Exam 2: ch6-8, 11

Open book, paper notes
No electronic devices
Please show your work

30 Oct 2012
CMPT231
Dr. Sean Ho
Trinity Western University

Exam 2: 40pts
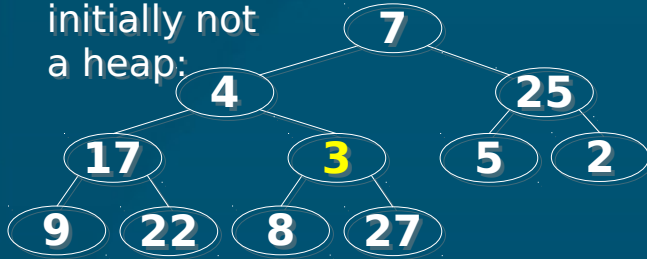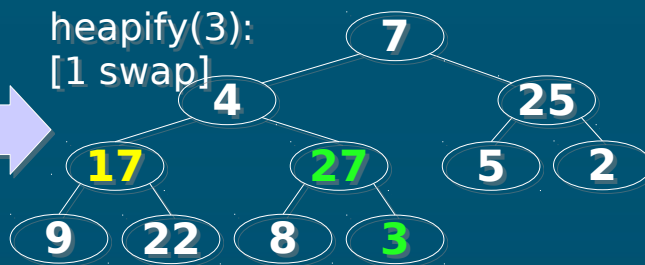
- Input for all: [7, 4, 25, 17, 3, 5, 2, 9, 22, 8, 27]

- **[10]** Demonstrate each step of Heapsort on the input. How many non-trivial swaps are performed?

- **[10]** Demonstrate each step of Quicksort on the input. How many non-trivial swaps?

- **[4]** Given the min/max and size of the input, find an optimal digit size for radix sort on the input.

- **[6]** Demonstrate radix sort on the input w/your digit size.

- Insert the input into an open-addr hash table with $h'(k)=k$:

  - **[3]** with linear probing

  - **[4]** with quadratic-(0,1) probing (c1=0, c2=1)

  - **[3]** Show that c1, c2 are poorly chosen: they yield probe sequences which do not cover all entries.

Exam 2: solutions #1
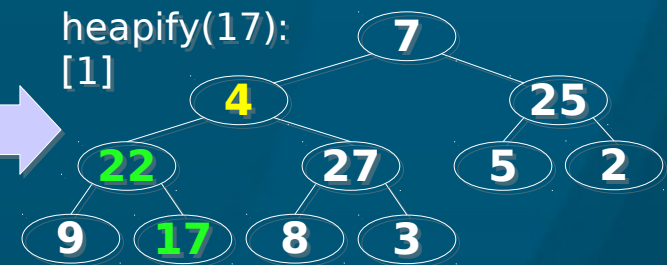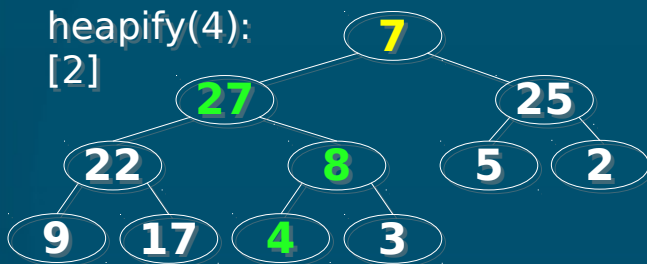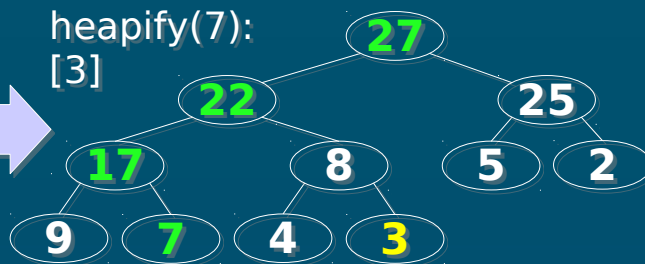
initially not a heap:
- 7
- 4, 25
- 17, 3, 5, 2
- 9, 22, 8, 27

