Assignment 1

CSE 5239 (Rountev)

Due: Sept 12 (Friday) by 2:20 pm

1. (10 pts) Consider a control-flow graph G with an entry node $ENTRY$ (a node without predecessors). Assume that every other node in G is reachable from $ENTRY$. Consider an arbitrary node $n \neq ENTRY$ and let $DOM(n)$ be the set of nodes m such that (1) $m \neq n$ and (2) m dominates n. (Note that in the paper by Cooper et al. discussed in class, $DOM(n)$ contains n by default, while in this problem we exclude n from $DOM(n)$.)
   - Can $DOM(n)$ be empty? Why?
   - Suppose that G is acyclic. Consider two distinct nodes $p, q \in DOM(n)$. Prove that $p \in DOM(q)$ or $q \in DOM(p)$. (Hint: try a proof by contradiction.)
   - Suppose that G contains cycles. We again want to prove that $p \in DOM(q)$ or $q \in DOM(p)$. Does your proof from the previous bullet still work? If yes, why? If no, generalize your proof.
   - Consider two distinct nodes $p, q \in DOM(n)$. In a general G with cycles, is it possible that $p \in DOM(q)$ and $q \in DOM(p)$? If yes, provide an example. If no, provide a proof.
2. (5 pts) Prove that dominance is a transitive relation.
3. (5 pts) Consider a node $n \neq ENTRY$ and all its predecessor nodes m_i where $i = 1, \ldots, k$ and $k > 0$. Consider any node p distinct from n and distinct from all m_i. Prove that p dominates n if and only if it dominates all m_i.