DFA TO REGULAR EXPRESSION

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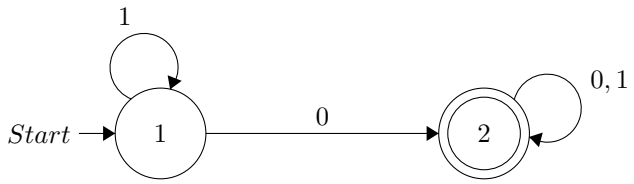
1 A DFA accepting all strings that have at least one 0.



2 Transition Table

$R_{11}^{(0)}$	$\epsilon + 1$
$R_{12}^{(0)}$	0
$R_{21}^{(0)}$	θ
$R_{22}^{(0)}$	$(\epsilon + 0 + 1)$

Table 1: A DFA accepting all strings that have at least one 0.

3 k-Paths

We need to find the k-Paths with k=1,2,3 and 4, using the ecuation:

$$R_{ij}^{(k)} = R_{ij}^{(k-1)} + R_{ik}^{(k-1)}(R_{kk}^{(k-1)})^* R_{kj}^{(k-1)}$$

- $R_{11}^{(k)}$:
  - $R_{11}^{(0)} = \epsilon + 1$
  - $R_{11}^{(1)} = R_{11}^{(0)} + R_{11}^{(0)}(R_{11}^{(0)})^* R_{11}^{(0)} = (\epsilon+1)+(\epsilon+1)[(\epsilon+1)^*](\epsilon+1) = (\epsilon+1)^*$
  - $R_{11}^{(2)} = R_{11}^{(1)} + R_{12}^{(1)}(R_{22}^{(1)})^* R_{21}^{(1)} = (\epsilon+1)^* + [0+(\epsilon+1)^*0][(\epsilon+0+1)^*]0 = (\epsilon+1)^*$
  - $R_{11}^{(3)} = R_{11}^{(2)} + R_{13}^{(2)}(R_{33}^{(2)})^* R_{31}^{(2)} = (\epsilon+1)^* + \theta = (\epsilon+1)^*$
  - $R_{11}^{(4)} = R_{11}^{(3)} + R_{14}^{(3)}(R_{44}^{(3)})^* R_{41}^{(3)} = (\epsilon+1)^* + \theta = (\epsilon+1)^*$
- $R_{12}^{(k)}$:
  - $R_{12}^{(0)} = 0$
  - $R_{12}^{(1)} = R_{12}^{(0)} + R_{11}^{(0)}(R_{11}^{(0)})^* R_{12}^{(0)} = 0 + (\epsilon+1)[(\epsilon+1)^*]0 = 0 + (\epsilon+1)^*0$
  - $R_{12}^{(2)} = R_{12}^{(1)} + R_{12}^{(1)}(R_{22}^{(1)})^* R_{22}^{(1)} = [0+(\epsilon+1)^*0] + [0+(\epsilon+1)^*0][(\epsilon+0+1)^*](\epsilon+0+1) = [0+(\epsilon+1)^*0](\epsilon+0+1)^*$
  - $R_{12}^{(3)} = R_{12}^{(2)} + R_{13}^{(2)}(R_{33}^{(2)})^* R_{32}^{(2)} = [0+(\epsilon+1)^*0](\epsilon+0+1)^* + \theta = [0+(\epsilon+1)^*0](\epsilon+0+1)^*$
  - $R_{12}^{(4)} = R_{12}^{(3)} + R_{14}^{(3)}(R_{44}^{(3)})^* R_{42}^{(3)} = [0+(\epsilon+1)^*0](\epsilon+0+1)^* + \theta = [0+(\epsilon+1)^*0](\epsilon+0+1)^*$
- $R_{21}^{(k)}$:
  - $R_{21}^{(0)} = \theta$
  - $R_{21}^{(1)} = R_{21}^{(0)} + R_{21}^{(0)}(R_{11}^{(0)})^* R_{11}^{(0)} = \theta + \theta(\epsilon+1)^*(\epsilon+1) = \theta$
  - $R_{21}^{(2)} = R_{21}^{(1)} + R_{22}^{(1)}(R_{22}^{(1)})^* R_{21}^{(1)} = \theta + (\epsilon+0+1)(\epsilon+0+1)^*\theta = \theta$
  - $R_{21}^{(3)} = R_{21}^{(2)} + R_{23}^{(2)}(R_{33}^{(2)})^* R_{31}^{(2)} = \theta + \theta = \theta$
  - $R_{21}^{(4)} = R_{21}^{(3)} + R_{24}^{(3)}(R_{44}^{(3)})^* R_{41}^{(3)} = \theta + \theta = \theta$
- $R_{22}^{(k)}$:
  - $R_{22}^{(0)} = (\theta + 0 + 1)$
  - $R_{22}^{(1)} = R_{22}^{(0)} + R_{21}^{(0)}(R_{11}^{(0)})^* R_{12}^{(0)} = (\epsilon+0+1) + \theta(\epsilon+1)^*0 = (\epsilon+0+1)$
  - $R_{22}^{(2)} = R_{22}^{(1)} + R_{22}^{(1)}(R_{22}^{(1)})^* R_{22}^{(1)} = (\epsilon+0+1) + (\epsilon+0+1)[(\epsilon+0+1)^*](\epsilon+0+1) = (\epsilon+0+1)^*$
  - $R_{22}^{(3)} = R_{22}^{(2)} + R_{23}^{(2)}(R_{33}^{(2)})^* R_{32}^{(2)} = (\epsilon+0+1)^* + \theta = (\epsilon+0+1)^*$
  - $R_{22}^{(4)} = R_{22}^{(3)} + R_{24}^{(3)}(R_{44}^{(3)})^* R_{42}^{(3)} = (\epsilon+0+1)^* + \theta = (\epsilon+0+1)^*$