

## Spanning

$\text{Span} \{ \vec{v}_1, \vec{v}_2, \vec{v}_3, \dots, \vec{v}_n \} = \text{set of all linear combinations of } \vec{v}_1, \vec{v}_2, \vec{v}_3, \dots, \vec{v}_n$

Column Space of a matrix A = span of the column vectors of A

(1) Does a particular vector belong to the span of a set of vectors ?

Does  $\vec{u} = (4, 2, 1)$  belong to the  $\text{Span} \{ (2, -2, -4), (-6, 8, 12), (-2, 4, 4) \}$ ?

Does  $\vec{v} = (-2, -2, 4)$  belong to the  $\text{Span} \{ (2, -2, -4), (-6, 8, 12), (-2, 4, 4) \}$ ?

This is identical to the question : Can  $\vec{u}$  (or  $\vec{v}$ ) be written as a L.C. of the vectors in the set ?

(2) Find  $\text{Span}$  {group of vectors} or  $\text{Col (A)}$ :

( a )  $\text{Span} \{ (0, 0, 0) \}$     ( b )  $\text{Span} \{ (2, 1, -3) \}$     ( c )  $\text{Span} \{ (2, 1, -3), (-4, -2, 6) \}$

( d )  $\text{Span} \{ (2, 1, -3), (1, 0, -2) \}$     ( e )  $\text{Span} \{ (1, 0, 0), (0, 1, 0), (0, 0, 1) \}$

( f )  $\text{Span} \{ (4, 5, -8), (2, -1, 4), (-1, 0, 7) \}$

( g )  $\text{Span} \{ (1, 1, -2), (1, 0, 1), (1, 5, -14), (-4, -3, 5) \}$

( h )  $\text{Span} \{ (3, 1, 4), (2, -3, 5), (5, -2, 9), (1, 4, -1) \}$

( i )  $\text{Span} \{ (0, 0) \}$     ( j )  $\text{Span} \{ (1, -3) \}$     ( k )  $\text{Span} \{ (1, 2), (3, 4) \}$

Answers:

(1)  $\vec{u} \notin \text{Span} \{ 3 \text{ given vectors} \}$  ,  $\vec{v} \in \text{Span} \{ 3 \text{ given vectors} \}$

(2) ( a )  $\vec{0}_v$     ( b ) the line  $(x, y, z) = t(2, 1, -3)$     ( c ) see ( b )    ( d ) plane :  $2x - y + z = 0$

( e )  $\mathbb{R}^3$     ( f )  $\mathbb{R}^3$     ( g ) plane :  $x - 3y - z = 0$     ( h ) plane :  $17x - 7y - 11z = 0$

( i )  $\vec{0}_v$     ( j ) the line  $(x, y) = t(1, -3)$     ( k )  $\mathbb{R}^2$