Challenge 1

1 Problem

Convert hex to base64

The string:

49276d206b696c6c696e6720796f757220627261696e206c696b65206120706f69736f6e6f7573206d757368726f6f6d

Should produce:

SSdtIGtpbGxpbmcgeW91ciBicmFpbiBsaWtlIGEgcG9pc29ub3VzIG11c2hyb29t

So go ahead and make that happen. You'll need to use this code for the rest of the exercises.

2 Solution

Hex represents a value in base 16 e.g. $f6d = f \cdot 16^2 + 6 \cdot 16 + d$ where $a = 10, b = 11, \ldots f = 15$.

Similarly, base64 represents a value in base 64, where the alphabet used is $A = 0, B = 1, \ldots, a = 26, b = 27, \ldots, 0 = 52, 1 = 53, \ldots, + = 62, / = 63$.

Since a single character of hex is 4 bits, and a character of base64 is 6 bits, we can see that three hex characters can be converted to two base64 characters:

$$
\begin{aligned}
h_2 \cdot 16^2 + h_1 \cdot 16 + h_0 &= h_2 \cdot 16^2 + (h_1^{(1)} \cdot 4 + h_1^{(2)}) \cdot 16 + h_0 \\
&= h_2 \cdot 256 + h_1^{(1)} \cdot 64 + h_1^{(2)} \cdot 16 + h_0 \\
&= (4h_2 + h_1^{(1)}) \cdot 64 + (16h_1^{(2)} + h_0)
\end{aligned}
$$

where $h_1^{(1)} \cdot 4 + h_1^{(2)}$ is the base4 representation of h_1.

To see this is valid, we require that $4h_2 + h_1^{(1)} < 64$ and $16h_1^{(2)} + h_0 < 64$.

This is clear since $h_2 \le 15$ so $4h_2 \le 60$ and $h_1^{(1)} \le 3$.

Similarly, $h_1^{(2)} \le 3$, so $16h_1^{(2)} \le 48$ and $h_2 \le 15$.

First attempt at pseudocode. We need to iterate the following process:

1. Let `hex_string` $= h_\ell \, h_{\ell-1} \ldots h_0$.

2. Take h_0, h_1, h_2 and express as binary $b_0 b_1 b_2 \ldots b_{11}$.

3. Convert $b_0 b_1 \ldots b_5$ to base64 representation, and similarly for $b_6, \ldots b_{11}$.