1 Overview

There is only one problem this week. We are going to use loops to calculate the area under a curve.

Firstly however here are some notes on how to print output from your program to the screen. For the moment that will be the only way to see the results of your program. It is also useful to print intermediate results to help understand or to bebug your code.

For C use $printf$ and for FORTRAN use the $write$ command with unit 6. In each case you have to state which variables or text you want to print. Also there is formatting information which places the output on the in the order/style you want.

2 Printing Syntax

2.1 Printf Syntax

- printf is used to display information on the screen. It will print variable $r - value$s as they are in memory at the moment when the statement is executed. The basic syntax for printf is:

```
printf(format,variable1,variable2,...);
```

- The number and type of each variable must match those in the format. Each %# corresponds to a variable, with # determining the variable type. Spaces and punctuation appear as written as they appear.
- Below is a table of some of the format symbols.

format	variable type
%d	integer
%.nf	floating point, n decimals
%.ne	scientific notation, n decimals
%c	character
%s	string
\n	new line
\t	tab

- Here is an example below.

```
// default format
printf("Two ints %d %d and two floats %f %f\n", int1, int2,
                                                float1, float2);
// floats with 4 decimal places
printf("Two ints %d %d and two floats %.4f %.4f\n", int1, int2,
                                                    float1, float2);
```

2.2 FORMAT in Fortran

- The format statement in FORTRAN formats the output. Here is an example below.

```
! default format
write(6,*) ' Two ints ',int1,int2,' and two floats ',x1,x2
!
write(6,'(a,2i6,/,a,f8.2,f10.3)') ' Two ints ',int1,int2,&
                                   ' and two floats ',x1,x2
```

- Below is a table of format symbols for FORTRAN:

Symbol	Description
a	character string
iN	integer with N spaces
fN.M	real with N spaces and M decimnals
Nx	N spaces
/	new line

3 Exercises

- Computing the area under the curve of $f(x)$ where $x \in [a,b]$ can be done using the Trapezodial rule:

$$\int_a^b f(x)dx \sim \frac{b-a}{2N}(f(x_0)+2f(x_1)+2f(x_2)+\cdots+2f(x_{N-1})+f(x_N))$$

  where $x_0 = a$ and $x_N = b$ with $N-1$ equidistant points between a and b.

- The integral is changed into a sum, using the values of the function at certain points. Increasing the number of points increases the accuracy.

- Find the integral of $f(x) = \tan(x)$ from $0 \to \pi/3$. Compare with the actual result: $\int_0^{\pi/3} \tan(x)dx = log(2)$.

  1. So $a = 0$ and $b = \pi/3$.
  2. Get the firt part of the sum $\tan(0) + \tan(\pi/3)$. For C use tan which is part of the maths library. You used the maths library in the last practical for Conversion.c. tan is available in FORTRAN by default.
  3. Create a loop that generates 11 equidistant points between $0 \to \pi/3$. Thus $N = 12$ and $x_0 = a = 0$ and $x_{12} = b = \pi/3$.
  4. Change the loop so that you are adding $2\tan(x_i)$ for the each of the 11 points.
  5. Add that sum to that of the end points and multiply by $\frac{b-a}{2N}$.
  6. Compare this against $\log(2)$ you should not be too far out.