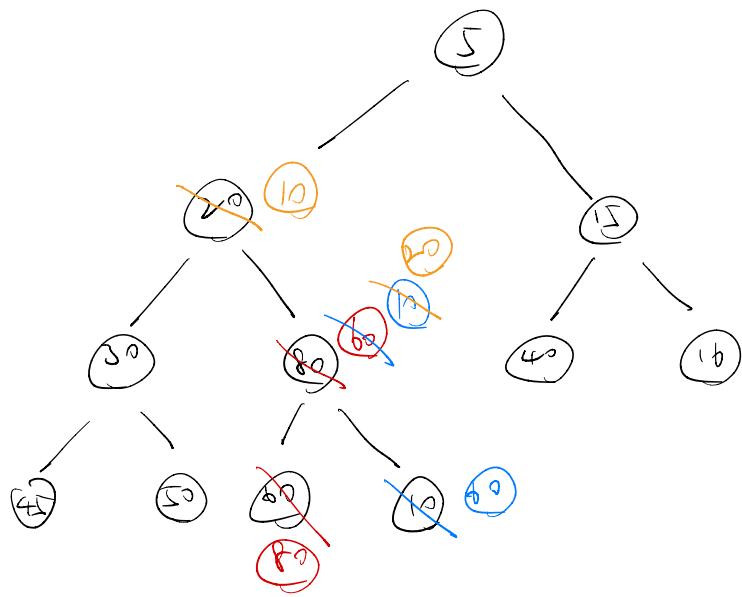
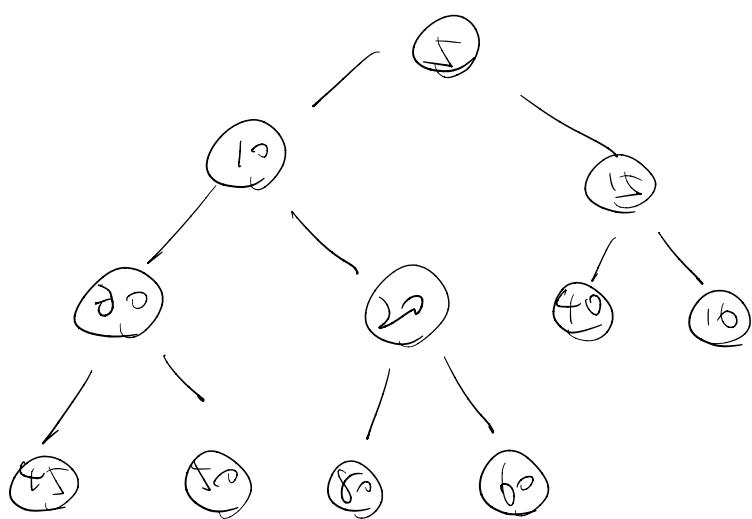
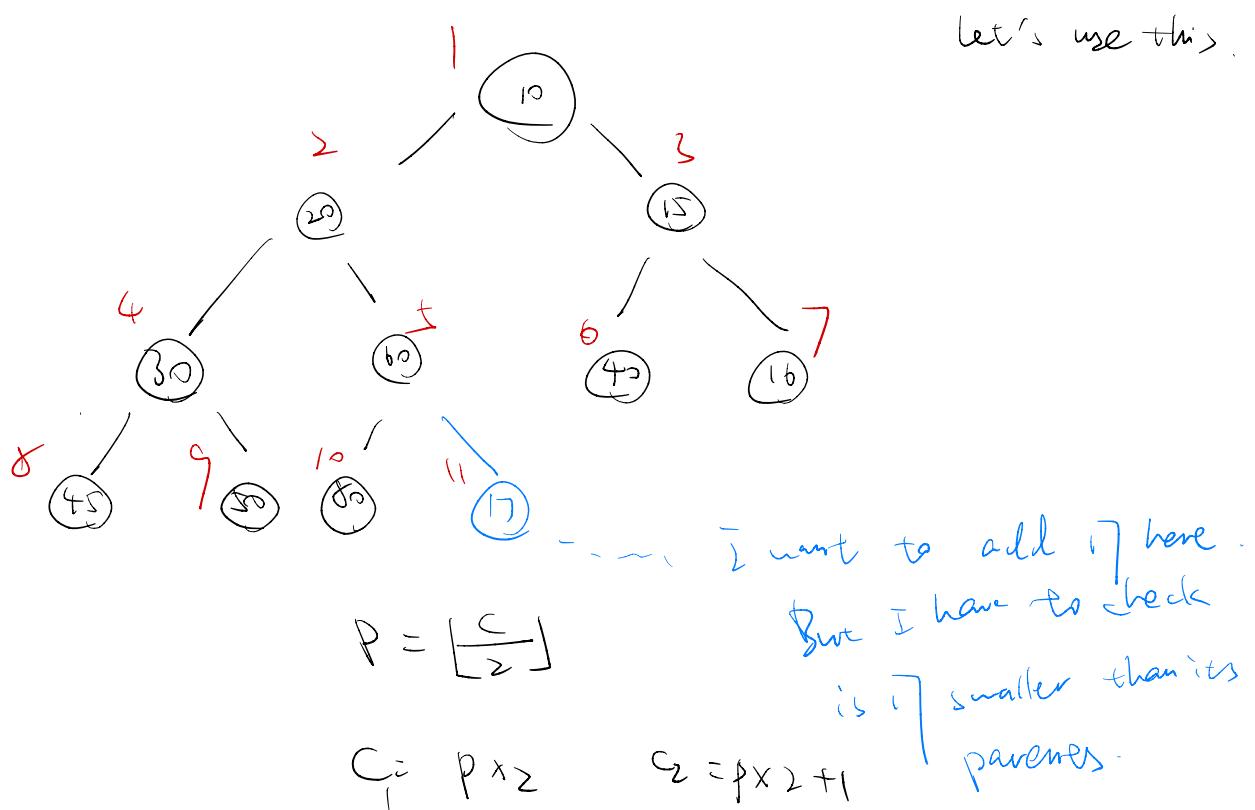
