

ADS Homework 3

Problem 1:

a) $f(n) = 9n$ and $g(n) = 5n^3$

$f \in \theta(g)$ ~~$f = \theta(g)$~~ , assume $n_0 < n$
 $f(n) = c g(n)$ $C_1, C_2 > 0$

$C_1 g(n) \leq f(n) \leq C_2 g(n)$ ~~\otimes~~ Use $g(n)$ as
function input
for f

$C_1 5n_0^3 \leq 9n_0^2$ & $5 \times 9n_0^2 \leq C_2 5n_0^3$

$C_1 5n_0 \leq 9 \times 5$

$5 \times 9 \leq C_2 5n_0^2$

~~Guess: $f(n) = O(g)$~~

$\frac{45}{5} \leq C_2$

$C_1 5 \leq 45$

$C_1 \leq 9$

because
holds $9 \leq C_2 \lim_{n \rightarrow \infty} \frac{9n}{5n^2} = 0$

- so $f \in \theta(g)$ if and only if $n \rightarrow \infty$ and $f \notin \theta(g)$

or $f \in \theta(g)$ ~~no~~ $C_1 \leq 9$ and $C_2 \geq 9$ for $n_0 < n$ which
means by induction it also applies
to n otherwise $f \notin \theta(g)$, without
these

- $f \in O(g)$, ~~$f(n) \leq c g(n)$~~ restrictions:

~~$C_1 \geq 0$ & $n_0 < n$~~

$\lim_{n \rightarrow \infty} \frac{f(n)}{g(n)} < \infty$

$\lim_{n \rightarrow \infty} \frac{9n}{5n^2} < \infty$

$0 < \infty$

so yes

~~$9n_0 \leq C_1 5n_0^2$~~

~~$\frac{9}{5} \leq C_1 n_0$~~

~~$\frac{9}{5n_0^2} \leq C_1$~~

~~$C_1 \geq \frac{9}{5n_0^2}$~~

then \uparrow

~~$f \in O(g)$~~

~~$f \in O(g)$~~ $f \in O(g)$ holds