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CS470: AI

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Part 1

1. **Suppose *f*(*x*) = − 3(*x* − 2)2. At what value of *x* does *f*(*x*) take its maximum value?**

Derivative = -6(x-2) \* (1)  
0 = -6(x-2)  
0 = x – 2  
**2 = x**

1. **Suppose that we use gradient ascent (from page 131 and 132 of the book) to find the maximum of the function from problem 1. Let α = 0.1 and suppose that our first guess of the maximum is *x* = 0. What is our guess after one iteration of applying the equation at the top of page 132? What is our guess after two iterations of applying the algorithm?** (Hint: be careful that you carefully plug your answer from the first iteration into the update for the second iteration.)
2. Compute the gradient of *f*(*x*,*y*) = 3*x*2*y*3 − *x*2 + 5*y*2 by computing the partial derivatives \frac{\partial f}{\partial x}  and \frac{\partial f}{\partial y} . (See [this link](http://en.wikipedia.org/wiki/Partial_derivative) for hints.)
3. Suppose that we use gradient ascent (from page 131 and 132 of the book) to find the maximum of *f*(*x*,*y*) = − (*x* − 3)2 − 5*y*2 + 2*xy*. Let α = 0.05 and suppose that our first guess of the maximum is *x* = 0,*y* = 1. What is our guess after one iteration of applying the equation at the top of page 132? What is our guess after two iterations of applying the algorithm? (Hint: Notice that this equation is different from the one in the previous problem.)

Part 2

The attached [Local Search MATLAB code](https://facwiki.cs.byu.edu/cs470fall2011/index.php/Local_Search_MATLAB_code) has you play with various local search algorithms: hill-climbing, random restart hill-climbing, and beam-forming. The code is organized as follows:

* hill climbing on a surface with one bump
* hill climbing on a surface with more than one bump
* random restart hill climbing on a surface with more than one bump
* local beam search on a surface with more than one bump

Run the code so that you learn how hill-climbing, random restart hill-climbing, and local beam search differ. Then, answer the following questions:

1. What is the probability that hill climbing will reach the maximum point on a surface with more than one bump? How does this probability depend on the footprint of the hill?
2. When would you perform random restart hill-climbing rather than hill-climbing? How would you know which to run?
3. What would happen if you changed the beam search algorithm so that it took the 10 best solutions instead of the 7 best? Why?

Don't include all of the plots generated from the MATLAB code, but if a print-out helps you answer the above questions then include the print-out with your homework.