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Twelve ways to fool the masses when reporting performance of deep learning workloads! (not to be taken too seriously)

IPAM workshop "HPC for Computationally and Data-Intensive Problems" at UCLA, November 2018
Los Angeles, CA, USA

https://www.arxiv.org/abs/1802.09941

http://htor.inf.ethz.ch/blog/index.php/2018/11/08/twelve-ways-to-fool-the-masses-when-reporting-performance-of-deep-learning-workloads/

NOV 8 2018

Twelve ways to fool the masses when reporting performance of deep learning workloads

blog Uncategorized

Deep learning and HPC

- **Deep learning is HPC**
  - In fact, it's probably (soon?) bigger than traditional HPC

    Definitely more money …

- **Interest in the HPC community is tremendous**
  - Number of learning papers at HPC conferences seems to be growing exponentially

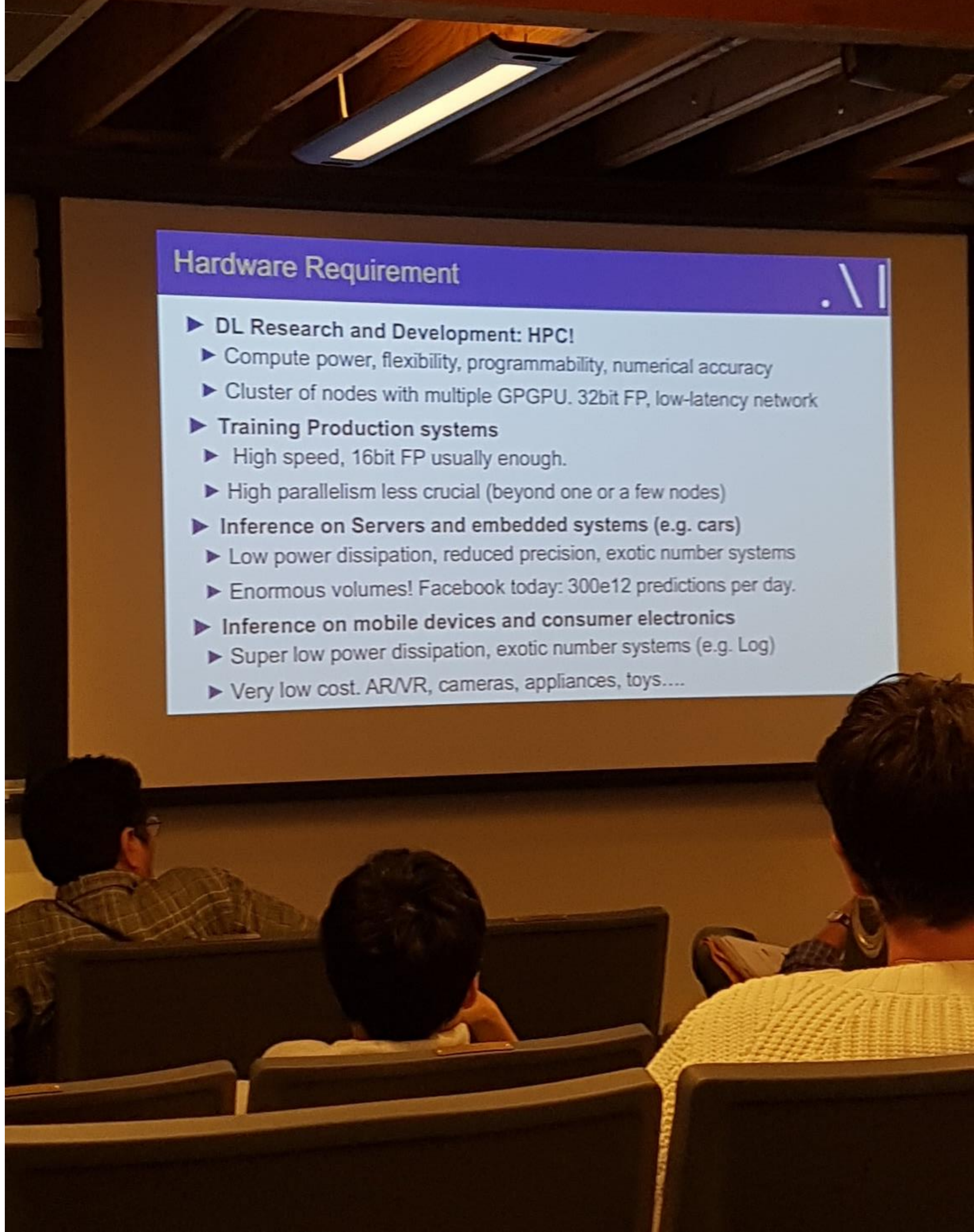
    Besides at SC18, whut!?

- **Risk of unrealism**
  - HPC people know how to do HPC
  - And deep learning is HPC, right?

    Not quite … while it's really similar (tensor contractions)

    But it's also quite different!

