Discrete Math

CSCI 150 Math for Computer Scientists

Math for Daily Life / puzzles

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"Read your hunter email

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Discrete Math:

- Counting / Combinatorics
- Proofs
- Number Theory (study integers & properties)
- Functions / relations / sets
- Graph theory

Example: Birthday Paradox

- Estobished by Counting
- Proofs: Can you prove that we have infinitely many primes?
- Number Theory

Two games

Game 1:

Pick an integer $x > 0$

- x is even: $x \leftarrow x/2$
- x is odd: $x \leftarrow 3x + 1$
- Repeat

Ex: 10, 5, 16, 8, 4, 2, 1

Game 2

Example: 4 integers.

(2, 3, 4, 5)

(1, 1, 1, 3)

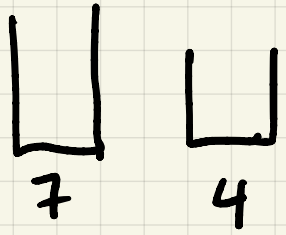
(0, 0, 2, 2)

(0, 2, 0, 2)

(2, 2, 2, 2)

(0, 0, 0, 0)

Puzzle:



$7x - 4y$

Co-prime

Sequences: example: Fibonacci

0, 1, 1, 2, 3, 5, 8, 13, ...

Recurrences / Induction

$F_n = F_{n-1} + F_{n-2}$

Def. technique

Proof technique

- Sums : $1+2+3+4+5+\cdots+n=\frac{n(n+1)}{2}$

Example: $n=1$: 1

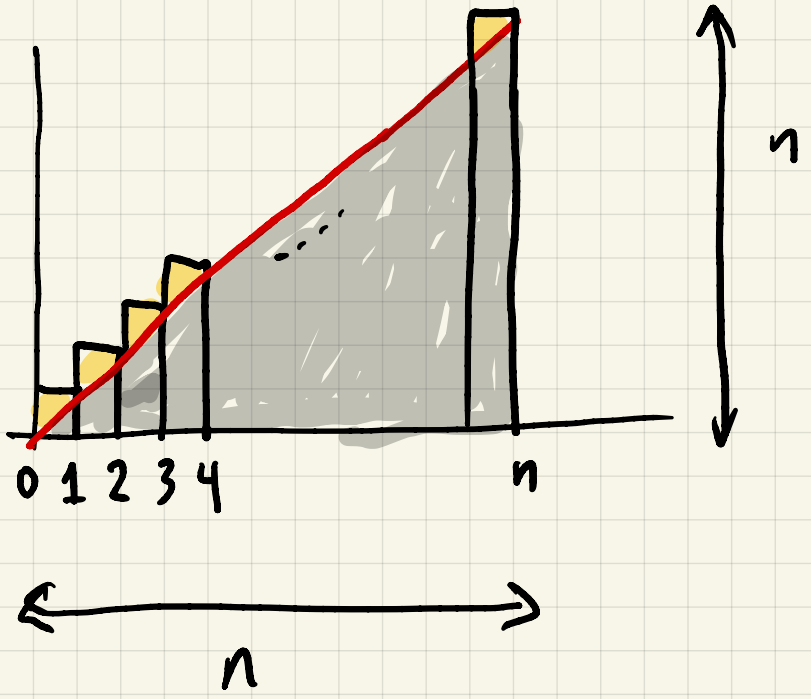
$n=2$: 3

$n=3$: 6

$n=4$: 10

⋮

Geometric Interpretation:



Area of grey triangle: $\frac{n^2}{2}$

Area of small triangle: $\frac{1\times 1}{2}=\frac{1}{2}$

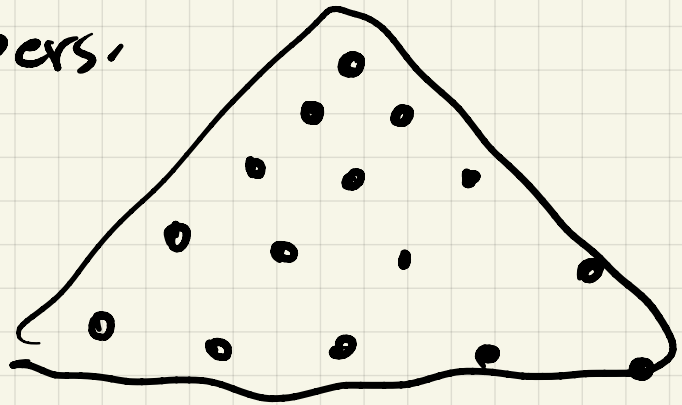
Total: $\frac{n^2}{2}+n\times\frac{1}{2}=\frac{n(n+1)}{2}$

$T_n = 1 + 2 + \dots + n$

$T_1 = 1$, $T_2 = 3$, $T_3 = 6$, $T_4 = 10$, ...

