Multiplication Principle

Problem 5

Consider 8 digit binary strings such as 10011011 or 00001010.

- How many such strings are there?

$Y = \{0, 1\}$

look at elements of

$\underbrace{Y \times Y \times \cdots \times Y}_{8 \text{ times}}$

$\overbrace{|Y \times Y \times Y \cdots \times Y|}^{8} = 2^8$

$|Y_1 \times Y_2 \times \cdots \times Y_n| = |Y_1| \cdots |Y_n|$

$Y = \{0,1\}$

- How many such strings end in 0

such a string is an element of

$|Y \times Y \times Y \times Y \times Y \times Y \times \{0\}| = 2^7$

2 2 2 2 2 2 1

- How many such strings have 1's for their second and fourth digits

$$Y = \{0,1\}$$

$$\left| Y \times \{1\} \times Y \times \{1\} \times Y \times Y \times Y \times Y \right| = 2^6$$

- How many such strings have 1's for their second OR fourth digits.

	2nd digit	4th digit	
$\Sigma^* \times \{1\} \times \Sigma \times \{0\} \times \Sigma^* \times \Sigma^* \times \Sigma^*$	1	0	2^6
$\Sigma^* \times \{0\} \times \Sigma^* \times \{1\} \times \Sigma^* \times \Sigma^* \times \Sigma^*$	0	1	2^6
$\Sigma^* \times \{1\} \times \Sigma^* \times \{1\} \times \Sigma^* \times \Sigma^* \times \Sigma^*$	1	1	2^6
			$3 \cdot 2^6$

Count strings with a 0 in both the 2nd and 4th position.

all strings 2^8 = (0 in 2nd and 0 in 4th) 2^6 + (1 in either 2nd or 4th) $2^8 - 2^6 = 2^6(2^2 - 1)$

$= 2^6 \cdot 3$