



## 5. DIVIDE AND CONQUER I

### ► quickselect demo

Lecture slides by Kevin Wayne

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<http://www.cs.princeton.edu/~wayne/kleinberg-tardos>

Last updated on Sep 8, 2013 6:33 AM

## Quickselect demo

### 3-way partition array so that:

- Pivot element  $p$  is in place.
- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

select the  $k = 8^{\text{th}}$  smallest

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
65	28	59	33	21	56	22	95	50	12	90	53	28	77	39

$k = 8^{\text{th}}$  smallest

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## Quickselect demo

### 3-way partition array so that:

- Pivot element  $p$  is in place.
- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

choose a pivot element at random and partition

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
65	28	59	33	21	56	22	95	50	12	90	53	28	77	39

$k = 8^{\text{th}}$  smallest

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## Quickselect demo

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- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

partitioned array

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
28	33	21	56	22	50	12	53	28	39	59	65	95	90	77

$k = 8^{\text{th}}$  smallest

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## Quickselect demo

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- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

recursively select 8<sup>th</sup> smallest element in left subarray

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
28	33	21	56	22	50	12	53	28	39	59	65	95	90	77

$k = 8^{\text{th}}$  smallest

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Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

choose a pivot element at random and partition

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
28	33	21	56	22	50	12	53	28	39	59	65	95	90	77

$k = 8^{\text{th}}$  smallest

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## Quickselect demo

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- Pivot element  $p$  is in place.
- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

partitioned array

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
21	22	12	28	28	33	56	50	53	39	59	65	95	90	77

$k = 8^{\text{th}}$  smallest

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## Quickselect demo

### 3-way partition array so that:

- Pivot element  $p$  is in place.
- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

recursively select the 3<sup>rd</sup> smallest element in right subarray

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
21	22	12	28	28	33	56	50	53	39	59	65	95	90	77

$k = 3^{\text{rd}}$  smallest

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## Quickselect demo

### 3-way partition array so that:

- Pivot element  $p$  is in place.
- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

choose a pivot element at random and partition

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
21	22	12	28	28	33	56	50	53	39	59	65	95	90	77

$k = 3^{\text{rd}}$  smallest

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## Quickselect demo

### 3-way partition array so that:

- Pivot element  $p$  is in place.
- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

partitioned array

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
21	22	12	28	28	33	39	50	53	56	59	65	95	90	77

$k = 3^{\text{rd}}$  smallest

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## Quickselect demo

### 3-way partition array so that:

- Pivot element  $p$  is in place.
- Smaller elements in left subarray  $L$ .
- Equal elements in middle subarray  $M$ .
- Larger elements in right subarray  $R$ .

Recur in **one** subarray—the one containing the  $k^{\text{th}}$  smallest element.

stop: desired element is in middle subarray

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
21	22	12	28	28	33	39	50	53	56	59	65	95	90	77

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