

Vježbe I

Brojni sistemi; konverzija iz jednog u drugi brojni sistem

Dekadni brojni sistem: osnova 10, cifre {0, 1, 2, ..., 9}

$$\text{npr. } 136_{(10)} = 1 \times 10^2 + 3 \times 10^1 + 6 \times 10^0$$

Binarni brojni sistem: osnova 2, cifre {0, 1}

$$\text{npr. } 1011_{(2)} = 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

Oktalni brojni sistem: osnova 8, cifre {0, 1, 2, 3, 4, 5, 6, 7}

$$\text{npr. } 256_{(8)} = 2 \times 8^2 + 5 \times 8^1 + 6 \times 8^0$$

Heksadecimalni brojni sistem: osnova 16, cifre {0, 1, 2, ..., 8, 9, A, B, C, D, E, F}

$$\text{npr. } AC23_{(16)} = 10 \times 16^3 + 12 \times 16^2 + 2 \times 16^1 + 3 \times 16^0$$

1. Dat je broj 1044.75 u dekadnom brojnemu sistemu. Pretvoriti ga u binarni brojni sistem.

	ostatak				cijeli dio				
1044	: 2 =	522	0		0.75	× 2 = 1.5	1	↓	
522	: 2 =	261	0		0.5	× 2 = 1.0	1		
261	: 2 =	130	1						
130	: 2 =	65	0	↑					
65	: 2 =	32	1						
32	: 2 =	16	0						
16	: 2 =	8	0						
8	: 2 =	4	0						
4	: 2 =	2	0						
2	: 2 =	1	0						
1	: 2 =	0	1						

$$1044_{(10)} = 10000010100_{(2)}, 0.75_{(10)} = 0.11_{(2)} \Rightarrow 1044.75_{(10)} = 10000010100.11_{(2)}$$

*** konverzija sa zadatom tačnošću

npr. 5 decimala

		cijeli dio	
0.075	× 2 =	0.150	0
0.150	× 2 =	0.3	0
0.3	× 2 =	0.6	0
0.6	× 2 =	1.2	1
0.2	× 2 =	0.4	0...
0.075 ₍₁₀₎ = 0.00010... ₍₂₎			

2. Dat je broj 10001011.1101 u binarnom brojnemu sistemu. Pretvoriti ga u dekadni brojni sistem.

$$\begin{aligned}
 & \overset{7}{1} \overset{6}{0} \overset{5}{0} \overset{4}{0} \overset{3}{1} \overset{2}{1} \overset{1}{0} \overset{0}{1} \overset{-1}{.} \overset{-2}{1} \overset{-3}{0} \overset{-4}{1} \\
 10001011.1101_{(2)} &= 1 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4} = \\
 &= 2^7 + 2^3 + 2^1 + 2^0 + 2^{-1} + 2^{-2} + 2^{-4} = 128 + 8 + 2 + 1 + 0.5 + 0.25 + 0.0625 = 139.8125_{(10)}
 \end{aligned}$$

3. Dat je broj 1045 u dekadnom brojnom sistemu. Pretvoriti ga u oktalni brojni sistem:

- a) direktnom konverzijom,
 b) konverzijom u binarni, a potom u oktalni brojni sistem.

a)

$$\begin{array}{r}
 1045 : 8 = 130 \quad 5 \quad \uparrow \\
 130 : 8 = 16 \quad 2 \quad \uparrow \\
 16 : 8 = 2 \quad 0 \\
 2 : 8 = 0 \quad 2 \\
 1045_{(10)} = 2025_{(8)}
 \end{array}$$

b)

$$\begin{array}{r}
 1045 : 2 = 522 \quad 1 \quad \uparrow \\
 522 : 2 = 261 \quad 0 \\
 261 : 2 = 130 \quad 1 \\
 130 : 2 = 65 \quad 0 \\
 65 : 2 = 32 \quad 1 \\
 32 : 2 = 16 \quad 0 \\
 16 : 2 = 8 \quad 0 \\
 8 : 2 = 4 \quad 0 \\
 4 : 2 = 2 \quad 0 \\
 2 : 2 = 1 \quad 0 \\
 1 : 2 = 0 \quad 1
 \end{array}$$

$$1045_{(10)} = \begin{array}{cccc} & 2 & 1 & 0 \\ \hline 0 & 1 & 0 & 0 \\ & 2 & & 0 \\ & & 2 & & 1 \\ & & & 5 & \\ & & & & 8 \end{array} \begin{array}{l} 210 \\ 210 \\ 210 \\ 210 \end{array} \begin{array}{l} 010 \\ 000 \\ 010 \\ 101 \end{array} \begin{array}{l} (2) \\ \\ \\ \end{array} =$$

4. Dat je broj 345 u dekadnom brojnom sistemu. Pretvoriti ga u heksadecimalni brojni sistem:

- a) direktnom konverzijom,
 b) konverzijom u binarni, a potom u heksadecimalni brojni sistem.

