cse 101 2-1-22

Pa4:

function changeEntry(M, i, j, x)

4 cases: **do**

- (ij^{th} entry) = 0, x = 0 (nothing)
- (ij^{th} entry) = 0, $x \neq 0$ insert
- (ij^{th} entry) $\neq 0$, x = 0 delete
- (ij^{th} entry) $\neq 0$, $x \neq 0$ overwrite

function sum(A, B), diff(A, B)

- create helper function

$\boxed{\text{List addList (L, M)}}$

function ~~mult~~ product (A, B)

- create helper fcn

$\boxed{\text{doubledot (L, M)}}$

how to write dot(L, M)?

L: (10, 3), (20, 4), (50, -1), (60, 2)

M: (15, 4), (25, 5), (50, 3), (55, 1)

$s \mathrel{+}= (-1) \cdot 3 \quad = -3$

how to write addList(L, M)

newList: S

L: (10, 3), (20, 4), (50, -1), (60, 2)

M: (15, 4), (25, 5), (50, 3), (55, 1)

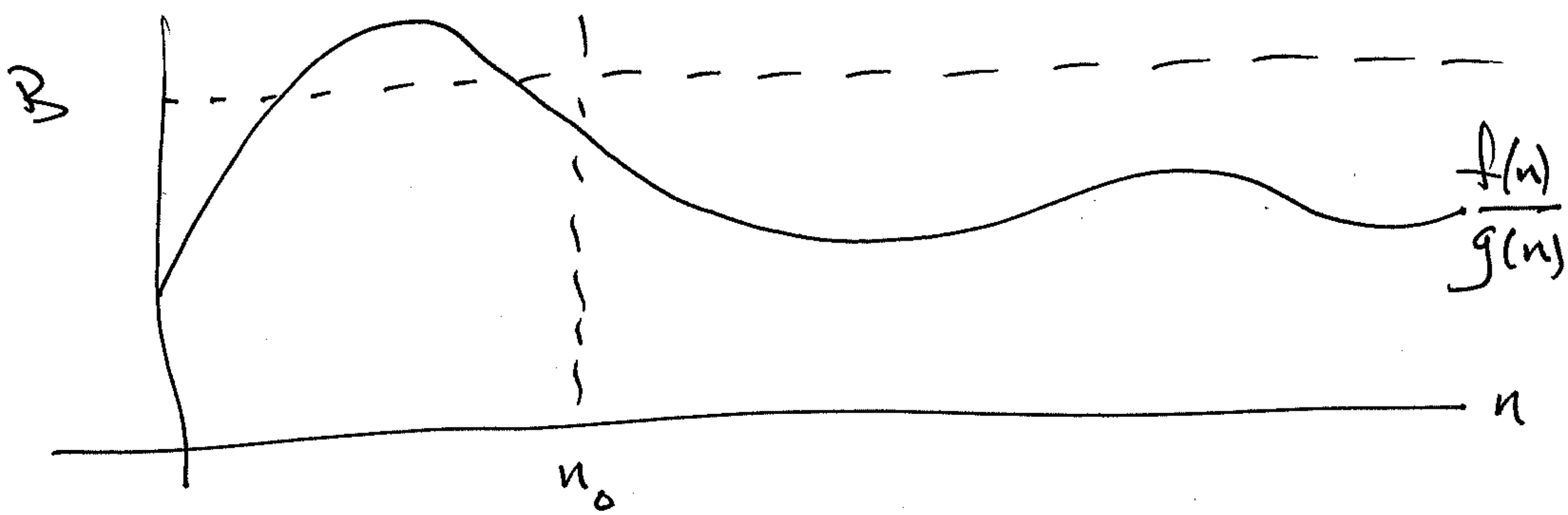
S: (10, 3), (15, 4), (20, 4), (25, 5), (50, 2), (55, 1), (60, 2)

Recall:

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

$\exists B > 0, \exists n_0 > 0$ s.t. $\forall n \geq n_0$:

$$\frac{f(n)}{g(n)} \leq B$$



Ex.

$f(n) = 2n+5, \quad g(n) = n$

so $\dfrac{f(n)}{g(n)} = 2 + \dfrac{5}{n} \leq 3$ for $n \geq 5$

so $B = 3, \; n_0 = 5$

Observe: there's nothing special about 2 & 5, or the 1, 0

$f(n) = 2 \cdot n + 5$
$g(n) = 1 \cdot n + 0$

so for any $a, b \; (a \geq 0)$:

