

CS 3305

Box types: note, warning, definition theorem

Syllabus

Syllabus: [CS 3305.HON Syllabus \(Spring 2021\)](#)

Textbook: [Mathematics for Computer Science](#)

Meeting times: T/Th 11:30am-12:45pm

Last day of lecture: Thursday, May 6

Grading Criteria:

1. Midterm 1: 20%
2. Midterm 2: 20%
3. Final exam: 20%
4. Homework: 25%
5. Paper review: 10%
6. Class participation: 5%

Day 1: 1/19**Why Discrete?**

Rigorous understanding of algorithms: Proving the correctness of algorithms and verify that their performance is as expected.

Time complexity and space complexity: space complexity is also important because RAM can only hold so much information before slowing down (due to accessing hard drive for swapping)

Asymptotic Bound

1. **Big-O:** Upper bound of complexity
2. **Big-Omega:** Lower bound
3. **Big-Theta:** Tight bound, set intersection of **Big-O** and **Big-Theta**

Modular Arithmetic

$$a \equiv b \pmod{m} \iff a \bmod m = b \bmod m \iff (a - b) \equiv 0 \pmod{m}$$

Representation of Numbers

- **Decimal:** 0, 1, 2, ..., 9
- **Binary:** 0, 1
- **Hexadecimal:** 0, 1, 2, ..., 9, A, B, C, D, E, F

Binary multiplying by power of 2

$$5_{10} = 101_2 \implies 10_{10} = 1010_2 \implies 20_{10} = 10100_2$$

Bit shift left for multiplying by 2, bit shift right for dividing (truncate) by 2.

Prime and Composite Numbers

Prime: only 2 factors, 1 and itself

Composite: more than 2 factors

Definition**Sieve of Eratosthenes**

Discard multiples of prime numbers to sieve through set of all numbers less than n .

```
1 def primes_less_than_n(n):
2     primes = set([i for i in range(2, n + 1)])
3     for i in range(int(sqrt(n))):
4         if i in primes:
5             j = 2
6             while i * j <= n:
7                 primes.discard(i * j)
8                 j += 1
9     return primes
```

Induction and Recursion

- **Recursion:** express problem as smaller instances
- **Induction:** used to prove recursion solutions
- **Strong Induction:** induction based on all previous steps rather than just the one previous step