



UPPSALA  
UNIVERSITET

Department of Information Technology

# Scientific Computing for Data Analysis

Davoud Mirzaei

# Lecture 11: Exam Info

## Agenda

- ▶ Exam setup
- ▶ Some old exam questions

## When? Where? How?

- ▶ Exam date: 2024-03-08, Time: 14:00 - 14:00
- ▶ Exam hall: Råbyvägen 95, Sal 2
- ▶ Exam in Inspira

## Exam structure

- ▶ Part A: grade 3: 6 questions (2 questions per each objectives **concepts**, **algorithms**, **analysis**). You must answer at least one question per each objective.
- ▶ Part B: higher grades: 3 questions from **all objectives**.

More detailed info concerning points will follow - this is the rough structure

## Concepts:

- ▶ Stochastic and deterministic models and methods
- ▶ Markov processes, Random walk, Brownian motion
- ▶ norms and condition numbers
- ▶ orthogonality
- ▶ least squares problem (best approximation)
- ▶ matrix decomposition
- ▶ low rank approximation
- ▶ similarity transformations
- ▶ iterative methods

## Algorithms:

- ▶ Monte Carlo method
- ▶ Inverse Transform Method
- ▶ SSA
- ▶ computing a least squares fit
- ▶ computing least squares solutions via normal equation, QR factorization and SVD
- ▶ Householder method (making zeros)
- ▶ power method
- ▶ QR-iteration

## Analysis:

- ▶ Convergence of Monte Carlo  $e_N = c \cdot \frac{1}{\sqrt{N}}$
- ▶ Convergence of power method,  $e_k = c \cdot \left| \frac{\lambda_2}{\lambda_1} \right|^k$
- ▶ Deriving properties from a matrix using e.g. SVD
- ▶ How to improve condition number for LS fit, when to use which approach
- ▶ Complexity (computational cost) of some algorithms

### Key considerations for achieving higher grades:

- ▶ Tackling more challenging problems that demonstrate more advanced problem-solving skills
- ▶ Exhibiting a deeper understanding of the course objectives
- ▶ Establishing connections between various parts of the course
- ▶ Demonstrating a link between theoretical concepts and their practical implementation
- ▶ Presenting solutions in a structured, step-by-step manner

## Available tools (see 'General Information' module)

- ▶ An online Python will be available
- ▶ Numpy manual (without search function)
- ▶ Formula sheet (check that out in detail beforehand!)
- ▶ Online calculator
- ▶ You can bring your own calculator

## Do we need to write and execute Python code in the exam?

- ▶ Yes! it is possible that questions requiring Python code may arise. For example in Monte Carlo part, or least squares problem, eigenvalue computations, etc.
- ▶ Python can also be used as an advanced calculator for some side computations like as matrix inversion, QR factorization, matrix-vector and matrix-matrix multiplications, etc.