\[ \begin{array}{c}
010010 \\
\times \text{uvwxyz} \\
\hline
0100010p \\
p0p0p0p0p0p0p0\end{array} \]

\[ w^* w \quad w \text{ is a Palindrome} \]
Show $L$ is not a CFL.

know $J$ is a CFL
" $M$ is not
$L \cup J = M$

Show $L$ is a CFL.

$A \cup B = L$
$A, B$ are CFL's

---

$A, B$ are CFL's.

$A \cap B$?
\[ A_{\text{TM}} = \{ \langle m, w \rangle \mid m \text{ is a TM that accepts } w \} \]

\[ A_{\text{TM}} \text{ is recognizable} \]

**Construct TM U.**

U = on input \( \langle m, w \rangle \) where

- \( m \) is a TM and \( w \) is a string.

1. Simulate \( M \) on \( w \)
2. If \( M \) enters an accept state, accept
   if \( M \) enters a reject state, reject.
Infinite Sets

Countable/Uncountable

\(\text{one-to-one} \quad \text{onto} \quad \text{one-to-one}\)
\[ E = \{ 2, 4, 6, \ldots \} \]
\[ f : \mathbb{N} \rightarrow \mathbb{E} \]
\[ f(n) = 2 \cdot n \]
\[ \mathbb{Q} = \left\{ \frac{m}{n} \mid m, n \in \mathbb{N} \right\} \]
Uncountable

IR

Suppose IR is countable

<table>
<thead>
<tr>
<th>n</th>
<th>f(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.01011...</td>
</tr>
<tr>
<td>2</td>
<td>3.14159...</td>
</tr>
<tr>
<td>3</td>
<td>0.9999999...</td>
</tr>
<tr>
<td>4</td>
<td>35.36217806</td>
</tr>
</tbody>
</table>

\[ x = 0.1232... \]