Computer Science

COMPSCI 111/111G

L2 - 6/1

Bits and Bytes

Exercise Sheet

The following three questions relate to dials that have 10 different states (0-9).

Exercise 1: Given a machine that used 4 dials, how many different numbers could we represent?

$10^4 = 10,000$ numbers (ie 0 - 9999)

Exercise 2: If we wanted to represent 123 different colours, each encoded as a different number, how many dials do we need?

3 dials (ie. hundreds, tens, ones)

Exercise 3: If we used numbers to represent each letter of the alphabet, how many dials would we need to store a single letter?

2 dials, since there are 26 letters in the alphabet

Exercise 4: How many different numbers can we represent using 3 bits?

$2^3 = 8$ numbers (ie. 0 - 7)

Exercise 5: How many different numbers can we represent using 4 bits?

$2^4 = 16$ numbers (ie 0 - 15)

Exercise 6: How many different numbers can we represent using 5 bits?

$2^5 = 32$ numbers (ie. 0 - 31)

Exercise 7: How many kB are there in 4GB?

$4 \times 1000 \times 1000 = 4,000,000$ kB

Exercise 8: How many MiB are there in 1TiB?

$1 \times 2^{10} \times 2^{10} = 1,048,576$ MiB

Exercise 9: Which is bigger, 1 MB or 1 MiB?

1 MiB, since 1×2^{20} is greater than 1×10^6

Exercise 10: If it took 256 bytes to store one picture, and we wanted to send 40 pictures, how many bytes would be required? Use the most appropriate prefix in your answer.

$256 \times 40 = 10,240$ bytes $\quad 10240 \div 1000 = 10.24$ kB

Exercise 11: What decimal number is equal to the binary number 1101?

$\underset{2^3}{1}\ \underset{2^2}{1}\ \underset{2^1}{0}\ \underset{2^0}{1} \Rightarrow 2^3 + 2^2 + 2^0 = 8 + 4 + 1 = 13_{10}$

Exercise 12: What decimal number is equal to the binary number 101010?

$\underset{2^5}{1}\ \underset{2^4}{0}\ \underset{2^3}{1}\ \underset{2^2}{0}\ \underset{2^1}{1}\ \underset{2^0}{0} \Rightarrow 2^5 + 2^3 + 2^1 = 32 + 8 + 2 = 42_{10}$