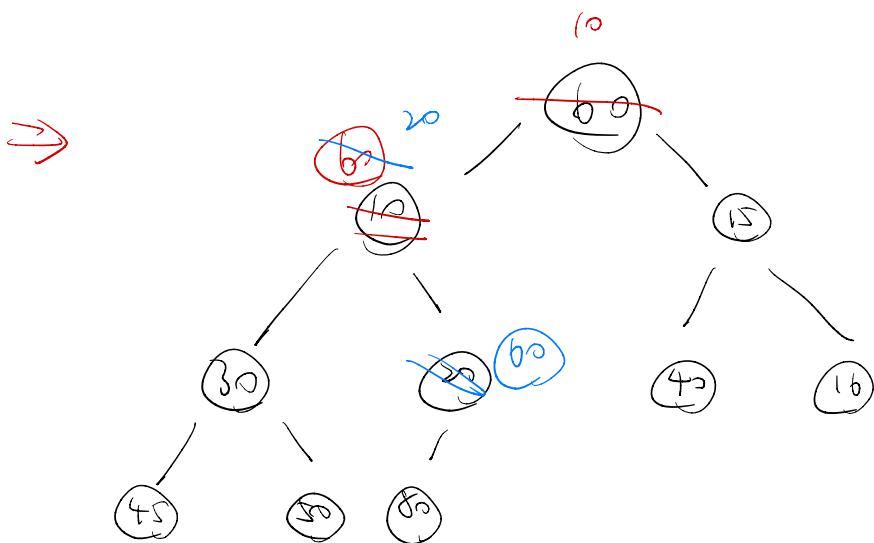
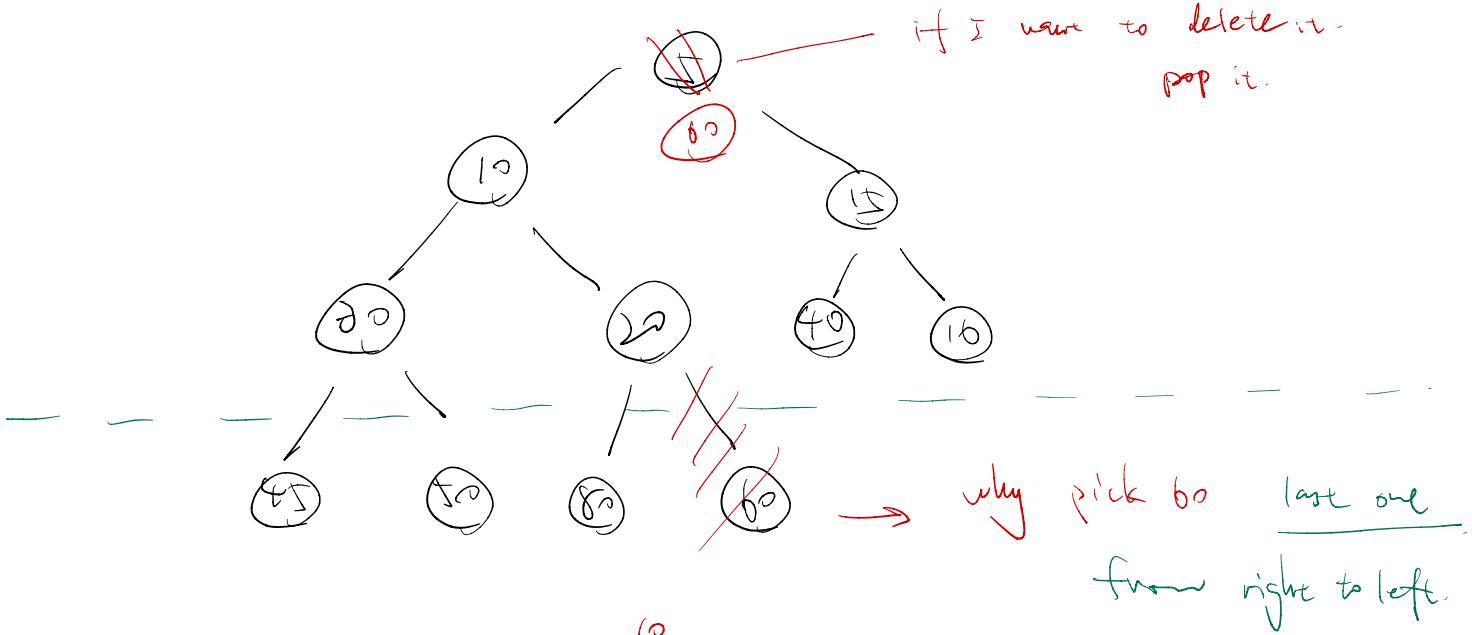


