Polynomial time
Easy
Tractable

Binary search (n*logn)
Bubble sort (n*n)
Merge sort (n*logn)

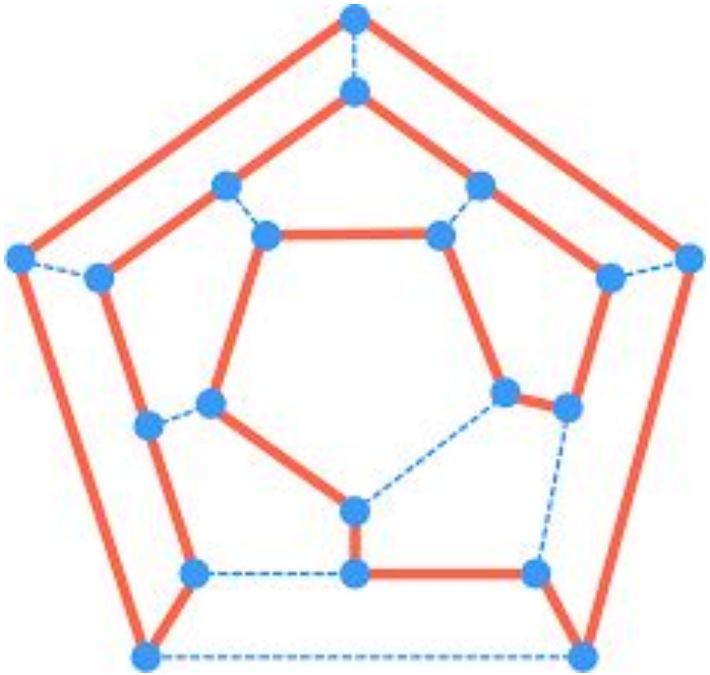
Exponential time
Hard
Intractable

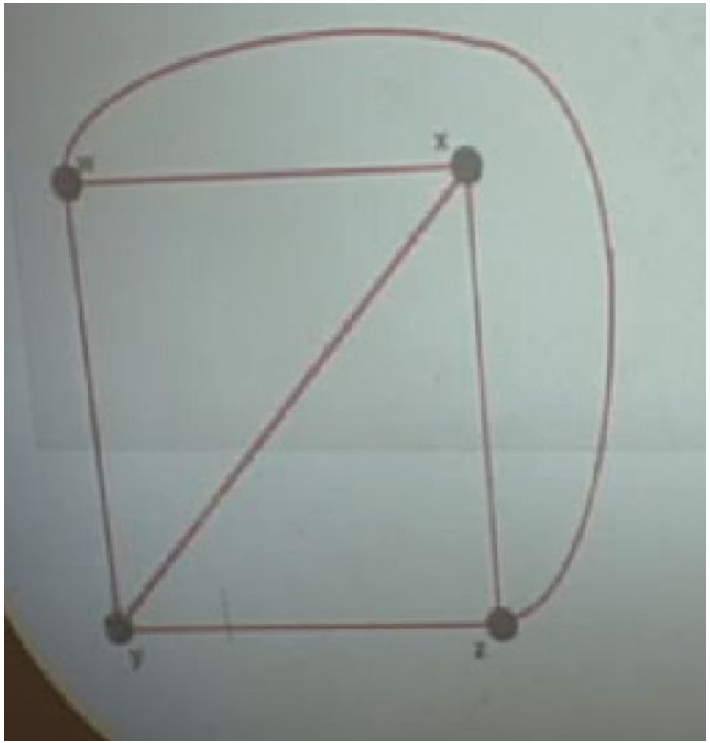
CNF satisfuability
Hamiltonion cycle problem
Travelling salesman problem

2^n (Brut force)

Running time of algorithm $f(n)$	Maximum size solvable in 1 second		
	Current computer	100 times faster	1000 times faster
n	$N_0 = 100$ million	$100N_0$	$1000N_0$
$100n$	$N_1 = 1$ million	$100N_1$	$1000N_1$
n^2	$N_2 = 10,000$	$10N_2$	$31.6N_2$
n^3	$N_3 = 464$	$4.64N_3$	$10N_3$
2^n	$N_4 = 26$	$N_4 + 6.64$	$N_4 + 9.97$

