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% % Mfile name
%   mtl_aae_sim_bin2decusf.m

% Version:
%   Matlab R2007a

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% Purpose
%   To illustrate the concept of the conversion of a fixed binary number to
%   decimal format.

% Keywords
%   Binary to decimal conversion
%   Fixed point register

% Clearing all data, variable names, and files from any other source and
% clearing the command window after each successive run of the program.
clc
clear all

% Inputs:
%   This is the only place in the program where the user makes the changes
%   based on their wishes.
%   Enter number to be converted to decimal number:
%   NOTE: Do NOT remove the apostrophe(') symbol from the number or the
%   worksheet will not work!
bin_num = '111111101.11';

% *****

disp(sprintf('\n\nConcepts of Conversion of Base 2 Fixed Register Binary '))
disp(sprintf('Number to Base 10 Decimal'))
disp(sprintf('\nUniversity of South Florida'))
disp(sprintf('United States of America'))
disp(sprintf('kaw@eng.usf.edu'))
disp(sprintf('Website: http://numericalmethods.eng.usf.edu'))
disp(sprintf('\nNOTE: This worksheet illustrates the use of Matlab to convert'))
disp('a fixed binary point number to a decimal number.')

disp(sprintf('\n*****Introduction*****'))

disp(sprintf('\nThe following worksheet illustrates how to convert a fixed point '))
disp(sprintf('register binary (base-2) number to a decimal number (base-10) '))
disp(sprintf('using loops and various conditional statements. The user inputs a '))
disp(sprintf('binary number in the Input section of the program, and then an '))
disp(sprintf('equivalent decimal number is given as an output.'))
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disp(sprintf('\n\n*****Input Data*****'))
disp(sprintf('\n'));
str = ['Binary number to convert to decimal number, bin_num = ',bin_num];
disp(str);

disp(sprintf('\n\n*****Procedure*****'))

% Using the floor command to isolate the "integer" part of the base-2 number.
int_bin = str2num(bin_num);
int_bin = floor(int_bin);

% Determining the length of the entire binary number and all the characters
% in the string.
n = length(bin_num);

% Converting each individual number in the "integer" part back to a string
% which also enters it into a character array.
str_int = num2str(int_bin);

% Determining the length of the character array for use in loop.
m = length(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 = 0;

for i = 1:1:m

    % Converting each number in the character array to a number in another
    % array.
    bin_int(i) = str2num(str_int(i));

    % Summing values based on the values in the new array. This value is
    % the summation of each individual digit in the "integer" part of the
    % base-2 number.
    sumint = sumint + bin_int(i)*2^(m-i);

end

% 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.
sumfrac = 0;

% This loop variable, 'j' is used to create a new array of numbers that
% represent the "fractional" portion of the binary number.
j = 1;

% 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. The ending point (n) is equal to the length of the entire
% character array (bin_num).
for i = m+2:1:n
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% Using the loop variable 'j' to create a new number array.
bin_frac(j) = str2num(bin_num(i));

% Creating a new character array of only the "fractional" portion for
% later use.
bin_frac_str(j) = bin_num(i);

% Summing values of the "fractional" portion using loop variable
% 'sumfrac'.
sumfrac = sumfrac + bin_frac(j)*2^(-j);

% Adding '1' to the loop variable each time such that it creates a new
% position in the array for the next iteration.
j = j+1;

end

% Adding the "fractional" portion of the base-2 number with the "integer"
% portion which yields the base-10 number.
total_dec = sumint + sumfrac;

% Displaying the results:
% Integer Portion
fprintf('\n');
str1 = 'The conversion of the "integer" portion (';
str2 = ') of the base-2 number';
str3 = ['to a base-10 number yields a value of, sumint = ',num2str(sumint,'%g'),''];
str = [str1,str_int,str2];
disp(str)
disp(str3)
% Fractional Portion
fprintf('\n');
str1 = 'The conversion of the "fractional" portion (';
str2 = ') of the base-2 number';
str = [str1,bin_frac_str,str2];
disp(str);
str3 = ['to a base-10 number yields a value of, sumfrac = ',num2str(sumfrac,'%g'),''];
disp(str3)
disp(sprintf('\nThe total value of the conversion of the base-2 number to a base-10'));
disp(sprintf('number is, total_dec = %f',total_dec));

disp(sprintf('\n\n*****Conclusion*****'))
disp(sprintf('This worksheet illustrates the use of Matlab to convert a base-2 '))
disp(sprintf('binary number to a base-10 number. It is important to understand '))
disp(sprintf('the binary system as it has numerous applications. Critical to this '))
disp(sprintf('understanding is being able to convert decimal numbers to binary '))
disp(sprintf('numbers, and vice-versa.'))

disp(sprintf('\n\n*****References*****'))
disp('See: <a href = "http://numericalmethods.eng.usf.
edu/mtl/gen/01aae/mtl_gen_aae_txt_binaryrepresentation.pdf">Binary Representation of
Numbers</a>')

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disp(sprintf('not liable for any damages resulting from the use of this'))
disp(sprintf('material. This application is intended for non-commercial, '))
disp(sprintf('non-profit use only. Contact the author for permission if'))
disp(sprintf('you wish to use this application in for-profit activities.'))
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