Answers to Problem Set 2

1. Let a bit of 1 or a 0 stand for each of the four possible changes—1 indicating the change is used, and 0 indicating it isn't. Let Inverted (I) be the first bit, Flipped (F) be the second, Shifted (S) be the third, and Twisted (T) be the fourth. So the six cases in the problem would look like this:

I	F	S	T	
0	0	0	0	Normal
1	0	0	0	Inverted only
0	1	0	0	Flipped only
0	0	1	0	Shifted only
0	0	0	1	Twisted only
1	0	1	1	Inverted, Shifted, and Twisted

   We've seen that a 4-bit binary number can be a code for $2^4 = 16$ different things. So there are 10 more possibilities beyond the 6 listed above.

2. Acting like a bar-code scanner, we estimate the thickness of each black and white stripe to guess how many 1s or 0s it represents:

10100011010111011001001100011010110111010111101010111001010011101100110111001010100001100110101

   Separate the bits into sync patterns (3 or 5 bits) and number patterns (7 bits):

101|0001101|0111011|0010011|0001101|0110111|0101111|01010|1110010|1001110|1100110|1110010|1010000|1100110|101

   Using the UPC chart in lecture 2, we find the decimal numbers corresponding to each group of 7 bits:

sync	0	7	2	0	8	6	sync	0	5	1	0	6	1	sync

3. If the UPC is upside-down and the bar-code reader is scanning it backwards, it will find even parity on the left and odd parity on the right, which is wrong.

4. `ff` is hex code for 15 15, where the first 15 is weighted by $16^1 = 16$ and the second 15 is weighted by $16^0 = 1$. So $\texttt{ff}_{16} = 15 \times 16 + 15 \times 1 = 255_{10}$. This is the Red strength.
   `f4` is hex code for 15 4, where the 15 is weighted by 16 and the 4 is weighted by 1.
   So $\texttt{f4}_{16} = 15 \times 16 + 4 \times 1 = 244_{10}$. This is the Green strength.
   `e0` is hex code for 14 0, where the 14 is weighted by 16 and the 0 is weighted by 1.
   So $\texttt{e0}_{16} = 14 \times 16 + 0 \times 1 = 224_{10}$. This is the Blue strength. The color looks like this:

5. ASCII 0169 stands for ©. ASCII 0176 stands for °.

6. With 32 characters that can be one of 26 things, $26^{32} = 1.90 \times 10^{45}$. $(1.90 \times 10^{45})/(7 \times 10^9) = 2.71 \times 10^{35}$ for each person on Earth. We'll never run out.