

**Speaker:** Guillermo Badia

**Title:** Containment of Conjunctive Queries with Equations and Disequations for Databases over Semirings (joint work with Carles Noguera, Gaia Petreni, and Val Tannen)

**Abstract:** For two queries  $P$  and  $Q$ , the containment problem asks whether (in all databases) the answers of  $P$  are contained in those of  $Q$ . Conjunctive queries (CQ) are first-order formulas with a string of existential quantifiers at the front followed by a quantifier-free matrix where the only connective used is conjunction. CQs with equations and disequations further allow the presence of formulas of the form  $x = y$  and  $\neg(x = y)$  in the quantifier free matrix. This talk looks at the problem of containment for CQs with equations and disequations over databases with relations annotated with elements of a commutative semiring. The latter kind of databases has received a considerable level of attention in the last two decades. Containment for CQs were studied in a 2011 paper by TJ Green. We use some ideas from that paper, together with known results for CQs with equations and disequations over regular databases, to establish complexity bounds for the containment problem of CQs with equations and disequations for distributive lattices, lineage, why-provenance, and provenance polynomial annotations, among others. For example, this problem over the semiring of natural numbers is undecidable (Jayram, Kolaitis & Vee 2006) but we show it is in the second level of the polynomial hierarchy for the case of provenance polynomial annotations (i.e. the semiring of polynomials over the natural numbers).