Week 3
last time
help50
eprintf
debug50
string

Z a m y l a
string

Z a m y l a
<table>
<thead>
<tr>
<th>z</th>
<th>a</th>
<th>m</th>
<th>y</th>
<th>l</th>
<th>a</th>
<th>\0</th>
</tr>
</thead>
</table>
int main(void)
int main(int argc, string argv[])

this time
linear search
for each element in array
    if element you're looking for
        return true
return false
binary search
look at middle of sorted array
if element you're looking for
    return true
else if element is to left
    search left half of array
else if element is to right
    search right half of array
else
    return false
bubble sort
repeat until no swaps
    for i from 0 to n-2
        if i'th and i+1'th elements out of order
            swap them
selection sort
for i from 0 to n-1
find smallest element between i'th and n-1'th
swap smallest with i'th element
insertion sort
for i from 1 to n-1
    call 0'th through i-1'th elements the "sorted side"
    remove i'th element
    insert it into sorted side in order
running time
bubble sort
$(n - 1)$
\((n - 1) + (n - 2)\)
\((n - 1) + (n - 2) + \ldots + 1\)
\[(n - 1) + (n - 2) + \ldots + 1\]

\[n(n - 1)/2\]
\[(n - 1) + (n - 2) + \ldots + 1\]
\[= n(n - 1)/2\]
\[= (n^2 - n)/2\]
\[(n - 1) + (n - 2) + \ldots + 1\]
\[n(n - 1)/2\]
\[(n^2 - n)/2\]
\[n^2/2 - n/2\]
\[
n^2/2 - n/2
\]
\[ \frac{n^2}{2} - \frac{n}{2} \]

\[ 1,000,000^2/2 - 1,000,000/2 \]
\[
\frac{n^2}{2} - \frac{n}{2}
\]
\[
1,000,000^2/2 - 1,000,000/2
\]
\[
500,000,000,000,000 - 500,000
\]
\[ \left( \frac{n^2}{2} - \frac{n}{2} \right) \]

\[ 1,000,000^2/2 - 1,000,000/2 \]

\[ 500,000,000,000 - 500,000 \]

\[ 499,999,500,000 \]
\( \frac{n^2}{2} - \frac{n}{2} \)
$O(n^2)$

$O(n \log n)$

$O(n)$

$O(\log n)$

$O(1)$

...
$O(n^2)$

$O(n \log n)$

$O(n)$

$O(\log n)$

$O(1)$

\ldots
$O(n^2)$
$O(n \log n)$
$O(n)$
$O(\log n)$
$O(1)$

...
\(O(n^2)\)
\(O(n \log n)\)
\(O(n)\)
\(O(n)\)
\(O(\log n)\)
\(O(\log n)\)
\(O(1)\)
\(O(1)\)
\(\ldots\)
$O(n^2)$

$O(n \log n)$

$O(n)$

$O(\log n)$

$O(1)$

...
\[ \Omega(n^2) \]
\[ \Omega(n \log n) \]
\[ \Omega(n) \]
\[ \Omega(\log n) \]
\[ \Omega(1) \]
\[ \ldots \]
\( \Omega(n^2) \)
\( \Omega(n \log n) \)
\( \Omega(n) \)
\( \Omega(\log n) \)
\( \Omega(1) \)
\( \ldots \)
\( \Omega(n^2) \)
\( \Omega(n \log n) \)
\( \Omega(n) \)
\( \Omega(\log n) \)
\( \Omega(1) \)

\( \ldots \)
\( O(n^2) \)
0  pick up phone book
1  open to middle of phone book
2  look at names
3  if Smith is among names
   4    call Mike
5  else if Smith is earlier in book
6      open to middle of left half of book
7      go back to step 2
8  else if Smith is later in book
9      open to middle of right half of book
10     go back to step 2
11  else
12    quit
0  pick up phone book
1  open to middle of phone book
2  look at names
3  if Smith is among names
   4    call Mike
5  else if Smith is earlier in book
   6    search for Mike in left half of book
7
8  else if Smith is later in book
   9    search for Mike in right half of book
10
11  else
12    quit
merge sort
On input of n elements

if $n < 2$
    return

else
    sort left half of elements
    sort right half of elements
    merge sorted halves
<table>
<thead>
<tr>
<th>1</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
$O(n \log n)$
On input of $n$ elements
    if $n < 2$
        return
    else
        sort left half of elements
        sort right half of elements
        merge sorted halves
On input of $n$ elements

if $n < 2$
  return

else
  sort left half of elements
  sort right half of elements
  merge sorted halves
$$T(n) = O(1)$$

if \( n < 2 \)
On input of $n$ elements

if $n < 2$
    return

else

    sort left half of elements
    sort right half of elements
    merge sorted halves
On input of $n$ elements

if $n < 2$

return

else

sort left half of elements

sort right half of elements

merge sorted halves
On input of $n$ elements

if $n < 2$
    return

else
    sort left half of elements
    sort right half of elements
    merge sorted halves
$T(n) = T(n/2) + T(n/2) + O(n)$

if $n \geq 2$
$O(n \log n)$
Week 3