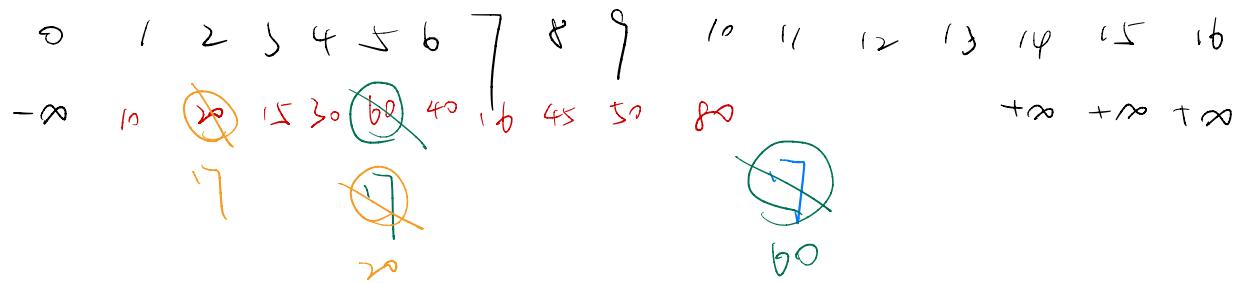
Lecture 9 2023. 9. 5



$$\frac{P \leq C}{\text{parent} \quad \text{child}}$$







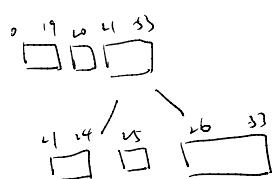
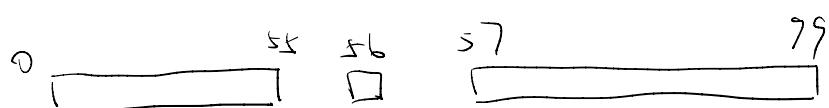
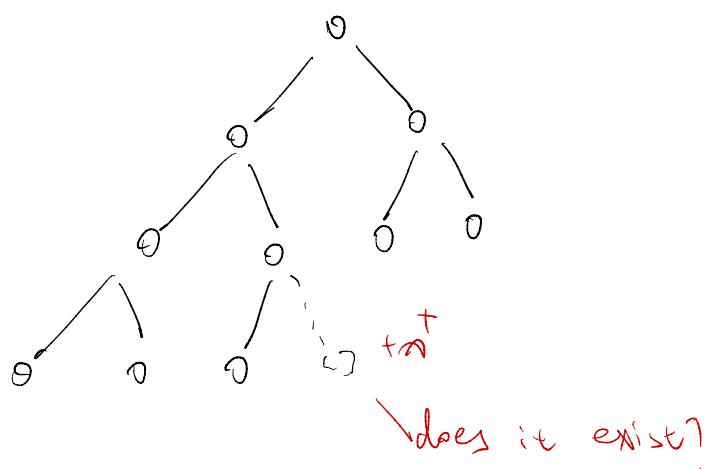
~~10~~ ~~15~~ ~~40~~
~~5~~ ~~10~~ ~~15~~

