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Introduction to Computer Science, Winter Semester 2016
Practice Assignment7

Discussion: 10.12.2016 - 15.12.2016

Exercise 7-1

Convert the following numbers to decimal. Please show your workout.

a) $(1001001)_2$

b) $(12121)_3$

c) $(1032)_4$

d) $(50)_7$

e) $(198)_{12}$

f) $(ABC)_{16}$

Solution:

a) $(1001001)_2 = 2^0 + 2^3 + 2^6 = 1 + 8 + 64 = 73$

b) $(12121)_3 = 1 * 3^0 + 2 * 3^1 + 1 * 3^2 + 2 * 3^3 + 1 * 3^4 = 1 + 6 + 9 + 54 + 81 = 151$

c) $(1032)_4 = 2 * 4^0 + 3 * 4^1 + 0 * 4^2 + 1 * 4^3 = 2 + 12 + 0 + 64 = 78$

d) $(50)_7 = 0 * 7^0 + 5 * 7^1 = 0 + 35 = 35$

e) $(198)_{12} = 8 * 12^0 + 9 * 12^1 + 1 * 12^2 = 8 + 108 + 144 = 260$

f) $(ABC)_{16} = 12 * 16^0 + 11 * 16^1 + 10 * 16^2 = 12 + 176 + 2560 = 2748$

Exercise 7-2

Can you convert the follwoing numbers to binary? Show your workout.

a) 0

b) 1

c) 2

d) 22

e) 197

f) 1000

g) 673

Solution:

a) $0 = 0_2$

b) $1 = 1_2$

c) $2 = 10_2$

d) $22 = 10110_2$

Division	Quotient	Remainder
22/2	11	0
11/2	5	1
5/2	2	1
2/2	1	0
1/2	0	1

e) $197 = 11000101_2$

Division	Quotient	Remainder
197/2	98	1
98/2	49	0
49/2	24	1
24/2	12	0
12/2	6	0
6/2	3	0
3/2	1	1
1/2	0	1

c) $673 = 1010100001_2$

d) $1000 = 1111101000_2$

Exercise 7-3

Perform the following number system conversions. Please show your workout.

a) $1101011_2 = \ldots_{16}$

b) $10110111_2 = \ldots_{16}$

c) $F3A5_{16} = \ldots_2$

d) $15C_{16} = \ldots_2$

e) $101111_2 = \ldots_8$

f) $11101_2 = \ldots_8$

g) $12122_3 = \ldots_9$

Solution:

a) $1101011_2 = 6B_{16}$

Partition the binary number into groups of four bits, starting with the rightmost bit:

0110	1011
6	B

b) $10110111_2 = B7_{16}$

Partition the binary number into groups of four bits, starting with the rightmost bit:

1011	0111
B	7

c) $F3A5_{16} = 1111001110100101_2$

Every hexadecimal digit can be converted to exactly four binary digits:

F	3	A	5
1111	0011	1010	0101

d) $15C_{16} = 101011100_2$

Every hexadecimal digit can be converted to exactly four binary digits:

1	5	C
0001	0101	1100

e) $101111_2 = 57_8$

- Partition the binary number into groups of three bits, starting with the rightmost bit:

101	111
5	7

- First, convert 101111_2 to decimal

  $101111_2 = 2^0 + 2^1 + 2^2 + 2^3 + 2^5 = 47_{10}$

  Now, convert the decimal number 47 to base 8:

Division	Quotient	Remainder
47/8	5	7
5/8	0	5

  Thus, $47_{10} = 57_8$

f) $11101_2 = 35_8$

Partition the binary number into groups of three bits, starting with the rightmost bit:

011	101
3	5

a) $12122_3 = 178_9$

Partition the ternary number into groups of two, starting with the rightmost bit:

1	21	22
1	7	8

Exercise 7-4

Determine whether the following statements are true or false. Please show your workout.

a) $1001_2 < 5_{10}$

b) $0111_2 = 111_{10}$

c) $1001_2 > 1101_2$

d) $1011_2 = 11_{10}$

e) $0000_2 < 0_{10}$

f) $10111_2 < 25_{10}$

Solution:

a) $1001_2 < 5_{10}$: false

$1001_2 = 9_{10}$

b) $0111_2 = 111_{10}$: false
$0111_2 = 7_{10}$

c) $1001_2 > 1101_2$:
$1001_2 = 9_{10}$ and $1101_2 = 13_{10}$

d) $1011_2 = 11_{10}$: true
$1011_2 = 11_{10}$

e) $0000_2 < 0_{10}$: false
$0000_2 = 0_{10}$

f) $10111_2 < 25_{10}$: true
$10111_2 = 23_{10}$

Exercise 7-5

Each of the following five numbers has a different base. Which of the six numbers have the same value in decimal? Please show your workout.

a) $(12011)_3$

b) $(3312)_4$

c) $(2022)_5$

d) $(2A7)_{11}$

e) $(19A)_{12}$

f) $(AB9)_{16}$

Solution:

a) $(12011)_3 = 1*3^4+2*3^3+0*3^2+1*3^1+1*3^0 = 1*81+2*27+0*9+1*3+1*1 = (139)_{10}$

b) $(3312)_4 = 3*4^3+3*4^2+1*4^1+2*4^0 = 3*64+3*16+1*4+2*1 = (246)_{10}$

c) $(2022)_5 = 2*5^3+0*5^2+2*5^1+2*5^0 = 2*125+0*25+2*5+2*1 = (262)_{10}$

d) $(2A7)_{11} = 2*11^2+10*11^1+7*11^0 = 2*121+10*11+7*1 = (359)_{10}$

e) $(19A)_{12} = 1*12^2+9*12^1+10*12^0 = 1*144+9*12+10*1 = (262)_{10}$

f) $(AB9)_{16} = 10*16^2+11*16^1+9*16^0 = 10*256+11*16+9*1 = 2745_{10}$

$(2022)_5$ and $(19A)_{12}$ have the same value in decimal.

Exercise 7-6

Given the following decimal representation of an IP address, represent its hexadecimal, binary and its corresponding decimal value. You can check more conversion on the online converter: www.silisoftware.com/tools/ipconverter.php

`66.220.159.255`

Solution:

- Hexadecimal representation: 42 DC 9F FF
- Binary representation: 1000010 11011100 10011111 11111111
- Decimal value: 1121755135

Exercise 7-7

Given a list of `0s` and `1s`, write an algorithm to perform the integer division by 4 for the number represented in the list.

Solution:

Shift numbers by 2 digits to the right.

```
list_A = eval(input())
n = len(list_A)
list_B = []
i = 0
while (i < 2):
  list_B= list_B + 0
  i = i + 1

i = 0
while (i < n-2):
  list_B = list_B + list_A[i]
  i = i + 1
print(list_B)
```

Exercise 7-8

Given a list of `0s` and `1s`, check whether the number is even or odd without converting into decimal.

Solution:

```
list_A = eval(input())
n = len(list_A)

if (list_A[n-1] == 0):
   print("The number is even")
else:
   print("The number is odd")
```

Exercise 7-9

Converting a decimal integer to its binary equivalent can be performed by repeatedly dividing the decimal number by 2. Division by 2 will either give a remainder of 1 (dividing an odd number) or no remainder (dividing an even number). Collecting the remainders (starting by the last one) from the repeated divisions gives the binary answer. Express this algorithm using a pseudo-code.

Solution:

```
Number = eval(input())
list_A = []
while not Number == 0:
    list_A = list_A + Number % 2
```

```
    Number = int(Number/2)

i = len(list_A) - 1
while i>=0:
  print(list_A[i],end="")
  i -=1
```