

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

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### 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

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

- Enter number to be converted to decimal number:

```
bin_num := "111111101.11"
```

## Section 2: Procedure

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.

```
int_bin := floor(str2num(bin_num))
```

```
n := strlen(bin_num)
```

```
str_int := num2str(int_bin)
```

```
m := strlen(str_int)
```

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 := | sumint ← 0  
          | for i ∈ 0..m - 1  
          | | bin_inti ← str2num(substr(str_int, i, 1))  
          | | sumint ← sumint + bin_inti · 2m-i-1
```

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 1 which effectively skips the decimal point in the character array.

```
sumfrac := | sumfrac ← 0  
           | j ← 1  
           | for i ∈ m + 1..n - 1  
           | | bin_fracj ← str2num(substr(bin_num, i, 1))  
           | | sumfrac ← sumfrac + bin_fracj · 2-j  
           | | j ← j + 1  
           | sumfrac
```

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

```
total_dec := sumint + sumfrac = 509.75
```

## Conclusion

This worksheet illustrates the use of Mathcad 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/mcd/gen/01aae/mcd\\_gen\\_aae\\_txt\\_binaryrepresentation.pdf](http://numericalmethods.eng.usf.edu/mcd/gen/01aae/mcd_gen_aae_txt_binaryrepresentation.pdf)

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