

# TORIC VARIETY

ABSTRACT. In this seminar, we are trying to learn the basic theories of toric variety, and some selected topics. The main reference is [CLS11].

## 0. SCHEDULE

### 0.1. Lecture 1: Preliminaries (Bowen Liu 09/23).

- Affine semigroups;
- Strongly convex rational polyhedral cone;
- Affine toric variety.

### 0.2. Lecture 2: Projective toric variety (Chenchen Zuo 10/07).

- Lattice points and projective toric varieties;
- Polytopes and projective toric varieties;
- Properties of projective toric varieties.

### 0.3. Lecture 3: Fans and toric varieties, orbit-cone correspondence (Qiliang Luo 10/15).

- Construction of toric varieties from fans;
- Examples of toric varieties.
- Orbit-Cone correspondence.

### 0.4. Lecture 4: Toric morphism (Shengyu Hou 10/21).

- Category of fans and categories of (normal) toric varieties.
- Examples.

### 0.5. Lecture 5: Divisors on toric varieties (Bowen Liu 10/28).

- Review of basic theory of divisors;
- Weil divisors on toric varieties;
- The sheaf of a torus-invariant divisor;

### 0.6. Lecture 6: Canonical divisors of toric varieties (Bowen Liu 11/11).

- Review of basic theory of Kähler differentials;
- Useful exact sequences of 1-forms on toric varieties;
- The canonical sheaf of toric varieties.

### 0.7. Lecture 7: Sheaf cohomology of toric varieties (Bowen Liu 11/18).

- Cohomology of toric divisors;
- Vanishing theorems.

- 0.8. **Lecture 8: Line bundles on toric varieties I** (Shengyu Hou 11/26).
- Base point freeness;
  - Very ampleness.
- 0.9. **Lecture 9: Line bundles on toric varieties II** (Shengyu Hou 12/16).
- Intersection products on toric varieties;
  - Nef cone and Mori cone.
- 0.10. **Lecture 10: Intersection theory on toric varieties** (Chenchen Zuo 12/30).
- To be determined.
- 0.11. **Lecture 11: GIT structure of toric varieties** (Shengyu Hou).
- Review of projective GIT;
  - GIT structure of toric varieties;
  - Examples;
  - Homogeneous coordinate on toric varieties;
  - Coherent sheaves on toric varieties.

## REFERENCES

- [CLS11] David A. Cox, John B. Little, and Henry K. Schenck. *Toric varieties*, volume 124 of *Graduate Studies in Mathematics*. American Mathematical Society, Providence, RI, 2011.