UNIVERSITY OF WATERLOO
FACULTY OF ENGINEERING
Department of Electrical & Computer Engineering
ECE 204 Numerical methods
Approximating the solution to a system of linear algebraic equations
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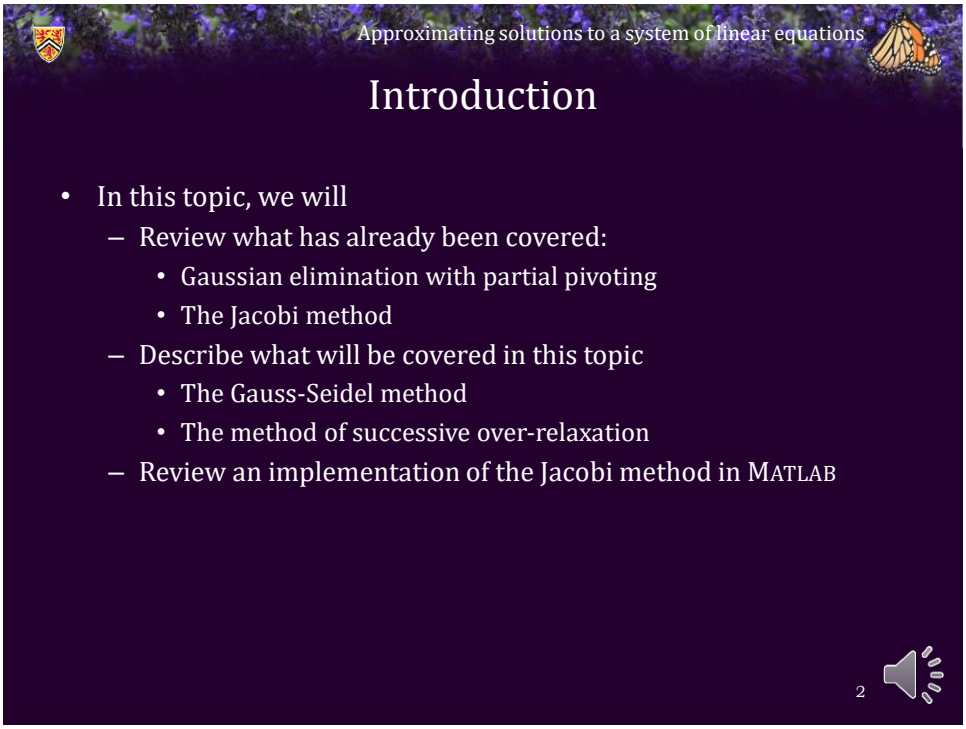
Approximating solutions to a system of linear equations
Introduction
• In this topic, we will
– Review what has already been covered:
• Gaussian elimination with partial pivoting
• The Jacobi method
– Describe what will be covered in this topic
• The Gauss-Seidel method
• The method of successive over-relaxation
– Review an implementation of the Jacobi method in MATLAB
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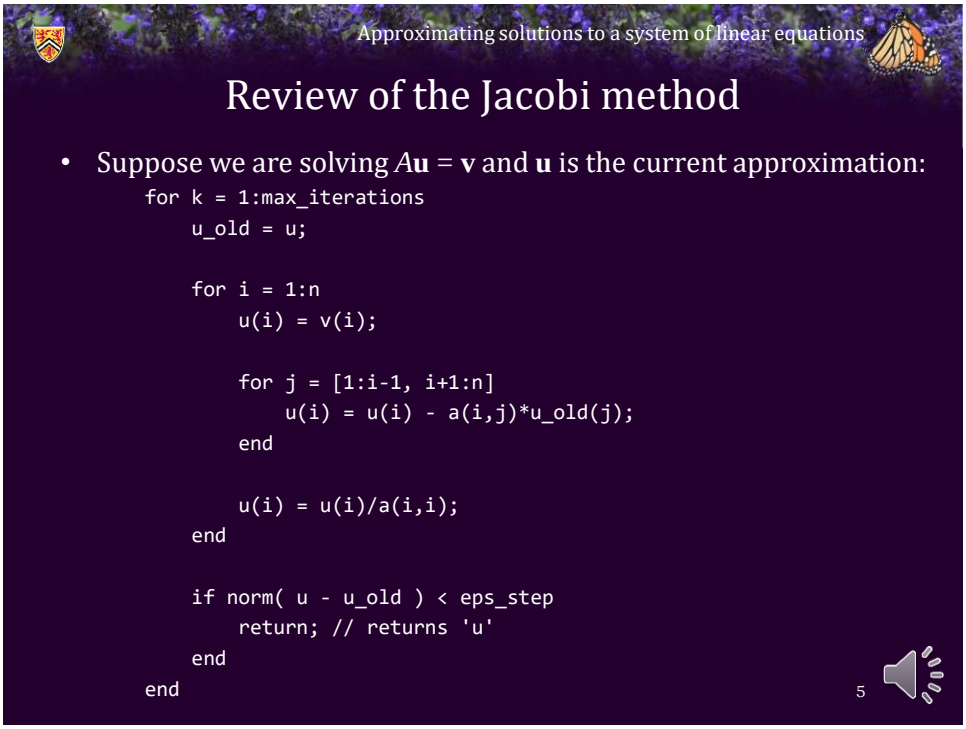
Looking back