Yann LeCun's conclusion slide yesterday!

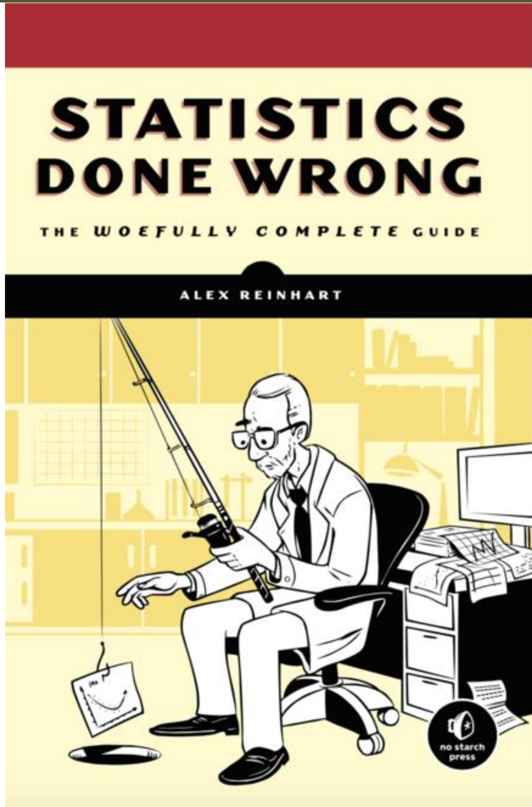


“Statistical performance” vs. “hardware performance”

- **Tradeoffs between those two**
  - Very weird for HPC people – we always operated in double precision
    Mostly out of fear of rounding issues

- **Deep learning shows how little accuracy one can get away with**
  - Well, examples are drawn randomly from some distribution we don’t know …
  - Usually, noise is quite high …
  - So the computation doesn’t need to be higher precision than that noise
    Pretty obvious! In fact, it’s similar in scientific computing but in tighter bounds and not as well known

- **But we HPC folks like flop/s! Or maybe now just ops or even aiops? Whatever, fast compute!**
  - A humorous guide to **floptimization**
  - Twelve rules to help present your (not so great?) results in a much better light



1) Ignore accuracy when scaling up!

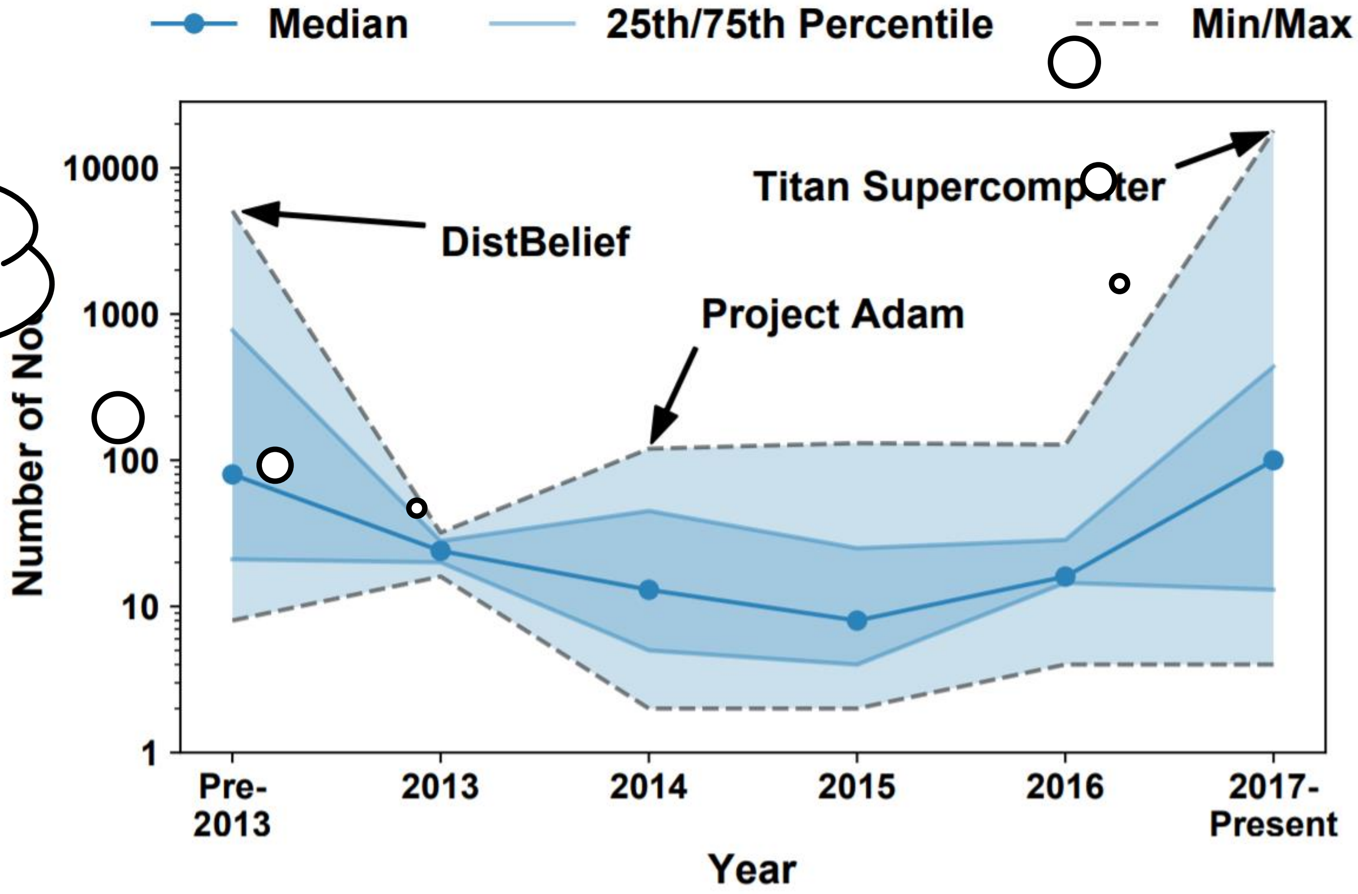
- **Too obvious for this audience**
  - Was very popular in 2015!

