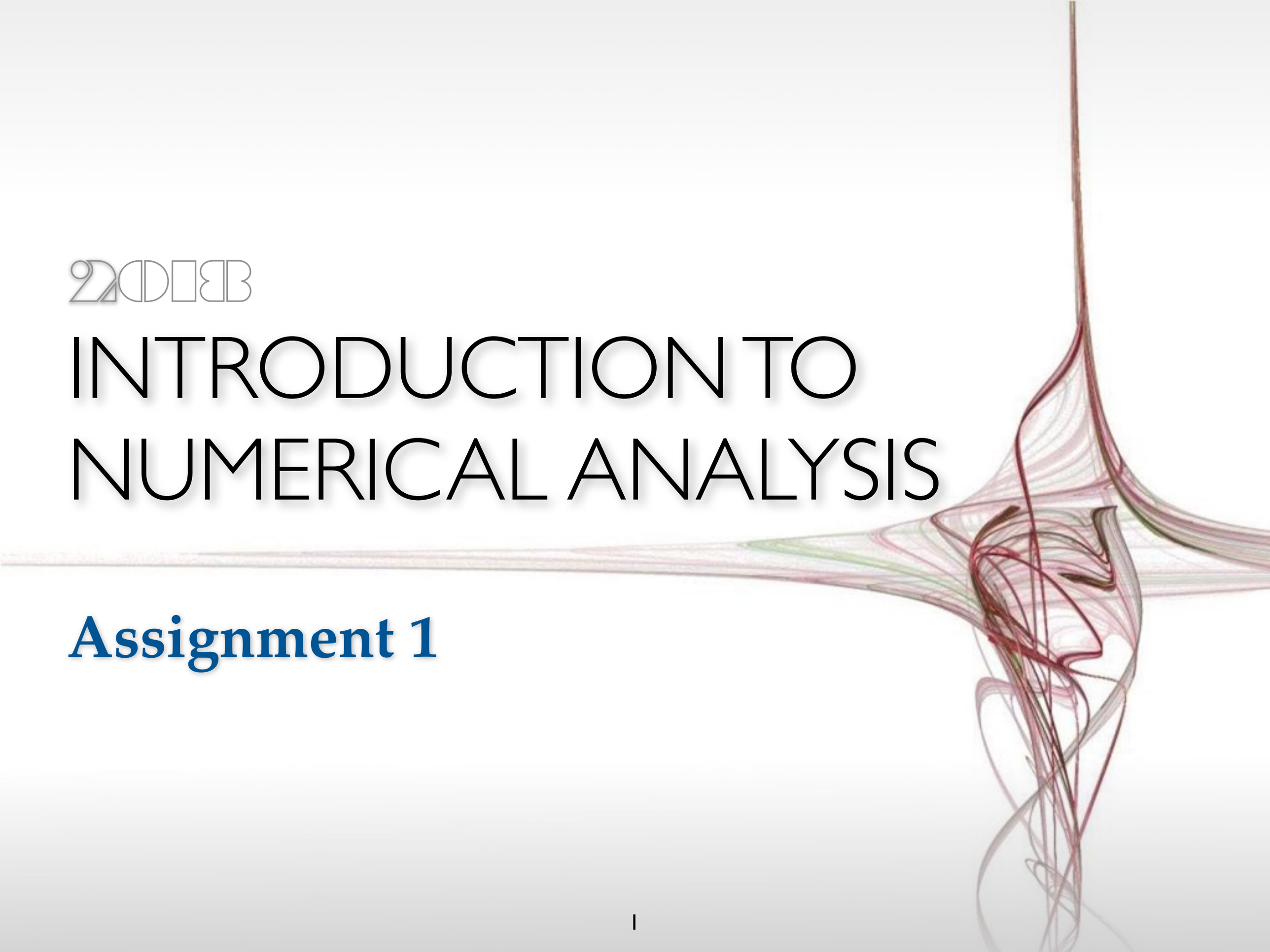
2018

INTRODUCTION TO NUMERICAL ANALYSIS



Assignment 1

REMINDER

- **Please download the template code from CEIBA and implement your answer accordingly!**
- You will have **maximum 2 weeks** to answer the assignment, you can discuss with our people or googling, but please do not just COPY the answers!
- Remember: you have to upload <u>your code</u> (as a .py file), not the snapshot of your output screen!
- Mini-TA should check whether your code is working properly or not. If not working properly, mini-TA will ask you to correct it.

ASSIGNMENT 1-1

Simply numerical differential

- Given the function f(x) below, with x as the only argument. Please implement the given function accordingly, as well as the function which should returns the first derivative, using the numerical derivative tool from SciPy with a fixed step size of **h = 10^{-5}**, ie.:

$$f(x) = \prod_{n=1}^{4} \left[\cos\left(\frac{n\pi x}{2}\right) \cosh(x) + \sin\left(\frac{n\pi x}{2}\right) \sinh(x) \right], \quad f'(x) = ?$$

- You need to implement both `func(x)` and `func_first_derivative(x)` functions.

ASSIGNMENT 1-2

Simply numerical integration

- Given the function f(x) below, with x as the only argument. Please implement the function itself as well as the integrated function g(x) using the numerical integral tool from SciPy:

$$f(x) = \sum_{n=1}^{5}[1 + \sin(n\pi x)x + \cos(n\pi x)x^2], \quad g(x) = \int_{t=-x}^{t=+x} f(t)dt$$

- You need to implement both `func(x)` and `func_integrated(x)` functions.

ASSIGNMENT 1-3

Convolution with numerical integration

- Convolution is a mathematical operation on two functions, producing a third function that is typically viewed as a modified version of one of the original functions. For example, a Breit–Wigner distribution is used to describe the line-shape produced by a resonance:

$$f(E; M, \Gamma) = \frac{1}{(E^2 - M^2)^2 + M^2\Gamma^2}$$

- However, in some of the practical cases, the actual measured line-shape has to be modified by the convolution operation in order to take the finite resolution into account.

ASSIGNMENT 1-3 (CONT.)

Convolution with numerical integration

- If the resolution can be described by a Gaussian distribution, the resulting function can be expressed as:

$$f(E; M, \Gamma, \sigma) = \int_{x=-\infty}^{x=+\infty} f(E - x; M, \Gamma) \cdot \exp\left(-\frac{x^2}{2\sigma^2}\right) dx$$

- Given the later part of the function (the Gaussian smearing term) drops rapidly when ***x*** is away from zero, one can replace the integration upper and lower bounds with some finite numbers, such as **+3σ** and **–3σ**, respectively. Please implement this convoluted function **F(E; M, Γ, σ)** accordingly with the scipy numerical integration tool.