

Administrivia.

- Midterm 1 is graded. 34 ± 10 pts.
28 ± 6 pts remainy others.
- Schedule oral exam w/ me!
- HW4 due 2/15 (Mon)



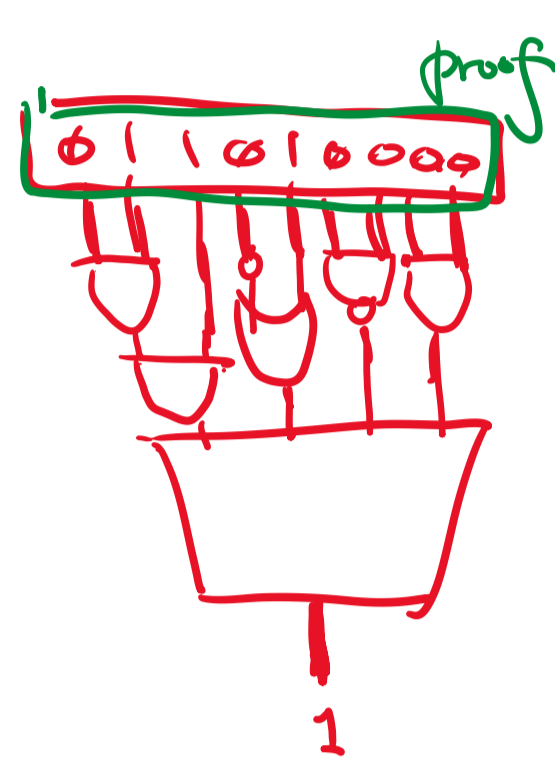
Last time in complexity land: $P = NP$?

An unnatural next Q: \Rightarrow $NP=P$
 Could it be that there's a hardest problem in NP?

NP-hard: If you solve X fast ($X \in P$) then all NP-problems can be solved fast. ($NP = P$)

NP-complete: NP-hard + in P.

CIRCUIT SAT



input: A circuit consists of AND, OR, NOT gates, some input wires, one output wire

output: Is there an input to the circuit such that the output wire is 1?

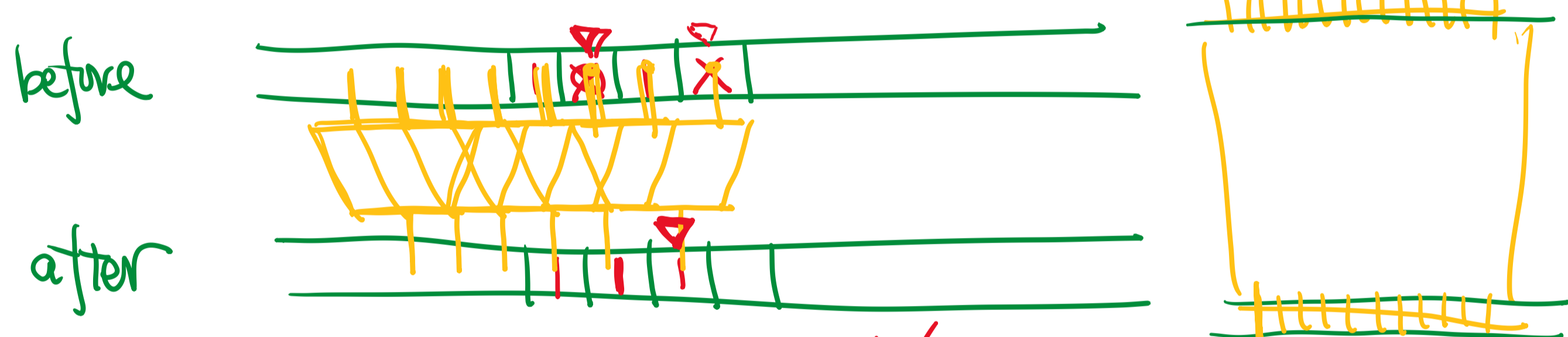
Cook-Levin Thm. CIRCUIT SAT is NP-complete.

CIRCUIT SAT in NP!