heapify(3): [1 swap]
- 7
- 4, 25
- 17, 27, 5, 2
- 9, 22, 8, 3

heapify(17): [1]
- 7
- 4, 25
- 22, 27, 5, 2
- 9, 17, 8, 3

heapify(4): [2]
- 7
- 27, 25
- 22, 8, 5, 2
- 9, 17, 4, 3

heapify(7): [3]
- 27
- 22, 25
- 17, 8, 5, 2
- 9, 7, 4, 3

return 27, heapify(3): [3]
- 25
- 22, 5
- 17, 8, 3, 2
- 9, 7, 4, 27
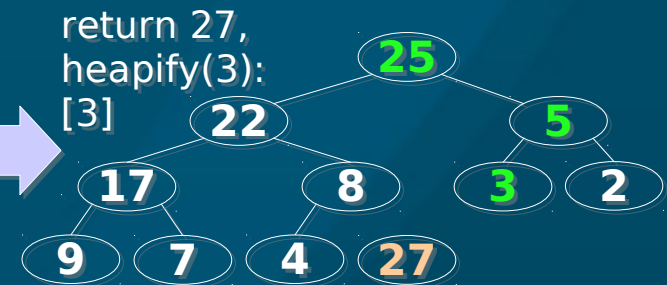
return 25, heapify(4) [4]
- 22
- 17, 5
- 9, 8, 3, 2
- 4, 7, 25, 27
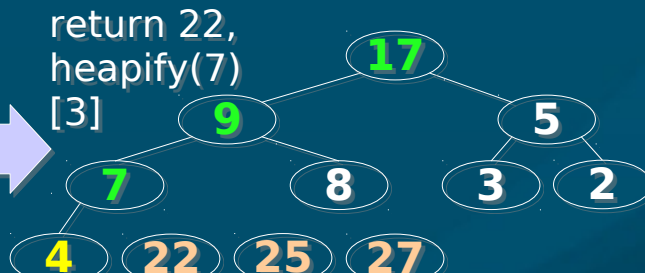
return 22, heapify(7) [3]
- 17
- 9, 5
- 7, 8, 3, 2
- 4, 22, 25, 27
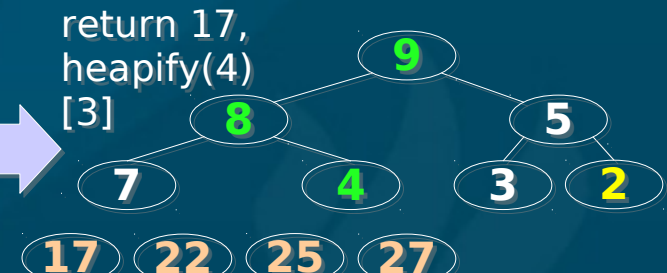
return 17, heapify(4) [3]
- 9
- 8, 5
- 7, 4, 3, 2
- 17, 22, 25, 27

return 9, heapify(2) [3]
- 8
- 7, 5
- 2, 4, 3, 9
- 17, 22, 25, 27

return 8, heapify(3) [3]
- 7
- 4, 5
- 2, 3, 8, 9
- 17, 22, 25, 27

return 7, heapify(3) [2]
- 5
- 4, 3
- 2, 7, 8, 9
- 17, 22, 25, 27

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Exam 2: solutions #1-2

return 5,
heapify(2):
[2]

(4)
(2) (3)
(5) (7) (8) (9)
(17) (22) (25) (27)

→

return 4,
heapify(3):
[1]

(3)
(2) (4)
(5) (7) (8) (9)
(17) (22) (25) (27)

→

return 3, 2
[1]

