

If a DFA M accepts $a_1 a_2 a_3 \dots a_n$ (string of length n), the run of M witnessing this passes through $n+1$ states, from start to accepting state inclusive. If $n \geq \# \text{states}$, then these $n+1$ states cannot all be distinct, so we can cut out the part of the string corresponding to the return to this twice-visited state, to get an acceptable string of strictly shorter length. Repeat until we get an accepted string of length $< \# \text{states}$.