MATH 3300 is taken by students in several majors such as Computer Science, Computer Systems Engineering, Data Science, Mathematics, and Statistics. Math majors can take it as an alternative to the more theoretical MATH 3000; unlike 3000, it does not have MATH 3200 as a prerequisite. Correspondingly, students should not be expected to produce general abstract proofs, though they should engage with theoretical concepts such as linearity, subspaces, and dimension, in addition to developing computational skills. C students should be able to perform basic computations such as inverting a matrix using row reduction. B students should be able to reason about broader ideas such as the relationship between the rank of a matrix and the existence or uniqueness of solutions to systems (e.g., they should be able to recognize that if a 4x3 matrix has rank 2 then it has nontrivial nullspace).

The most commonly used books for the course are Lay, Lay, and McDonald's *Linear Algebra and Applications* and Strang's *Introduction to Linear Algebra*; instructors have had varying opinions as to which of these is preferable, and you could also choose to use a different book as long as it covers all of the core topics.

Since this is a course in Applied Linear Algebra, a fair amount of attention should be given to application topics. Two that should certainly be covered are the least squares method and singular value decomposition. Several others that you might consider are mentioned below.

Here is a list of topics together with their locations in Lay et al. and Strang. (Of course, the order in which you cover them will depend on your preference and the book you are using, and the miscellaneous applications should be introduced at natural times rather than all put at the end.) "Days" are assuming a MWF 50 min/day schedule and 42 instructional days not counting exams and review.

| Topic | Lay et al. | Strang | days |
|---|---|---|---|
| Vector algebra | 1.3 | 1.1-1.2 | 2 |
| Row reduction, echelon form, and solving systems | 1.1-1.2 | 1.3, 2.1-2.3 | 3 |
| Matrix algebra: product, inverse, and transpose | 2.1-2.3 | 2.4, 2.5, 2.7 | 4 |
| Subspaces: nullspace and column space of a matrix | 2.8, 4.1-4.2 | 3.1-3.2 | 3 |
| Solution sets to linear systems | 1.4-1.5 | 3.3 | 2 |
| Linear independence, basis, and dimension | 2.9, 4.3, 4.5 | 3.4 | 3 |
| Row space, rank, and invertibility | 4.6 | 3.5 | 2 |
| Dot product, orthogonality, orthogonal complements | 6.1 | 4.1 | 3 |
| Orthogonal projections | 6.2-6.3 | 4.2 | 1 |

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| Gram-Schmidt process | 6.4 | 4.4 | 1 |
| Least squares approximation | 6.5 | 4.3 | 2 |
| Determinants and their basic properties | 3.1-3.2 | 5.1-5.2 | 3 |
| Eigenvalues and eigenvectors | 5.1-5.2 | 6.1 | 3 |
| Change of basis | 4.7 | 8.1-8.2 | 2 |
| Diagonalizability | 5.3 | 6.2 | 1 |
| Spectral theorem for symmetric matrices | 7.1 | 6.4 | 2 |
| Singular value decomposition | 7.4 | 7.2 | 2 |
| Miscellaneous application topics | see below | see below | 3 |

Possible application topics include networks (Lay 1.6, Strang 10.1), computer graphics (Lay 2.7, Strang 10.6), Markov chains (Lay 4.9, Strang 10.3), principal component analysis in image processing and statistics (Lay 7.5, Strang 7.1 and 7.3), and linear programming (Lay Chapter 9, Strang 10.4).