(2)
(3) (4)
(5) (7) (8) (9)
(17) (22) (25) (27)
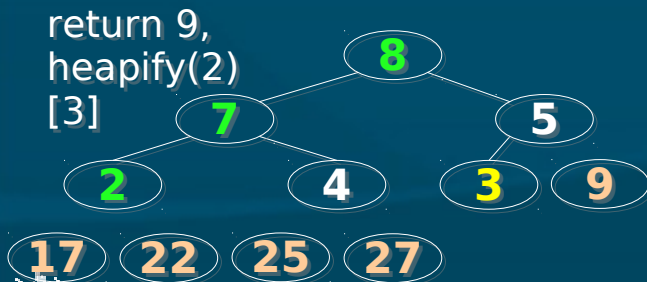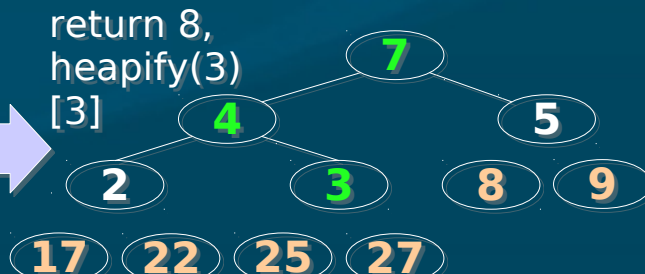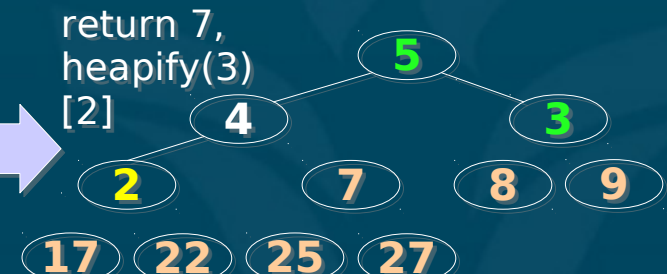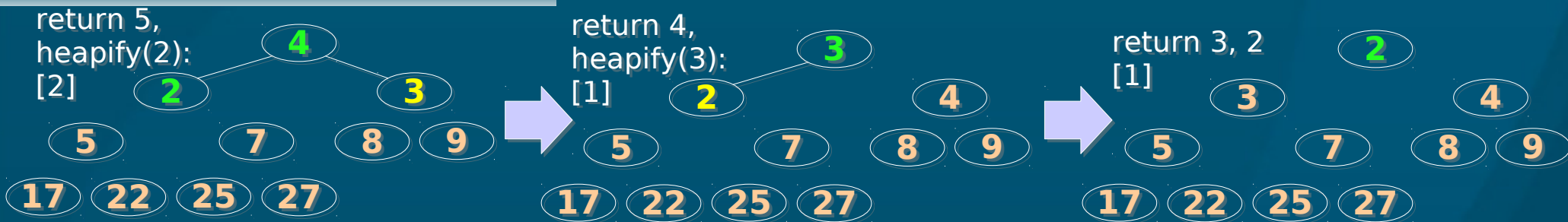
- Heapsort: 32 swaps

- Quicksort: only 8 swaps!

Pivot=27:	7	4	25	17	3	5	2	9	22	8	27	Swaps
8:	7	4	3	5	2	8	25	9	22	17	.	4
2:	2	4	3	5	7	.	.	.	.	.	.	1
7:	.	4	3	5	7	.	.	.	.	.	.	.
5:	.	4	3	5	.	.	.	.	.	.	.	.
3:	.	3	4	.	.	.	.	.	.	.	.	1
17:	.	.	.	.	.	.	9	17	22	25	.	2
25:	.	.	.	.	.	.	.	.	22	25	.	.

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Exam 2: solutions #3

- max-min range is $25 \Rightarrow b = 5$ bits
  - $n = 11 \Rightarrow \lfloor \lg n \rfloor = 3$ bits
- So by the rule of thumb on p.199, $b \geq \lfloor \lg n \rfloor$, so we use $r = \lfloor \lg n \rfloor = 3$ bits, i.e., base-8

			convert to octal				sort digit				sort digit				convert to decimal	
7				0	7			1	0			0	2			2
4				0	4			3	1			0	3			3
25				3	1			2	1			0	4			4
17				2	1			1	1			0	5			5
3				0	3			0	2			0	7			7
5				0	5			0	3			1	0			8
2				0	2			3	3			1	1			9
9				1	1			0	4			2	1			17
22				2	6			0	5			2	6			22
8				1	0			2	6			3	1			25
27				3	3			0	7			3	3			27