$T_n = T_{n-1} + n$: Recurrence

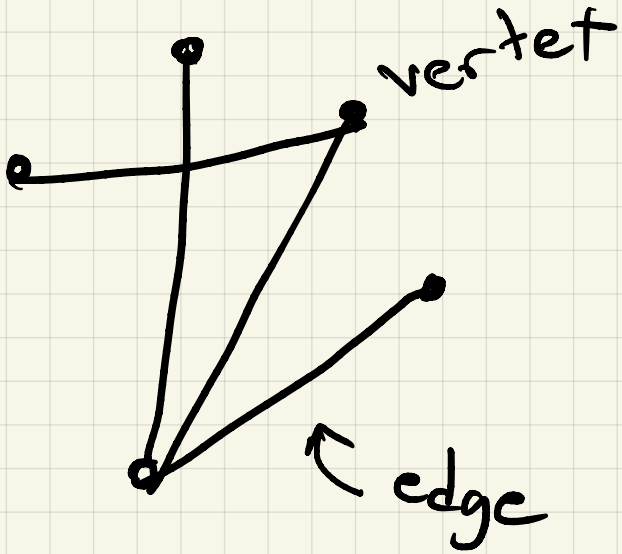
Triangular Numbers.



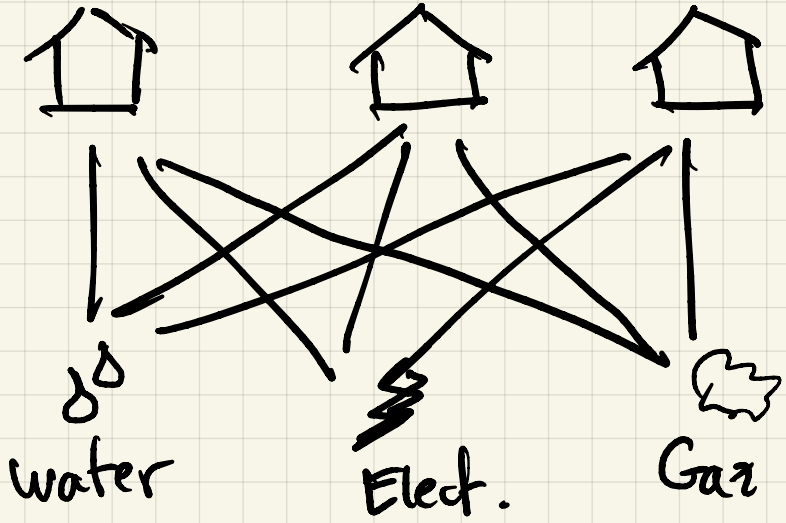
T_5

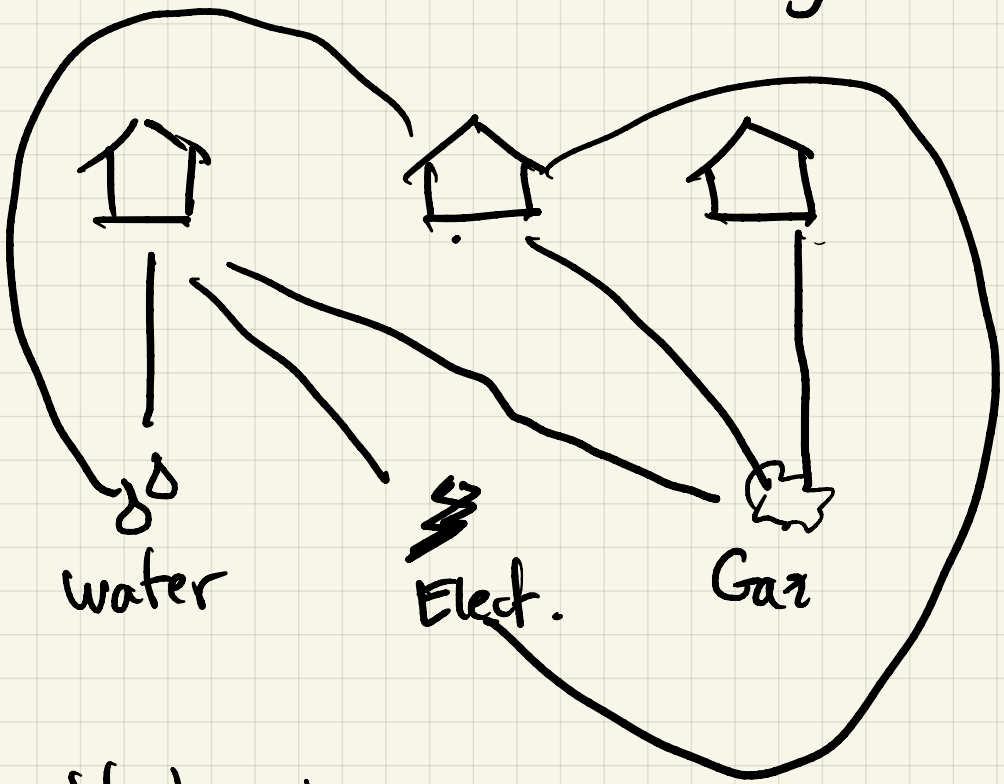
Graphs:

