1. In a DFA long paths are loopy paths.

2. In any DFA of $N$ states, consider an accepting path $p$ of some length. Consider a sub-path $q$ of $p$ of length $N$.

$p$ describes some string $x$
$q$ describes some string $y$

\[ p = p_0 \xrightarrow{x_1} p_1 \cdots \xrightarrow{x_m} p_{m-1} \xrightarrow{x_{m+1}} p_m \]

\[ q = p_k \xrightarrow{y_1} p_{k+1} \cdots \xrightarrow{y_N} p_{l-1} \xrightarrow{y_{N+1}} p_l \]

Then one of $p_k \ldots p_l$ are the same state!

Call it $p_m$
Call the portion leading up to $p_n = u$

Call the $p_k$ to $p_r$ loop $= v$

All the first $p_m$... REVISIT to $p_m = w$

Then

- $u \in L$
- $ww \in L$ because $x \in L$
- $w^2w \in L$
- $w^n \in L$ for $n \geq 0$
Consider
\[ L_{2p} = \{ \varepsilon, ( ), (( )) \} \]
\[ L_{3p} = \{ \varepsilon, ( ), (( )) , ( ( ( )) ) ) \} \]
\[ L_{100p} = \{ \varepsilon, ( ), \ldots , (^{100})^{100} \} \]
All of these have DFAs!

But suppose someone claims that
\[ L_{loop} \text{ has a DFA } \rightleftharpoons \text{ Loop } \]
\[ L_{loop} = \{ \varepsilon \ ( \ )^{n} \mid n \geq 0 \} \].

Then merely ask that person "how many states in that DFA"? Suppose they say "N".
Then consider \( (N)^{N} \)
Clearly \( (N)^{N} \in L(\text{Loop}) \).

Consider \( \rightarrow P_{0} \rightarrow \text{ (B) } \).
Clearly Fa is a state in this path.

We don't know what exactly things look like — EXCEPT:

\[ w = i \quad \text{for some } i \geq 0 \]

\[ n^* = j^* \quad \text{for some } j^* \geq 1 \]

\[ w = \text{whores! some (but then)} \]
But now

A1. ∀w ∈ L(Doop)
A2. w w w ∈ L(Doop)
A3. w w ∈ L(Doop)

A1 is fine.

A2 is a contradiction!

If you want more then

A3 is a contradiction!

So Doop can't exist.

"(If it exists, it can't be for language L_{Doop} ! !)"

Treating (= 0 and ) = 1, we see that

\[ L_{\text{on}n} = \sum_{i=1}^{n} | n \geq 0 \] not regular as well !
\[ L_{eq01} = \{ w \mid w \in \{0,1\}^* \text{ and } \#_0(w) = \#_1(w) \} \]

\[ 10/18/11 \]

L<sub>eq01</sub> not regular!

**Proof 1:**

Suppose L<sub>eq01</sub> reg.

Then FA L<sub>eq01</sub>.

Clearly FA D<sub>0*1*</sub>

But then L<sub>eq01</sub> \cap D<sub>0*1*</sub> = D<sub>01</sub> non-\text{CONS}

**Proof 2:** Choose an \text{w} in L<sub>eq01</sub>

Proceed to contradiction.

\[ L_{abc} = \{ a^i b^j c^k \mid i, j, k \geq 0 \text{ and if odd } (i) \text{ then } j = k \} \]

- Hmm!

Consider now \text{Rev}(L_{abc})