- **Surprisingly many (still) do this**

HPC picking up!

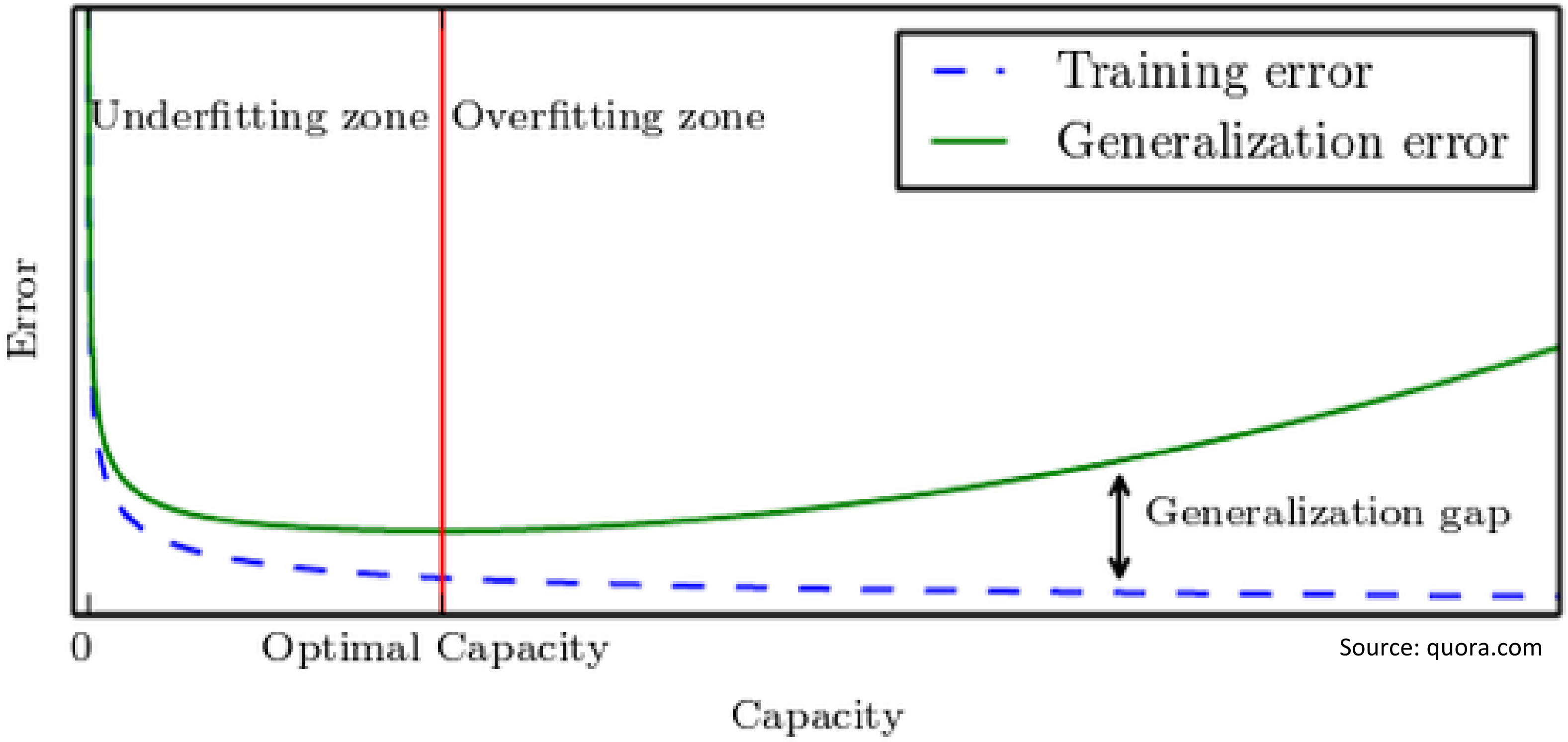
Learning community's self-correction (Y. LeCun)

Scalability without a good baseline? (D. Bailey)



2) Do not report test accuracy!

