Lab 1

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CS311 - Computer Architecture 1

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The first laboratory exercise requires you to code two conversion schema's in Java.

Question 1 - Base number conversion.

The first programming exercise requires you to code the general algorithm to convert any numeric base system number to base 10 (decimal). This implies any base system from base 2 (binary) to base 9. The following algorithm gives the description of the procedure.

Algorithm 1 Base b conversion to decimal

Input: A number $d_{n-1}d_{n-2}\dots d_1d_0$ in base b
Output: Equivalent decimal number

```
1: procedure THE DIGITS OF THE INPUT NUMBER ARE PROCESSED FROM LEFT TO RIGHT ONE DIGIT AT A TIME.
2:     Result = 0
3:     for (i = n − 1 downto 0) do
4:         Result = (Result x b) + d_i
5:     end for
6:     return Result
7: end procedure
```

Using Algorithm 1 as the template, code the conversion routine. You are not allowed to use any inbuilt language specific conversion commands. Your code should be able to convert any base from 2 till 9 to decimal.

The algorithm should do the following:

1. Ask the user to enter the required base.
2. Check if the base is between 2 and 9 inclusive.
3. If not, ask the user again to enter the base.
4. Using the given equation, compute the decimal equivalent number in a for loop starting from the left to the right.

5. Display the decimal number in console.

The output should be formatted exactly in the shown invocation samples.

```
Please enter a base from 2 - 9: 2
Enter a base 2 number: 100101
The equivalent number in base 10 format is 37
```

```
Please enter a base from 2 - 9: 16
Incorrect base system. Please enter a base from 2 - 9:
```

```
Please enter a base from 2 - 9: 8
Enter a base 8 number: 247
The equivalent number in base 10 format is 167
```

The submission is a program named *BaseToDecimal*. All codes should have appropriate documentation.

Question 2 - Decimal to binary, octal and hexadecimal number conversion.

The second programming exercise requires you to code the general algorithm to convert a base 10 (decimal) number to a base 2 (binary), base 8 (octal) and base 16 (hexadecimal) number. The following Algorithm 2 gives the description of the procedure.

Algorithm 2 Decimal to base b conversion

Input: A number $d_{n-1}d_{n-2}\ldots d_1d_0$ in decimal
Output: Equivalent number in the target base b number system

```
1: procedure RESULT DIGITS ARE OBTAINED FROM LEFT TO RIGHT. IN THE FOLLOWING, MOD REPRESENTS THE MODULO OPERATOR AND DIV THE INTEGER DIVIDE OPERATOR.
2:     Quotient = decimal number to be converted
3:     while (Quotient ≠ 0) do
4:         Remainders (next most significant digit of result) = Quotient MOD b
5:         Quotient = Quotient DIV b
6:     end while
7:     return Remainders
8: end procedure
```

An example for converting the decimal number 167 into its equivalent binary, octal and hexadecimal numbers is shown in Tables 1 - 3.

Table 1: Decimal to binary conversion

Quotient	**Remainder**
$167/2 = 83$	1
$83/2 = 41$	1
$41/2 = 20$	1
$20/2 = 10$	0
$10/2 = 5$	0
$5/2 = 2$	1
$2/2 = 1$	0
$1/2 = 0$	1

Table 2: Decimal to octal conversion

Quotient	**Remainder**
$167/8 = 20$	7
$20/8 = 2$	4
$2/8 = 0$	2

Table 3: Decimal to hexadecimal conversion

Quotient	**Remainder**
$167/16 = 10$	7
$10/16 = 0$	A

The desired base numbers can be obtained by writing the remainders generated in the reverse order from left to right. For this example, the binary number is 10100111_B, octal number is 247_O and hexadecimal number is $A7_H$.

Using Algorithm 2 as the template, code the conversion routine. You are not allowed to use any inbuilt language specific conversion routines for bases.

The output should be formatted exactly as in the shown invocation sample below.

```
Please enter a base 10 number: 167
Base 2: 1 0 1 0 0 1 1 1
Base 8: 2 4 7
Base 16: A 7
```

The submission is a program named *DecimalToBase*. All codes should have appropriate documentation.

Submission

All submitted files **MUST** have the **student name**, **student CWU ID** and the **honor code** in them (and not written on Canvas). If any of these mandatory requirements are missing from the submission, it will **NOT** be graded and the student will be given **0 points** for the lab.

The student must submit the following separate `java` (source) files to canvas:

1. `BaseToDecimal`
2. `DecimalToBase`

The two Java source files must be submitted through Canvas by 5pm April 9, 2021. The grading rubric is given in Table 4.

Table 4: Grading rubric

File	Aspects	Points
`BaseToDecimal`	Compiles and Executes	15
	Correct algorithm translation	15
	Documentation	5
	Correct results	15
`DecimalToBase`	Compiles and Executes	15
	Correct algorithm translation	15
	Documentation	5
	Correct results	15