$$\boxed{an + b = O(n)}$$

Defn

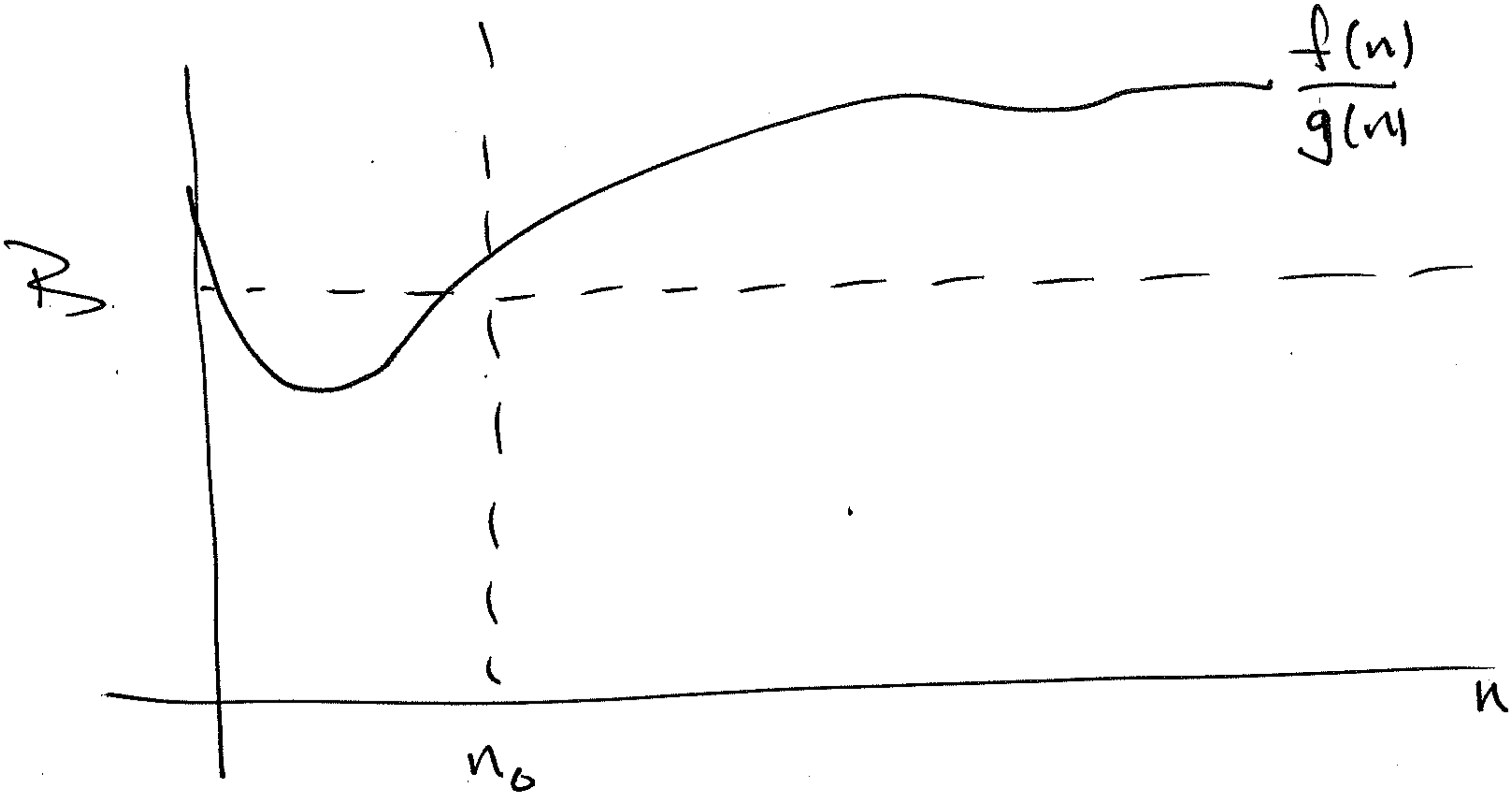
$f(n) = \Omega(g(n))$ iff

$\exists B > 0, \exists n_0 > 0$ s.t. $\forall n \geq n_0$

$$B \leq \frac{f(n)}{g(n)}$$

We say • $g(n)$ is an asym. lower bd for $f(n)$

• $f(n)$ is asym. bdd. below by $g(n)$.



Ex. $f(n) = 6n^3 + 4n$, $g(n) = 2n^2$. Then

$$\frac{f(n)}{g(n)} = 3n + \frac{2}{n} \geq 7 \text{ for all } n \geq 2$$

$B = 7$, $n_0 = 2$

note: nothing special about 6, 4

In fact

$$an^3 + bn^2 + cn + d = \Omega(n^2)$$

for any $a, b, c, d \in \mathbb{R}$, $a > 0$

<u>Notice</u>:

$$\frac{f(n)}{g(n)} \le B_1 \text{ iff } \frac{g(n)}{f(n)} \ge B_2$$

where $B_2 = \dfrac{1}{B_1}$

<u>Thus</u>:

$$f(n) = O(g(n)) \text{ iff } g(n) = \Omega(f(n))$$

<u>Defn</u>

$f(n) = \Theta(g(n))$ iff there exist

$B_1 > 0, B_2 > 0, n_0 > 0$ s.t.

