*let’s do an example with equal roots solving the homogeneous matrix differential equation first*

*where*

1. *Form A-rI ==*
2. *Find determinant of A-rI, namely ad-bc=0*

*(1-r)(3-r)-1(-1) = =*

1. *To find vectors : For r1 = 2 , put r1 into A- r1 I*

*and then form .*

*Note 2nd subscript for y is same as subscript for r*

*Since Row 1 is a multiple of row 2, choose only one row to work with. For example, use row 1. The equation will be -1y11-1y21 =0. So Let*

***. So one solution is***

*Cannot do this for second root as this would lead to a multiple of*  ***and 2 would be a multiple of 1. 2 must be independent of 1.***

*So formand put into the differential equation. This leads to (A-r1I)* ***y2****=****y1***

*and*

*Since Row 1 is a multiple of row 2, choose only one row to work with. For example, use row 1. The equation will be -1y12-1y22 =1. So, solve for*

*The vector* ***y2*** *==* ***y2***

*If you use the second equation, namely,*

*Now* ******* then . Here k replaces in the* ***y2*** *expression above, and k is any number. k can be taken as zero without loss in generality of solution*

1. ***Now*** ; and

The vector solution is a linear combination of the two solutions, namely, ****C****C****or

1. += when written out for each row;

And the fundamental matrix becomes

1. *and where*

*Following the method described to find the particular solution, we need to find*

*and det*

1. *=;*

Now *to get*  ***:***  *Suppose that then*

*h)*  and  ***integrate to get d***

*dt = =. Note that the first term of is obtained by IBP*

*Now*

1. *the total solution is where*

*=.*

*Note that the first part of* ***total*** *is from part e) above, and, the second part is from part i) above.*

*So the first state variable has a solution given by the first line of the vector* ***total*** *and the second state variable has a solution given by the second line of the vector* ***total.*** *The unknowns* *can only be obtained when initial conditions for each state variable are given.*