Complexity Theory

What is computation?

Why are some things easy/hard to compute?

How does access to more time/space/randomness/quantum entanglement affect computational power?

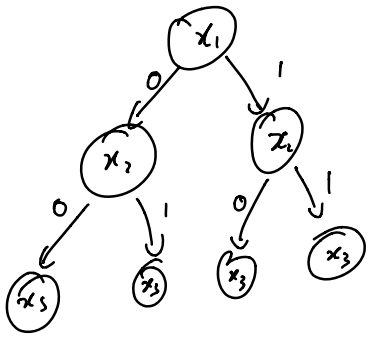
⋮

$f : D \to R$

D: $\{0,1\}^n$ or $\{0,1\}^*$

R: $\{0,1\}$

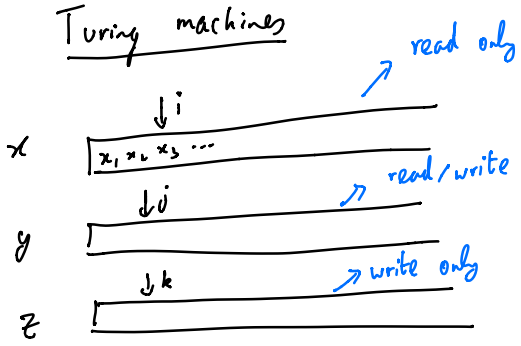
Branching Program



⋮

- Can compute functions that are easy
- Comes with a meaningful measure of complexity

Turing machines



$x \in \{0,1\}^*$

- Everything we can do efficiently with real computers, we can do with Turing machine and vice/versa.

Program

step: (read x_i, y_j) → write to y_j, z_k
→ increment or decrement i, j, k
→ jump to new step or HALT

Example:

1. If x_i is empty, HALT.
   else set $z_k = x_i$, increment i, k, goto 2.
2. If x_i is empty, HALT
   else increment i, k, goto 1.