

## MATB24 Outline

- Sets and binary operations on sets
- Abstract vector spaces over a field, subspace of an abstract vector space, examples with a focus on spaces of functions and polynomials
- Basic concepts of vector spaces (possibly infinite dimensional) such as linear combination, spanning sets, basis, linear dependency
- Linear transformation on vector spaces. Isomorphism, rank-nullity
- Coordinate isomorphisms, change of coordinate, matrix representation of linear transformation
- linear transformations and change of coordinates, similar matrices
- Diagonalization seen as a matrix representation of a linear transformation with respect to an eigenbasis. Diagonalizable transformations
- Dot product, projection, orthogonal complement, orthogonal and orthonormal basis, Gram Schmidt , QR factorization, projection matrices, least square method
- Inner product space, orthogonal complements, orthogonal linear transformation, classification of inner products on  $\mathbb{R}^n$
- Definition of determinant as a unique function in the space of alternation multilinear maps. Geometric interpretation of determinant
- Complex vector spaces, complex eigenvalues, Focus on  $\mathbb{C}^n$  and its subspace
- Hermitian inner products with a focus on Euclidean inner product
- Unitary and Hermitian operators, unitary diagonalizable linear transformations, self adjoint maps
- Gram-Schmidt over complex vector spaces
- Spectral theorem over complex number, spectral theorem over real numbers, normal matrices
- Jordan canonical forms
- time permits: Quadratic forms