Exercise 1:

What is the largest natural number that can be stored on 1 byte? 

\[ N \text{ bits} \mid \text{store } 2^N \]
\[ \text{largest } 2^N - 1 \]

Exercise 2:

Assume that the Unicode contains 250,000 characters. What is the minimal number of bits that is needed to guarantee that each character is stored properly?

On N bits, you can store \(2^N\) numbers. You want to find \(N\) such that 

\[ 2^{N-1} < 250,000 \leq 2^N \]
\[ N - 1 < \log_2 250,000 \leq N \]
Exercise 3:

Let $A$ be the number whose binary representation is $1010$

$A = (1010)_2$

Let $B$ be the number whose binary representation is $(11011)_2$

Find the binary representation of the number $X$ that satisfies $A + \sqrt{X} = B$.

$A = \begin{pmatrix} 1010 \\ 2^3 2^2 2^1 2^0 \end{pmatrix}_2 = \begin{pmatrix} 10 \\ 10 \end{pmatrix}_{10}$

$B = \begin{pmatrix} 11011 \\ 2^4 2^3 2^2 2^1 2^0 \end{pmatrix}_2 = (27)_{10}$

$10 + X = 27$

$X = (17)_{10} = (10001)_2$
Exercise 4

What is the binary representation of the number \(37\)?

\[
3 
\equiv (0011)_2 \\
(13)_{10} = 8 + 4 + 1 \\
(1101)_{12} \\
(00111101)_{12} \\
(111101)_{2}
\]
On the island of knights and knaves, there are knights, knaves, and spies. You meet John, Bill, and Sauch.

One of them is a knight, one is a knave, one is a spy.

John: Sauch is the knave.
Bill: John is the knight.
Sauch: I am the spy.

<table>
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<tr>
<th>John</th>
<th>Bill</th>
<th>Sauch</th>
<th>S_J</th>
<th>S_B</th>
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<td>Spy</td>
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</tbody>
</table>

The solution is that John is the knight, Bill is the knave, and Sauch is the spy.