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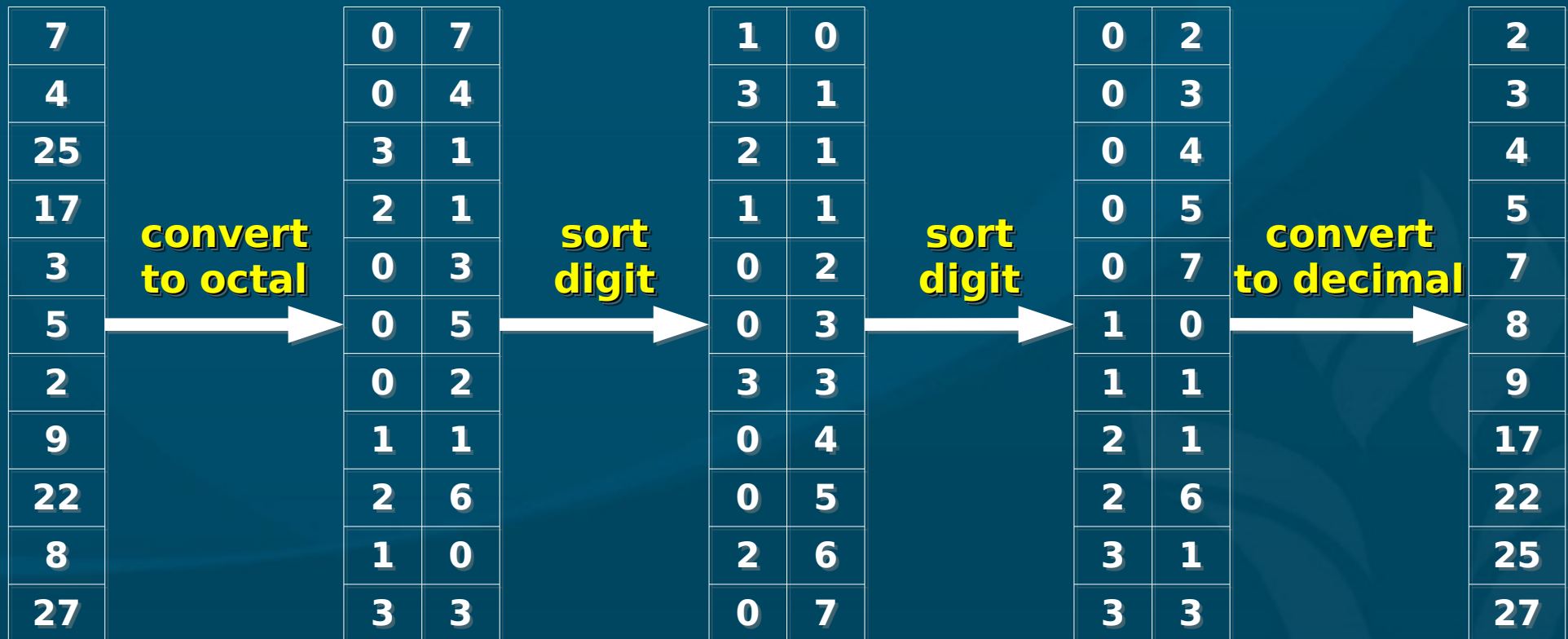
Exam 2: solutions #4

- Quadratic-(0,1) probe sequence:
  0, 1, 4, 9, 5 (4^2 mod 11), 3, 3, 5, 9, 4, 1, 0, 1, ...
  - Probe sequence only hits 6 entries out of 11, so may miss an open slot in the table
- Asterisk (*) indicates number of hash collisions:

Slot	0	1	2	3	4	5	6	7	8	9	10
Linear	22	27 *7	2	25	4	3 *	17	7	5 *3	9	8 *2
Quad	22	3 *3	2	25	4	5	17	7	8	9	27 *4

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