Topics:

- List, Stacks, Queues
- Combinatorics
- Algorithms,
  - Asymptotic Analysis
  - Order of functions
  - Run time
- Divide + conquer
- Proofs
- Probability
- Graphs

- Write algorithm to determine if a string is an algorithm.
- Sort this list using selection sort:

  (define sel. sort)

  -3 5 4 1 2

  -5 4 3 2 1

- Use greedy algorithm to make change using quarters, dimes, nickels & pennies.
  - 87 cents
  - 33 cents
- Is x^3 $O(g(x))$ for each $g(x)$:
  - $g(x) = x^2$
  - $g(x) = x^3$
  - $g(x) = x^2 + x^3$
  - $g(x) = x^3/2$

- Show these functions are of the same order:
  - $3x + 7, x$
  - $\lfloor x + 1/2 \rfloor, x$
  - $2x^2 + x - 7, x^2$
- Give big-O estimate:

```
t := 0
for i = 1 to 3
    for j = 1 to 4
        t = t + ij
```

```
i = 1
t = 0
while i ≤ n
    t = t + i
    i = 2i
```

Proofs:

- Prove $1 \cdot 1! + 2 \cdot 2! + 3 \cdot 3! \ldots n \cdot n! = (n+1)! - 1$ when n is positive.

- Find formula for the sum of the first n even positive numbers.
  - prove the formula.

- Find formula: $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots \frac{1}{2^n}$
  - prove.

- $f(0) = 1$
  $f(n+1) = f(n) + 2$

  $f(1) =$
  $f(2) =$
  $f(3) =$
  $f(4) =$

- Trace alg 1 w/ 5 as input. (Rosen p. 370).

- Give recurseve alg for finding the min of a finite set of integers.

- Recursive alg for finding $x^n \bmod m$ when x, n, m are positive ints.

  Observe: $x^n \bmod m =$
  $(x^{n-1} \bmod m \cdot x \bmod m) \bmod m.$

- Recursive alg for finding mode of a list.

- Define rec. alg for multiplying two non-negative ints x and y.

  Observe: $xy = 2(x \cdot (y/2))$

  when y is even

  + $xy = 2(x \cdot \lfloor y/2 \rfloor) + x$

  when y is odd.

  $xy = 0$ when $y = 0$.

- Prove ↑ correct.

- Use merge sort to sort

  4, 3, 2, 5, 1, 8, 7

- Prove this segment is correct:

```
y = 1
z = x + y
```

initial assertion: $x = 0$,

final assertion: $z = 1$

- Use a loop invariant to prove this is correct:

```
power := 1
i = 1
while i ≤ n:
    power = power * x
    i = i + 1
```

- How many positive ints between 5 and 31:
  - are divisible by 3?
  - are divisible by 4?
  - divisible by 3+4?
- How many positive ints < 1000:
  - are divisible by 7?
  - div by 7 but not 11?
  - have distinct digits?
- How many bit strings of length n start and end w/ 1?