

Class 08

DECREASE AND CONQUER

DECREASE BY A CONSTANT FACTOR

Student Learning Objectives

Students should be able to...

- Explain the behavior and list the varieties of decrease-and-conquer algorithms
- Analyze insertion sort and compare it to selection sort
- Analyze decrease-by-a-constant-factor algorithms

Decrease-and-Conquer

Problem \rightarrow Single smaller problem

Variations:

- decrease by a constant $n \rightarrow n - c$
- decrease by a constant factor $n \rightarrow n/c$
- variable size decrease $n \rightarrow <n$

Can be recursive or iterative algorithm

Decrease-and-Conquer

$$f(n) = \begin{cases} f(n-1) * a & \text{if } n > 0 \\ 1 & \text{if } n = 0 \end{cases}$$

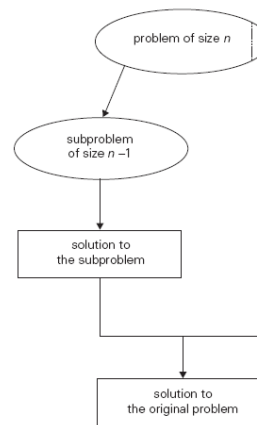


FIGURE 4.1 Decrease-by one-and-conquer technique.

Decrease-and-Conquer

$$a^n = \begin{cases} (a^{n/2})^2 & \text{if } n \text{ is even and pos.} \\ (a^{(n-1)/2})^2 & \text{if } n \text{ is odd} \\ 1 & \text{if } n = 0 \end{cases}$$

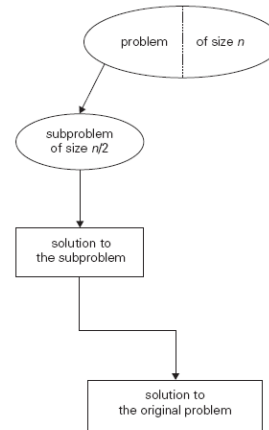
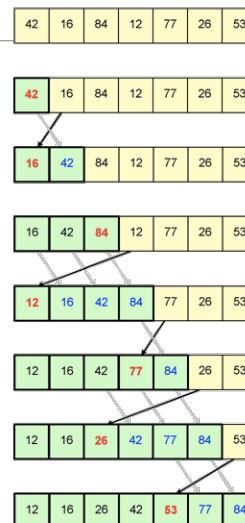


FIGURE 4.2 Decrease-(by half)-and-conquer technique.

Insertion Sort

ALGORITHM *InsertionSort*($A[0..n-1]$)
 //Sorts a given array by insertion sort
 //Input: An array $A[0..n-1]$ of n orderable elements
 //Output: Array $A[0..n-1]$ sorted in nondecreasing order
for $i \leftarrow 1$ **to** $n-1$ **do**
 $v \leftarrow A[i]$
 $j \leftarrow i-1$
 while $j \geq 0$ **and** $A[j] > v$ **do**
 $A[j+1] \leftarrow A[j]$
 $j \leftarrow j-1$
 $A[j+1] \leftarrow v$



Insertion Sort

```
ALGORITHM InsertionSort( $A[0..n-1]$ )
//Sorts a given array by insertion sort
//Input: An array  $A[0..n-1]$  of  $n$  orderable elements
//Output: Array  $A[0..n-1]$  sorted in nondecreasing order
for  $i \leftarrow 1$  to  $n-1$  do
     $v \leftarrow A[i]$ 
     $j \leftarrow i-1$ 
    while  $j \geq 0$  and  $A[j] > v$  do
         $A[j+1] \leftarrow A[j]$ 
         $j \leftarrow j-1$ 
     $A[j+1] \leftarrow v$ 
```

How is it decrease-and-conquer?

Develop summation for best case and solve

Develop summation for worst case and solve

Average case options