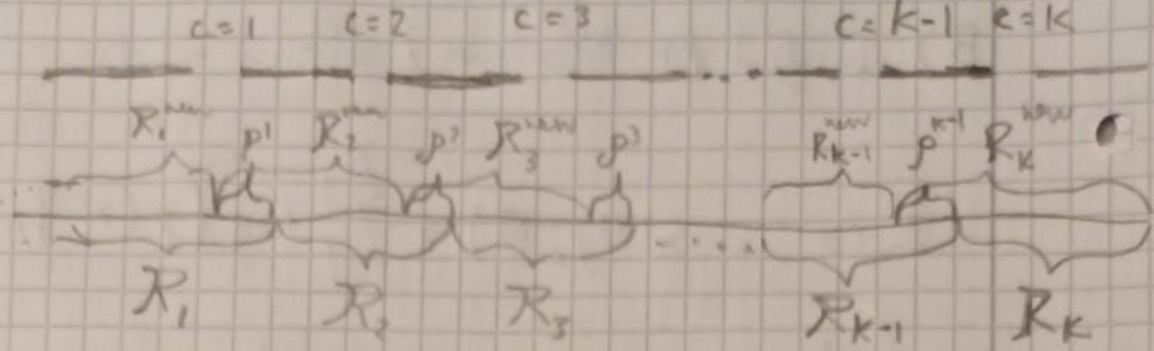
$\boxed{4}$



A)

$$P_{correct} = p(x \in R_1, c=1) + \dots + p(x \in R_k, c=k)$$

$$= \sum_{n=1}^{k} p(x \in R_n, c=n)$$

$$P_{correct} = \sum_{n=1}^{k} \int_{R_n} p(x, c=n) \cdot dx$$

$$= \left(\sum_{n=1}^{k-1} \int_{R_n \setminus p_n} p(x, c=n) + \int_{p_n} p(x, c=n) \cdot dx \right) + \int_{R_k} P(x, c=k)\, dx$$

When thinking about the optimal R_n^{opt} of each region R, except for regions R_1^{opt} & R_K^{opt}, where their optimals would be:

$$R_1^{opt} = \{ \vec{x} \mid \underbrace{P(c=1 \mid \vec{x})}_{p_1} > \underbrace{p(c=2 \mid \vec{x})}_{p^1} \}$$

$$R_K^{opt} = \{ \vec{x} \mid \underbrace{P(c=k \mid \vec{x})}_{p_{k-1}} > \underbrace{P(c=k-1 \mid \vec{x})}_{p_{k-1}} \}$$

For the rest of the intermediate regions 'R', the optimal should be found not just between one region 'p', but between two of them (their side neighbours), therefore:

for $R_j \in \{R_2, \dots, R_{k-1}\}$, and $\rho_j \in \{\rho_2, \dots, \rho_{k-1}\}$

$$R_j^{opt} = \left\{ \vec{x} \,\middle|\, \left(p(c=j-1 \mid \vec{x})_{\rho_{j-1}} < p(c=j \mid \vec{x})_{\rho_{j-1}}\right) \;\&\; \left(p(c=j+1 \mid \vec{x})_{\rho_j} < \dots \right.\right.$$

$$\left.\left. \dots < p(c=j \mid \vec{x})_{\rho_j}\right) \right\}$$

B) A given 'R_k' can be an empty set at some 'R_j' defined before if the intermediate regions 'ρ_{j-1}' & 'ρ_j' are both including all the available for optimality.