```
while ( left z = reght)
   I'f ( a [mid] < search-element
    mid = left + (right-left) /2; if (a [mid] == search-ele)
                                    acilia return mid;
    if ( search-ele e a [mid])
                                       Mashel
            left = mid+1
else if ( search-ele > a[mid])
                         amiliar sout the 300
             right mid of 1. sight awyords the our
             the state citamonis on form in the
Recursive approach
   public static int binarysearch ( Ent array [], Ent left,
          Ent right, int etem) [
     if ( lefte=right)
            int mid: left+ (right-left)/2 1
            (f( array[mid] == item)
                    retorn mid;
             if (array[mid] > item)
              return binaugsearch (array, left, midtl, ite
                 return binary Search (array, mid+1, right,
                                                 item)
                   ( +11; Fast -1; ost that) est
            return di ustai cont dost cot
                  (Cirllag Dia) +
  Tence complexity Space complexity
      But ou)
                                   600
      Average : o(log n)
      worst : O(log n)
```

_ sorted array)

is many season

Sorting Corted Array Chrony Supplied Not-in-place sorting in-place sorting Bubble sortin selection, c/ (1951-14) Quick + +31 = 6210 Merge Manto) ([, Swith ele c a [mid.]) Heap Library Hol. Bubble sort t We will take starting two elements from the list. we will compare those elements with 3 If There elements are found in unsorted order, we will sort them. else we will compare next to elements. 5. Repeat until we } gets + 28 oxted guray pax 1 28 6 4 2 24 -> 6 28 4 2 24:11 و غود لا الحي علاوني لا علا علا علا 6 4 2 28 24 7 6 4 2 24 28 24 28 6 4 24 28 1 5 liping 1 20 24 21 4 6 2 24 24 27 4 2 6 24 28 return throughoust discontinues for (Int 1=0; i < len-1; i++) { for (Int 3=0; j< len-1-1; j++) { if calgionalgeil) Messlynde wint temp-alffredquas mil algi : aljtil alj+1] = temposto soora (a polito direct)

Best:O(n) Average + O(n2) Worst + O(n2) Space complexity

In optimized bubble sort, we a boblean variable swapped, initialize with false for every steration? It it remains false at end of steration i.e., no swapping occurs in a pass (it indicates that array is already sorted) then you can break the loop.

Selection Sort - At any pt of implementation, we'll have array divided into a sorted array part on the left and unsorted array part on the sight.

- 1. We find smallest ele on unsorted part of array
- 2 replace it with first item on unsorted part of array
- 3 sorted are to by one element.

78 4 50 10 44 8 20 -> 81 50 10 44 72 20

- 10 50 44 TZ 20

- 8 10 1 20 1 44 72 SD

- 8 10 20 44 1 72 TO

- 10 20 44 TO 7

Mar

Ass (100, 10 len-1; 1++) & min=1

for (scien; scien; see)

If (algscalmin)

Tempte complexity

males = 3

O(n2)

aways asment, assil)

Insertion Sort 531982 47 ->35 L9 812 4 7 120W ×135812 442 En 1 3 5 9 8 2 4 7 10 3 5 9 \$ 2 4 9 mg one to mentale to be to post 8 grandary to 1: 3 5 8 9 4 3 7 Car 1 2 3 4 5 8 9 7 7 Proces 12345789 Selection Sort = At any pr of this ends notherland hove away divided into a carred for a fine the key and I will be that the would (i) =0 at arr[1] 5 (key) hard and arr[j+i]=arr[j] carty +i] = tey 15288 1 complisity Times complexity O(n2) 1333. 133589 blasmin of pales

11 choose prot element Quick sort en Java 2 more ple less than privot in left partition 3. more ele greater than prot to right " 4. partition ender a descovered at the end pivot-high 10 30 50 20 60 60 100000000 10 20 30 50 to 701-90 pp) holding 10 20 30 - 10 10 10 30 50 20 60 Teme complexity O(nlogn) - But, Average now swap (set 2 pivot) O(n2) - If proof is 10 30 50 20 60 90 70 element. \$1 10 30 50 20 10 30 50 20 10 30 50 20 Spea complexity swap (51711 Plant) 1 + sammigare 11.10 20 30 S (wo. 10 50 30 nunied tany space complianty octogn) function call stack

```
Quick sort
      main (
                  to thoon phot turned
ent all=[1,2,314,5,6,7,8,43]
   int size = a length;
          quick Sort (a, 0,512e-1)
        quickSort ( and all, but low, but high )
           if ( low chigh) &
                int index PI = partition (arr, low, high)
       quickSort (arrow, low, indexPI-1),
                quickSort( array, indexPI+1, high);
         postition ( int all, int low, int high)
            prot = arr[high]
                                              leave comparity
                swap index = low-1
               for ( j=10w, jc=high-la nist) (appla)
               if (arrli] < pivot)
                         swap Endex, ++ tovid to - (5010)
                         ([[]) r ([ [ xwapindex], ] rig) qqawa
                   1
        swap( arr [swapindex + 1], alhigh),
        retun
                    swapindex +1.
                                       · 12 to 1 front factoria
                              Capple of Logar
```

Mage Sort -11 main() mergesort (a10, size-1) mergesort (a, left, right) ine mid > if lifte right & mid = left + (right - left) /2 merge Sort (a, left, mid); meage Sort (a, mid+1, right); merge (a, left, mid, right); with adapted and an Same ways as the merge (arr, left, mid, right) (ngoln)o int 1, 1, K, M1, M2 11 length of left subcuracy M = mid-left +1 nz = right - left mid L[MI], R[n2] for (1=0 ; ten1 ; 1+t) L[1] = arr[left+i] for (1=0; j<n2; j++) R[]] = arr [mid+1+]] \$=0,3=0 11 Starting index of LIR merged subarray) while (9 cm kk f cnz) f 1f(L[1]<= R[7] { an[k] - L[i] else i arrik] = R[i] ; j++ k++

```
wate (1 ani) ?
          arith a LCTJ;
                               (1 - bell - and ) finite grounds
           松本本
     B Cens Dalmen
                             Callete Hall to grandpula
           ant+1 = P[]]
                                    THE BURN
  & menge method close the trape of
                      mergy Somet a latter with).
                  Ludgie intine, b) + obspecies
                  mone Cantitationide rights
Tame complexity
                              Space complexity
                       ( we is 1611 of the ) 201519
 Best
 worst ( o (n log n)
                                 ellin tairi Lui
 Average moder files to Here 1 " It 4761 bin = all
                                   Lendy pells
                              (fri; 10=# 0=1) =
                        [17 +781] 100 = [7] J
                              (44) (100) 100)
                 All the pind to 1 19
                     A, J to reply Baltunia 1 to 10
           basecours bagains
                              f (in al 12 inst Juliated
                                子工程和公司的分子
                            1001 - [4]00
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