

# Higher dimensional algebraic geometry

## **1 The minimal program for surfaces (27.10)**

- birational transformations for surfaces
- Castelnuovo's Theorem
- every surface admits a relatively minimal model

We follow [3].

## **2 Curves and divisors on algebraic varieties (03.11)**

- the cone of curves
- criteria for ampleness

## **3 Rational curves (10.11)**

- exceptional locus of a morphism
- rational curves on exceptional loci
- parametrizing rational curves

[27-38] from [2].

## **4 Parametrizing morphisms(17.11)**

- parametrizing morphisms
- parametrizing morphisms with extra structures
- producing rational curves

[39-59] from [2].

## **5 Bend and break I (24.11)**

- rational curves on Fano's
- a stronger bend-and-break
- rational curves on varieties whose canonical divisor is not nef
- a relative bend-and break

[60-73] from [2].

## **6 Bend and break II (1.12)**

- images of varieties with nef or ample canonical divisor
- the albanese map of varieties with nef anticanonical divisor
- another relative bend-and-break

[73-83] from [2].

## **7 Uniruled and Rationally connected varieties (08.12)**

## **8 Quotients by algebraic relations(15.12)**

- quotients by flat algebraic relations
- quotients by proper algebraic relations
- construction of a rational quotient

[113-129] from [2].

## **9 Fano varieties (05.01)**

- rational connectedness
- bounds on the degree
- singular Fano's

[130-141] from [2].

## **10 The cone of curves (12.01)**

- the cone theorem
- examples

[143-164] from [2].

## **11 Canonical models(18.01)**

- canonical models
- singularities
- Kawamata-Vieweg vanishing

[179-184] from [2].

## **12 The base-point-free Theorem (26.01)**

- singularities of pairs
- multiplier ideal of an effective  $\mathbb{Q}$  divisor
- non vanishing theorem
- the base-point-free theorem

[184-197] from [2].

## **13 The cone theorem and the contraction theorem (02.02)**

- the rationality theorem
- the cone theorem
- the contraction theorem
- flips

## **14 Examples of flips by toric deformations (09.02)**

an overview of [1].

## References

- [1] K. Altmann, One parameter families containing three dimensional toric Gorenstien singularities, Explicit birational geometry of 3-folds, 2150, London Math. Soc. Lecture Note Ser., 281, Cambridge Univ. Press, Cambridge, 2000.
- [2] O. Debarre, Higher Dimensional Algebraic Geometry, Universitext. Springer-Verlag, New York, 2001.
- [3] R. Hartshorne, Algebraic geometry. Graduate Texts in Mathematics, No. 52. Springer-Verlag, New York-Heidelberg, 1977.