C and Python

G V V Sharma*

***Abstract*—This manual shows how to generate data in a file using a C program and importing it in Python.**

Problem 1. Graphically show that the function

$$f(x) = \begin{cases} -x & x < 1 \\ a + \cos^{-1}(x+b) & 1 \le x \le 2 \end{cases} \tag{1.1}$$

is continuous at $x = 1$ for $b = -1, a + b = -\frac{\pi}{2}$.

Solution: The following python code yields Fig. 1 verifying the above result.

```
import numpy as np
import matplotlib.pyplot as plt
#Computation
b = -1
x2 = np.linspace(-1,1,100)
x3 = np.linspace(1,2,100)
a = -1 - np.pi/2.0
y = -x2
z = a + np.arccos(b+(x3))

#Plotting
plt.plot(x3,z, label = '$f(x) = -x$')
plt.plot(x2,y, label = '$f(x) = a + \cos^{-1}(x+b)$')

sol = np.zeros((2,1))
sol[0] = 1
sol[1] = -1

#Display solution
A = sol[0]
B = sol[1]

plt.plot(A,B,'o')
for xy in zip(A,B):
    plt.annotate('(%s, %s)' % xy, xy=xy, xytext=(30,0), textcoords='offset points')

plt.grid()
plt.legend(loc='best',prop={'size':11})
plt.xlabel('$x$')
plt.ylabel('$f(x)$')
#Comment the following line
plt.savefig('../figs/ee16b1005.eps')
plt.show()
```

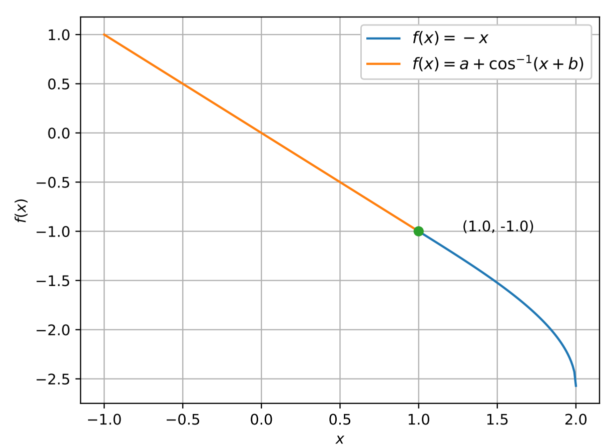

Fig. 1: Substituting the values of a and b in $f(x)$, the graph is smooth at $x = 1$. So $f(x)$ is continuous as well as differentiable $x = 1$.

Problem 2. Write a C program to generate an arithmetic progression with first term $a = -1$, last term $l = 1$ and number of terms $n = 100$ and print the numbers on the screen.

Solution:

*The author is with the Department of Electrical Engineering, Indian Institute of Technology, Hyderabad 502285 India e-mail: gadepall@iith.ac.in.

```c
#include <stdio.h>

int main(void)
{
float a = -1.0, l = 1.0, d;
int n = 100, i;

//Common difference
d = (1-a)/(n-1);

for(i = 0; i < 100; i++)
{
printf("%f\n",a+i*d);
}

return 0;
}
```

Problem 3. Repeat the above exercise by printing the numbers in a file called test.dat

Solution:

```c
#include <stdio.h>

int main(void)
{
FILE *fp;
float a = -1.0, l = 1.0, d;
int n = 100, i;

//Common difference
d = (1-a)/(n-1);

//Open file for writing
fp = fopen("test.dat", "w");

for(i = 0; i < 100; i++)
{
fprintf(fp, "%f\n", a+i*d);
}
fclose(fp);
return 0;
}
```

Problem 4. Now run the following program. Comment.

```python
import numpy as np
import matplotlib.pyplot as plt

#Computation
b = -1
x2 = np.loadtxt('test.dat',dtype='float')
#x2 = np.linspace(-1,1,100)
x3 = np.linspace(1,2,100)
a = -1 - np.pi/2.0
y = -x2
z = a + np.arccos(b+(x3))

#Plotting
plt.plot(x3,z, label = '$f(x) = -x$')
plt.plot(x2,y, label = '$f(x) = a + \cos^{-1}(x+b)$')

sol = np.zeros((2,1))
sol[0] = 1
sol[1] = -1

#Display solution
A = sol[0]
B = sol[1]

plt.plot(A,B,'o')
for xy in zip(A,B):
        plt.annotate('(%s, %s)' % xy, xy=xy, xytext=(30,0), textcoords='offset points')

plt.grid()
plt.legend(loc='best',prop={'size':11})
plt.xlabel('$x$')
plt.ylabel('$f(x)$')
plt.show()
```

Problem 5. Do all the computations in problem 1 in C and verify your results by plotting in python.