

Discrete Structures: CMPSC 102

Oliver BONHAM CARTER

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Consider This!'

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Fall 2022 Week 1





The Class Websites

General Information

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• The course Website:

 https://www.oliverbonhamcarter.com/classes/ discretestructures/





The Class Website

Office hours

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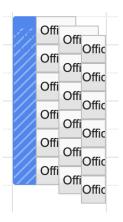
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Booking office hours:

https://www.oliverbonhamcarter.com/contactandabout/





The Class Website

Please be familiar with the course syllabus

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Check the syllabus

https:

//github.com/CMPSC-102-Allegheny-College-Fall-2022/ classDocs/blob/main/README.md



Figure: Did I search for Syllabus correctly?



Class and lab meeting times

Please read the syllabus before next class!!

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- Lecture, Discussion, Presentations, and Group Work:
 - Monday, Wednesday, Friday 1:30pm 2:20pm, Alden Hall 101
- Laboratory Session:
 - Tuesday 2:30PM 4:20PM, Alden Hall 101



Textbook

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Programming and Mathematical Thinking

A Gente Introduction to Discrete Math Featuring Python

Allan M. Stavely

 Programming and Mathematical Thinking - A Gentle Introduction to Discrete Math Featuring Python by Allan M. Stavely; ISBN paperback 978-1-938159-00-8 and ISBN ebook: 978-1-938159-01-5



Textbook

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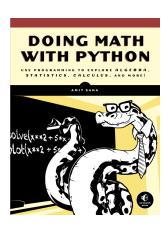
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 Doing Math with Python by Amit Saha; ISBN paperback: 1-59327-640-0



Learning as a Computer Scientist?

In terms of programming

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Key Question

How do I connect mathematical terminology (e.g., mapping, function, number, sequence, and set), to the implementation of Python programs that declare and call functions and declare and manipulate variables?

Learning Objectives

To remember and understand some of the discrete mathematics and Python programming concepts, setting the stage for the exploration of discrete structures.



Learning as a Computer Scientist?

For example

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Discrete Structures = Math + Code

Discrete mathematics

- P Made up from: symbols, character strings, truth values, objects, and collections of these entities as stored in sets or tuples (for example)
- •
- Specifying and designing a **computer program**
 - Describe input, output, and internal objects
 - Use the vocabulary of discrete mathematics
 - Implement and test the program in a language

Our goal:

To implement a program P that meets a particular specification S



Learning as an Analytical Thinker?

In terms of mathematics

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"An introduction to the foundations of computer science with an emphasis on understanding the abstract structures used to represent discrete objects."

Wait! What?

We keep using the word, **discrete**. What do we mean here?

Discreet or Discrete

- **Discreet** means *unobtrusive* or *unnoticeable* (not this course!)
- **Discrete** means *separate*, not continuous or *not sharing* any common space



Discrete and Countable Objects

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Consideration This!'



- Discrete means "countable" (can be listed in an order)
- We can count the number of animals.



So, Discrete Objects, Then?

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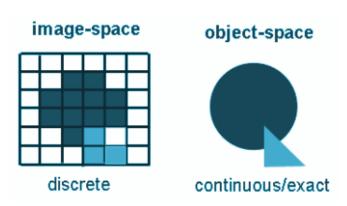
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• Discrete mathematics involves being able to count (*list*) things individually.



... And, Continuous Objects?

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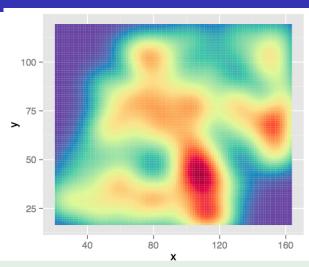
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 "Overlapping" objects cannot be counted (i.e., listed) separately.



Discrete Mathematics

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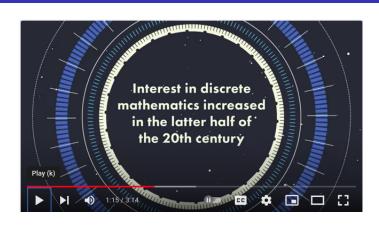
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- Discrete Mathematics for Computer Science (developed during the latter half of the 20th century!
 - https://www.youtube.com/watch?v=q4L-wUF3yig



Non-Discrete and Un-Countable Objects

Really big amounts of things



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- Are the numbers of grains *un*countable (i.e., unlistable)?
- Is anything *un*countable at the beach?
- How do we count an uncountable object? Why?



Relationships to Computing

Computer MUST be able to count to compute

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Binary Numbers

In mathematics and digital electronics, a binary number is a number expressed in the base-2 numeral system or binary numeral system, which uses only two symbols: typically, 0 (False, zero) and 1 (True, one).

- Computers use binary to function
- Processes (i.e., memory, computation, networking) are broken down into binary-driven procedures



Binary Numbers

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| 2 ² = 2 ³ = 2 ⁴ = 2 ⁵ = | = 8 = 16 = 32 |
|---|---------------------|
| 2° = | = 64 = 128 |

| Binary Value | | | Re | Decimal Representation | | | | | | Decimal Value | |
|--------------|---|---|----|---------------------------|-----|---|---|---|---|---------------|----|
| | | | 8 | | 4 | | 2 | | 1 | Decimal value | |
| 0 | 0 | 0 | 0 | 0 | + | 0 | + | 0 | + | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | + | 0 | + | 0 | + | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 | + | 0 | + | 2 | + | 0 | 2 |
| 0 | 0 | 1 | 1 | 0 | + | 0 | + | 2 | + | 1 | 3 |
| 0 | 1 | 0 | 0 | 0 | + . | 4 | + | 0 | + | 0 | 4 |
| 0 | 1 | 0 | 1 | 0 | + . | 4 | + | 0 | + | 1 | 5 |
| 0 | 1 | 1 | 0 | 0 | + . | 4 | + | 2 | + | 0 | 6 |
| 0 | 1 | 1 | 1 | 0 | + . | 4 | + | 2 | + | 1 | 7 |
| 1 | 0 | 0 | 0 | 8 | ı | 0 | 1 | 0 | 1 | 0 | 8 |
| 1 | 0 | 0 | 1 | 8 | + | 0 | + | 0 | + | 1 | 9 |
| 1 | 0 | 1 | 0 | 8 | + | 0 | + | 2 | + | 0 | 10 |

- Computing implies digital processing
- Computing binary values is a *countable* task.
- Can anything, or any number, that a computer computes be written in binary?



Countable and Not Countable?

What can be *listed* and what cannot be listed?

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Consider This!'

- Get into groups and discuss the following. Take notes to report back to the class.
- Can you think of countable objects?
- Can you think of un-countable objects?
 - Can you think of types of numbers that may fit into each of these above groups?

