\( f(n) = \Theta(g(n)) \)

if \( \text{pos. int } c \) and \( n_0 \)
exist such that for every \( n \geq n_0 \)
\( f(n) \leq c \cdot g(n) \)
\[ f(n) = 5n^3 + 2n^2 + 3n + 6 \]

\[ f(n) \text{ is } O(n^3) \]
\[ \text{is } O(n^4) \]
\[ \text{is } O(2^n) \]
\[ \text{is not } O(n^2) \]
\[ f(n) = \sigma(g(n)) \]

\[ \lim_{n \to \infty} \frac{f(n)}{g(n)} = 0 \]
\[ A = \{0^k1^k \mid k \geq 0 \} \quad |w| = n \]

\[ M_1 = \text{on input string } w \]

O(n)
1. scan tape and reject if we find a \( \emptyset \) after a 1

\[ O(n^2) \]
2. repeat if there are both 0s and 1s on the tape.

\[ O(n) \]
3. \( \rightarrow \) cross of a 1 and a 0

\[ \alpha_n \]
4. if 0s but no 1s \( \rightarrow \) reject

\[ 0(n) \]
if 1s but no 0s \( \rightarrow \) reject

\[ O(n^2) \]
otherwise accept.
\textsf{TIME}:

let $t : \mathbb{N} \rightarrow \mathbb{R}^+$

The Time complexity class $\textsf{TIME}(t(n))$ is the collection of all languages that are decidable by some $O(t(n))$ time TM.

so $A \in \textsf{TIME}(n^2)$
$O(\log n)$

Check even

$O(n)$

cross out half of 0's and 1's

$O(n \log n)$

$0000 \begin{array}{c} \text{1111} \end{array}$

Copy 0's to 2nd tape

$0000 \begin{array}{c} \text{1111} \end{array}$

$0000$ $0(n)$
Let \( t(n) \) be a function where \( t(n) = n \).

Then every \( t(n) \) time multi-tape TM has an equiv. \( O(t^2(n)) \) single tape TM.

\[ \text{-non-det TM (time } t(n) \text{)} \]

\[ O(t(n)) \]

\[ 2 \text{-time single tape TM} \]