HAMILTONION CYCLE PROBLEM

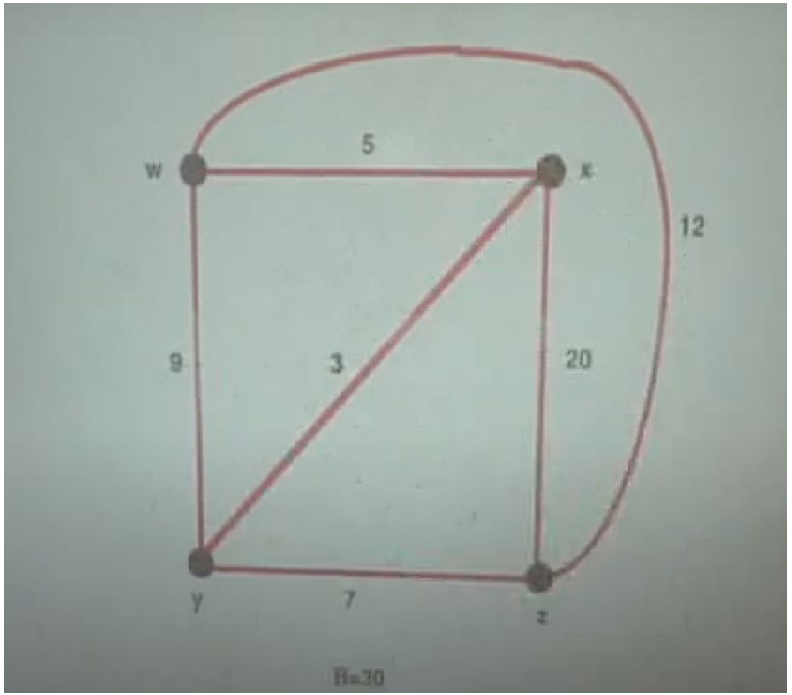


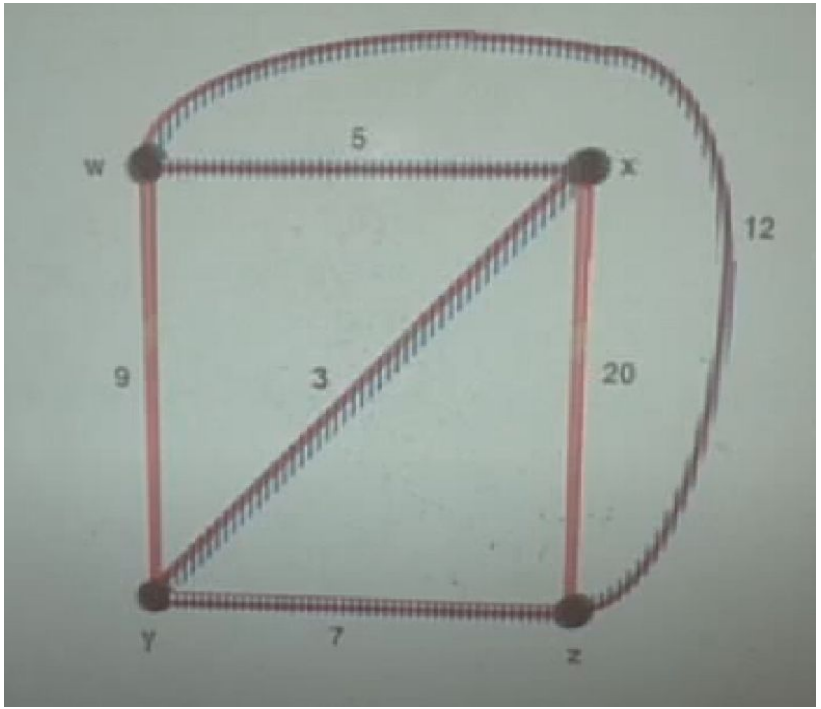


BRUT FORCE- N!

POLYNOMIAL TIME VERF - N

TRAVELLING SALESMAN PROBLEM





BRUT FORCE- N!

POLYNOMIAL TIME VERF - N

CONJUCTIVE NORMAL FORM SATIFIABILITY PROBLEM

$$f(a,b,c,d) = (a \vee b \vee c) \cdot (a \vee b \vee \bar{c}) \cdot (\bar{a} \vee c \vee d) \cdot (\bar{a} \vee c \vee \bar{d}) \cdot (\bar{b} \vee \bar{c} \vee d) \cdot (\bar{b} \vee \bar{c} \vee d)$$

BRUT FORCE- 2^N

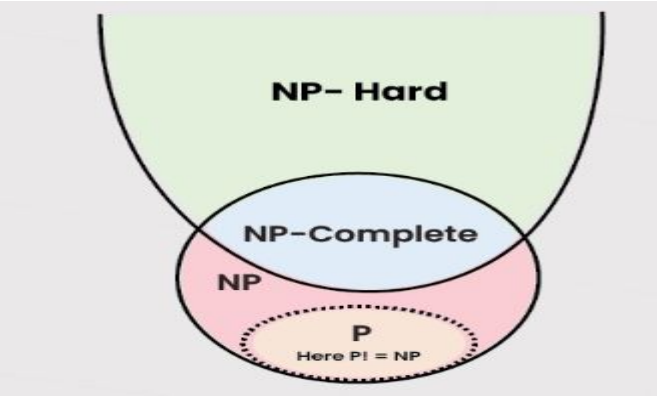
POLYNOMIAL TIME VERF - N

P, NP COMPLETE AND HARD

P : POLYNOMIAL DETERMINISTIC TIME ALGO {SOLVED IN POLYNOMIAL TIME AND ALGO IS DETERMINISTIC}

NP HARD :NON POLYNOMIAL NON-DETERMINISTIC TIME ALGO {SOLVED IN NON POLYNOMIAL AND INSTANCE WITH POLYNOMIAL TIME DOES NOT EXIST}

NP COMPLETE :NON POLYNOMIAL NON-DETERMINISTIC TIME ALGO {SOLVED IN NON POLYN TIME AND INSTANCE WITH POLYNOMIAL TIME EXIST}



PROOF THEM NP COMPLETE

REDUCTION

A <=P* B

COOK’S P=NP