~~40~~

$$\left\lfloor \frac{11}{2} \right\rfloor = 6$$

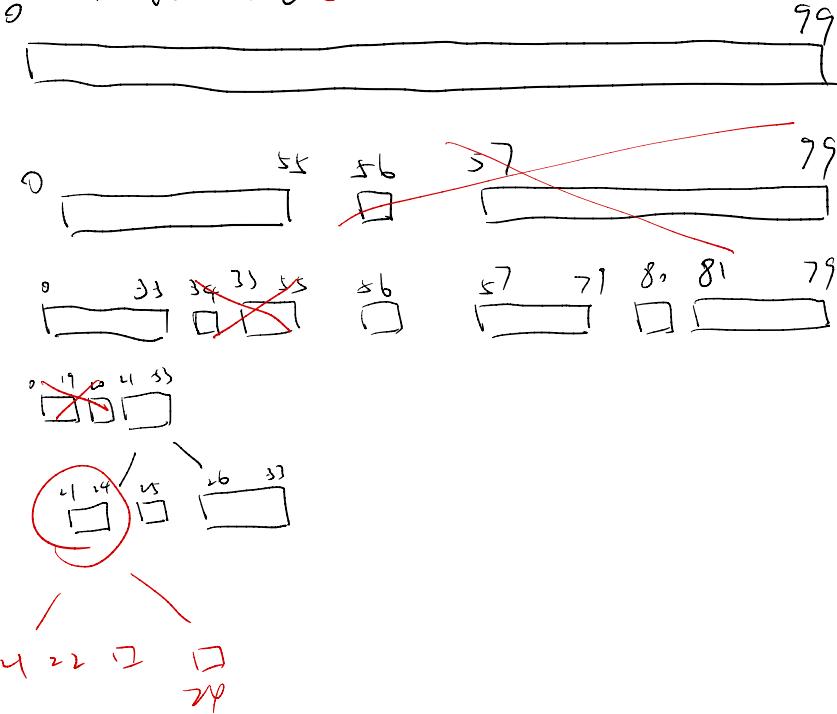
$$\left\lfloor \frac{6}{2} \right\rfloor = 3$$

$$\left\lfloor \frac{3}{2} \right\rfloor = 1$$

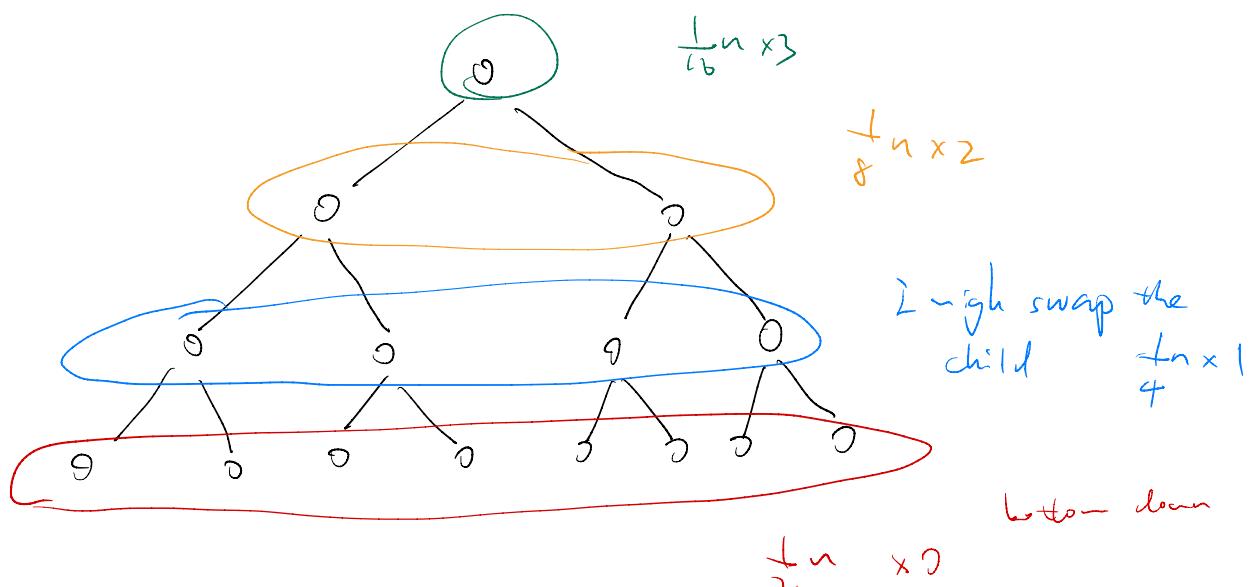


Quick Sort Select

e.g. 24



$$n(1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots) = 2n$$



$\text{nlgn}(n)$

So you always build the heap from the bottom up.

