
PROBABILISTIC AND SMOOTHED ANALYSIS OF ALGORITHMS
END SEMESTER EXAMINATION

May 4, 2023

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ANSWERING ANY 4 Question.

1. Question 1 from Probabilistic Analysis

Ans: We need to show the following

$$\langle f^{=k}, f^{=l} \rangle = \begin{cases} W^k[f] & \text{if } k = l \\ 0 & \text{otherwise} \end{cases}$$

Definition For $f : \{-1, 1\}^n \rightarrow \mathbb{R}$ and $0 \leq k \leq n$ Fourier weight at degree k is the following

$$W^k[f] = \sum_{\substack{\text{card}(S)=k \\ S \subseteq [n]}} \hat{f}(S)^2 \quad (1)$$

Using last definition we can arrive at the inner product asked in the question. From Parseval's theorem we can say that $W^k[f] = \|f^{=k}\|_2^2$. Where $f^{=k} = \sum_{\text{card}(S)=k} \hat{f}(S) \chi_S$.

Ans: