# COMP 540 **MATRIX COMPUTATIONS** (Fall 2016)

**Course Objectives:**
To provide students with a strong knowledge and understanding of the important algorithms in numerical matrix computations, as well as the difficulties involved in practical implementation and use of these algorithms. The course also gives students an increased understanding of the basic problems in the area, together with the sensitivity of these problems.

**Prerequisites**:
Facility with a high level scientific programming language or MATLAB, and a good introductory matrix theory course. Previous experience of numerical computations is also important, such as COMP 350 or MATH 317.

**Detailed Description:**

Norms and floating-point arithmetic.
Cholesky factorization and symmetric positive definite linear systems of equations.
LU factorization and general linear systems of equations.
Sensitivity of problems and numerical stability of algorithms.
Blocking algorithms for higher performance.
QR factorization and linear least squares problems.
Singular value decomposition and generalized inverses.
Theory of matrix eigenvalue problems.
QR algorithm and the inverse power method for eigenvalue problems.
The Lanczos algorithm for large sparse symmetric eigenvalue problems.
Conjugate-gradient method for large sparse linear systems of equations.

**References, in approximate order of increasing difficulty & sophistication:**


D. Watkins, *Fundamentals of Matrix Computations*, 3rd Edn., John Wiley, 2010.
L. N. Trefethen & D. Bau, III, *Numerical Linear Algebra*, SIAM, 1997.
J. W. Demmel, *Applied Numerical Linear Algebra*, SIAM, 1997.
Å. Björck, *Numerical Methods in Matrix Computations*, Springer, 2015.
G. H. Golub & C. F. Van Loan, *Matrix Computations*, 4th Edn., The Johns Hopkins University Press, Baltimore, 2013.


We mainly use our lecture notes, which are available from McGill's myCourses.

**Assessment**:

Class participation (10%)
6 assignments, which can be downloaded from myCourses (30%)
In-class midterm test (25%, Monday, October 17)
In-department final exam (35%, TBA)

**Integrity**:
*All graded work must represent your own efforts only.* McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/integrity for more information).

**Right to submit in English or French written work that is to be graded:**
In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

**Class Time & Place:** MW 9:35am-10:55am, McConnell Engineering Building 103

**Course Web Page:** http://www.cs.mcgill.ca/∼chang/cs540/540.html

**Instructor:** Prof. Xiao-Wen Chang

**Office:** McConnell Eng. Bldg., Room 302

**Office Hours:** Monday 2:40pm to 4:00pm

**Phone:** 398-8259, **Email:** chang@cs.mcgill.ca

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**TA**: Xinye Lin

**Office:** Scientific Computing Lab, McConnell Eng. Bldg., Room 229

**Office Hours:** Wednesday 3:30pm to 5:00pm