated objects requires mental and mathematical discipline.
  - Real-world software systems must be **reliable**
    - They control economies, airplanes, nuclear weapons and your car
    - **Systematic** discipline is necessary to avoid errors
- Mathematics provides the disciplined and systematic language to reason about such systems.

General Information

- **Blackboard** will be used for assignments, grades and course material.
- Staff:
  - Instructor: Dr. Paul Fodor
  - 214 New Computer Science Department, Stony Brook University
  - Email: paul.fodor@stonybrook.edu
- Class Time and Place
  - Lecture: Tuesdays and Thursdays 9:00AM - 12:25PM, Online.
  - Recitation: Tuesdays and Thursdays 12:30PM - 1:25PM, Online.

Textbook

- Discrete Mathematics: Introduction to Mathematical Reasoning

  Author: Susanna S. Epp

  Publisher: Brooks Cole; 1st edition (2011)

  ISBN-10: 0495826170

  ISBN-13: 978-0495826170

Grading

- Grades will be based on homework and exams according to the following formula:
  - Homeworks -- 25%
  - Midterm exams (2) -- 50% (25% each)
  - Final exam -- 25%
    - Do not miss the exams. Make-up exams will be given only in extenuating circumstances (e.g., doctor's note stating that you were ill and unfit to take the exam). Students who miss an exam for a valid reason may need to take a make-up exam; specific arrangements will be made on a case-by-case basis.
- **Grade Cutoffs:**
  - A [95-100], A- [90-95), B+ [87-90), B [83-87), B- [80-83), C+ [77-80), C [73-77), C- [70-73), D+ [65-70), D [60-65), F [0-60)
- ***SPECIAL RULE:*** If all your grades, including homework assignments, quizzes, recitation and your three exam grades are above the respective class averages, you're guaranteed to receive a grade of C or higher for this class.

Grading

- **The Pass/No Credit (P/NC) option is not available for this course.**
  - This policy applies to *all* CSE/ISE undergraduate courses used to satisfy the graduation requirements for the major.
- Exam dates:
  - Midterm exam 1: Tu. 7/21, on Respondus Lockdown Browser with Monitoring.
  - Midterm exam 2: Th. 7/30, on Respondus Lockdown Browser with Monitoring.
  - Final exam: Th. 8/13, on Respondus Lockdown Browser with Monitoring.
- The grades will be posted on Blackboard: http://blackboard.stonybrook.edu for privacy reasons.

Homework

- There will be homework assignments given regularly.
- The homework assignments are to be completed individually in the allotted time.
- No Late Submissions Are Allowed.
- No makeup homework will be given.
- The homework assignments will be posted on Blackboard:

http://blackboard.stonybrook.edu.

Regrading of Homework/Exams

- Please meet with a TA or the instructor and arrange for regrading.
- **You have one week from the day grades are posted or mailed or announced**
  - Late requests will not be entertained

Tentative Class Schedule

Week	*Date*	*Lecture Topics / Notes*	*Readings*
1	Tu. 7/7	Administrative (course information and introduction to speaking mathematically), The Logic of Compound Statements	Read Epp chs. 1 and 2, and Introduction to LaTeX
	Th. 7/9	The Logic of Compound Statements: Logical arguments , The Logic of Quantified Statements , Supplemental: Application of Logic - Digital Cirduits	Read Epp ch. 3
2	Tu. 7/14	Elementary Number Theory and Methods of Proof	Read Epp ch. 4
	Th. 7/16	Sequences and Mathematical Induction	Read Epp ch. 5
3	Tu. 7/21	**MIDTERM EXAM 1**	see Blackboard
	Th. 7/23	Set Theory	Read Epp ch. 6
4	Tu. 7/28	Functions	Read Epp ch. 7
	Th. 7/30	**MIDTERM EXAM 2**	see Blackboard
5	Tu. 8/4	Recursion	n/a
	Th. 8/6	Functional Programming (ML)	Standard ML
6	Tu. 8/11	Relations	Read Epp ch. 8
	Th. 8/13	**FINAL EXAM 2**	see Blackboard

