

Q4: Choose  $(M, d) = (\mathbb{R}, d_{0,1})$  where  $d_{0,1}$  is the discrete metric on  $\mathbb{R}$ . Suppose there is some countable dense subset  $A = \{a_m\}$ . It must intersect with every open set in  $\mathbb{R}$ . Since every point under the discrete metric is open, we must have that  $A = \mathbb{R}$ . Thus,  $A$  is countable. We obtain a contradiction.