Key to Tutorial 1
Number Bases

Exercise 1

1. Work out the following positive powers of two.

- $2^0 = \mathbf{1}$
- $2^1 = \mathbf{2}$
- $2^2 = \mathbf{4}$
- $2^3 = \mathbf{8}$
- $2^4 = \mathbf{16}$
- $2^5 = \mathbf{32}$
- $2^6 = \mathbf{64}$
- $2^7 = \mathbf{128}$
- $2^8 = \mathbf{256}$
- $2^9 = \mathbf{512}$
- $2^{10} = \mathbf{1,024}$
- $2^{11} = \mathbf{2,048}$
- $2^{12} = \mathbf{4,096}$
- $2^{13} = \mathbf{8,192}$
- $2^{14} = \mathbf{16,384}$
- $2^{15} = \mathbf{32,768}$
- $2^{16} = \mathbf{65,536}$
- $2^{17} = \mathbf{131,072}$
- $2^{18} = \mathbf{262,144}$
- $2^{19} = \mathbf{524,288}$
- $2^{20} = \mathbf{1,048,576}$

From now on, you have to know the first positive powers of two by heart (at least from 2^0 to 2^{16}).

2. Work out the following negative powers of two.

- $2^{-1} = \mathbf{0.5}$
- $2^{-2} = \mathbf{0.25}$
- $2^{-3} = \mathbf{0.125}$
- $2^{-4} = \mathbf{0.0625}$
- $2^{-5} = \mathbf{0.03125}$
- $2^{-6} = \mathbf{0.015625}$
- $2^{-7} = \mathbf{0.0078125}$
- $2^{-8} = \mathbf{0.00390625}$
- $2^{-9} = \mathbf{0.001953125}$
- $2^{-10} = \mathbf{0.0009765625}$

From now on, you have to know the first negative powers of two by heart (at least from 2^{-1} to 2^{-5}).

Exercise 2

1. Convert the following numbers from the source form into the destination form. Do not write down the result in a fraction or a power form (e.g. write down 0.25 and not ¼ or 2^{-2}).

Number to Convert	Source Form	Destination Form	Result
10101101	Binary	Decimal	**173**
ABC	Hexadecimal	Decimal	**2,748**
251	Decimal	Binary	**1111 1011**
622	Decimal	Hexadecimal	**26E**
A4D	Hexadecimal	Binary	**1010 0100 1101**
1101101101101110	Binary	Hexadecimal	**DB6E**
1001.101	Binary	Decimal	**9.625**
3C.28	Hexadecimal	Decimal	**60.15625**
35.23	Decimal	Binary (5 digits after the point)	**10 0011.0011 1**
18.15	Decimal	Hexadecimal (3 digits after the point)	**12.266**
A7.F3	Hexadecimal	Binary	**1010 0111.11110011**
1100101.11011	Binary	Hexadecimal	**65.D8**

2. Same question (homework).

Number to Convert	Source Form	Destination Form	Result
1001100101101100	Binary	Decimal	**39,276**
12BE	Hexadecimal	Decimal	**4,798**
631	Decimal	Binary	**10 0111 0111**
3,129	Decimal	Hexadecimal	**C39**
BD9F	Hexadecimal	Binary	**1011 1101 1001 1111**
110111011010011001	Binary	Hexadecimal	**37699**
110101.1011001	Binary	Decimal	**53.6953125**
A4C.148	Hexadecimal	Decimal	**2,636.080078125**
48.12	Decimal	Binary (7 digits after the point)	**11 0000.0001 111**
92.47	Decimal	Hexadecimal (4 digits after the point)	**5C.7851**
8.DECA	Hexadecimal	Binary	**1000.1101 1110 1100 101**
11001010110.01101011	Binary	Hexadecimal	**656.6B**

Exercise 3

1. Perform the following binary additions:
   - 10101110 + 11001100 = **1 0111 1010**
   - 1110011 + 1110011 + 1001011 + 101111 = **1 0110 0000**

2. Perform the following binary subtractions:
   - 11100001 – 10011011 = **100 0110**
   - 11101100110 – 110110110 = **101 1011 0000**

3. Perform the following binary multiplications:
   - 1101011 × 10101 = **1000 1100 0111**
   - 10001100 × 100101 = **1 0100 0011 1100**

4. Perform the following binary divisions:
   - 1100110 / 101 (6 digits after the point) = **1 0100.0110 01**
   - 1011000100 / 1101 (4 digits after the point) = **11 0110.0111**

5. Perform the following hexadecimal additions:
   - A6B4 + DECA = **1857E**
   - 451 + 98D + E09 = **1BE7**