11.4
Selecting in Unsorted Lists
11.4.1

Problem definition and basic algorithm
Rank of element in an array

**A**: an unsorted array of \( n \) integers

**Definition**

For \( 1 \leq j \leq n \), element of rank \( j \) is the \( j \)th smallest element in \( A \).

<table>
<thead>
<tr>
<th>Unsorted array</th>
<th>16</th>
<th>14</th>
<th>34</th>
<th>20</th>
<th>12</th>
<th>5</th>
<th>3</th>
<th>19</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranks</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Sort of array</td>
<td>3</td>
<td>5</td>
<td>11</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>19</td>
<td>20</td>
<td>34</td>
</tr>
</tbody>
</table>
Problem - Selection

Input  Unsorted array $A$ of $n$ integers and integer $j$

Goal  Find the $j$th smallest number in $A$ (rank $j$ number)

Median: $j = \lceil (n + 1)/2 \rceil$

Simplifying assumption for sake of notation: elements of $A$ are distinct
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2. Pick $j$th element in sorted order

Time taken = $O(n \log n)$

Do we need to sort? Is there an $O(n)$ time algorithm?
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Algorithm II

If $j$ is small or $n - j$ is small then

1. Find $j$ smallest/largest elements in $A$ in $O(jn)$ time. (How?)
2. Time to find median is $O(n^2)$. 
THE END

... (for now)