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N - # of states $q_0, \ldots, q_{N-1}$ initial

M - # of symbols $S_0, \ldots, S_{M-1}$

state[n][m] q_n moves if it sees symbol S_m

final[n] - boolean

```
public static void main (String [ ] arcs){
   int N; i
   S.o.p ("Please enter # of states");
   N = reader.nextInt();
   int M;
   ...
    int [ ][ ] state = new int[N][M];
      for(int n=0; n<N; n++){
         for(int m=0; m<N; m++){
            S.o.p ("What state do you get in"+
               "if you are in state"+n+
               "and you see symbol"+m);
            state[n][m] = reader.nextInt();
         }
    }
```

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...

```
boolean done = false;
while (!done){
  int length;
  S.o.p. ask
     ...
  int[] word = ...;
    ask ...
  int currentState = 0;
  for(int i=0; i< length; i++){
     currentState =
        state[currentState][word[i]];}
  if (final[currentState])
        {S.o.p("Accepted");}
  else {S.o.p("Rejected");}
  S.o.p("Do you want to continue");
  ~~if~~ ( ...
}
```

Pumping lemma.

$\forall$ reg. $L\ \exists p\ \forall w_{\in L}(\text{len}(w) \geq p \rightarrow \exists x, y, z$
$(w = xyz\ \&\ \text{len}(y) > 0\ \&\ \text{len}(xy) \leq p\ \&$
$\forall i\ (xy^i z \in L)))$

Th. $L = \{a^n b^n : n = 0, 1, 2, \ldots\} =$
Theorem $\{\Lambda, ab, aabb, aaabbb, \ldots\}$
is not regular.

Proof: by contradiction. Let's assume that L is regular, and let's derive a contradiction from this assumption. Since L is regular, by pumping lemma there exist an integer p such that every word w from L whose length is $\geq p$ can be represented as xyz, where $\text{len}(y) > 0$, $\text{len}(xy) \leq p$, and for all i, $xy^i z \in L$.
Let's take $w = a^p b^p = \underbrace{a \ldots a}_{p \text{ times}} \underbrace{b \ldots b}_{p \text{ times}}$.
$\text{len}(xy) \leq p$, $w = \underbrace{xy}z$ starts with xy
So y is in a's, in $x\underbrace{yy}z$ – we add a's but not b's
we started with word that has same # of a's and b's, so $xyyz$ has more a's than b's, so $xyyz \notin L$. But by pumping lemma $xyyz \in L$. We get a contradiction.
So our assumption – that L is regular – is false. Thus, L is not regular.

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$L = \{$all the words that have same number of as and bs$\} =$

$\{\Lambda, ab, ba, aabb, abba, abab, \ldots\}$

$L = \boxed{\{a^{n+1} b^n\}}$

$\{a^n b^n\}$ $\quad a^p b^p$ $\quad \cancel{aab}$ $\quad \cancel{abab}$

$\underbrace{a \ldots a}\underbrace{b \ldots b}$ $\quad len(\ ) = 2p \geq p$

$\cancel{a^{p-1} b^p}$ $\quad \cancel{2p-1}$

$\cancel{len(xy) \leq p}$ $\quad \cancel{\underbrace{a \ldots a}_{p-1}\ \underbrace{ab \ldots b}_{p}}$

$\{a^p b^{p+1}\}$

$\{a^n b^{2n}\}$ $\quad \cancel{a^1 b}$ $\quad \cancel{abb}$

$a^p b^{2p}$

$L = \{\boxed{WW}\} = \{$catcat, dogdog, bagbag, $\ldots\}$

$W = \boxed{a^p b^p a^p b^p} = xyz$ $\quad \underbrace{a \ldots a}_{p}\underbrace{b \ldots b}\underbrace{a \ldots a}\underbrace{b \ldots b}$

$xyyz$ $\quad len(xy) \leq p$

$\underbrace{a^{p+q} b^p}\ \underbrace{a^p b^p}$