4. **1.** Starting at the left side of the string, sweep right until the first 0 is found. If no 0 is found move to step 2. If a 0 is found replace it with an x. continue sweeping right after the x for another 0. If no 0 is found reject the string. If another is found replace it with an x. Go back to the beginning of the tape. Sweep right until the first 1 is found. If no 1 is found, reject. If found, replace with a y and go to step 1 to recursively begin again.

   2. Move to the beginning of the tape. Sweep right through the whole tape, if a 1 is found, reject. If none are found accept.

   Proof: This algorithm will work as we recursively find pairs of 0s and 1s in step 1. If we find an odd number of 0s we reject. If we don't find a 1 for every two 0s in step 1 we reject. If we find more 1's than we should, i.e. during step two we reject. If we meet all these conditions conditions there should be exactly twice as many 0s as 1s.