**DASC 2594 – Multivariable Math for Data Scientists**

**Unit 2: Vector Spaces, Eigen decompositions, Orthogonality, Symmetry, and Quadratic Forms**

**Lesson Plan 4: Vector Spaces, Rank, Dimension, and Bases**

**John Tipton, 2020**

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| **Units** | **Lesson Plan 4** | **Readings** |
| **Unit 2**  **Vector Spaces, Eigen decompositions, Orthogonality, Symmetry, and Quadratic Forms** | **Essential Questions**   * What is a vector space and what is a vector subspace? * What is the relationship between the null space, the column space, and linear transformations? * What is a basis and how to we transform between basis representations? * What is meant by dimension of a vector space? How is this related to matrix rank and linear independence? | Chapter 4 of Linear Algebra and It’s Applications. David C. Lay |
| **Day 1**   * Understand the definition of a vector space (in ) * Understand what makes a subspace of a vector space * Define a spanning set for a vector subspace * Understand the null space of a matrix * Understand the column space of a matrix * Identify the differences between the null space and column space of a matrix |
| **Day 2**   * Understand the properties of a linear transformation between vector spaces * Understand linearly independent bases and spanning sets * Apply the spanning set theorem * Define and use the standard basis |
| **Day 3**   * Understand coordinate systems and apply the uniqueness representation theorem * Understand coordinates in and apply change-of-coordinates transformations * Define and identify isomorphic vector spaces |
| **Day 4**   * Calculate the dimension of a vector space using a linearly independent basis * Understand the basis theorem (minimal spanning sets) * Identify that subspaces have smaller dimension than parent vector space |
| **Day 5**   * Define the row space * Define and apply the rank theorem * Define and apply the rank and invertible matrix theorem |
| **Day 6**   * Apply and understand a change of basis in |