Concepts of Conversion of Base 2 Fixed Register Binary Number to Base 10 Decimal

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Initialization

Clearing the definitions of all symbols in the current context:

```
ClearAll[Evaluate[Context[] <> "*"]]
```

Introduction

The following worksheet illustrates how to convert a fixed point register binary (base-2) number to a decimal number (base-10) using loops and various conditional statements. The user inputs a binary number in the *Input* section of the program, and then an equivalent decimal number is given as an output.

Section 1: Input Data

This is the only section where the user interacts with the program.

- Enter number to be converted to decimal number

```
binnum = "111111101.11";
```

This is the end of the user section. All information must be entered before proceeding to the next section. **RE-EVALUATE THE NOTEBOOK**.

Section 2: Procedure

The *ToExpression* command is used to take the *Mathematica* string *binnum* and parse the string as if it were a *Mathematica* input The *floor* command is used to isolate the *integer* part of the base-2 number. Then the *length* command determines the length of the entire binary number and all the characters in the string.

```
intbin = Floor[ToExpression[binnum]];
n = StringLength[binnum];
strint = ToString[intbin];
m = StringLength[strint];
```

Using a loop to sum values of the integer portion of the base-2 number. The loop variable *sumint* is used for summation and is initialized at 0.

```
sumint = 0
Do[
 binint_i = ToExpression[StringTake[strint, {i}]];
 sumint = sumint + binint_i * 2^(m-i),
 {i, 1, m}]

0
```

Using a loop to sum values of the fractional portion of the base-2 number. The loop variable *sumfrac* is used for summation and is initialized at 0. Note that the starting point in this loop is the length of the integer portion (m), plus 2 which effectively skips the decimal point in the character array.

```
sumfrac = 0;
j = 1;
Do[
 binfrac_j = ToExpression[StringTake[binnum, {i}]];
 binfracstr_j = StringTake[binnum, {i}];
 sumfrac = N[sumfrac + binfrac_j * 2^(-j), 10];
 j = j + 1,
 {i, m + 2, n}]
```

Adding the *fractional* portion of the base-2 number with the *integer* portion which yields the base-10 number.

```
totaldec = N[sumint + sumfrac, 10]

509.7500000
```

Conclusion

This worksheet illustrates the use of *Mathematica* to convert a base-2 binary number to a base-10 number. It is important to understand the binary system as it has numerous applications. Critical to this understanding is being able to convert decimal numbers to binary numbers, and vice-versa.

References

Binary Representation of Numbers.
See: http://numericalmethods.eng.usf.edu/nbm/gen/01aae/nbm_gen_aae_txt_binaryrepresentation.pdf