INF3490/INF4490 Exercises - Week 1

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September 20, 2016

$\mathbb{P}$ marks the programming exercises, we strongly recommend using the python programming language. Exercises may be added/changed after publishing.

1 Simple search algorithms

Given the function $f(x) = -x^4 + 2x^3 + 2x^2 - x$:

1.a Derivative

What is its derivative $f'(x)$?

$\mathbb{P}$ 1.b Plotting

Plot the function, and its gradient(derivative) from $x = -2$ to $x = 3$. Use python, wolfram alpha or another plotting tool of your choice.

$\mathbb{P}$ 1.c Gradient Ascent

Maximize using gradient ascent. You can try step size 0.1 and start somewhere in the range [-2, 3]. How does the choice of starting point and step size affect the algorithm's performance? Is there a starting point where the algorithm would not even be able to find a local maximum?

$\mathbb{P}$ 1.d Exhaustive Search

Assume that we are only interested in maxima of $f(x)$, where $-2 \leq x \leq 3$, and x increases in steps of length 0.5 ($\Delta x = 0.5$). Perform an exhaustive search to maximize $f(x)$ and plot the result.

1.e Greedy Search and Hill Climbing

In what way would greedy search and hill climbing differ for the maximization problem in Problem 1.c? Can you identify a starting position where the two algorithms might give different results?

1.f Possible improvements

Gradient ascent, greedy search and hill climbing are quite similar, and are all based almost exclusively on exploitation. Can you think of any additions to these algorithms in order to do more exploration?

1.g Exhaustive search vs. simulated annealing

Which algorithm do you think is the most efficient at maximizing $f(x)$ under the conditions in Problem 1.d; exhaustive search or simulated annealing? Explain.

Corrections and suggestions

Corrections of grammar, language, notation or suggestions for improving these exercises are appreciated. E-mail me at: **olehelg@uio.no** or use **GitHub** to submit an issue or create a pull request.