

OPTIMIZATION ALGORITHMS (550.662)  
Due Friday, February 6, 2009

Problem 1

State all the optimality conditions for

$$\max f(x) \quad \text{s.t. } x \in I.$$

(Hint:  $\max f(x) \iff \min -f(x)$  and  $f$  is concave if  $-f$  is convex.)

Problem 2

Let  $f$  and  $f'$  be continuous on  $I$ . Show that if  $f$  is convex on  $I$ , then

(a)  $(f'(x) - f'(y))(x - y) \geq 0 \quad \forall x, y \in I.$

(b)  $f'$  is monotone increasing; i.e.  $x \geq y \implies f'(x) \geq f'(y).$

Problem 3

Let  $f$ ,  $f'$ ,  $f''$ , and  $f'''$  be continuous on  $I$ . Suppose  $\hat{x} \in I$ ,  $f'(\hat{x}) = 0$ ,  $f''(\hat{x}) = 0$ , and  $f'''(\hat{x}) \neq 0$ . Show that  $\hat{x}$  is *not* a local minimizer.