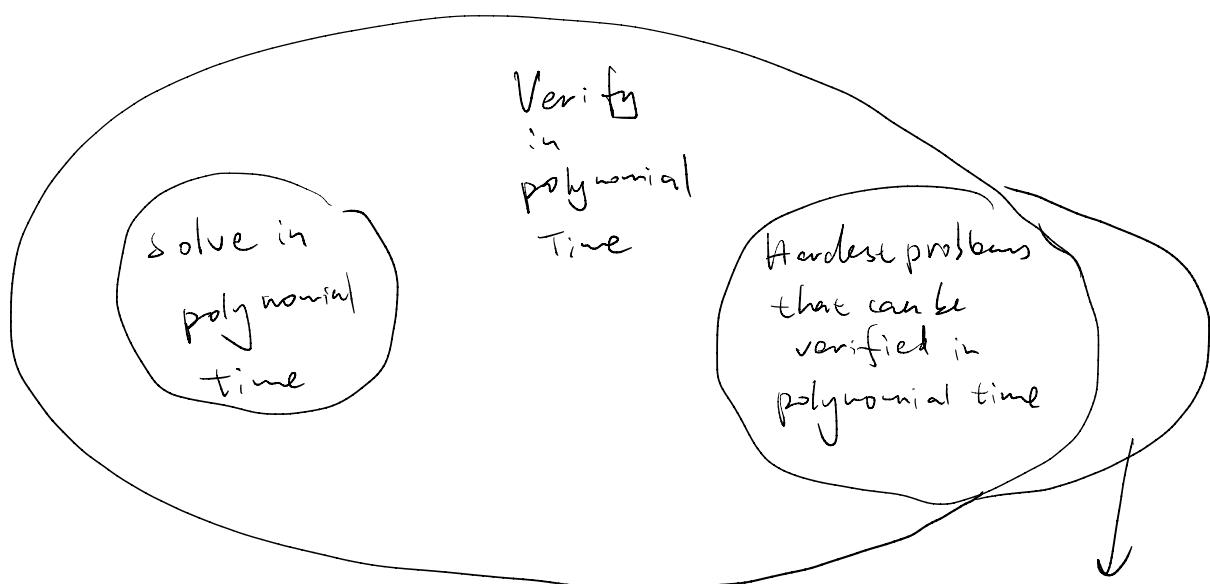
$$\frac{1}{2} + \frac{2}{4} + \frac{3}{8} + \frac{4}{16} + \frac{5}{32} + \frac{6}{64} + \frac{7}{128} + \frac{8}{256}$$

C - n $\Theta(n)$

0	$\overbrace{1 \ 2}^3$	$\overbrace{3}^2$	$\overbrace{4 \ 5 \ 6}^1$	$\overbrace{7}^3$	$\overbrace{8 \ 9}^4$	$\overbrace{10 \ 11}^5$	$\overbrace{12}^6$
5	20	30	40	10	45	55	20
						70	75
						6	20
							45
				20			
					40		
						10	
							30

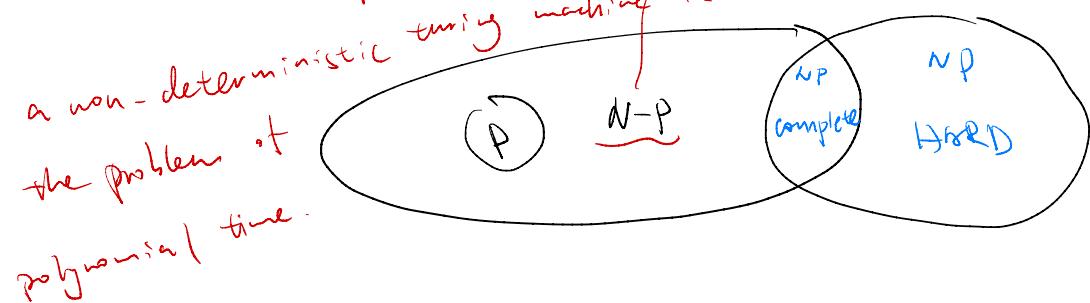
Groups of problems

polynomial : Σ^*

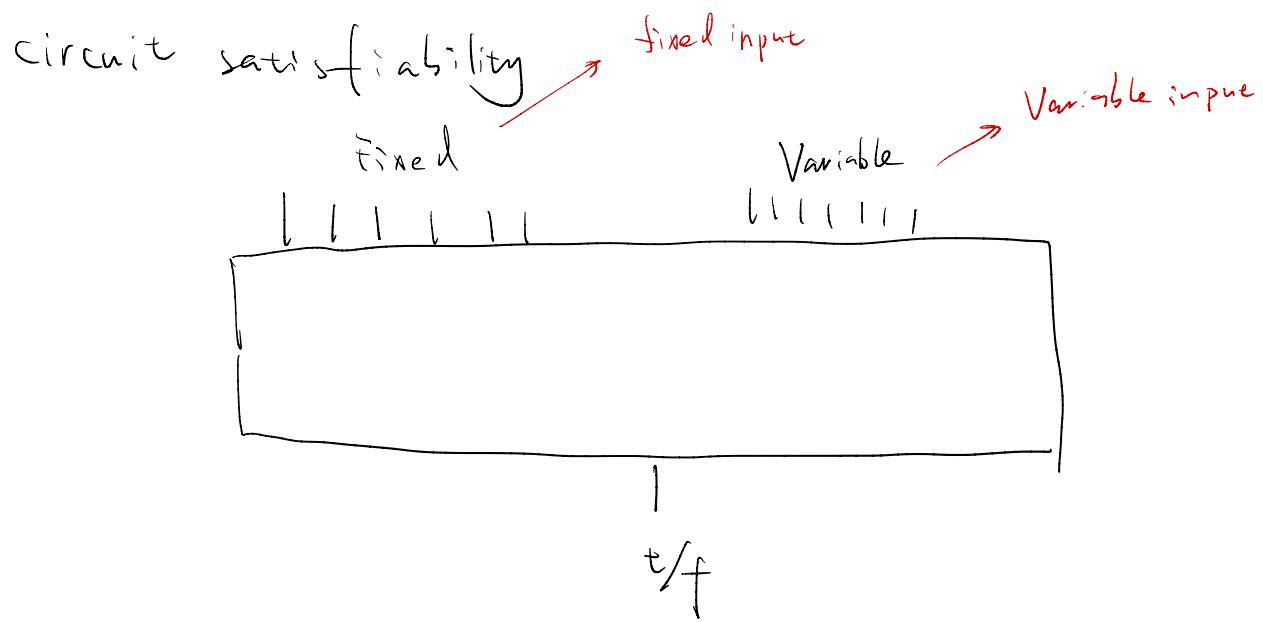


It means NOT-deterministic polynomial meaning if I have a non-deterministic Turing machine it can solve

