	(Review Quiz #1 questions on these]
	Heaps (Inscal Delete / Heap build)
5	Heap = data Structure to manage information
3	
3	- sometimes called binary Heaps
>	- hearly/complete binary trees
?	The Area were a second and the secon
	Exemple of Hesp.
	(2)
-6	(7) (15) -levels filled except the loves+
5	(1) (g) (13) -lovest level filled to a certain
9 0	Point Starting from the 1251.
	A STATE OF THE STA
P6 /	
	USes: types:
	- heap sort - max-heap
	- priority quese - min-heaps
=	
3	This is a max-heap, conditions for a max-heap is
5	Value of i & value of parent, Max-heaps are used for
19999	heap sort
3 .	Min-heap: value of i > value of parent, work great for priorits queen
2	height of a hear is O(10g N)

	i - in	aex
	Max-Heap Represented As an	array:
	(2)	
	(17) (15) 3 21 17	15 14 9 12 13 8 5 1
		2 3 4 5 6 7 8 9
6	160	
(6)		
	Fact - Ariz	10 9 C f
	Cindex 2 of the array)	left child = left(i) = 2i+1
		right child = right(i) = 2i+2
		parent(i) = (i-1)/2
I a programa	A SECOND LOS LOS LOS TO	
resistant p	Example toget (5) left ch	ild we would do:
3 % 20 1	left(i) = 2i+1	
		o this is the index we look at
	7	(index 5 we nave (12)]
	We put 3 for i, as in	
	that you	And gent
	SUM-Herres can pro-	
	pop maps and pages of a	heap itself, smaller portions of it.
	(Mar) the second of the second	
	(Max) Heaps: Inserting Values.	Lx.
		The state of the s
		top, the same was we god
	Values to a normal BST	. From left to right!
99 ₀ x 12 1	many in the great parties	to warm \$11,10 years company
		(May 10 of any 11 to the Mills

	(343)	So	adding (32) to this would
	(144) (99)	-	100h like adding it to (85)
	(5) (12) (12)		Chille to the same of the same
	(32)		
77 1.002	Now lots say we	Want	(343) as dead
	to and (150) though,		(50) (99)
	the incoming value is great	ter	(144) (120) (28) (12)
	than the parent, we need		(32) (5)
	move hodes around.		chart tool year of the same sound?
			ongs a some of the part of the soles
	Time Complexity For Ins	erting	Heap:
	Best: 0(1)		6
	Average: O (log N)	9	100 Feb.
	Worst: () (log N)		Com an and
	Tour Louisian Louis		
	Insertion for Min-Heaps	are si	milar, the only difference u, we
	will do sugps to ensure a	differe	nt condition is true for all
	nodes in the heap:	18	March 1997 Property
	- The roof is	lesser	than (or equal to) its children
			(Sa) 1981) (Sq. 1)

	Max (Heaps): Deleting	Values		
		43)	We	want to delete (85)
	(50)	(99)	Sinc	e It is just a leaf
	[44]	000	Nod	e 1ts super easy, we
	(32) (33)		can	just get tid of it!
		1		19.
	Now lets say	we want to	1	343)
	delete (343). 70 do			(150) (99)
	first Swap it with			144 (20) (28) (2) (2) (3)
	and delete &3. N		3	
	Sucp around the new	Poot Node,		
	til It is in the	Correct sport!	② ,	(85)
		a differente per		50 (99) 11 11 11 11 11 11 11 11 11 11
(3)	(150)		(144)	(2) (28) (12)
	7 (85) (99)		(32) (
	(143) (120) (28) (12)			
	(32)			Time Complexiti:
		Test Desirement		Best - (3(1)
(4)	150	Done! Since	7 2	Average - $\Theta(\log N)$
	(144) (99)	parent (85) is		Worst - 0(100 N)
	(85) (10) (28(12)	otester than Ch	ild	20131 O(103 N)
	(32)	Nodes (33)	10	

	Build Hesp
	Built Heap 123456
94-11-2-20-1	middle! with neapily
	0 06 6
	0,0,5 5 6 50 50
	(15) 46 (10) 3 (10) 46
	BuildHeap Time Complexity: O(A)
	CHAIL CHAIL
	Space Complexito (All Heap Types): O(1)
	Capada 1919 1107 1108
	(They complete, see forestance (MA) and see the control of
	CO CONTRACTOR DESCRIPTION
	The " also as Solve for the second the secon
	, tears teamed
	The same to be a second to be a seco
	The same of the sa
(6	