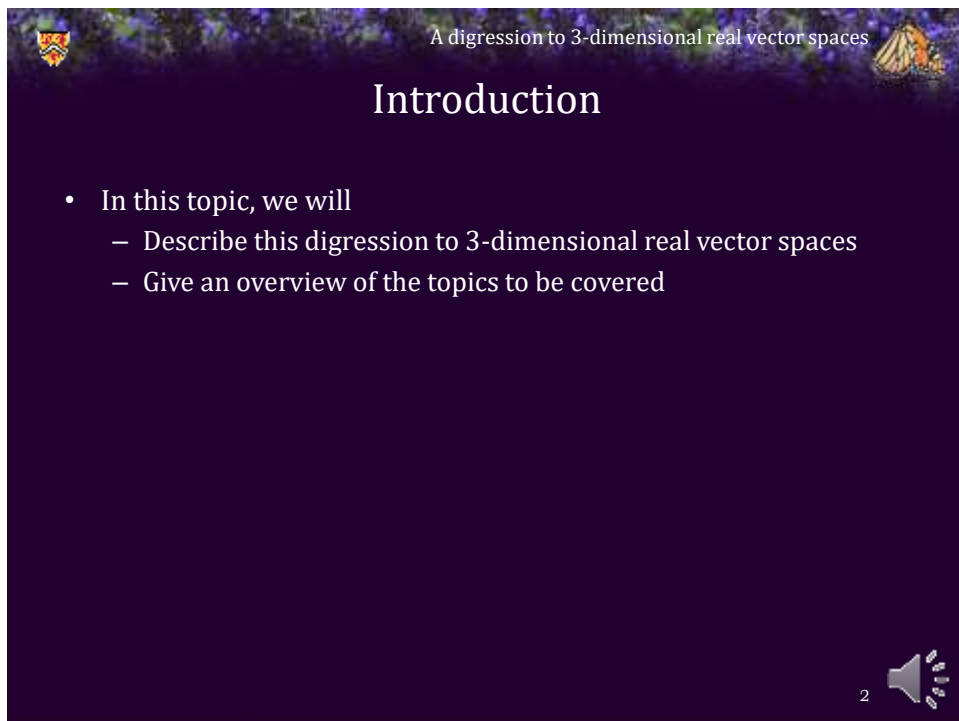




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A digression to 3-dimensional real vector spaces

$\mathbf{R}^3$

- This course is about generalized vector spaces
 - Humans, however, have a particular interest in $\mathbf{R}^3$
 - We will focus on lines and planes
 - Common applications include:
 - Navigation
 - Video games
 - 3D printing
 - Architecture
 - $\mathbf{R}^3$ may be referred to as 3D space or just 3-space

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A digression to 3-dimensional real vector spaces

Looking ahead

- We will look at:
 - The vector representation of a line
 - Finding a line through two points
 - The vector representation of a plane
 - The equation of a plane
 - The cross product
 - The equation of a line
 - The plane containing three points

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A digression to 3-dimensional real vector spaces

Discussion

- We call this a *diversion*, as it contains some ideas not really applicable to general linear algebra
 - For example, it introduces the cross product
 - This is an algorithm for finding a third vector orthogonal to two given vectors
 - This is only possible in $\mathbf{R}^3$

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A digression to 3-dimensional real vector spaces

A quick review

- In this chapter, it's useful to recall that the canonical basis, while usually represented as $\hat{\mathbf{e}}_1, \dots, \hat{\mathbf{e}}_n$, will be represented by

$$\hat{\mathbf{i}} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \quad \hat{\mathbf{j}} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \quad \hat{\mathbf{k}} = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$
 - Thus, for example, $3\hat{\mathbf{i}} + 5\hat{\mathbf{j}} - 2\hat{\mathbf{k}} = \begin{pmatrix} 3 \\ 5 \\ -2 \end{pmatrix}$
 - Recall that the *cap* indicates that these are unit vectors
 - Their 2-norm is one

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A digression to 3-dimensional real vector spaces 

Summary

- Following this topic, you now
 - Understand the topics to be covered in this chapter
 - Know that most of the material focuses entirely on 3-space



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A digression to 3-dimensional real vector spaces 

References

[1] https://en.wikipedia.org/wiki/Three-dimensional_space



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A digression to 3-dimensional real vector spaces

Acknowledgments

None so far.

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A digression to 3-dimensional real vector spaces

Colophon

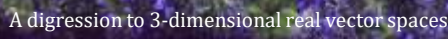
These slides were prepared using the Cambria typeface. Mathematical equations use Times New Roman, and source code is presented using Consolas. Mathematical equations are prepared in MathType by Design Science, Inc. Examples may be formulated and checked using Maple by Maplesoft, Inc.

The photographs of flowers and a monarch butter appearing on the title slide and accenting the top of each other slide were taken at the Royal Botanical Gardens in October of 2017 by Douglas Wilhelm Harder. Please see <https://www.rbg.ca/> for more information.



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