

# Math2310 - Fall '22

## Syllabus - Lecture 02

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### Review

#### 1 Basics of analytic geometry

- notation representing sets using parametric form: for example

$$A = \{(x, y, z) \in \mathbb{R}^3 : (x, y, z) = (1, 0, 0) + \lambda(1, 2, 3), \lambda \in \mathbb{R}\}$$

or the shorter version

$$A = \{(1, 0, 0) + \lambda(1, 2, 3) \in \mathbb{R}^3, \lambda \in \mathbb{R}\}$$

or even shorter

$$A = \{(1, 0, 0) + \lambda(1, 2, 3), \lambda \in \mathbb{R}\}$$

- The parametric equation of a line
  - in  $\mathbb{R}^2$  or  $\mathbb{R}^3$  passing through a point  $\vec{p}$  and in direction  $\vec{u}$ :

$$L = \{\vec{v} \in \mathbb{R}^2 : \vec{v} = \vec{p} + \lambda\vec{u}, \lambda \in \mathbb{R}\}$$

- in  $\mathbb{R}^2$  or  $\mathbb{R}^3$  passing through a point  $\vec{p}$  and a point  $\vec{q}$ :

$$L = \{\vec{v} \in \mathbb{R}^2 : \vec{v} = \vec{p} + \lambda(\vec{p} - \vec{q}), \lambda \in \mathbb{R}\}$$

- Parametric equations of a segment or of a ray: restrict the values of  $\lambda$ !
- Checking whether a point belongs to a set:
  - described in equation form: check whether the equation is satisfied.
  - described in parametric form: solve for the parameter.

### Topics

#### 1 Basics of analytic geometry [i]

##### 1.1 Planes in $\mathbb{R}^3$

- parametric representation
  - through 3 points

- through a point and containing two directions
- equation representation [1]

## 1.2 Lines in $\mathbb{R}^2$

- equation representation [1]

## 2 The dot product [2,3]

- Algebraic expression and properties.
- Geometric expression.
- defn length/norm/magnitude
- defn the word *orthogonal*.

## References

### Textbook

- [Ste] Chap 12.3 The Dot Product pp847 - 854
- [Ste] Chap 12.5 Equations of Lines and Planes pp864 - 870

### Videos

1. Equations of Lines and Planes | Multivariable Calculus #6 - YouTube
2. Vector dot product and vector length | Vectors and spaces | Linear Algebra | Khan Academy - YouTube
3. Angle between vectors leads to defining the Dot Product | Multivariable Calculus - YouTube
4. Physics - Test Your Knowledge: Vectors (9 of 30) Find the Sum, Difference, Dot and Cross Product - YouTube

## Additional material

### Videos

- i. Multivariable Calculus Unit 1 Lecture 16: More examples with lines and planes - YouTube

### Geogebra applets

- Dot Product Insight – GeoGebra
- 3. The Dot Product and Projections – GeoGebra
- 12.3 Dot Product – GeoGebra