# Bruno Benedetti

# Syllabus for the Topics Course ``Polytopes'', Fall 2016

**Textbook**: G. M. Ziegler, *Lectures on Polytopes*, Springer.

**Content**: The course is based on chapters 0, 1, 2, 3, 4, 8, which I will integrate with material from recent papers. Tentative topics (and possible extra arguments for seminars) include:

- Definitions and examples; equivalence of vertex and facet description (without proof).
- Operations: Pyramids, Prisms, products, Minkowski sum , Connected Sum [p. 274].
  *Extras: Proof of equivalence theorem. Face vectors of cyclic polytopes are unimodal.*
- Caratheodory's theorem [1.6]. Radon's theorem [page 184].
  *Extra: Tverberg's theorem.*
- Polarity [Chapter 2].
- Polytope graphs; The Hirsch conjecture [3.3].
  *Extras: Recent topics on Hirsch conjecture [2-3 seminar arguments available].*
- Balinski's theorem [3.5]; Steinitz' theorem [4.1]; Fary's theorem [p.120]
  *Extras: Graphs of simple polytopes; Menger's theorem and Max-Flow-Min-Cut; Embeddability of Simplicial Complexes.*
- Shellability [8.1 and 8.2].
  *Extras: Unshellable spheres.*
- h-vectors. Morse-theoretic interpretation and Dehn-Sommerville's relations.
- Upper bound theorem, g-theorem, and g-conjecture [8.4, 8.5].

**Grading policy**: Attendance and interactive participation will play a key role. Students will have to present two seminars throughout the course. The presentation can be either at the whiteboard, or using an overhead projector; be aware that I will interrupt with questions and objections. The presentations are integrating part of the course, so the other students should attend too. There will be no final.

**General rules**: We will start from the basics; knowing topology helps, but all our polytopes will be subset $R^n$, which is the most natural of all topological spaces. Questions, discussions , objections are always welcome. Cell phones are allowed, but must be put on silent mode. Same for pets.

**Office hours:** In Ungar 533 I will have office hours on Wednesday, from 10:30 to 12:30; but for this course I will keep an open door policy. So if you have questions, just come by!

Bruno Benedetti
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