C++ Programming – ENG TECH 1CP3
Functions

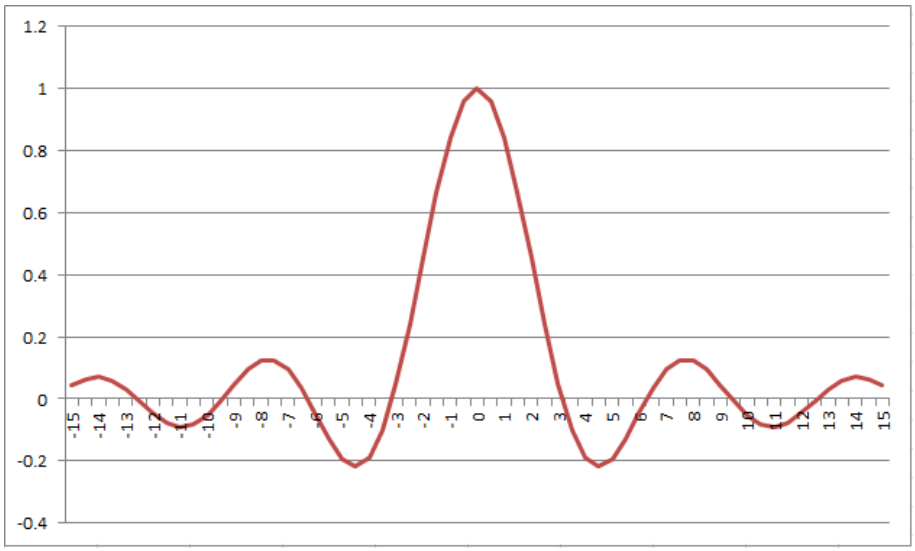
Assignment A2

1. (6 marks)
   The *sinc(x)* function, abbreviated from "sine cardinal" is used frequently in signal processing calculations but is not available as part of the C standard library. The most common definition for the *sinc(x)* function is the following:

$$f(x) = sinc(x)$$

$$= \frac{\sin(x)}{x}$$

The *sincx(x)* function is plotted below.



The values of this function can be calculated easily, except for *sinc(0)* which gives an indeterminant form of 0/0. In this case, l'Hopital's theorem from calculus can be used to prove that *sinc(0) = 1*.

Create a function called ***sinc*** that accepts a numeric value (x) as a parameter and returns a numeric value that is the calculated value of *sinc(x)*. Create a program that will prompt the user for the lower limit, and upper limit, and increment value. The program will

generate a table of values of *sinc(x)* using the user-defined function *sinc*. For instance, if the lower limit is -3, upper limit is 4 with increments of 0.5, the following table would be generated:

x	sinc(x)
-3	0.04704
-2.5	0.239389
-2	0.454649
-1.5	0.664997
-1	0.841471
-0.5	0.958851
0	1
0.5	0.958851
1	0.841471
1.5	0.664997
2	0.454649
2.5	0.239389
3	0.04704
3.5	-0.10022
4	-0.1892

2. (27 marks)
You are working for a Bio-pharmaceutical company that is in the process of running trials on a new drug. The drug is to be used to help people combat severe pain. One of the important parameters for determining dose amount and frequency is the length of time the drug stays active in the bloodstream of the patient. Like many drugs an estimate of the concentration of the drug in the patient's bloodstream can be determined by the following equations:

$$C_t = C_0 e^{-kt}$$

$$t_{\frac{1}{2}} = \frac{ln2}{k}$$

where : C_t is the concentration in ug/L at time t
C_0 is the initial concentration in ug/L and t is the time in hours.
k is the time constant (1/hrs)
$t_{1/2}$ is the half-life in hrs

Some experimental data has been collected on a few patients as shown below:

Patient#	C0(ug/L)	Ct(ug/L)	t(hrs)
1	325	160	2.0
1	600	100	6.2
2	325	220	1.0
3	600	200	4.4
4	325	100	3.0
4	325	88	3.2
2	600	200	3.3
2	325	100	3.3
4	600	210	3.4
5	325	105	3.5
1	600	110	6.0
3	325	100	3.1
2	600	120	5.5
2	600	125	5.5
5	120	60	2.2
2	325	100	3.4

You are to develop a menu-driven program that will allow the analyses of this data. The data shown above must be placed into a data file. The program must be designed using functions. The user of the program must be able to obtain the average $t_{½}$ along with the number of measurements used to calculate the average for any of the 5 patients for which data has been collected. The program must also be able to display the 2 patient numbers and averages of the patients that have the highest $t_{½}$ average values. A menu must be used to select the different options with an additional option for Exit. The program must run until exit is selected by the user. When reporting the average $t_{½}$ to the screen it must be reported to two decimal places. A function called **`analyzeData`** must take as input the patient number and must return both the average $t_{½}$ and the number of measurements in the average for the input patient number. A separate function called **`halfLife`** is to be used for calculating the $t_{½}$ based on C_0, C_t and t that are in the data file. A third function must also be used to determine the two patients with the longest average $t_{½}$ from the five different patients. All four values (patient1, half life 1, patient 2, half life 2) must be returned to the main function. Select an appropriate name for this function.

Create a Word .doc file that contains the source code and a screen captures of the console window as the program is running, for both C++ programs. Save this file as *YourName_Assignment_2.doc* and upload and submit to the appropriate AVENUE lab assignment drop-box.