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Problem 1-2d

$T(n) = T(\sqrt{n}) + \theta(lglgn)$

Set $lgn = m$.

$T(n) = T(2^{m/2}) + \theta(lgm)$

Set $S(m) = T(2^m)$.

This implies that $T(x) = S(lg(x))$.

So $S(m) = T(2^{m/2}) + \theta(lgm)$ can be converted to $S(m) = S(lg(2^{m/2})) + \theta(lgm)$ which can then by simplified down to $S(m) = S(m/2) + \theta(lgm)$

This new equation can be solved by the master method's third case: $S(m) = \theta(lgm)$. Since $S(m) = T(n)$ we have: $T(n) = S(m) = \theta(lgm) = \theta(lglgn)$.

This can be verified via the substitution method. Umm. Wait, no it can't. Shit.

$0 < c_1 lglgn \le T(\sqrt{n}) + \theta(lglgn) \le c_2 lglgn$

$\ldots\ clglg\sqrt{n} + \theta(lglgn) \ldots$

$\ldots\ clg\frac{lgn}{2} + \theta(lglgn) \ldots$

$\ldots\ clglgn - c + \theta(lglgn) \ldots$

$\ldots\ clglgn - (c - \theta(lglgn)) \ldots$

So I can see I'm making some sort of mistake, since it isn't verified...

At this point I looked up the answer in the problem set solutions, because I was confused. The answer set claimed that it was case 2, not case 3, which occurred. This means that we actually have $lgm * lgm$ or lg^2m which is $(lglgn)^2$. This is said to be the correct answer. My mental question is how this can be? Isn't $m^{lg1} = 1$.

Well heres my attempt at answering my own question: $\frac{1}{lglgn}$ doesn't have a power of n. It only has n. So its not polynomially larger.