

# COMP 760, Fall 2024

Session: Fall 2024	Time: Tuesday, Thursday 16:05-17:25
Room: Room 1265	Web: <a href="http://www.cs.mcgill.ca/~hatami/comp760-F2024">http://www.cs.mcgill.ca/~hatami/comp760-F2024</a>

## Instructor:

Instructor: Hamed Hatami	Email: <a href="mailto:hatami@cs.mcgill.ca">hatami@cs.mcgill.ca</a>
Office: McConnell 308	Phone: 1 (514) 398-7071
Office Hours: Tuesday, Thursday 11:00-12:00. (also by appointment)	

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**Evaluation:** Homeworks (5 homeworks) 75%, Final Project 25%

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## 1 Course Description

We will cover the following topics.

- Fundamentals of discrete Fourier analysis: Throughout the course, we will present basic tools and results in the area, such as the hypercontractive inequality, the KKL theorem, Junta theorems by Friedgut and Bourgain, sharp thresholds and the invariance principle.
- We will discuss several applications of Fourier analysis in areas such as property testing and theoretical machine learning.
- Applications of Fourier Analysis in Hardness of Approximation. We will discuss a prominent outstanding conjecture in theoretical computer science known as the Unique-Games Conjecture. We will use some basic results from Fourier analysis to show several consequences of this conjecture, such as the (conditional) optimality of the Goemans-Williamson algorithm for Max-Cut.
- Applications of Fourier analysis in Extremal Combinatorics, particularly in understanding set systems and some problems in additive number theory.
- Towards the end of the course, we will discuss more advanced topics, which are advances in the area that have only recently been achieved. These include the resolution of the sensitivity conjecture, an extension of the hyper-contractive inequality referred to in the literature as “global hypercontractivity.”

## 2 Assignments

There will be 5 assignments each worth 15% towards your overall grade.

### **3 Academic Integrity**

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offenses under the Code of Student Conduct and Disciplinary Procedures (see <http://www.mcgill.ca/integrity> for more information). Most importantly, work submitted for this course must represent your own efforts. Copying assignments or tests from any source, completely or partially, allowing others to copy your work, will not be tolerated.

### **4 Submission of written work in French**

In accord [sic] 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.