

AN ALGORITHM FOR FOR SOLVING LINEAR EQUATIONS AND SYSTEMS

In the first part of the course we see some methods for solving linear and non-linear first order equations but solving higher order *non-linear* equations is generally very hard and not a topic for MA2132. Instead, for the majority of the course, we concentrate on linear equations and first order linear systems. The specific methods for linear equations and systems are different from each other, and in particular you need to be careful to distinguish solutions which are functions from solutions which are vectors. For more details on these methods you should download the relevant files on second order equations and/or linear systems.

However there is a general procedure for solving linear problems which is outlined below, and you should always do the steps in this order. This procedure even works for first order linear equations although we stress an alternative method in the course.

The Algorithm:

- (1) Identify the corresponding *homogeneous equation* and solve it to find linearly independent solutions. You can check for linear independence using the Wronskian. The solution of an n th order homogeneous linear equation or an n -dimensional homogeneous first order linear system will be a linear combination of n linearly independent solutions. Thus it should contain n constants c_1, c_2, \dots, c_n .
- (2) Find ONE *particular solution* of the inhomogeneous equation or system. This is a single function or vector and should contain NO unknown constants.
- (3) The *general solution* is the sum of the homogeneous solution and the particular solution. Thus it should contain n constants.
- (4) If the problem is an *Initial Value Problem*, then you can solve for the n unknown constants to find a single solution. Remember to write out the solution after you find values for the constants.