(3) $R = 1/3$. octal generators (3,2,1).

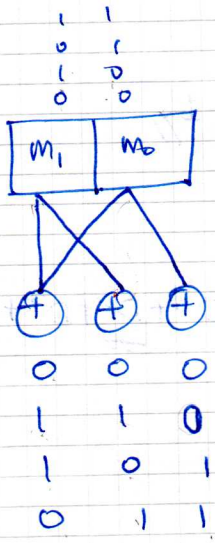
input = 1 ; output 3.

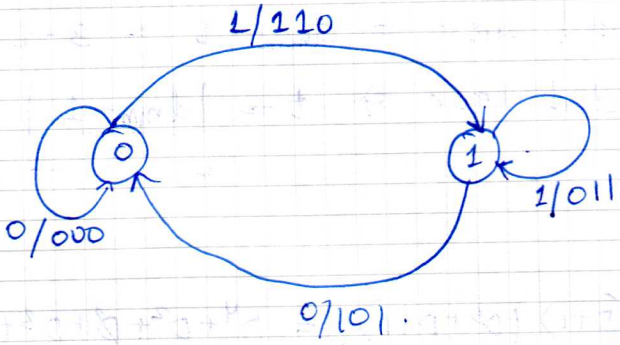
$3 = 011$

$2 = 010$

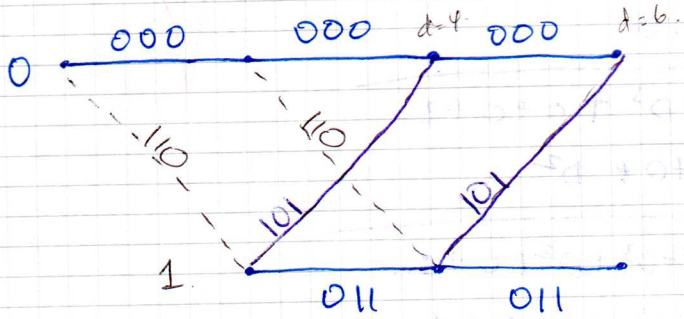
$1 = 001$

$2^{2-1} = 2$ states.

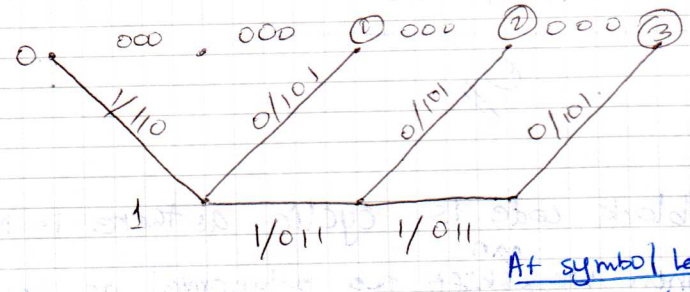




(a) Trellis diagram.



(b)



For (1) bit $\Rightarrow$ $d = 4$

For (2) $\Rightarrow$ $d = 6$.

For (3) , $d = 8$.

At symbol level.

$$P(E) \leq Q\left(\sqrt{\frac{2E_b}{N_0} \cdot 4R}\right) + Q\left(\sqrt{\frac{2E_b}{N_0} \cdot 6R}\right) + Q\left(\sqrt{\frac{2E_b}{N_0} \cdot 8R}\right)$$

At bit level.

$$P_b(E) \leq 1Q\left(\sqrt{\frac{2E_b}{N_0} \cdot 4 \cdot 1/3}\right) + 2Q\left(\sqrt{\frac{2E_b}{N_0} \cdot 6 \cdot 1/3}\right) + 3Q\left(\sqrt{\frac{2E_b}{N_0} \cdot 8 \cdot 1/3}\right).$$