CS 427, Assignment 1

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We can find the value of k by xoring m and c

$m \oplus c$:

110101100010110
100111011011111

010010111001001

Then, $k = 010010111001001$. We can use this info to then xor the value of m' with the value of k:

$m' \oplus k$:

010010111001001
001000000101111

011010111100110

Then our encrypted m', lets call it $c' = 011010111100110$

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We can show that these two libraries are not interchangable by inspecting the distribution of each library:

$\mathcal{L}_1$ has a probability distribution of $\{0,1\}^\lambda - 0^\lambda$

$\mathcal{L}_2$, on the other hand, has a probability distribution of $\{0,1\}^\lambda$

This makes it quite obvious that there is a difference between the two distributions. Specifically, that $\mathcal{L}_2$ can produce the key consisting of only 0's, while $\mathcal{L}_1$ cannot. While a key consisting of only zeroes isn't ideal, it is a difference in behavior which Eve can exploit. In an example case:

If calling program $prog(m_1)$ which calls $\mathcal{L}_1$ or $\mathcal{L}_2$, the adversary Eve can't choose the function, but she can choose the message m_1. In the case of $\mathcal{L}_2$, it simply returns a random ciphertext $c \leftarrow \{0,1\}^\lambda$, while $\mathcal{L}_2$ returns an OTP encrypted ciphertext with a random key without the possibility of an all zero key. The probabilities of $\mathcal{L}_1$ and $\mathcal{L}_2$ are as follows (where $P(x)$ is the probability of x):

$P(\mathcal{L}_1) = 1 - P(0^\lambda)$
$P(\mathcal{L}_2) = 1$

Because the probabilities differ, there is a case where Eve can find a difference in behavior, specifically that $\mathcal{L}_1$ cannot produce an all zero key.

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We can show these two functions, $\mathcal{L}_1, \mathcal{L}_2$ are interchangable by slowly changing bits of $\mathcal{L}_1$ to look like $\mathcal{L}_2$. Our end goal is to show that $\mathcal{L}_1$ values in the same range that $\mathcal{L}_2$ does:

1. change $\mathcal{L}_2$ to include: $c = c \bmod n$
   This doesn't change the calling function as the modulus function is the size of $\mathbb{Z}$, effectively leaving the output unchanged
2.
3.
4.

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