

Homework 14 of Introduction to Analysis(II)

AM15 黃琦翔 111652028

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1. Let $A_M = \{x \in E \mid f_M \text{ is discontinuous at } x\}$ and $A = \{x \in E \mid f \text{ is discontinuous at } x\}$. For any $M \in \mathbb{N}$, if x is a point that f_M is discontinuous at x , That means $f(x) \leq M$ and f is discontinuous at x . That is, $A_M \subseteq A$ for all M implies that $\cup A_m \subseteq A$.

And for any $x \in A$, there exists a $N \in \mathbb{N}$ s.t. $f(x) < N$. Then, $x \in A_N$. Therefore, $A = \cup A_M$.

2. Let $\int_0^1 f(x) dx = \alpha$ and $\sup_{x \in [0,1]} f(x) = M$. And since f is integrable, there exists a partition P s.t. $\int_0^1 f(x) dx - L(f, P) \leq \frac{\alpha}{4}$.
3. Since $\int_E f(x) dx = 0$, then for any $\varepsilon > 0$, there exists rectangles R_n that $(\cup) \int_E f(x) dx = \sum \sup_{x \in R_i} f(x) \cdot |R_i| < \varepsilon$. That is,