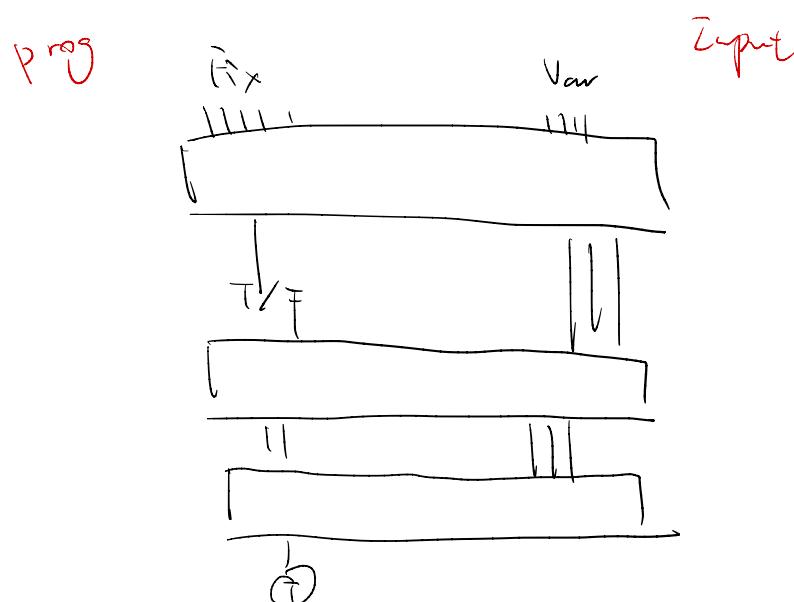
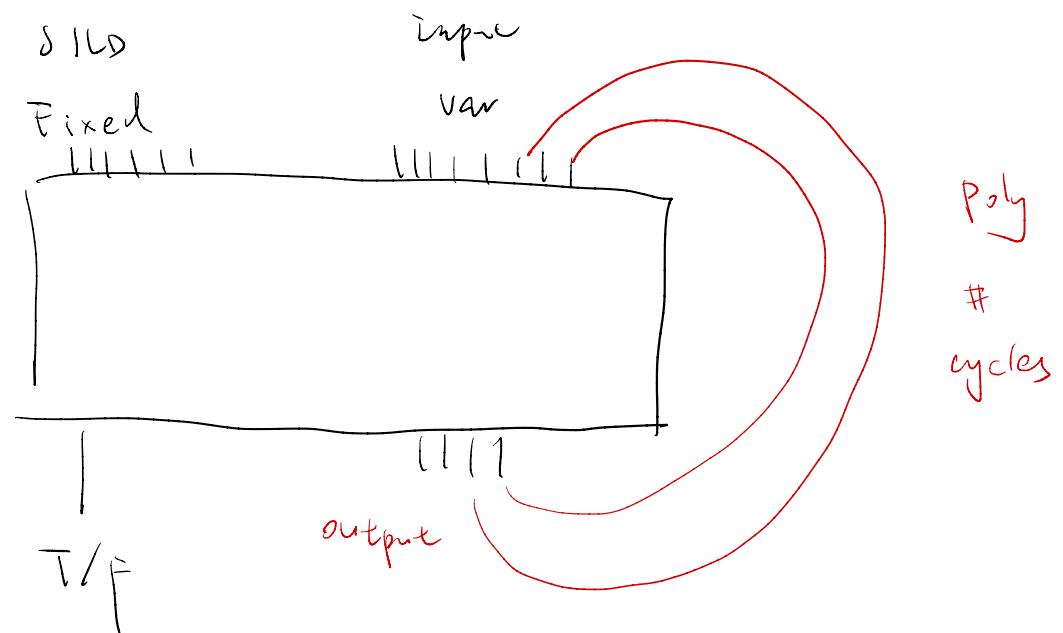
but these can't verify in polynomial time.

