Find The Median (code outline)

```
MedianFind(A[0..n-1])
     Let A[p] be the pivot //TODO need to select p.
     Let S and B be two arrays //"small" and "big" elements
     for(i from 0 to n-1 except p)
          if(A[i] <= A[p])
               Copy A[i] into S
          else
               Copy A[i] into B
     if(S.length == n/2-1) return A[p] //A[p] is median
     else if (S.length >= n/2)
          …//TODO what goes here?
     else
          …//TODO what goes here?
```

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Pivot Finding Example

You can still find the median of 5 elements in constant time. (5 is a constant).

Don't just find the median of 5 elements and make that a pivot

…split the array into groups of 5 and get $n/5$ candidate pivots

If the array starts

A	32	5	17	53	101	10	4	23	15	98	…

Blue medians are candidates

5	4
17	10
32	15
53	23
101	98

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Running Time Analysis (1)

Let $T(n)$ be the running time of `QuickSelect` on an array of size n.

Non-recursive work? $O(n)$

$$T(n) = \begin{cases} O(1) & \text{if } n < 100 \\ ??? + O(n) & \text{otherwise} \end{cases}$$

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Master Theorem

Given a recurrence of the following form, where a, b, c, and d are constants:

$$T(n) = \begin{cases} d & \text{if } n \text{ is at most some constant} \\ aT\left(\frac{n}{b}\right) + f(n) & \text{otherwise} \end{cases}$$

Where $f(n)$ is $\Theta(n^c \log^k n)$ for $k \geq 0$, $a \in \mathbb{Z}^+$, $c \geq 1$

If $\log_b a < c$ then $T(n) \in \Theta(n^c \cdot \log^k n)$

If $\log_b a = c$ then $T(n) \in \Theta(n^c \log^{k+1} n)$

If $\log_b a > c$ then $T(n) \in \Theta(n^{\log_b a})$

Theorem still holds even if there are ceilings/floors in the $T\left(\frac{n}{b}\right)$ term.

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