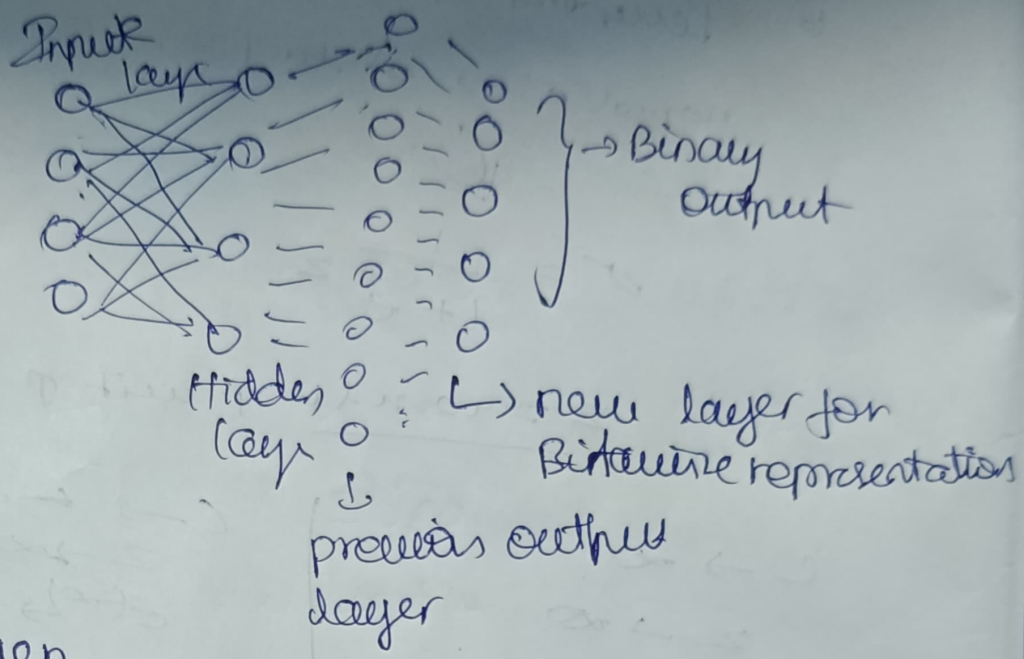
3. Output layer configuration



given

activation = 0.99 (for correct output) on previous layer

activation ≤ 0.01 (for incorrect option)

result is within (0-9)

0 - 0000
9 - 1001

we want to use four neurons to represent

0 - 0000
1 - 0001
2 - 0010
3 - 0011
4 - 0100
5 - 0101
6 - 0110
7 - 0111
8 - 1000
9 - 1001

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first neuron is check odd or even

$S_1 = \{1, 3, 5, 7, 9\} \rightarrow$ Bit 1

because last digit is one when odd and zero when even

$S_2 = \{2, 3, 6, 7\} \rightarrow$ Bit 2

- Third value is unique for 2 3 6 7
- Third value $1 \Rightarrow S_k \in S_2$

Ex

$S_3 = \{4, 5, 6, 7\} \rightarrow$ Bit 3

$S_4 = \{9\}$ { Full digit }

weight $\Rightarrow w_n^{(k)} = \begin{cases} +1 & \text{if } j \in S_k \\ -1 & \text{if } j \in S_k \end{cases}$

To finding bias

correct neuron ≥ 0.99

wrong neuron ≤ 0.01

Bit should be max for correct digit

$\sum w_i a_i = 0.99$

$z = 0.99 + x > 1$

so safely we choose bias as 0.1

$b = 0.1$

$e^{-z} \Rightarrow \frac{1}{1+e}$ $\quad e^{true} > 1$ $\quad \frac{1}{1+1} = \frac{1}{2} = 0.5$

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so if z is positive it means the sigmoid function output 0.5 and above

z < 0 case

for correct digit let

$$\sum w_i a_i + b = 0.99 \times 1 + 0.01 \times 9 + 0.1$$

$$= -0.80$$

z is negative

The $\sigma(z)$ is less than 0.5

Hence Bit is zero

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