

# Exam - 2

CS5580

13-Mar-2019 (8:25pm-9:25pm)

**Note:** Please answer the questions using rigorous and succinct mathematical justifications. Simplify expressions as much as possible. In all the following problems,  $f$ , is a function over the space of symmetric matrices with  $f(A)$  defined as the maximum eigenvalue of  $A$ .

**Problem 1.** Is  $f$  a norm?

**Problem 2.** Is  $f$  a support function? If yes, then find (a simplified expression for) the set for which  $f$  is the support function. Else, prove that there cannot exist such a set.

**Problem 3.** Find (a simplified expression for) the dual function of  $f$  (dual is defined in the space of symmetric matrices).

**Problem 4.** Prove or disprove the statement: “If  $g$  is a closed conic function, then  $g(\lambda x) = \lambda g(x) \forall \lambda \geq 0, x \in \text{dom}(g)$ ”.

**Problem 5.** Show that a polyhedral cone’s dual cone will have finite dual description. Likewise, show that the dual cone of a cone with finite dual description will be a polyhedral cone.