Basics of Programming 1

Integration C program

User Manual

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Compiling and Running

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In the directory where the program files are there exits the a.out
file. You can run this file immediately from the console:

```
$  ./a.out
```

And the program will run and show this:

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```
Partition = 0.001    Lower bound = -3.14   Upper bound = 3.14
   0.Change the partition.
   1.Change Lower bound.
   2.Change Upper bound.
   3.Continue.
Choose option:
```
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If you want to compile the program from the beginning in your device
than if you are using linux and gcc is installed in your program
than run the r.sh file:

```
$  bash r.sh
```

A a.out file should be created in your directory.

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```
$  ls
bitmap.c        chararray.c     charlib.c       cursorlib.c
fucntion.bmp    main.c          menu.h          nodelib.h
parserlib.h     a.out           bitmap.h        chararray.h
charlib.h       cursorlib.h     fucntions.txt   menu.c
nodelib.c       parserlib.c     r.sh
```
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Run the a.out as shown before.

Note:
You can run the a.out file from everywhere. You can put it in the
desktop and the image will output there.

Menu and entering parameters

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After you have run the program. You will have the menu:

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Partition = 0.001   Lower bound = -3.14   Upper bound = 3.14
    0.Change the partition.
    1.Change Lower bound.
    2.Change Upper bound.
    3.Continue.
Choose option:
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You can now enter one of the options. If you entered 0:

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Partition = 0.001   Lower bound = -3.14   Upper bound = 3.14
    0.Change the partition.
    1.Change Lower bound.
    2.Change Upper bound.
    3.Continue.
Choose option: 0
Enter partition: 0.02
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No entered the partition 0.02. After we press enter the program will update and the new changed value will show up in the partition:

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Partition = 0.02   Lower bound = -3.14   Upper bound = 3.14
    0.Change the partition.
    1.Change Lower bound.
    2.Change Upper bound.
    3.Continue.
Choose option:
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Entering the lower and upper bound is the same just choose option 2 or 3:

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Partition = 0.02   Lower bound = -3.14   Upper bound = 3.14
    0.Change the partition.
    1.Change Lower bound.
    2.Change Upper bound.
    3.Continue.
Choose option: 1
Enter Lower bound: -3.54
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Enter and it will be updated:

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Partition = 0.02   Lower bound = -3.54   Upper bound = 3.14
   0.Change the partition.
   1.Change Lower bound.
   2.Change Upper bound.
   3.Continue.
Choose option:
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To continue to the next part of the program just type 3 and enter:

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Partition = 0.02   Lower bound = -3.54   Upper bound = 3.14
   0.Change the partition.
   1.Change Lower bound.
   2.Change Upper bound.
   3.Continue.
Choose option: 3
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You will be asked to enter a function:

Enter the function:

Entering the expression

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There is a specific format of expression the user can enter.
The user can use:
 - Binary operators: ^ * / + -
 - Real Numbers: 3425.5324
 - Functions: sin cos abs log exp
 - Special: (4x) (x) (-x) (+45)

They are called special cases because they can be formed from the
binary operators. In our case:

        (4x) (x) (-x) (+45) => 4*x 1*x 0-x 0+45

Therefore they need to be closed with brackets. The only time they
don't need brackets is when they are just a single expression.
Example:

        f(x)=x   f(x)=4x   f(x)=+x   f(x)=-45

but not

        f(x)=3x+1 => f(x)=(3x)+1

You can use any combination of the mentioned expresion.
Some expressions that the user can enter:
x
-x
1/x
1/(-x)
(3x)+1
x^2
exp(x^2)
1/2 *x^4 + x^2- 5.32 +x
x*sin(x)
sin(x) + cos(x) -x + 1
sin(x) + exp(x)/(x)
cos(3x) + sin(x^2)
(x^3-x)/(x^2-4)
exp(-x^2)

If you have entered an invalid expression the program will tell you
what the problem was most of the time.

Riemann Sum and Definite Integral

After entering the expression and pressing enter the program will
calculate the Reimann Sum and the Definite Integral. It will display
it in the console:

Enter the function: 1/2 *x^4 + x^2- 5.32 +x

The Riemann Sum: 73.226252
The Definite Integral: 48.331941
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Here is another example:

Enter the function: cos(3x) + sin(x^2)

The Riemann Sum: 2.415905
The Definite Integral: 1.548423
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More examples can be find in the developers doc at the testing subpart.

Opening the Image

After you have entered the expression the program will show the results and exit. If you want to open the generated image you need to go to the directory where the program is located. More precisely, where the a.out file is. The name of the image file will be function.bmp. The file format is bmp. You can open it in a windows image viewer or GIMP in linux.

```
$ ls
README.md    charlib.c     fucntions.txt  nodelib.h
bitmap.c     charlib.h     main.c         parserlib.c
bitmap.h     cursorlib.c   menu.c         parserlib.h
chararray.c  cursorlib.h   menu.h         r.sh
chararray.h  fucntion.bmp  nodelib.c
```

This how the images of the functions we entered before will look:
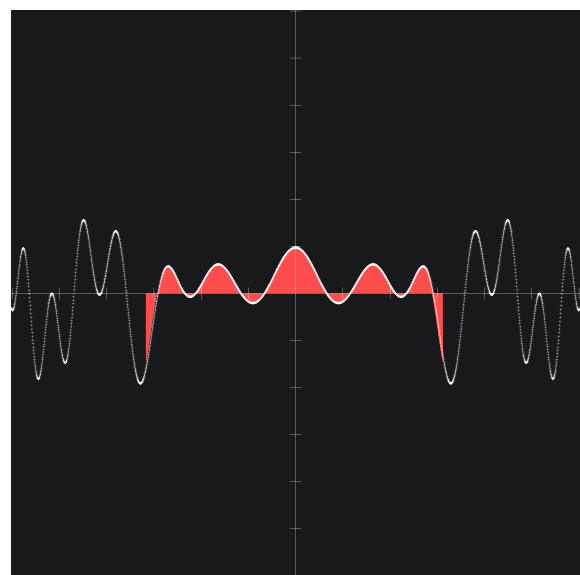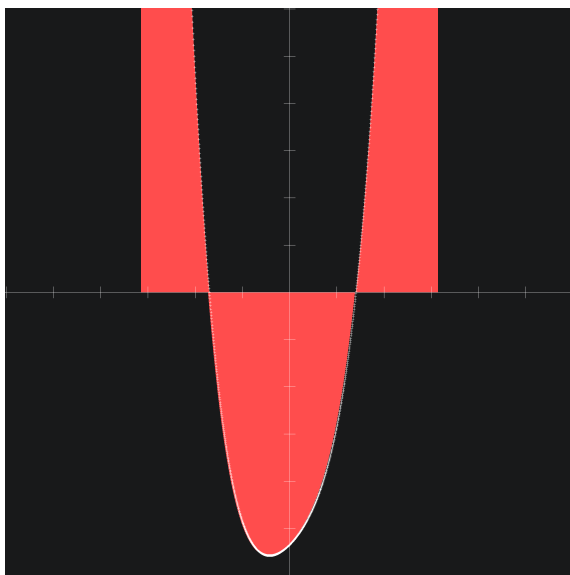
Partition = 0.001   Lower bound = -3.14   Upper bound = 3.14
a)1/2 *x^4 + x^2- 5.32 +x
b)cos(3x) + sin(x^2)