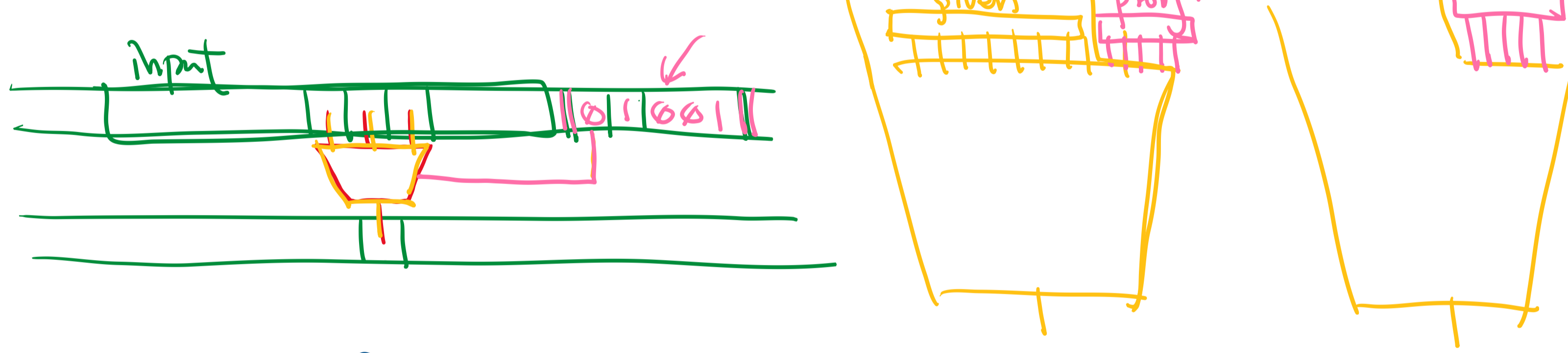
CIRCUIT VALUE

input: A circuit consists of AND, OR, NOT gates, some input wires, one output wire + ^{input} 0s to the circuit.

output: ~~Is there an input to the circuit such that~~
 Is the output wire \rightarrow 1?



Thm. CIRCUIT VALUE ~~is in P~~ is ^{SAT} NP-hard / NP-complete. (actually P-complete)



Question. Now what?



Reductions.

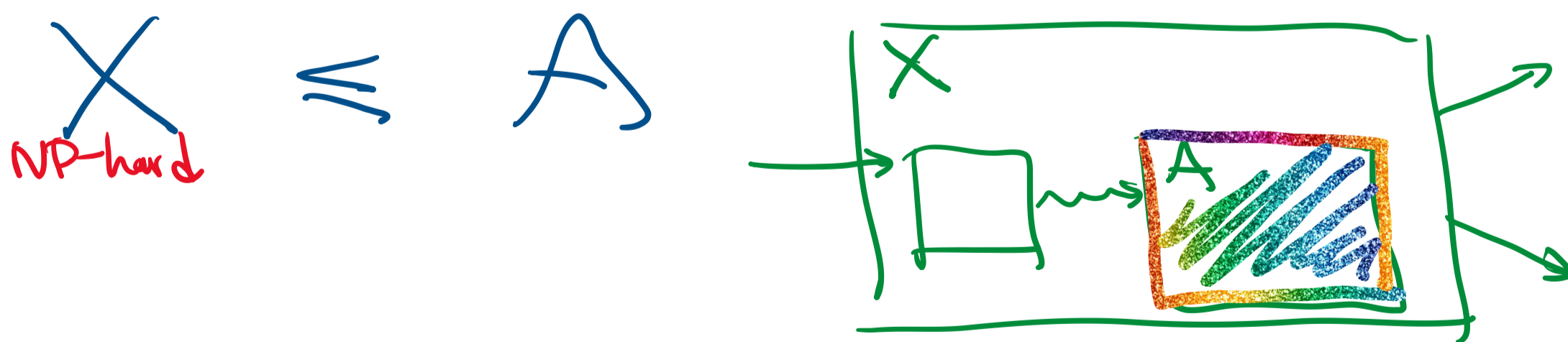
Problem A reduces to B ($A \leq B$) if solving B \Rightarrow solving A.

Q. Is A or B harder?

example. searching \Rightarrow sorting sorting \Rightarrow searching
 find a triangle, \leq find the biggest clique

all NP problems ^{Cook-Levin.} \leq CIRCUIT SAT.

To prove Problem A is NP-hard, reduce known NP-hard problem to A



The reduction has to run in poly. time

example.

COMPUTESAT

input: a circuit,
 output: an input satisfying the circuit

$SAT \leq COMPUTESAT$:
 $COMPUTESAT \leq SAT$

