# Computing for mathematics handout 7 - The class test, srange, tangents and more applications of functions or classes to data.

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## What you have learnt this week:

* How to plot in Sage (domain of plot and 'addition' of plots);
* How to obtain limits in Sage;
* How to differentiate in Sage;
* How to integrate in Sage;
* How to to upload data to Sage.

## Obtaining the values from a solution of an equation

Let's consider the following equation:

To find the roots of the equation we can simply use the solve function:

sols = solve(x ^ 2 - x - 1 == 0, x)

Before viewing the solutions of our equation what type of object is sols?

type(sols)

sols is a 'generic sequence' (a type of list).

sols

We see that our solutions are given in the form of a list of relationships. The solutions to exercise 3 show a way of extracting the solutions. Here is another:

sols = solve(x ^ 2 - x - 1 == 0, x, solution\_dict=True)

Sols is now a list of dictionaries. Let us try and extract the positive solution to our equation:

phi = [k[x] for k in sols if k[x] >= 0][0]

If you're not familiar with what is try the following:

for n in range(1): print expand((phi ^ n - (1 - phi) ^ n) / sqrt(5))

## Question 9

Question 9 was a tricky task. The solution file shows a function that takes a function and a point and outputs a plot. If the solution is not clear: come and speak to me.

## Importing data

Let's carry out the following exercise:

1. Use Python to obtain a list of the Fibonacci numbers;
2. Write those numbers to file;
3. Import that data file in to Sage;
4. Plot the ratio of the differences between two consecutive Fibonacci numbers.
5. Here's the python script:

import csv # Use the csv librarydef fib(n): """ A function that returns the nth Fibonacci number. Arguments: n (an integer) Outputs: The nth Fibonacci number (an integer) """ if n == 0: return 0 if n == 1: return 1 return fib(n-1) + fib(n-2)f = open('fibonaccinumber.csv', 'w') # Open a file in write modecsvwrtr = csv.writer(f) # Create a writer object (see exercise 10 of sheet 2)for n in range(31): # Loop n over the first 30 integers csvwrtr.writerow([fib(n)]) # Write the nth Fibonacci numberf.close() # Close the file

Now let us import that file in to Sage and use the following code to obtain the ratios of two successive numbers:

import csv # Use the csv libraryf = open(DATA + 'fibs', 'r') # Open the newly loaded file in Sage.csvrdr = csv.reader(f) # Create a reader objectdata = [float(row[0]) for row in csvrdr] # Read in the data and convert to floatf.close() # Close the fileratios = [] # Create a new listfor k in range(1, len(data) - 1): # Iterate over integers ratios = [[k, data[k + 1] / data[k]]] # Add a tuple with the ratio of two consecutive number from the Fibonacci sequencelist\_plot(k) # A list plot

**We could do all of the above using Sage but this is just an example of using data written to file.**

## What you should do next:

* **Start the next sheet**: make sure you spend time working on the sheet **BEFORE** the labs.
* Contribute to the wiki.
* To make the best use of the lab sessions turn up having finished your sheets;
* If anything is still unclear **please** come and see me during office hours.