



**Dept. of Mathematics & Computer Science & Machine Learning Institute
St. John's College**

MATHEMATICS COLLOQUIUM MINISERIES

**Jon Lenchner, IBM T.J. Watson Research Center,
Yorktown Heights, NY**

Title:

**An Introduction to Computational Complexity via Finite
Model Theory and Games.**

**Wednesdays, February 3-24, 2024
5:00-6:00 PM**

Location: <https://sju.webex.com/meet/grabarnng>

Abstract: In this mini course Jon will provide a quick guide to the most common complexity classes, explain the notion of NP-Completeness, and give a few techniques for establishing NP-Completeness. He will then provide a brief tour of finite model theory and describe a way to attack the famous $P=NP$ question via some fun-to-play games.

Class 1: Turing machines, the complexity classes P and NP , deterministic vs. non-deterministic Turing machines, NP-Completeness, Cook's Theorem

Class 2: Examples of NP-Complete problems, sample NP-Completeness reductions, number problems

Class 3: The class $coNP$, an approach to trying to prove that $P \neq NP$: Games as a vehicle for separating complexity classes, Ehrenfeucht Fraisse games and inexpressibility in 1st order logic

Class 4: Fagin's Theorem, existential 2nd order logic, monadic NP , more sophisticated games: Fagin, Ajtai-Fagin and multi-structural games with examples.

About the speaker: Jon has been with IBM for 24 years, the last 20 of which have been spent in research. Some of Jon's career highlights include working on the Watson Jeopardy-playing system, building a system for the professional basketball team, the Toronto Raptors, to help them with trades and draft picks, and building two different robots. Copies of one of the robots were deployed to IBM's commercial data centers around the globe. From 2016-2018 Jon served as the Chief Scientist of IBM's two research labs in Africa. Jon is currently trying to use combinatorial games to characterize complexity classes and make progress on the famous P vs. NP problem.