- **Training accuracy is sufficient isn't it?**

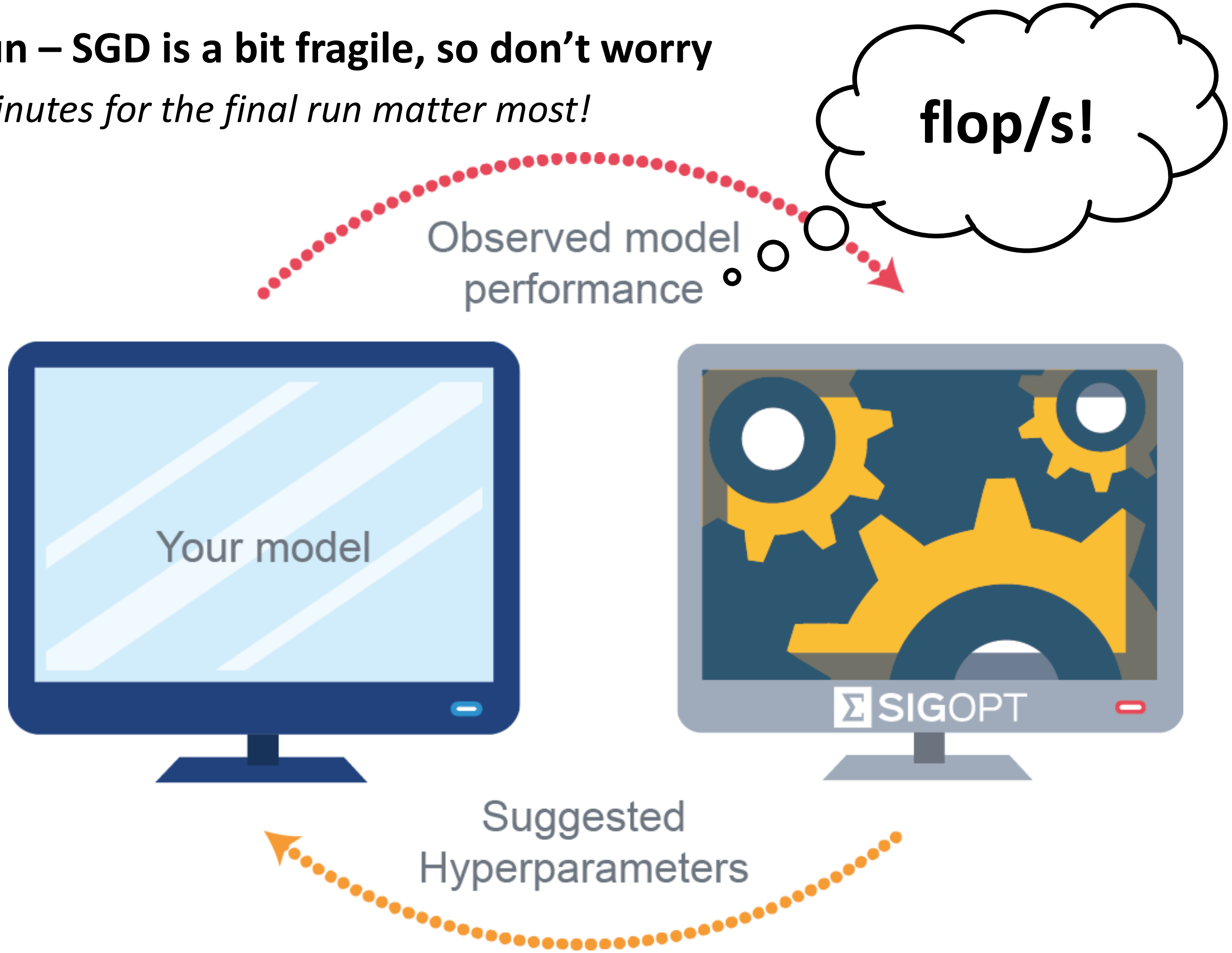


Source: quora.com

3) Do not report all training runs needed to tune hyperparameters!