people:



Nasty Neighbors

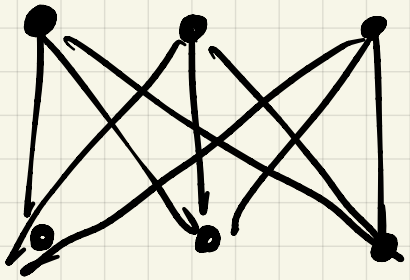




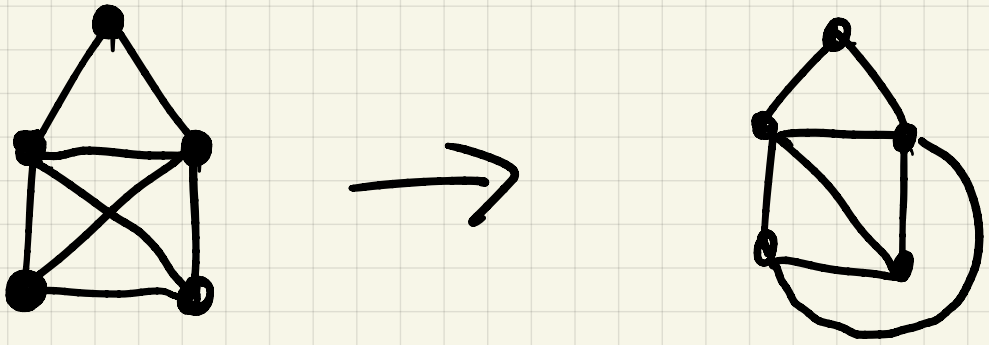
Can't be done without overlap

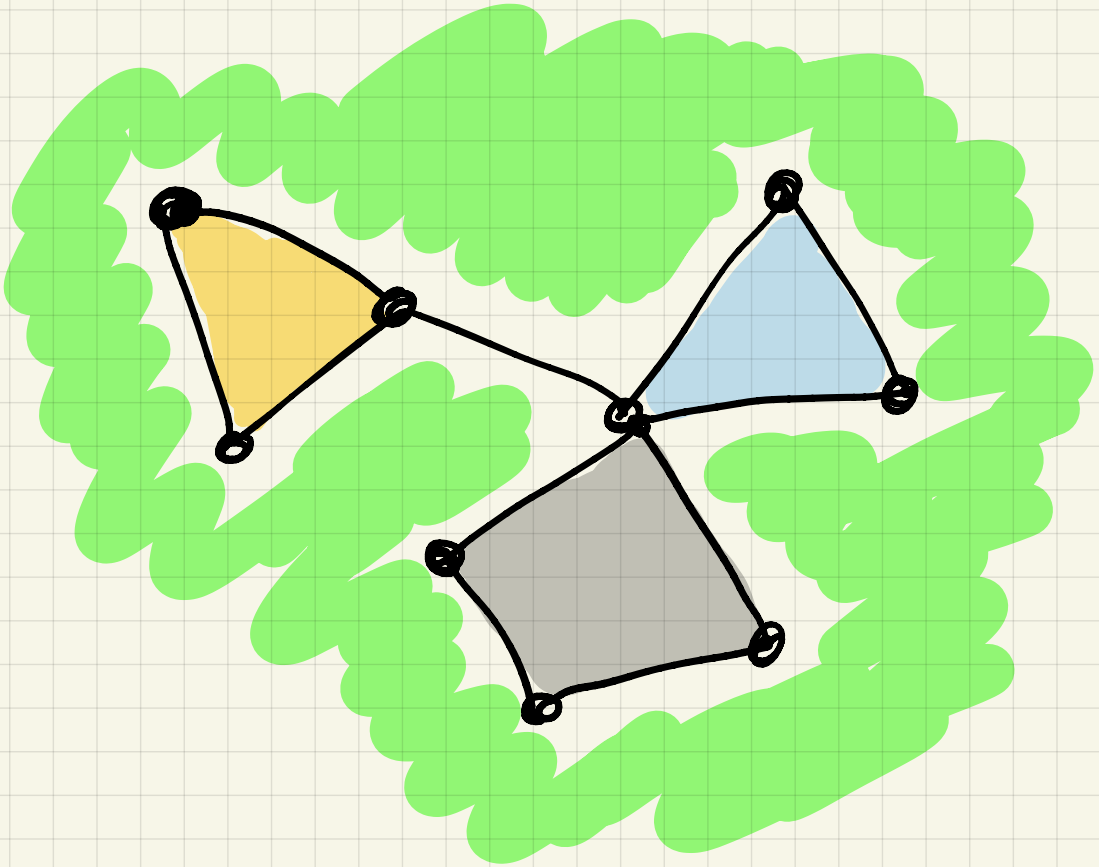
Planar Graph

Graph that you can draw in the plane without overlap.



Not planar



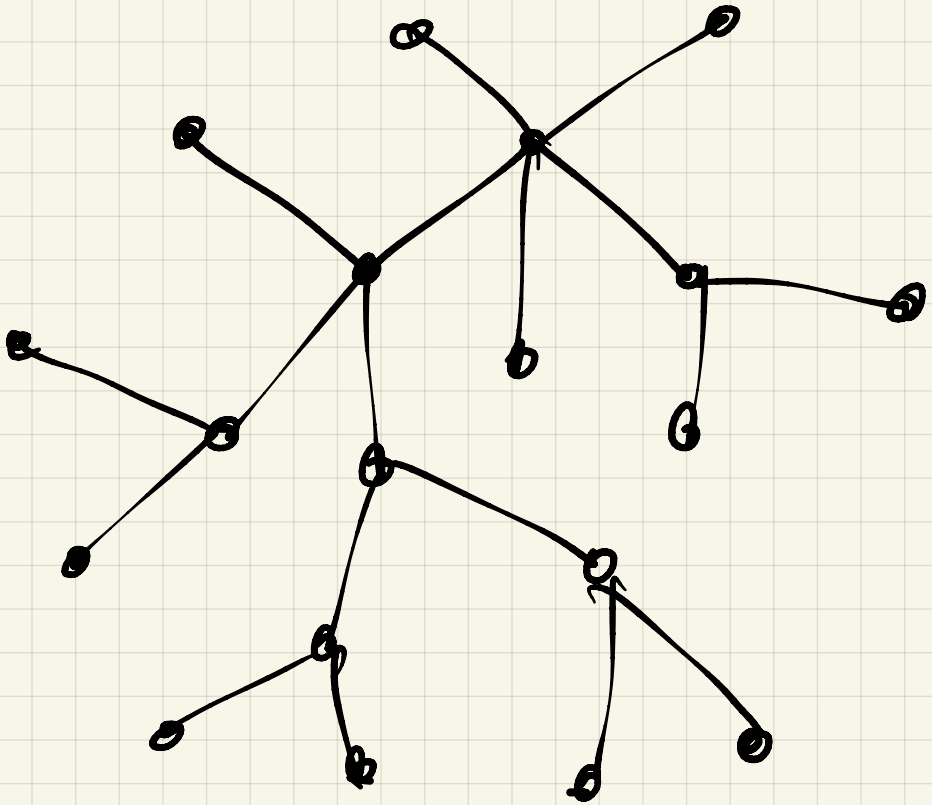


$v = 9$

$e = 11$

$f = 4$

Euler's Formula : $v - e + f = 2$



$V = e - 1$

$$1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

$$1 \times 2 \times 3 \times \cdots \times n = n!$$

"Factorial of n"

"n Factorial"

"n!"

$1! = 1$

$2! = 1 \times 2 = 2$

$3! = 1 \times 2 \times 3 = 6$

$4! = 1 \times 2 \times 3 \times 4 = 24$

$\vdots$