1 Construct and Plot Matrices

In this exercise you need to make use of the Python packages numpy and `matplotlib`.

1. Construct an identity matrix I of dimension 100x100 as numpy array.

2. Construct a banded matrix A of the form

$$A = \frac{100^2}{4\pi^2} \begin{bmatrix} -2 & 1 & 0 & 0 & \cdots & 0 & 0 \\ 1 & -2 & 1 & 0 & \cdots & 0 & 0 \\ 0 & 1 & -2 & 1 & \cdots & 0 & 0 \\ 0 & 0 & 1 & -2 & \cdots & 0 & 0 \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ 0 & 0 & 0 & 0 & \cdots & -2 & 1 \\ 0 & 0 & 0 & 0 & \cdots & 1 & -2 \end{bmatrix}$$

   of dimension 100x100 as numpy array.

3. Plot both matrices with the function `imshow()` of the package `matplotlib.pyplot`.

4. Construct a vector z with the `linspace()` function of the numpy package. It should contain a grid of 102 values between 0 and 2π.

5. Use Python's *slicing* capabilities to save all except from the first and the last value of z into another vector x.

6. Calculate $y = \sin(x)$ and the matrix vector product $d = Ay$ using `numpy.sin()` and `numpy.dot()`.

7. Plot y and d into the same plot using `plot()` from the `matplotlib.pyplot` package.

Hint: You might need to use `matplotlib.pyplot.show()` in order to guarantee that the notebook shows some output.

Solution: