Valuations and their appilcations to birational geometry and resolution of singularities.

Abstract. In the first lecture we will define valuations and give examples, with emphasis on valuations centered on the plane, that is, valuations of the field $k(u, v)$. We will proceed to study valuation rings and their various characterizations, particularly, the fact that valuation rings are maximal among the local domains with the given field of fractions with respect to the relation of birational domination. We will define the notion of a valuation centered at a point of an algebraic variety. We will state and prove Zariski's theorem which says that the set of valuations centered at points of a given algebraic variet X is in a natural onie-to-one correspondence with the the projective limit of the projective system consisting of all the birational projective morphisms $\pi_\alpha : X_\alpha \to X$.

We will discuss the problem of Resolution of Singularities and its local version, the Local Uniformization Theorem which asserts the existence of a birational projective morphism π_α as above such that the center of a given valuation ν on X_α is non-singular.

Finally, we will cover the recent theory of key polynomials associated to a simple extension of valued fields, which provides a useful and important tool for studying the Local Uniformization Theorem.