- **Report the best run – SGD is a bit fragile, so don't worry**

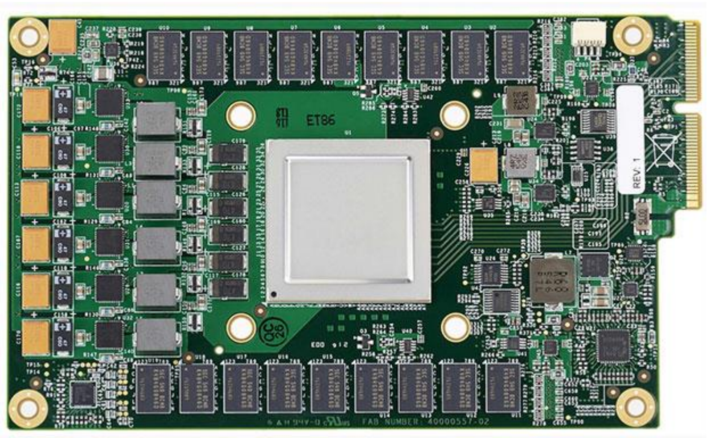
  At the end, the minutes for the final run matter most!



4) Compare outdated hardware with special-purpose hardware!

- **Tesla K20 in 2018!?**

  Even though the older machines would win the beauty contest!



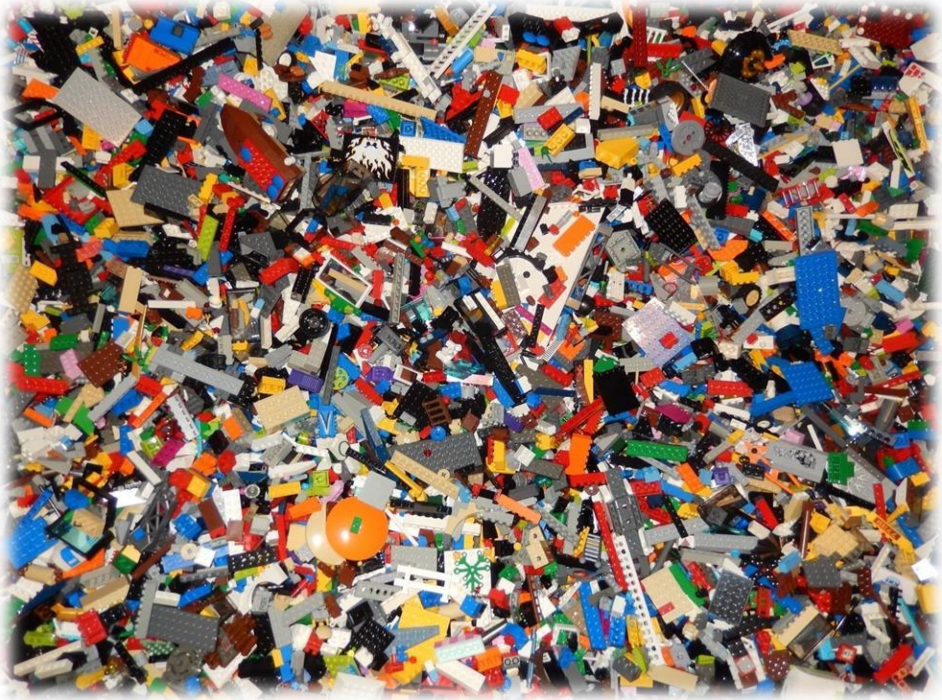
vs.

5) Show only kernels/subsets when scaling!

- **Run layers or communication kernels in isolation**
  - Avoids issues with accuracy completely ☺

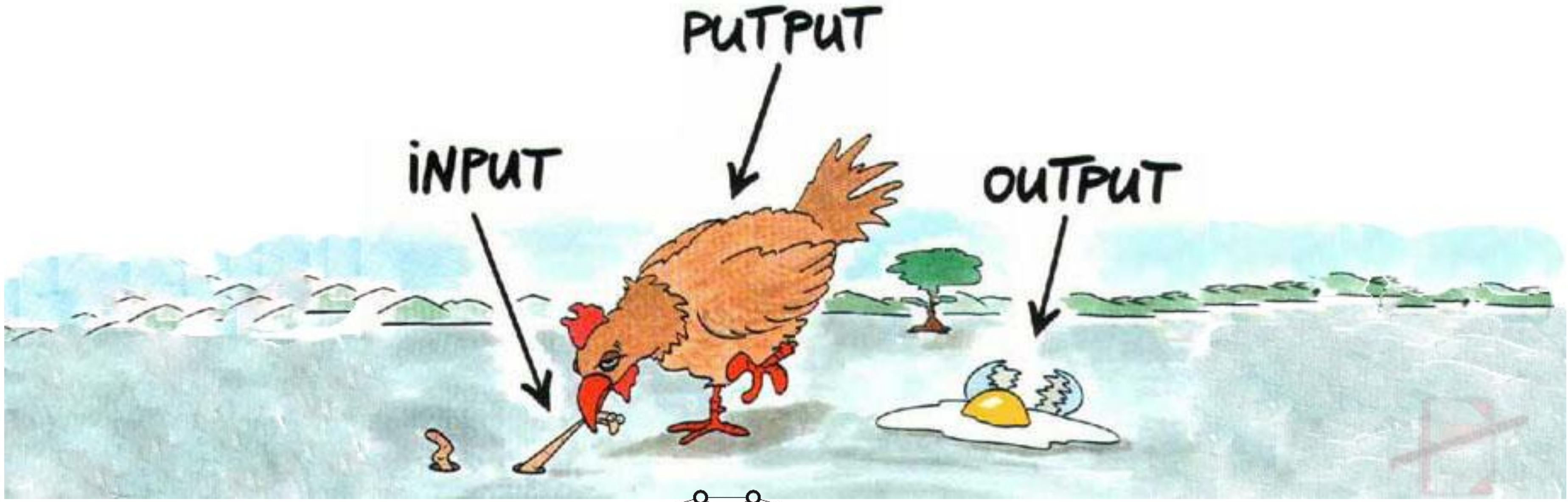
    Doesn't that look a bit like GoogLeNet?

