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**Slide 1**

ECE 204 *Numerical methods*

# Using interpolating polynomials

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**Slide 2**

## Introduction

- In this topic, we will
  - Describe the assumptions that will be made in the next three sub-topics
  - Explain how we are assuming negligible error
  - Look at what information we are trying to extract from these readings

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**Slide 3**

## Representing a polynomial

- Recall that we have pointed out that sensors are generally sampled periodically
  - The next three topics will attempt to:
    - Evaluate an interpolating polynomial at a point close to $x_k$
    - Estimate the derivative at the point $x_k$
    - Estimate an integral from some point $x_{k-n}$ up to $x_k$
  - We will assume negligible error in the readings or values of $f(x_k)$

$f(x_{k-2})$ $f(x_{k-1})$ $f(x_k)$ $f(x_{k+1})$ $f(x_{k+2})$

$x_{k-2}$ $x_{k-1}$ $x_k$ $x_{k+1}$ $x_{k+2}$

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**Slide 4**

## Representing a polynomial

- In each case, we will assume that the $x_k$ values are equally spaced, so in general

$$x_k = x_0 + kh$$

  - Also, it follows, therefore, that:

$$x_{k-1} = x_k - h$$
$$x_{k+1} = x_k + h$$

$f(x_{k-2})$ $f(x_{k-1})$ $f(x_k)$ $f(x_{k+1})$ $f(x_{k+2})$

$x_{k-2}$ $x_{k-1}$ $x_k$ $x_{k+1}$ $x_{k+2}$

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**Slide 5**

## Looking ahead

- Once we have examined these approaches, we will proceed to look at techniques that can be used when there are significant errors in the readings
  - These errors may be due to difficulty in making readings or limitations on the sensors in question
  - For example, GPS is only so accurate to approximately 4 m

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**Slide 6**

## Summary

- Following this topic, you now
  - Understand that in the next three sub-topics, we will use interpolating polynomials
  - Understand that the errors in the sampled values are assumed to be negligible
  - Know that in the following topic, we will look at solutions that don't necessarily assume negligible error

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## References

[1]     https://en.wikipedia.org/wiki/Polynomial_interpolation

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## Acknowledgments

None so far.

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## 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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