Lecture 9-2 : Array Examples : Bubble Sort and Binary Search

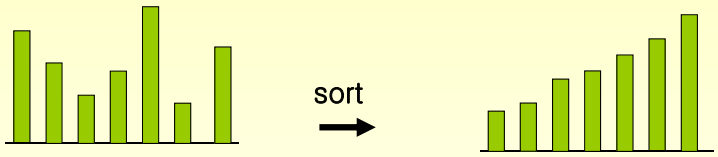
Acknowledgment : Lecture notes from Ohio Supercomputing Center

Array arguments in function

```
#include <stdio.h>

void myFunction(int yourArray[], int n);

int main ()
{
    int i;
    int myArray[4] = {0};
    myFunction( myArray, 4);
    for (i = 0; i < 4; i++)
        printf("%d\n",myArray[i]);
    return 0;
}

void myFunction (int yourArray[], int n)
{
    int i;
    for (i = 0; i < n; i++)
        yourArray[i] = i;
}
```

```
0
1
2
3
```

Examples : Sorting , Binary Search



Linear search vs binary search

Search 12

?

In worst case, 15 comparisons are necessary using lineary search

25	34	7	36	29	91	83	42	6	13	73	54	22	63	12

sort

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6	7	12	13	22	25	29	34	36	42	54	63	73	83	91

If sorted, at most 4 comparisons are enough using binary search.

bubble sorting

- Simple sorting algorithm
- Relatively slow
- Time Complexity
  - Worst case O(N^2)
  - Average case O(N^2)

Step-by-step example sorting (5, 1, 4, 2, 8)

- First Pass :

  (5 1 4 2 8) -> (1 5 4 2 8)
  (1 5 4 2 8) -> (1 4 5 2 8)
  (1 4 5 2 8) -> (1 4 2 5 8)
  (1 4 2 5 8) -> (1 4 2 5 8)

- Second Pass :

  (1 4 2 5 8) -> (1 4 2 5 8)
  (1 4 2 5 8) -> (1 2 4 5 8)
  (1 2 4 5 8) -> (1 2 4 5 8)

- Third Pass :

  (1 2 4 5 8) -> (1 2 4 5 8)
  (1 2 4 5 8) -> (1 2 4 5 8)

- Forth Pass :

  (1 2 4 5 8) -> (1 2 4 5 8)

Bubble sort function

```
void bubbleSort(int A[], int N)
{
   int temp,i, j;
   for (i=N-1;i>=1;i--)
        for (j=1;j<=i;j++)
               if (A[j-1]>A[j]) {
                      temp=A[j-1];
                      A[j-1]=A[j];
                      A[j]=temp;
               }
}
```

```
#include <stdio.h>

void bubbleSort(int A[], int N);

int main()
{
   int i;
   int a[5]={5,1,4,2,8};
   bubbleSort(a,5);
   for (i=0;i<5;i++)
        printf("%d\n",a[i]);

   return 0;
}
```

Binary Search

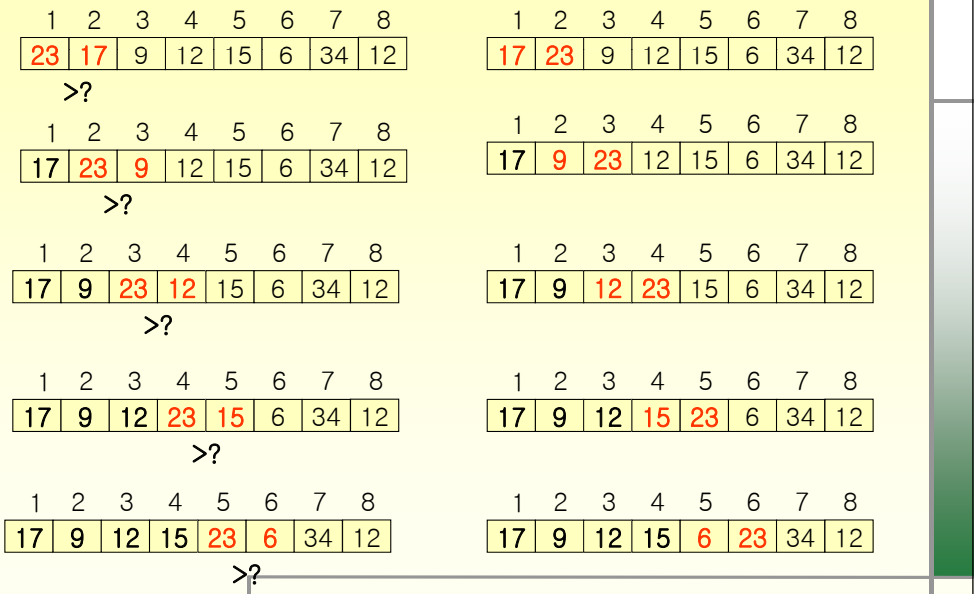
```
/* This function searches for v in array a
   with size N.
   If found, it returns the array index.
   If not found, it returns -1. */
int binsearch(int a[], int N, int v)
{
   int l=0; int r=N-1; int x;
   while (r>=l) {
        x=(l+r)/2;
        if (v<a[x]) r=x-1;
        else l=x+1;
        if (v==a[x]) return x;
   }
   return -1;
}
```

