

Exercise 1: Using `root`

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1. **Root tutorial** Go through the basic `root` tutorial (Exercise 0) and make sure you understand all the steps - otherwise ask.
2. **Root documentation** Using the `root` documentation (<http://root.cern.ch/root/html528/ClassIndex.html>), find the difference between a TH1F and a TH1D histogram. When would you use which?
3. **Root macro/PyRoot macro** Write a macro in C++ that implements a function taking two numbers as arguments and printing their arithmetic and geometric mean, then returns the sum. In C++, output happens via

```
cout << "A string followed by " << 17 << " a number" << endl;
```

Make a habit of including the appropriate header files and using statements as you would in compiled code, even if `root` is not very strict in these issues, thus start with

```
#include <iostream>
```

```
using std::cout;
```

```
using std::endl;
```

or alternatively

```
using namespace std;
```

Write the same function in Python, but this time take a list of numbers as argument (the list is a standard type in Python, which you can fill with `l = [1,2,3,4]`, its length is `len(l)`; you iterate over a list with `for x in l:`). You will need the `math` module of Python, thus add

```
import math
```

For the n^{th} root needed in the geometric mean use `math.pow()` with a fractional power. Output in Python is via `print`.

(Attach the `.C` and `.py` file).

4. **Root histogram** Write a macro (either C++ or Python) creating a histogram with 10 bins from 0 to 10 . Fill each histogram bin with its bin centre value. Create a linear function (here shown for the C++ case):

```
TF1 * fun = new TF1("function", "[0]+x*[1]", 0, 10)
```

the first argument is as usual the name, the second the formula, with x being the independent variable and [0], [1] denoting free parameters, the last two parameters are the range. You can now set the parameters using

```
fun->SetParameter(0, 1.7);  
fun->SetParameter(1, 2.2);
```

and draw the function using

```
fun->Draw();
```

More interestingly, you can fit the function to histogram using

```
hist->fit(fun);
```

The fit parameters are printed in the terminal - are they what you expect? If not, how would you fix that problem? Do so... (Hint: `root` will always use the centres of bins in fits).

(Attach a .C or .py file)

5. **Presentation** Take the fitted histogram from the last exercise and make it nice-looking: Add labels to the axes, display the fit results, show the fit as a dotted blue line and the histogram as round markers with error bars. Make sure to get rid of all grey backgrounds. Save the result as a .png file.

(Attach the .png file)