DIFFERENTIAL GEOMETRY

MATH 136

Unit 0: Syllabus

Administrative

```
Instructor: Oliver Knill, Office SC 432
Course assistants: Zak Adams (zakadams),
Jayanti Leslie-Iyer  (jleslieiyer), Eric Sui (ericsui)
Luke Zhu  (lukezhu) and Hugo Nunez (hugonunez).
Class hours:    TuTh 12-1
Office hours Oliver:  MWF, 11-12
Weakly homework, individually hand written. Submitted on Canvas
Midterm inclass quiz, and midterm paper on a topic of the course.
Final inclass quiz and final project paper.
Grades: HW 50 percent, midterm 20, final 30
Reading suggestions: Kuehnel and DoCarmo
```

Synopsis

1.1. This is an introduction to Riemannian geometry and in particular to Riemannian geometry of curves and surfaces. We also develop less technical discrete differential geometry. Low dimensional Riemannian geometry is an active area of mathematics with many open problems and applications, especially in computer science and computer graphics. It is not only the language of gravity, it is an inspiration for art and architecture The subject features many unsolved problems.

Policies

1.2. The landscape of teaching changes rapidly. Generative AI's are already strong. Autonomous thinking, problem solving skills and creativity become more important. Those who rely on AI for thinking are the first to be replaced: using it only requires minimal abilities:a monkey can submit a PDF and submit the result.

```
No AI for homework or exams
Computer algebra systems can be used, if acknowledged
Handwritten work for home and inclass work
Final paper should be typed
Class attendance is necessary
Collaboration for Psets is ok
But each submit individual work
```

Lectures

1.3. The goal is to reach 4 mountain peaks: Frenet-Serret theorem, Gauss-Bonnet theorem, Theorema egregium, Riemannian manifold setup, Einstein equations.

W1	1	Tuesday	September 2th:	What is differential geometry? Notations.
	2	Thursday	September 4:	Parametrized and implicit surfaces.
W2	3	Tuesday	September 9:	Jacobean map, Surface area
	4	Thursday	September 11:	Parametrization of Curves, Arc length, Curvature
W3	5	Tuesday	September 16:	The Frenet theorem in two and 3 dimensions
	6	Thursday	September 18:	The Frenet theorem in arbitrary dimensions
W4	7	Tuesday	September 23:	A global result: The Hopf Umlaufsatz
	8	Thursday	September 25:	A global result: The four vertex theorem
W5	9	Tuesday	September 30:	The fundamental forms I,II,III
	10	Thursday	October 2:	The Gauss Map A and Curvature K
W6	11	Tuesday	October 7:	Euler characteristics
	12	Thursday	October 9:	Discrete Differential geometry
W7	13	Tuesday	October 14:	Review for midterm
	14	Thursday	October 16:	Inclass part Midterm
W8	15	Tuesday	October 21:	Calculus of variations and Geodesics
	16	Thursday	October 23:	Exponential map and geodesic coordinates
W9	17	Tuesday	October 28:	Differential forms and Green's Theorem
	18	Wedneday	October 30:	The Theorema Egregium
W10	19	Tuesday	November 4:	Local Gauss Bonnet theorem
	20	Thursday	November 6:	Global Gauss Bonnet theorem
W11	21	Tuesday	November 11:	Riemannian manifolds
	22	Thursday	November 13:	Discrete manifolds
W12	23	Tuesday	November 18:	The curvature and Ricci tensors
	24	Thursday	Novemer 20:	General relativity
W13	25	Tuesday	November 25:	
		November 27 until December 1th		Thanksgiving
W14	26	Tuesday	December 2:	Final review
	27	Thursday	December 4:	In class part final