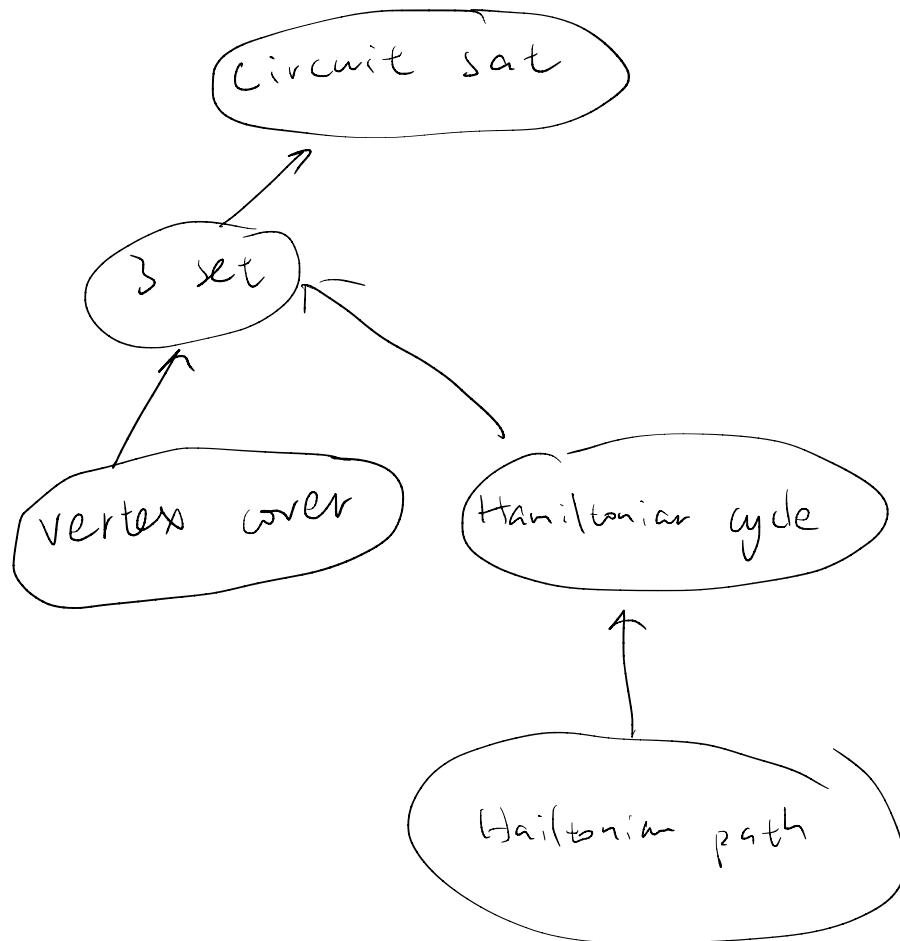


a non-deterministic polynomial time.



given fixed input : is there a setting on Variable input that gives a True.





$$\begin{array}{r}
 & \overline{3 \ 7 \ 1 \ 2} & \Rightarrow & 3 \ 6 \ 9 \ 2 \\
 38 & \overline{| \ 1 \ 4 \ 0 \ 2 \ 9 \ 6} & & | \\
 & \overline{| \ 1 \ 4} & & | \\
 & \overline{| \ 2 \ 6 \ 0} & & | \\
 10 \times & + & & | \\
 & \overline{2 \ 6 \ 2} & & | \\
 & - & & | \\
 & \overline{2 \ 6 \ 6} & & | \\
 10 \times & - & & | \\
 & \overline{-4 \ 0} & & | \\
 & + & & | \\
 & \overline{9} & & | \\
 & - & & | \\
 & \overline{-3 \ 1} & & | \\
 & - & & | \\
 & \overline{-3 \ 8} & & | \\
 \hline
 & \overline{x \ 1 \ 0} & & | \\
 & 7 \ 0 & & | \\
 & + & & | \\
 & \overline{7 \ 6} & &
 \end{array}$$

3 2 1

$$3 \times 10^2 + 2 \times 10^1 + 1 \times 10^0$$

$$3 \underline{2} \bar{1} = 3.9$$

$$3 \times 10^2 + 2 \times 10^1 + -1 \times 10^0$$

$$3 \underline{2} \bar{1} = 330$$

$$3 \times 10^2 + 2 \times 10^1 + \cancel{1} \times 10^0$$

$$\begin{array}{r} 3 \quad 2 \quad 6 \\ + \quad \quad 4 \\ \hline 3 \quad 2 \quad (10) \end{array}$$

$$\begin{array}{r} 3 \quad 5 \quad 1 \quad 2 \\ \hline 38 \quad \overline{1 \quad 3 \quad 7} \quad 2 \quad 5 \quad 6 \\ \quad \quad \quad \overline{1 \quad 1 \quad 4} \\ \quad \quad \quad 2 \quad 3 \quad 0 \\ \quad \quad \quad + \quad \quad 2 \\ \quad \quad \quad \hline 2 \quad 3 \quad 2 \\ \quad \quad \quad + \quad \quad 1 \\ \quad \quad \quad \hline 1 \quad 9 \quad 0 \\ \quad \quad \quad + \quad \quad 4 \\ \quad \quad \quad \hline 4 \quad 2 \quad 0 \end{array} \quad \begin{array}{l} 35(11)2 \\ 3612 \end{array}$$

$$\begin{array}{r} + \quad \quad 5 \\ \hline 4 \quad 2 \quad 5 \\ + \quad \quad 4 \\ \hline 4 \quad 1 \quad 8 \end{array}$$

$$\begin{array}{r} \overline{x_1.} \quad \overline{7 \quad 0} \\ \hline 7 \quad 6 \\ \hline 7 \quad 6 \quad 0 \end{array}$$

why computers do this? because it's faster. save space

$$38 \quad \sqrt{;}$$

$$7 \quad \overline{3628}$$

$$\begin{array}{r} 3612 \\ 1 \overline{7} 612 \end{array}$$

division problem

$$3 \quad 1 \quad 2$$

$$3 \times 10^2 + 1 \times 10^1 + 2 \times 10^0$$

$$0 \quad 11 \quad 0 \quad 11$$

$$0 \times 2^8 + 1 \times 2^7 + 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4$$

$$\beta 4 \quad D = \{ -2 \quad -1 \quad 0 \quad 1 \quad 2 \}$$

$$1001010 \times 1101101$$

$$\begin{array}{r} 1101101 \\ 1022 \\ \hline \end{array}$$

$$\begin{array}{r} 1101101 \\ 10210 \\ \hline 00000 \end{array}$$