- We have seen how we can use Gaussian elimination with partial pivoting together with backward substitution to approximate the solution to a system of linear equations
  - We say approximate because we are using double-precision floating-point numbers
- We have also seen the iterative Jacobi method
  - This is useful only for strictly diagonally dominant matrices
    - The absolute value of each diagonal entry is greater than the sum of the absolute values of all other entries in that row

Looking ahead

- We will look at two additional techniques:
  - The Gauss-Seidel method
    - A slight modification of the Jacobi method
  - The method of successive over-relaxation
    - The idea of pushing ahead in the same direction we're already going


Approximating solutions to a system of linear equations
Review of the Jacobi method
• Suppose we are solving A**u** = **v** and **u** is the current approximation:
for k = 1:max_iterations
u_old = u;
for i = 1:n
u(i) = v(i);
for j = [1:i-1, i+1:n]
u(i) = u(i) - a(i,j)*u_old(j);
end
u(i) = u(i)/a(i,i);
end
if norm(u - u_old) < eps_step
return; // returns 'u'
end
end
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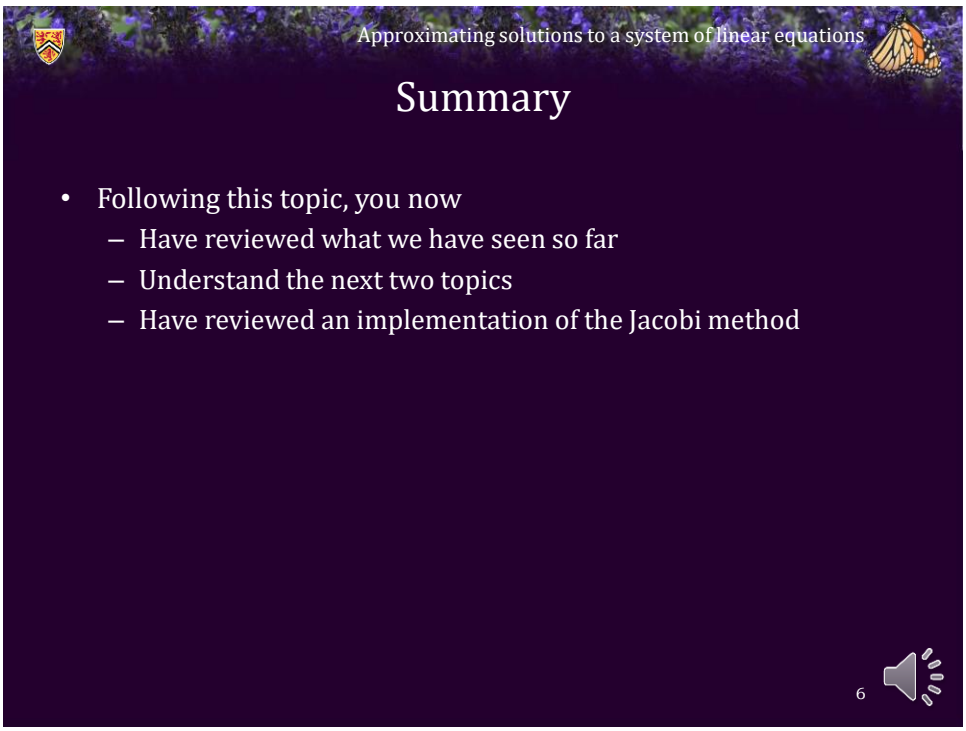
Approximating solutions to a system of linear equations
Summary
• Following this topic, you now
– Have reviewed what we have seen so far
– Understand the next two topics
– Have reviewed an implementation of the Jacobi method
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References

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

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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

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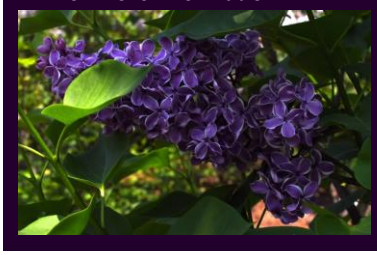

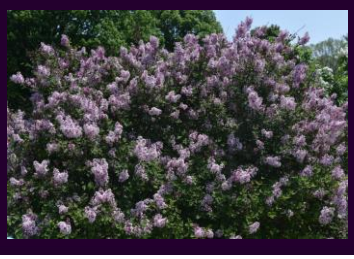

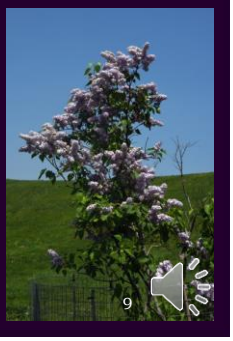

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