

# FORK1003

## Preparatory Course in Linear Algebra 2015/16

### Syllabus

August, 2015

Here is a list of concepts and techniques you should be familiar with after this course:

## Lecture 1

- Linear systems
  - Linear equations and systems
  - Connection between solutions to linear systems and points of intersection of graphs
- Row reduction
  - Coefficient and augmented matrices
  - Elementary row operations
  - Row reducing a matrix to solve a linear system
- Echelon form
  - Definition of echelon and reduced echelon form
  - Describing solution sets in the case of zero, one or infinitely many solutions
- Pivot columns, basic and free variables
  - Determining the number of solutions from the pivot columns

## Lecture 2

- Matrix addition, subtraction and scalar multiplication
- Vector dot products

- Matrix multiplication
  - The basic properties of matrix multiplication
- Transpose
  - The basic properties of the transpose
- Square matrices, diagonal matrices, upper-diagonal matrices
- Inverse matrices
  - Finding inverse matrices using row reduction
- Expressing linear systems as matrix equations
  - Solving linear systems by inverting the coefficient matrix
- Expressing linear systems as linear combinations of column vectors
- Linear combinations and spanning sets
  - Checking if vectors span  $\mathbb{R}^n$
  - What it means for linear system if columns span  $\mathbb{R}^n$

## Lecture 3

- Connection between determinants and invertibility of matrices
- Formula for determinant of  $2 \times 2$  matrix
- Clever trick for calculating  $3 \times 3$  matrices using diagonal lines
- Minors and cofactors
- Cofactor expansion of determinants
- The effect of elementary row operations on determinants
- The determinant of upper-diagonal matrices
- Finding determinants through row reduction
- Combining row reduction and cofactor expansion
- The adjugate matrix
- Calculating the inverse using the determinant and adjugate matrix
- Using Cramer's rule to solve linear systems