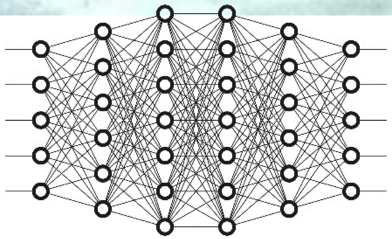
VS.



6) Do not consider I/O!

- Reading the data? Nah, make sure it's staged in memory when the benchmark starts!





7) Report highest ops numbers (whatever that means)!

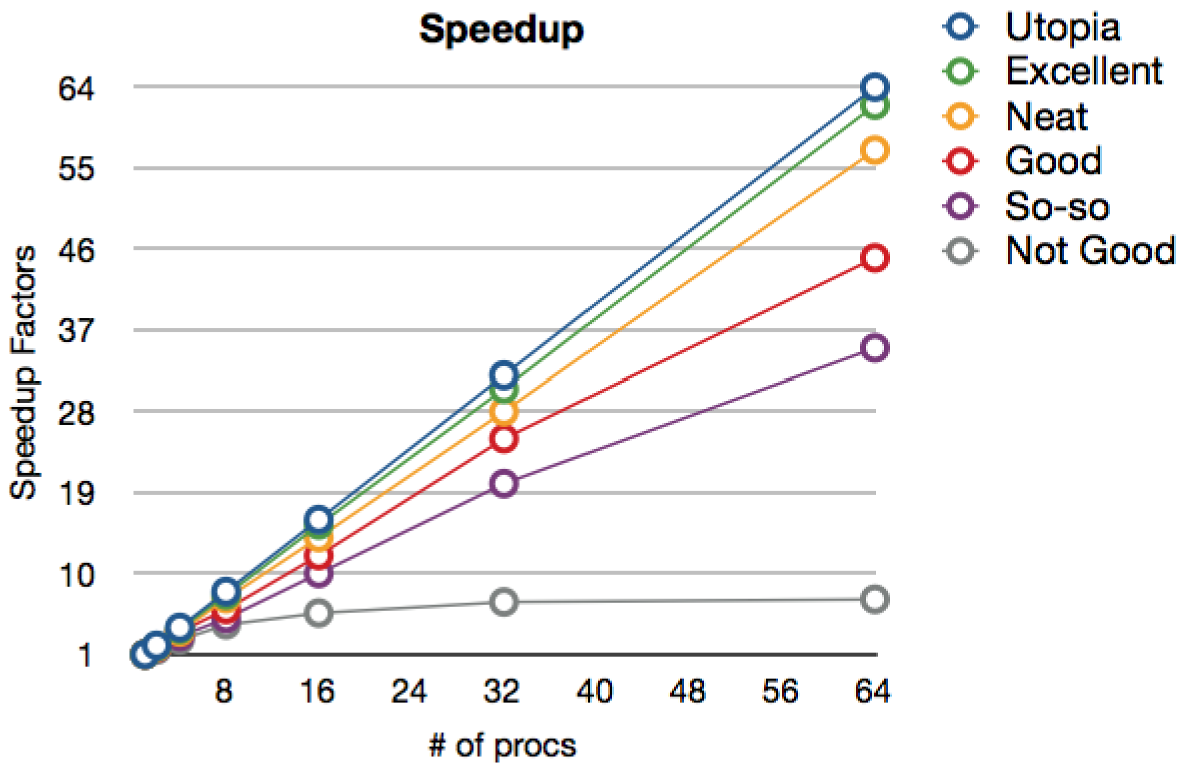
- **Yes, we're talking ops today, 64-bit flops was so yesterday!**
  - If we don't achieve a target fast enough, let's redefine it!
    And never talk about how many more of those ops one needs to find a solution, it's all about the rate, op/s!
- **Actually, my laptop achieves an "exaop":**
  - each of the 3e9 transistors switching a binary digit each at 2.4e9 Hz

