# MATH 480/818 2026-2027
# Spinors as a Unifying Language for Qubits, Geometry, and Physics T2


## Instructor:

Dr. Jacek Szmigielski
szmigiel@math.usask.ca


## Course Details

MATH 480 CRN 32907
MATH 818 CRN 32908

## Schedule:

Term 2
Times TBD

## Tentative Topics:

Some of the topics covered will include qubits as spinors, the Bloch sphere, one-qubit gates and SU(2), multiple qubits and tensor products, stereographic projection and the geometry of spinors, projective spaces, orthogonal groups and spinors, Clifford algebras, spin in nonrelativistic Quantum Mechanics, relativistic spinors, and the Dirac equation.

## Course Objective:

This course introduces spinors as a single mathematical concept that appears in several seemingly different settings: quantum computing, projective geometry, classical and quantum rotations, Clifford algebras, and relativistic physics. Rather than treating quantum computing, mathematics, and physics as separate blocks, the course follows a single central object across its different realizations

## Students Who May Be Interested:

Undergraduate students in Mathematics, Mathematical Physics, Computer Science, and Theoretical Physics
Graduate students in Mathematics and Theoretical Physics

## Other Information:

Guiding Theme: The course is organized around the following principle:
A spinor is one object with several languages: quantum, geometric, algebraic, and physical.
In quantum computing, a spinor appears as a qubit. In geometry, it appears through projective space and the Bloch sphere. In group theory, it appears through the double cover $SU(2) \Rightarrow SO(3)$
In algebra, it appears as a representation of a Clifford algebra. In physics, it appears through spin-1/2 Stern--Gerlach experiment, and eventually the Dirac equation.

Prerequisites: Students should have a solid background in linear algebra over **R** and **C**. They should be comfortable with eigenvalues, Hermitian matrices, unitary matrices, tensor products, and basic group theory. Some prior exposure to quantum mechanics, representation theory, or differential geometry would be useful, but is not required.