a)

$$\begin{array}{r}
 345 : 16 = 21 \quad 9 \quad \uparrow \\
 21 : 16 = 1 \quad 5 \\
 1 : 16 = 0 \quad 1 \\
 345_{(10)} = 159_{(16)}
 \end{array}$$

$$\begin{array}{r}
 345 : 2 = 172 \quad 1 \\
 172 : 2 = 86 \quad 0 \\
 86 : 2 = 43 \quad 0 \\
 43 : 2 = 21 \quad 1 \\
 21 : 2 = 10 \quad 1 \\
 10 : 2 = 5 \quad 0 \\
 5 : 2 = 2 \quad 1 \\
 2 : 2 = 1 \quad 0 \\
 1 : 2 = 0 \quad 1
 \end{array}$$

$$345_{(10)} = \begin{array}{ccc} & 3 & 2 \\ \hline 0 & 0 & 0 \\ & 1 & 5 \\ & & 9 \end{array} \begin{array}{l} 210 \\ 210 \\ 210 \end{array} \begin{array}{l} 0001 \\ 0101 \\ 1001 \end{array} \begin{array}{l} (2) \\ \\ \\ \end{array} =$$

5. Dat je broj 251 u oktalnom brojnom sistemu. Pretvoriti ga u binarni, heksadecimalni i dekadni brojni sistem.

$$251_{(8)} = \underline{010} \underline{101} \underline{001} = \underline{1010} \underline{1001} \begin{array}{l} (2) \\ \\ \end{array} = A9_{(16)} = 10 \times 16^1 + 9 \times 16^0 = 169_{(10)}$$

6. Dat je broj AF12.3F u heksadecimalnom brojnom sistemu. Pretvoriti ga u binarni, oktalni i dekadni.

$$\begin{aligned}
 AF12.3F_{(16)} &= \underline{1010} \underline{1111} \underline{0001} \underline{0010} . \underline{0011} \underline{1111} \begin{array}{l} (2) \\ \\ \end{array} = \\
 &= \underline{001} \underline{010} \underline{111} \underline{100} \underline{010} \underline{010} . \underline{001} \underline{111} \underline{110} \begin{array}{l} (2) \\ \\ \end{array} = \\
 &= 1 \quad 2 \quad 7 \quad 4 \quad 2 \quad 2 \quad . \quad 1 \quad 7 \quad 6 \begin{array}{l} (8) \\ \\ \end{array} =
 \end{aligned}$$

$$=2^{15}+2^{13}+2^{11}+2^{10}+2^9+2^8+2^2+2+2^{-3}+2^{-4}+2^{-5}+2^{-6}+2^{-7}+2^{-8}=$$

$$=44818.24609_{(10)}$$

ili

$$AF12.3F_{(16)}=10 \times 16^3+15 \times 16^2+1 \times 16^1+2 \times 16^0+3 \times 16^{-1}+15 \times 16^{-2}=44818.24609_{(10)}$$

ili

$$127422.176_{(8)}=1 \times 8^5+2 \times 8^4+7 \times 8^3+4 \times 8^2+2 \times 8^1+2 \times 8^0+1 \times 8^{-1}+7 \times 8^{-2}+6 \times 8^{-3}=44818.24609_{(10)}$$

Binarna aritmetika: sabiranje

Pravila sabiranja u binarnom brojnem sistemu:

0 + 0 = 0	Prenos: 0	*** slučaj: 1 + 1 + 1 + 1 = 100
0 + 1 = 1	0	
1 + 0 = 1	0	
1 + 1 = 0	1	
1 + 1 + 1 = 1	1	

7. Sabrati binarne brojeve i izvršiti provjeru u dekadnom brojnem sistemu.

a)

$$\begin{array}{r} 10110 \\ + 11001 \\ \hline 101111 \end{array}$$

$$\begin{array}{r} 2^4+2^2+2^1=22_{(10)} \\ + 2^4+2^3+2^0=25_{(10)} \\ \hline 2^5+2^3+2^2+2^1+2^0=47_{(10)} \end{array}$$

b)

$$\begin{array}{r} 1101011 \\ + 111010 \\ \hline 10100101 \end{array}$$

$$\begin{array}{r} 2^6+2^5+2^3+2^1+2^0=107_{(10)} \\ + 2^5+2^4+2^3+2^1=58_{(10)} \\ \hline 2^7+2^5+2^2+2^0=165_{(10)} \end{array}$$

c)

$$\begin{array}{r} 1011011.11 \\ + 1100111.1 \\ \hline 11000011.01 \end{array}$$

$$\begin{array}{r} 2^6+2^4+2^3+2^1+2^0+2^{-1}+2^{-2}=91.75_{(10)} \\ + 2^6+2^5+2^2+2^1+2^0+2^{-1}=103.5_{(10)} \\ \hline 2^7+2^6+2^1+2^0+2^{-2}=195.25_{(10)} \end{array}$$

d)

$$\begin{array}{r} 110111.11 \\ + 1101101.01 \\ \hline 10100101.00 \end{array}$$

$$\begin{array}{r} 2^5+2^4+2^2+2^1+2^0+2^{-1}+2^{-2}=55.75_{(10)} \\ + 2^6+2^5+2^3+2^2+2^0+2^{-2}=109.25_{(10)} \\ \hline 2^7+2^5+2^2+2^0=165.00_{(10)} \end{array}$$