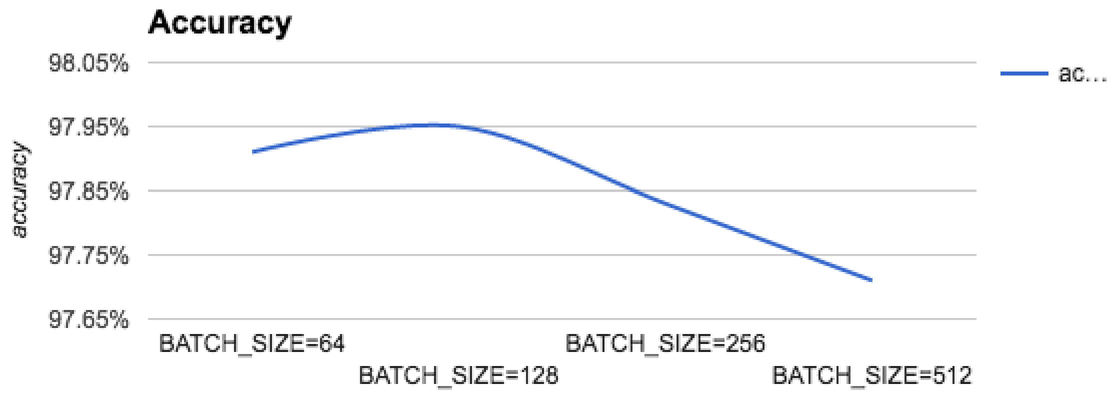
vs.

8) Show performance when enabling option set A and show accuracy when enabling option set B!

- **Pretty cool idea isn't it? Hyperparameters sometimes conflict**

  So always tune the to show the best result, whatever the result shall be!



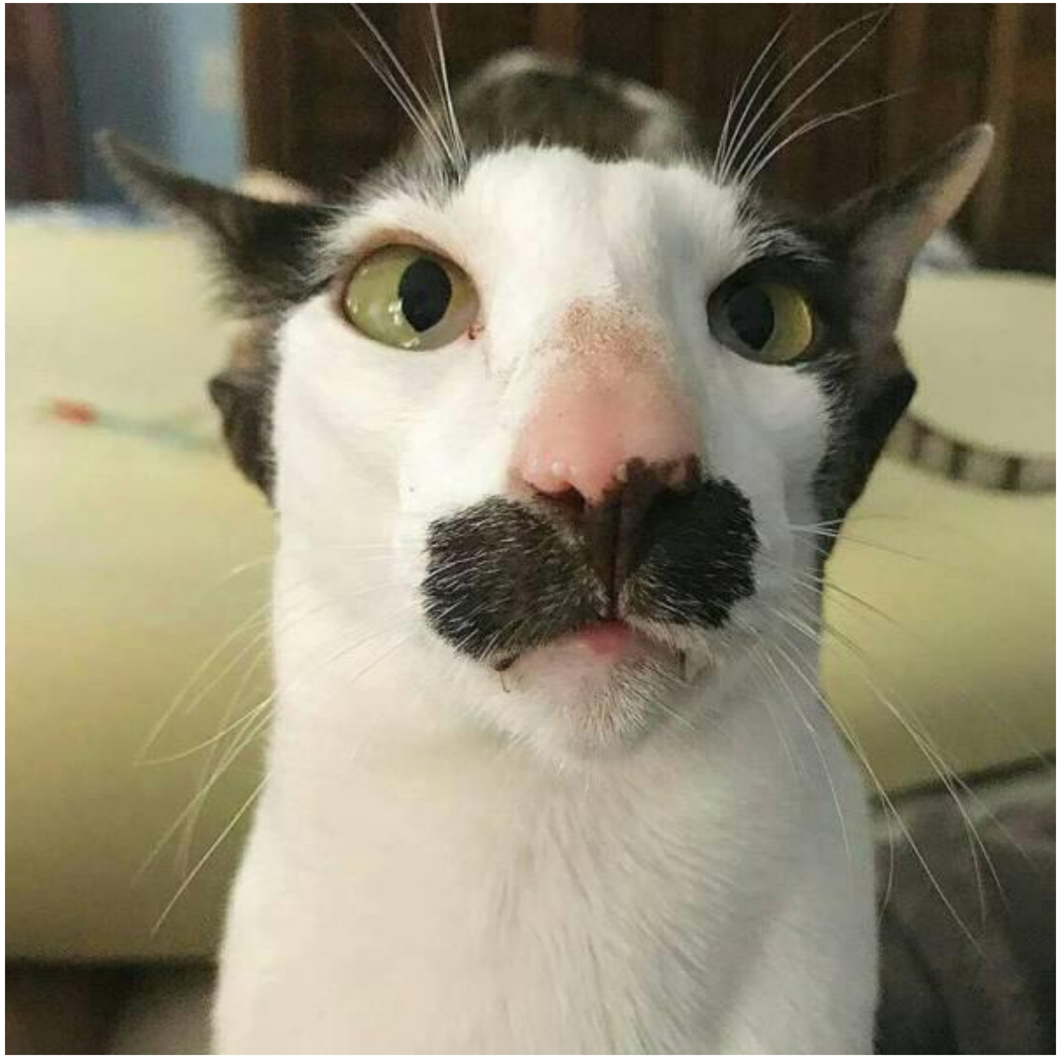


9) Train on (unreasonably) large inputs!

