During the lecture, one key conclusion we discovered was that log(N!) ∈ Θ(NlogN) and also that NlogN ∈ Θ(log(N!)). After proving the Big Omega bound in one direction, we then showed the Big Omega bound in the other direction, NlogN ∈ Ω(log(N!)). Which of the following steps were included in the derivation?

* 4 points

- [ ] NlogN = log(N) + log(N) + ... + log(N) where we add log(N) N times
- [ ] log(N!) = log(N) + log(N-1) + log(N-2) + ... + log(1)
- [ ] Asymptotic analysis drops multiplicative factors and lower order terms so N! ∈ Θ(N)
- [ ] Comparing terms after rewriting NlogN and log(N!), we see that log(N!) is always less than or equal to NlogN

To tighten the lower bound and show that asymptotically fastest comparison sort is Ω(NlogN), we used the puppy, cat, dog problem. Which of the following statements is true about sorting and the puppy, cat, dog problem.

* 4 points

- [ ] The puppy, cat, dog problem reduces to sorting because we can use sorting to solve the puppy, cat, dog problem
- [ ] Sorting reduces to the puppy, cat, dog problem because we can use the puppy, cat, dog problem to solve sorting
- [ ] The puppy, cat, dog problem on N items requires at least NlogN comparisons
- [ ] If comparison sorts could be faster than Ω(NlogN), then puppy, cat, dog could also be solved in fewer than Ω(NlogN) comparisons

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