PN Sequences and Scramblers

Exercise 1: How many bits are there in an m-sequence for $m = 6$? How many are 1's? How many are 0's?

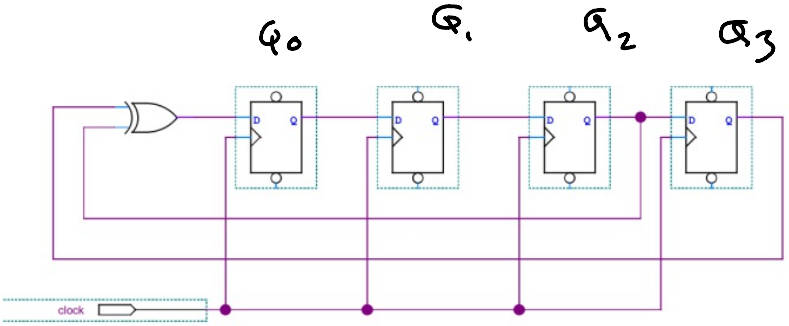
$2^m - 1$ bits $= 2^6 - 1 =$ 63 bits

- an approximately equal number of 1's and 0's: there are 2^{m-1} ones and $2^{m-1} - 1$ zeros.

$2^{6-1} = 2^5 = 32$ ones

$2^{6-1} - 1 = 2^5 - 1 =$ 31 zeros

Exercise 2: If the initial value of each flip-flop is 1, what are the values of the next 4 bits output by the right-most flip-flop?



$Q_2 \oplus Q_3$

Q_2	Q_3	
1	1	0
0	1	0
0	1	0
0	0	1
1	0	0
0	1	0
0	0	1
1	0	1
1	1	0

4 ones

0 0 0 0

3

Exercise 3: How many flip-flops would be required to generate a ML PRBS of period 8191? How many ones would the sequence have? What is the longest sequence of 0's?

$2^m - 1 = 8191$

$2^m = 8192$

$m = \log_2 8192 = \log_2 (8 \cdot 1024) = \log_2 (2^3 \cdot 2^{10})$

$= 13$

$\#\,1\text{'s} = 2^{m-1} = 4096$

$\#\,0\text{'s} = 2^{m-1} - 1 = 4095$

longest sequence of zeros $= m-1 = 12$

ones $= m = 13$

Exercise 4: Why not?

everyone knows the scrambling algorithm.

Exercise 5: How many errors will appear in the output of a V.34 descrambler if there is one input error?

3 - original error

and 1 each time the incorrect bit appears at a "tap".

Exercise 6: In the diagram above, what two signals would the receiver compare to detect errors?

A = received data