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Casorati-Weierstrass theorem

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Given a domain  $U \subset \mathbb{C}$ ,  $a \in U$ , and  $f : U \setminus \{a\} \rightarrow \mathbb{C}$  being holomorphic, then  $a$  is an essential singularity of  $f$  if and only if the image of any punctured neighborhood of  $a$  under  $f$  is dense in  $\mathbb{C}$ . Put another way, a holomorphic function can come in an arbitrarily small neighborhood of its essential singularity arbitrarily close to any complex value.