GITAM
(DEEMED TO BE UNIVERSITY)
(Estd. u/s 3 of the UGC Act, 1956)
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EID305: Design and Analysis of Algorithms
Module I: Part B: Finding Maximum and Minimum

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Finding Maximum and Minimum: Straight method

```
Algorithm Straightmaxmin(a, n, max, min)
//let max be the maximum and  min be the minimum of a[1:n]
{  max:=  min := a[1];
     for i:=2 to n do
        {  if(a[i] > max) then max :=a[i];
           if (a[i] < min) then min := a[i];
        }
  }
```

Index	Element
1	22
2	25
3	20
4	47
5	37
6	25
7	10
8	45
9	66
10	55

Max : 66
Min : 10

```
Case1:    if (a[i] > max) then max:=a[i];
          if (a[i] < min) then min:= a[i];
```

- This requires 2(n-1) elements comparisons in the best , average and worst case.
- The comparison a[i]<min is necessary only when a[i]>max is false.

```
if (a[i] > max) then max:=a[i];
else if (a[i] < min) then min:= a[i];
```

- The **best case** occurs when the elements are in increasing order.
- Number of elements comparisons : (n-1).
- The **worst case** occurs when the elements are in decreasing order.
- The no. of elements comparisons is 2(n-1).

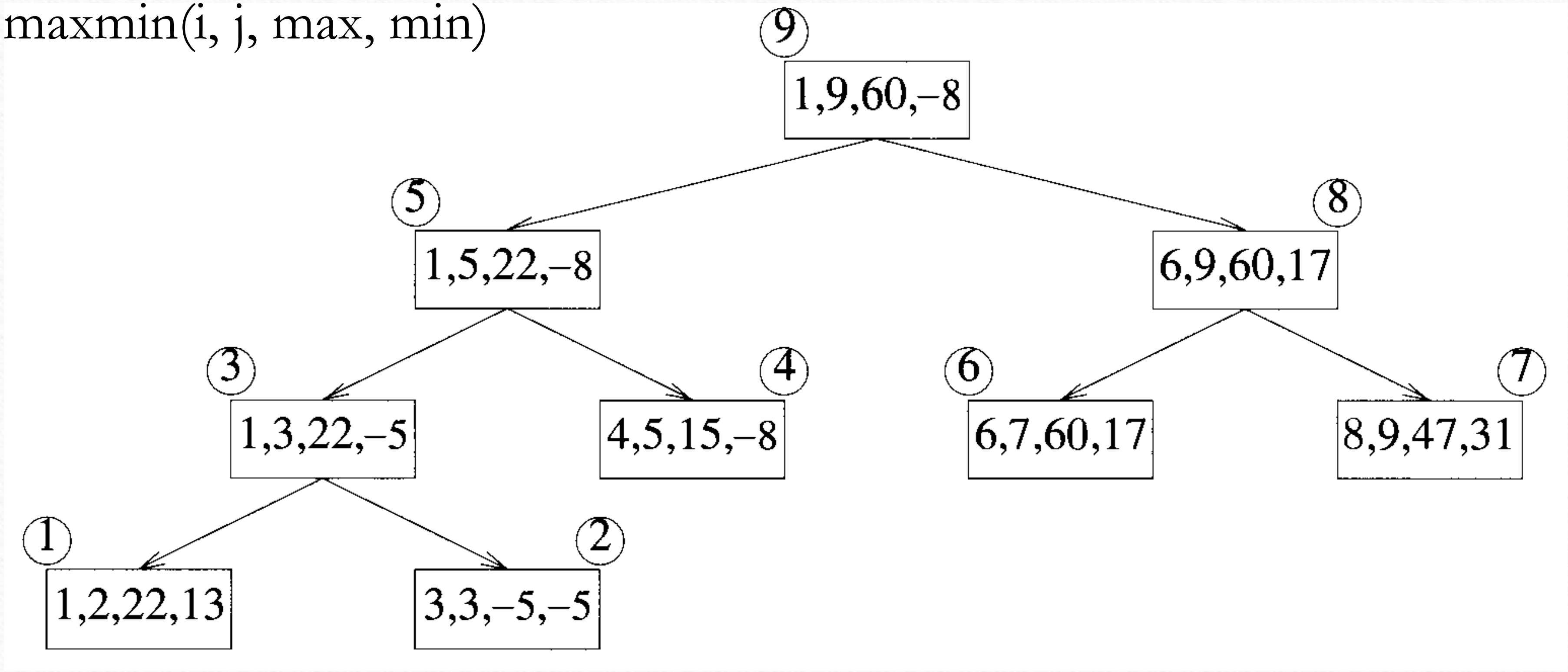
Index	Element
1	22
2	32
3	34
4	47
5	57
6	65
7	70
8	85
9	86
10	95

Index	Element
1	92
2	82
3	64
4	57
5	47
6	45
7	40
8	35
9	26
10	15

Finding Maximum and Minimum: DAndC

```
Algorithm  maxmin(i, j, max, min)
// a[1:n] is a global array, i and j integers 1 ≤ i  ≤ j ≤ n
{  if(i=j) then max := min := a[i];   //Small(P)
    else if  (i = j-1) then // Another case for small(P)
                  {  if  (a[i] < a[j]) then  {  min :=a[i];   max :=a[j];
                      else {min := a[j]; max:=a[i]}
                    }
           else {  // if  P is not small divide P into sub problems. Find where to split the set.
                            mid= (i+j)/2;
                           // solve the sub problem/
                            maxmin (i, mid, max, min);
                            maxmin (mid+1, j, max1, min1);
                     }
    // combine the solutions
    if  (max< max1) then max:=max1;
    if(min>min1)the min := min1;
    } // end of if-else
} // end of algorithm
```

Index	1	2	3	4	5	6	7	8	9
Value	22	13	-5	-8	15	60	17	31	47



Finding Maximum and Minimum: Introduction

No . of elements comparisons needed for max min is:

- $$T(n)=\begin{cases} T(n/2)+T([n/2]+2 & n>2 \\ 1 & n=2 \\ 0 & n=1 \end{cases}$$

When n is a power of 2. I.e., $n=2^k$ where k is positive integer.

$$T(n)=2T(n/2)+2$$
$$2(2T(n/4)+2)+2$$
$$4T(n/4)+2^2+2$$
$$4(2T(n/8)+2)+2^2+2$$
$$8T(n/8)+2^3+2^2+2..$$
$$2^{k-1}T(2)+\sum_{1\le i\le k-1} 2^i$$
$$2^{k-1}+2^k-2$$

3n/2 -2 number of comparisons for best, average and worst case comparisons when n is a power of w.

- **Recursive calls of max min**
- In terms of storage maxmin is worse than the straight forward algorithm.. Because it requires stack space for i , j max, min, max1, min1.
- For n elements there will be $[\log_2 n] + 1$ levels of recursion need to save 'n' values for recursive call
- If comparisons among the elements of a[ ] are much more costly than comparisons of integers variables, then the divide and conquer technique has given a more efficient algorithm. If not, it yields a less-efficient algorithm.
- DAndC strategy is only a guide to better algorithm design which may not always succeed. Both maxmin & straightmaxmin are O(n)