Academic Integrity

- You can discuss general assignment concepts with other students: explaining how to use systems or tools and helping others with high-level design issues
- You **MAY NOT share** assignments, source code or other answers by copying, retyping, looking at, or supplying a file
  - Assignments are subject to manual and automated similarity checking (We do check! and our tools for doing this are much better than cheaters think)
- If you cheat, you will be brought up on academic dishonesty charges - we follow the university policy:
  - http://www.stonybrook.edu/uaa/academicjudiciary

Disability

- If you have a physical, psychological, medical or learning disability, contact the SACS office at phone 631-632-6748
- **All documentation of disability is confidential.**

What do you need to get started?

- Blackboard account
  - http://blackboard.stonybrook.edu

Mathematically Speaking: Variables

- *Is there a number with the following property: doubling it and adding 3 gives the same result as squaring it?*
  - In this sentence you can introduce a variable to replace the potentially ambiguous word “it”: *Is there a number x with the property that* $2x + 3 = x^2$*?*
  - A variable is a temporary name until we can find the possible value(s)
- *No matter what number might be chosen, if it is greater than 2, then its square is greater than 4.*
  - a variable is a temporary name to the (arbitrary) number you might choose enables you to maintain the generality of the statement: *No matter what number n might be chosen, if n is greater than 2, then* n^2 *is greater than 4.*

Some Important Kinds of Mathematical Statements

- Universal conditional statement: *For all animals a, if a is a dog, then a is a mammal.*
- Universal existential statement: *Every real number has an additive inverse.*
- Existential universal statement: *There is a positive integer that is less than or equal to every positive integer.*

Sets

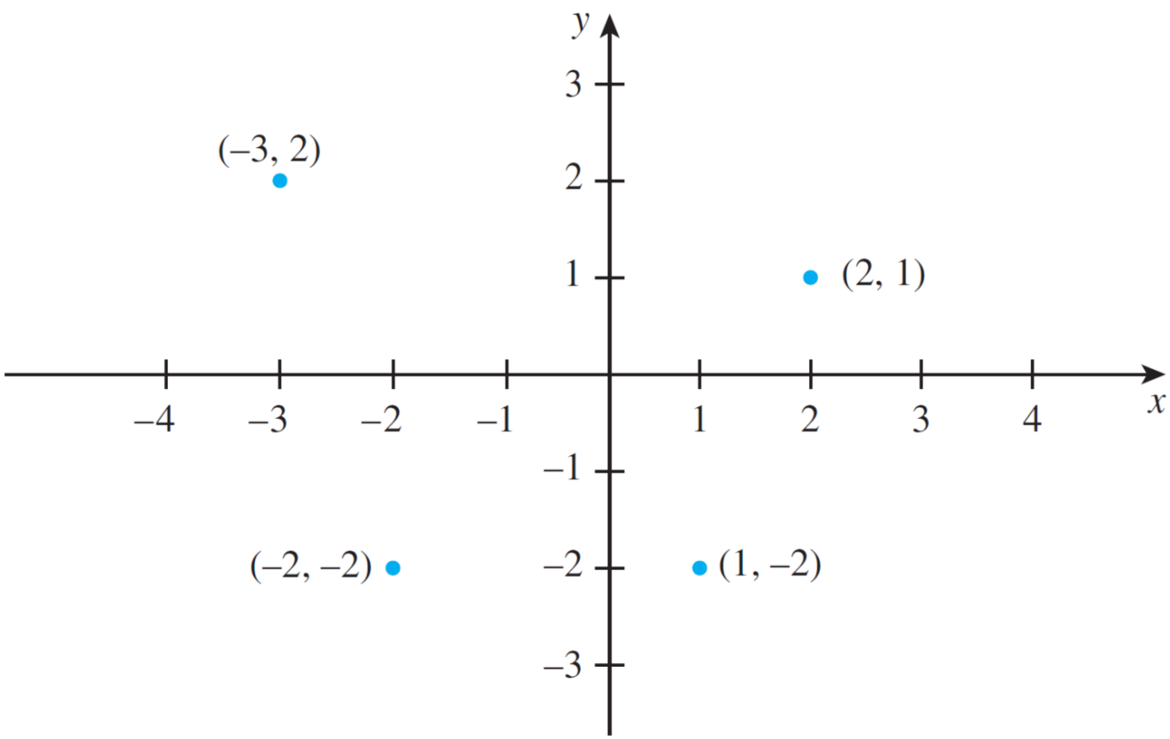
- Introduced in 1879 by Georg Cantor (1845–1918).
- A set is, intuitively, a collection of elements.
- Set-Roster Notation:
  - Let $A = \{1, 2, 3\}$, $B = \{3, 1, 2\}$, and $C = \{1, 1, 2, 3, 3, 3\}$.
    - What are the elements of A, B, and C?
    - How are A, B, and C related?
- Set-Builder Notation:

