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Introduction to Computer Science, Winter Semester 2017
Practice Assignment 8

Discussion: 09.12.2017 - 14.12.2017

Exercise 8-1 To be Discussed in Tutorial

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 8-2 To be Discussed in Tutorial

Can you convert the following 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 8-3 To be Discussed in Tutorial

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 8-4

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 8-5

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 8-6 To be Discussed in Tutorial

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 8-7

Given a list of `0s` and `1s`, write a Python program 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 8-8

Given a list of `0s` and `1s`, write a Python program that checks 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 8-9

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. Write a Python algorithm that does this conversion.

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
```

Exercise 8-10 To be Solved in Lab

Write a Python algorithm that given a list `binary` of `0`s and `1`s representing a binary number, converts it into the equivalent decimal number and displays it.

Solution:

```
binary=eval(input("Enter the binary representation of the number:"))

decimal=0
i=len(binary)-1
p=0
while i>=0:
    if binary[i]==1:
        decimal += 2**p
    i-=1
    p+=1
print("The converted decimal number is:",decimal)
```