Practical Programming Exam
Exercise 20 and question 10.3

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1 Question 3 from lecture 10*

*NOTICE: question taken from lecture 10 since lecture 11 does not contain a question 3.

Suppose you run the command make main *and it fails with diagnostics*

```
cc          main.c          -o main
main.c:1:19: fatal error: gsl_sf.h: No such file or directory
compilation terminated.
```

Explain the error and how to correct it.

The error occur because the header in main.c is wrong. The headerfile is #include<gsl_sf.h> when it should be #include<gsl/gsl_sf.h>. The reason for haveing gsl/... is because the gsl library files are installed in their own directory called gsl.

2 Exercise 20 - Numeric Arctan

This exercise require to calculate arctan as $\arctan(x) = \int_0^x \frac{1}{x^2+1} \mathrm{d}x$.
My arctan is calculated as seen in the file `numArctan.c`. Here the integrand is defined in the function *arctanInteg* and is used in the *gsl_function* to be used in *gsl_integration_qag* routine. To simplify the calculation I have reduced the argument in the following ways:

1. if $x = 0$ return $\arctan(x) = 0$
2. if $x < 0$ return $-\arctan(-x)$
3. if $x > 1$ return $\frac{\pi}{2} - \arctan(\frac{1}{x})$

In `main.c` a message is written to the error stream (stderr) if the result from my arctan is different from math.h's atan according to the equal method made

in lecture 2 with tau = 10^{-6} and epsilon = 10^{-6}. This never occur and in `outArctan.txt` the difference (error) can be seen to be maximum around 10^{-16}. My solution together with math.h's atan function is plotted as seen in Figure 1. It can be seen that the lines lie on top of each other with follows from the low errors from the output file.

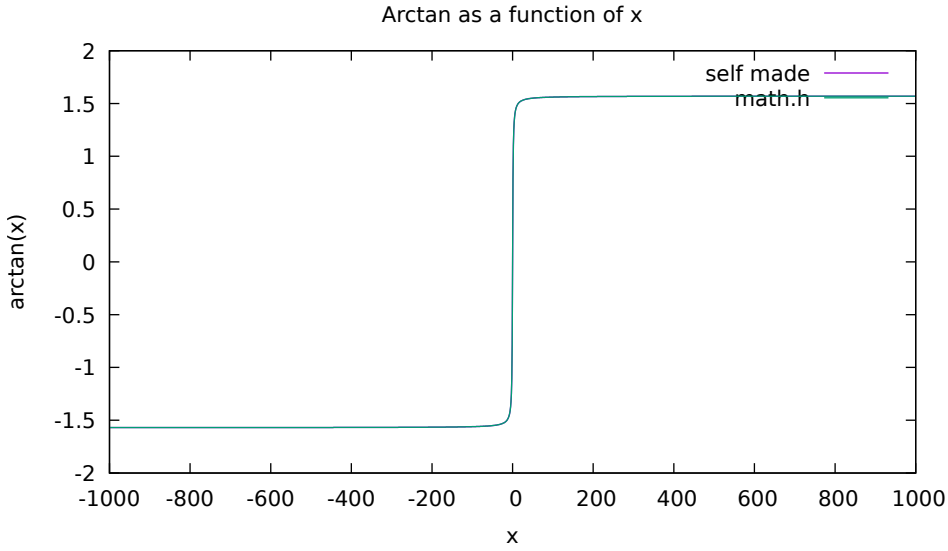

Figure 1: Self made arctan function plotted with math.h atan function. It can be seen that the two lines lie on top of each other.