- **The pinnacle of floptimization! Very hard to catch!**
  But Dr. Catlock Holmes below can catch it.

Low-resolution cat (244x244 – 1 Gflop/example)

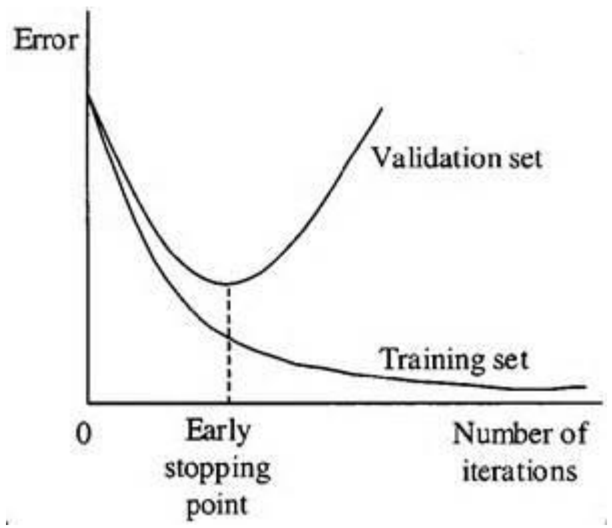
vs.



High-resolution cat (8kx8x – 1 Tflop/example)

10) Run training just for the right time!

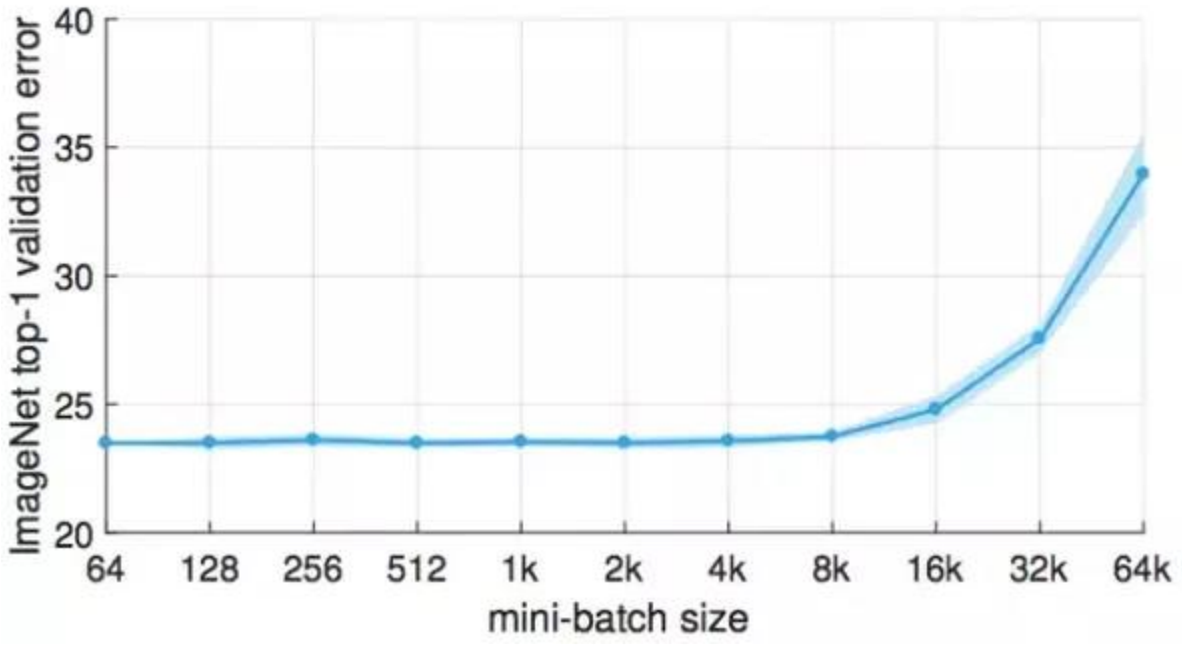
- **Train for fixed wall-time when scaling processors**
  - so when you use twice as many processors you get twice as many flop/s!
    But who cares about application speedup?



11) Minibatch sizing for fun and profit – weak vs. strong scaling.

- **All DL is strong scaling – limited model and limited data**
- **So just redefine the terms relative to minibatches:**
  - Weak scaling keeps MB size per process constant – overall grows (less iterations per epoch, duh!)
  - Strong scaling keeps overall MB size constant (better but harder)

- **Microbatching is not a problem!**



12) Select carefully how to compare to the state of the art!

- **Compare either time to solution or accuracy if both together don't look strong!**

  There used to be conventions but let's redefine them.