Fall 2019 Math 61CM: Modern Mathematics: Continuous Methods

The following is a rough and tentative schedule of the course. The schedule is very likely to change as we go along. Please come back to check it regularly.

The general structure of the course is as follows. Lectures will be held on Monday through Thursday, and a TA session will be held on Friday (except for 10/18 and 10/21). During the first six weeks, half of the week will consist of analysis lectures and the other half will consist of linear algebra lectures. The linear algebra lectures will be held together with 61DM (still in the same classroom), and the lectures will be given by both Professor Jan Vondrak and I.

The section numbers refer to the corresponding sections in the textbook (L. Simon, An Introduction to Multivariable Mathematics). We will cover Chapters 1-3 and the Appendix (with various handouts).

“HO” denotes that the material can be found on a posted handout.
“JV” denotes that the lecture will be given by Professor Jan Vondrak.

• Week 1:
  - 9/23: The real numbers: fields, ordered sets, completeness (§A.1)
  - 9/24: Sequences, limits and Bolzano–Weierstrass (§A.2)
  - 9/25: Linear algebra: Fields, vector spaces (§1.1, JV)
  - 9/26: Linear algebra: Vector spaces, subspaces, inner products, linear dependence (§1.2, 1.3, JV)

• Week 2:
  - 9/30: Continuity (§A.3)
  - 10/1: Open and closed sets, limits, continuity in $\mathbb{R}^n$ (§2.1, 2.2)
  - 10/2: Linear algebra: Gaussian elimination (§1.4)
  - 10/3: Linear algebra: Bases (§1.5)

• Week 3:
  - 10/7: Linear algebra: linear maps, matrices (§1.6, 3.6, JV)
  - 10/8: Linear algebra: rank-nullity (§1.7, JV)
  - 10/9: Metric spaces (HO)
  - 10/10: More on metric spaces (HO) Series (§A.4)

• Week 4:
  - 10/14: Series (§A.4)
- 10/15: Series: rearrangement (HO)
- 10/16: Linear algebra: Inner products, orthocomplements (§1.8)
- 10/17: Linear algebra: Inhomogeneous systems (§1.9, 1.10)
- 10/18: Power series (§A.5)

**Week 5:**
- 10/21: Meet with TA
- 10/22: Differentiability on $\mathbb{R}^n$ (§2.3)
- 10/23: Linear algebra: Permutations, multilinear maps (§3.1, JV)
- 10/24: Linear algebra: Determinants (§3.2, JV)

**Week 6:**
- 10/28: Directional derivatives, partial derivatives (§2.4)
- 10/29: Chain rule (§2.5)
- 10/30: Linear algebra: Inverses (§3.3, 3.4)
- 10/31: Linear algebra: Gram–Schmidt, Orthonormal basis (§3.5)

**Week 7:**
- 11/4: Linear algebra: Spectral theorem (§3.7)
- 11/5: Chain rule (HO)
- 11/5: Hessian test (§2.6)
- 11/6: Higher derivatives (§2.7)

**Week 8:**
- 11/11: Integration (HO)
- 11/12: Fundamental theorem of calculus (HO)
- 11/13: Integration on $\mathbb{R}^n$ (HO)
- 11/14: Integration on $\mathbb{R}^n$ (HO)

**Week 9:**
- 11/18: Taylor series in $\mathbb{R}$ (§A.7)
- 11/19: Taylor series in $\mathbb{R}^n$ (HO)
- 11/20: Trigonometric series (§A.9)
- 11/21: Curves in $\mathbb{R}^n$ (§2.8)

**Thanksgiving**

**Week 10:**
- 12/2: Submanifolds in $\mathbb{R}^n$ (§2.9)
- 12/3: Submanifolds in $\mathbb{R}^n$, Lagrange multipliers (§2.9)
- 12/4: Finishing
- 12/5: Finishing