

My Algorithms Cheat Sheet

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This is an informal list of things that we talked about in class.
Please contact me if you have any questions.
Good luck, Roy

1 An algorithm

- Data structures.
- Initialization (and input).
- Sequence of actions.
- Output (return...).
- Number of operations.

2 A proof

- Proof of number of operations.
- Termination.
- Correctness.

3 I'm stuck!

Ideas for an algorithm:

- Characterize the correct output.
- Restate the problem using different notation.
- Review recent classes.
- Attack the question: Can I prove that this can't be done? If I can't, why?
- Bag of algorithm tricks: Reduce to a problem that I already solved. Recycle old algorithm parts. Recursion.

Ideas for a proof:

- The workhorses of proofs: Contradiction. Induction.
- Attack the algorithm: Is my algorithm correct? Can I make it fail?
- Rewrite the requirement for correct output.
- Simplify the problem (WLOG, if possible. With reasonable loss of generality, if needed).

Everything should be made as simple as possible, but no simpler. Attributed to Einstein.

4 Checklist

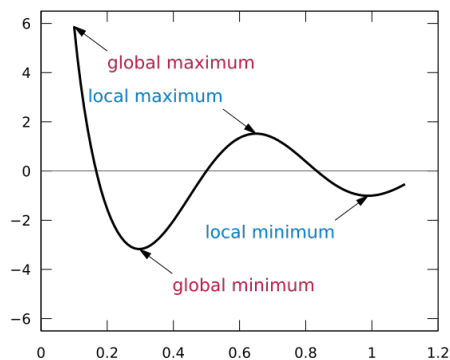
- What was the question?
- Do I have all the components of algorithms and proofs?
- Should I make smaller steps? Should I use more lemmas to clarify my argument?
If I put all the parts in place using simple lemmas, the proof becomes trivial.

Thus it is that in war the victorious strategist only seeks battle after the victory has been won, whereas he who is destined to defeat first fights and afterwards looks for victory. The Art of War, Sun Tzu.

- Did I solve a special case, or the general problem?
- Is “clearly” clear? Wait - is it even true?
- Is my proof linear? Have I used something that I am trying to prove?
- “Every step is an improvement” $\neq$ “the result is optimal.”
- “Can’t improve by any small change” $\neq$ “the result is optimal.”
- Correct algorithm $\neq$ correct proof. Does my argument work if I take it out of context?
- Do I really need to denote something by $\frac{\alpha_m}{\beta^q} \tilde{\tilde{\omega}}_l^* \hat{A}_{n_{a_3}}$?
- Would I be able to read this thing a month from now? Would I enjoy reading it?
- What was the question?

5 The most commons mistakes

- $A \Rightarrow B$ vs. $A \Leftarrow B$ vs. $A \Leftrightarrow B$.
- Local minimum. See figure, also:
Yoga weekend schedule:
A: 1:00-2:30pm. Hot: 2:00-3:30pm, Y: 3:00-4:30pm.
Claim: I can take only one class that day.
Proof: I take hot yoga, so I can’t add anything else.
Therefore, this is optimal.
Something about this proof doesn’t feel right...

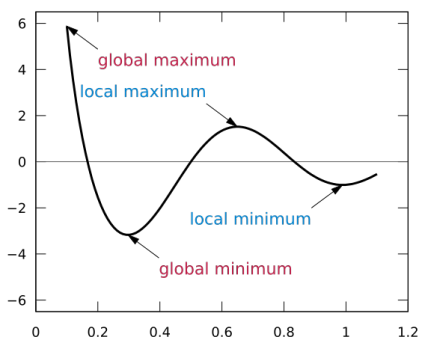


Source: http://en.wikipedia.org/wiki/Maxima_and_minima

Copies that I put on my computer screen, in my wallet and under my pillow (+spare).

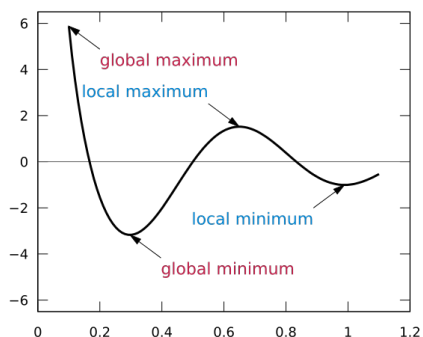
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- Local minimum (see figure).



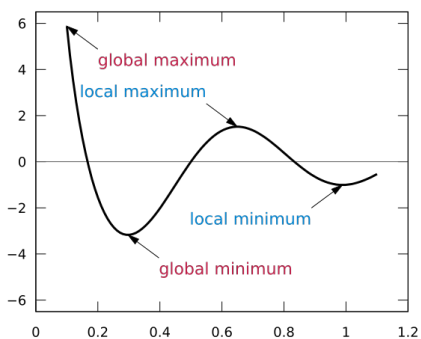
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