$$B_1 \leq \frac{f(n)}{g(n)} \leq B_2$$

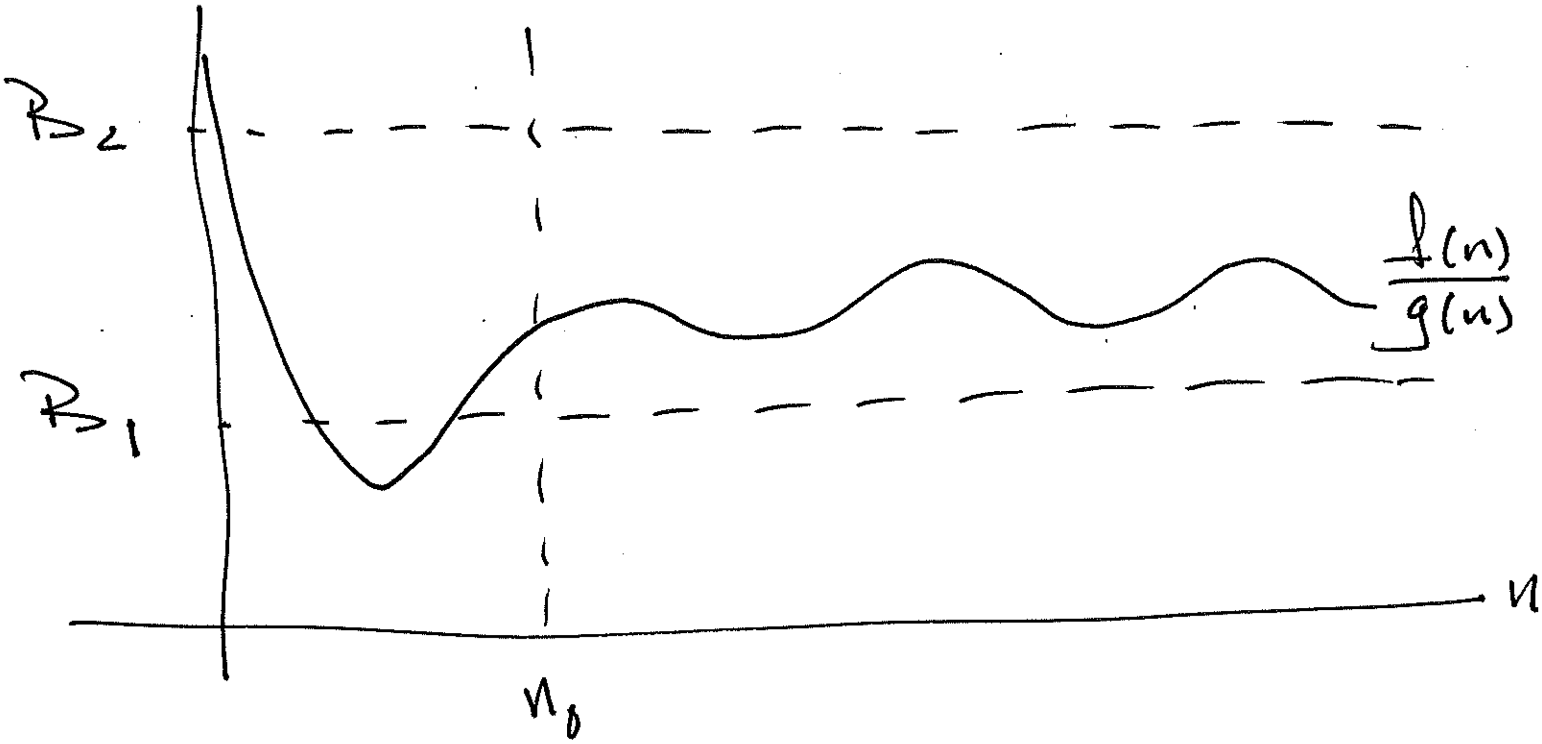
for all $n \geq n_0$.

Equivalently $f(n) = \Theta(g(n))$ iff

Both $f(n) = O(g(n))$ and

$f(n) = \Omega(g(n))$.

<u>Notice</u>: $f(n) = \Theta(g(n))$ iff
$g(n) = \Theta(f(n))$



Ex. $f(n) = 5n^2 + 11n - 24$, $g(n) = n^2$

Take $B_1 = 4$, $B_2 = 6$ $n_0 = 8$!

$$4 \le \frac{5n^2 + 11n - 24}{n^2} \le 6$$

for all $n \ge 8$.

$\therefore$ $5n^2 + 11n - 24 = \Theta(n^2)$

In fact:

$$an^2+bn+c = \Theta(n^2)$$

for any $a, b, c \in \mathbb{R}$ with $a > 0$.