# Task 1

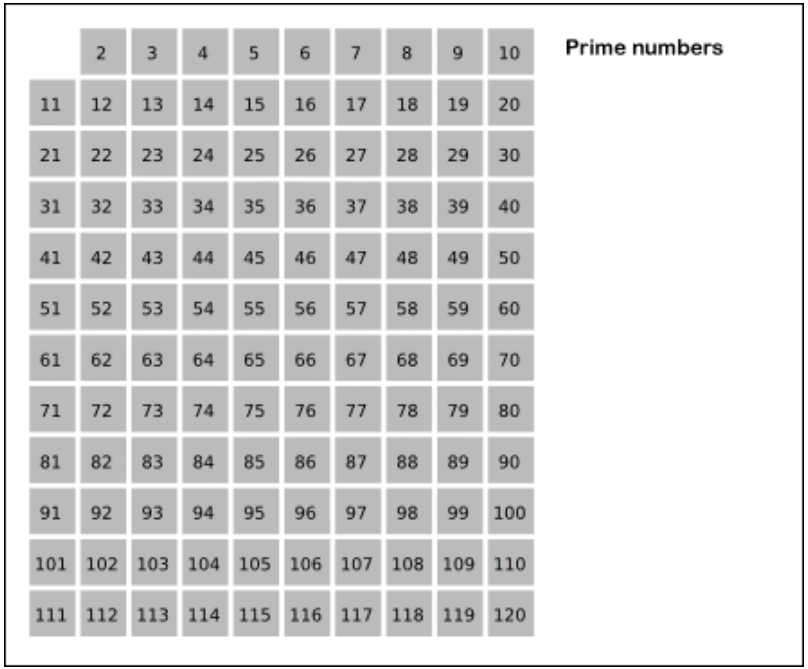
Last week you wrote a Fortran program that calculates the mean and standard deviation of a series of real numbers. Now edit the program to calculate these properties for an array. The program should:

- Ask for the number of numbers
- If the entered number is negative, repeatedly ask for a positive number
- Allocate the array
- Read the values into the array
- Calculate the mean and standard deviation of the array
- Display the result

Use as many whole array operations and as few loops as possible.

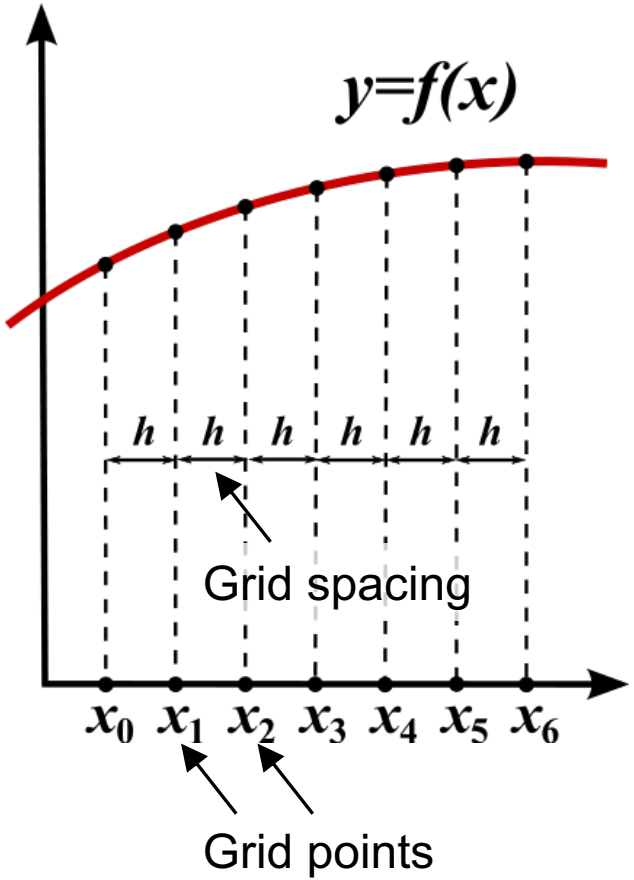
# Task 2

Write a Fortran program that uses the sieve of Eratosthenes to find all prime numbers less than or equal to a given number.




https://en.wikipedia.org/wiki/Sieve_of_Eratosthenes

# Finite differences




First derivative

$$\frac{dy}{dx} = f'(x) = \lim_{dx \to 0} \frac{f(x+dx) - f(x)}{dx}$$

Computer version of the first derivative

$$\frac{dy}{dx} \approx \frac{\Delta y}{\Delta x} \approx \frac{y_{i+1} - y_i}{x_{i+1} - x_i} = \frac{y_{i+1} - y_i}{h}$$

Computer version of the second derivative

$$\frac{d^2y}{dx^2} \approx \frac{y_{i+1} - 2y_i + y_{i-1}}{h^2}$$

# Task 3

Write a Fortran program that computes the second derivative of a 1D array using the finite difference method for a given number of grid points ($n$) and grid spacing ($h$).

- The second derivative is calculated at the points i = 2...n-1.
- At the boundaries (i=1 and n) the derivative is set to 0.
- The result is another 1D array.

Test the program for two idealized functions for which you know the correct result, e.g. sin(x) or $x^2$. Compare the result of your program with the correct result and calculate the error.

# Exercise 2

Deadline:

- Please hand in your solutions (.f90 files and results of the two tests) until Tuesday, **19 March 2024, 23:59** at the latest.

Questions?

- Email me (marina.duetsch@univie.ac.at)
  Or pass by my office (UZA II, 2G551).