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Problem 1: Prove that the functor which associates to each presheaf \( F \) on a topological space \( X \) the sheafification \( \hat{F} \) satisfies the following universal property: For each sheaf \( G \) on \( X \) and each presheaf morphism \( \eta: F \rightarrow G \) there exists a unique sheaf morphism \( \hat{\eta}: \hat{F} \rightarrow G \) such that

\[ \eta = \hat{\eta} \circ \iota \]

with \( \iota: F \rightarrow \hat{F} \).

Problem 2: Let \( X \) and \( Y \) be Hausdorff topological spaces, and \( A \subset X \) a compact subspace. Additionally, let \( f: A \rightarrow Y \) be a continuous map. Show that then \( X \amalg_f Y \) is Hausdorff.

Problem 3: Show that

\[ \mathbb{C}P^n \cong e^0 \cup e^2 \cup \ldots \cup e^{2n} \]

and determine from this the homology and the Euler characteristic of the complex projective spaces.