$$\{x \in \mathbf{R} \mid -2 < x < 5\}$$

- Subset: is a basic relation between sets : $\{2\} \subseteq \{1, 2, 3\}$

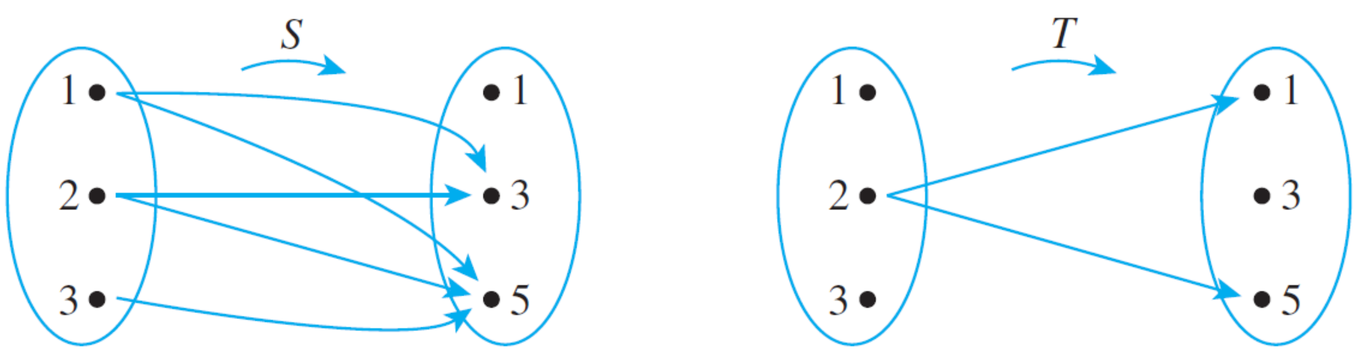
Cartesian product

- Example: R x R is the set of all ordered pairs (x,y) where both x and y are real numbers
- Cartesian plane:



Relations

- The notation x R y as a shorthand for the sentence "x is related to y", for example: 1 < 2
  - From relations to sets: $x \; R \; y$ means that $(x, y) \in R$
  - Arrow Diagrams of Relations:



Functions

- **Definition**

A **function F from a set A to a set B** is a relation with domain A and co-domain B that satisfies the following two properties:

1. For every element x in A, there is an element y in B such that $(x, y) \in F$.
2. For all elements x in A and y and z in B,

$$\text{if} \quad (x, y) \in F \text{ and } (x, z) \in F, \quad \text{then} \quad y = z.$$

Example: The **successor function** g from **Z** to **Z** is defined by the formula $g(n) = n + 1$

Please

- Please be on time
- Please show respect for your classmates
- Please turn off (or use vibrate for) your cellphones

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- On-topic questions are welcome

Welcome and Enjoy!