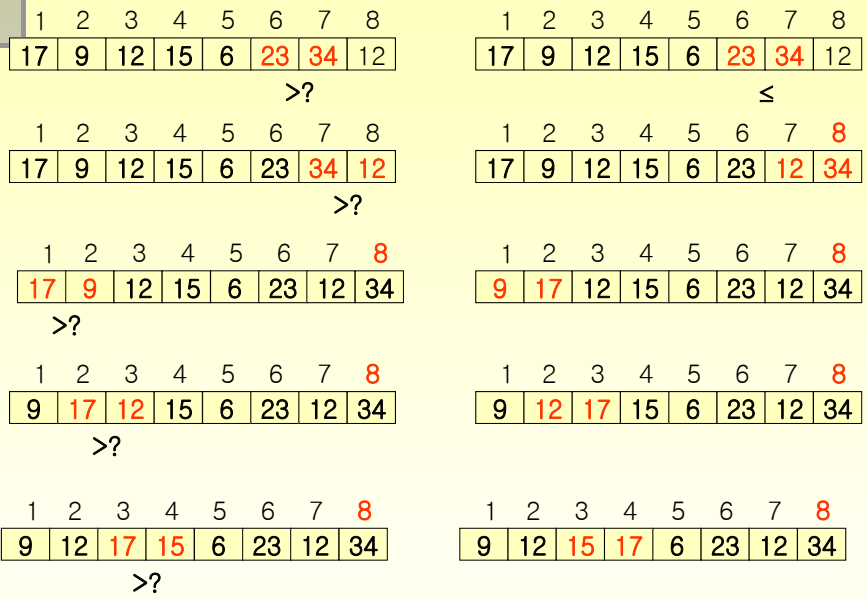
```
#include <stdio.h>

int binsearch(int a[], int N, int v);

int main()
{
   int position;
   int a[5]={1,2,4,5,8};
   position = binsearch(a, 5, 2);
   printf("%d\n",position);

   return 0;
}
```

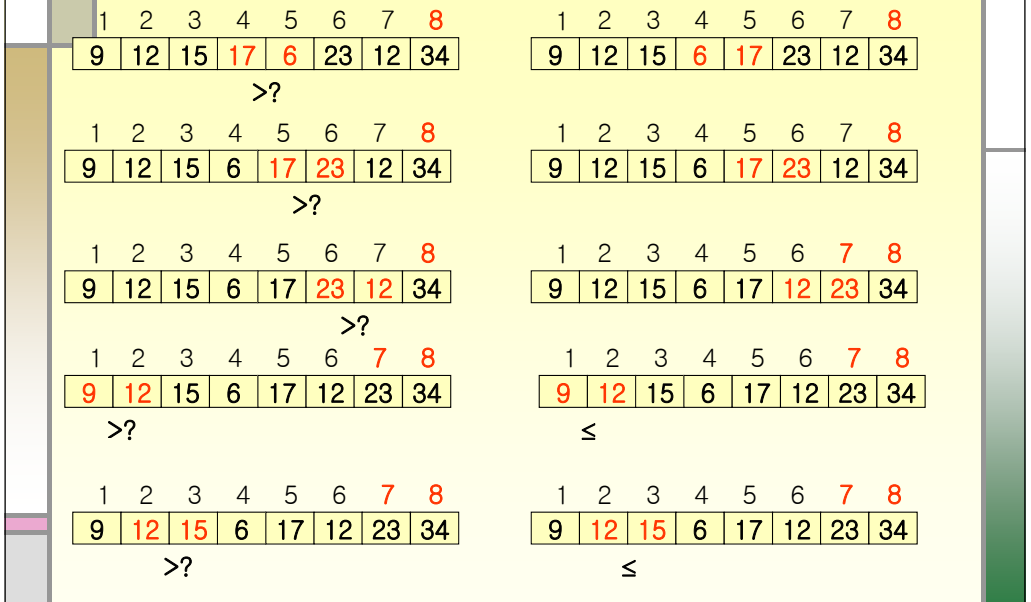
binary search (recursive function)

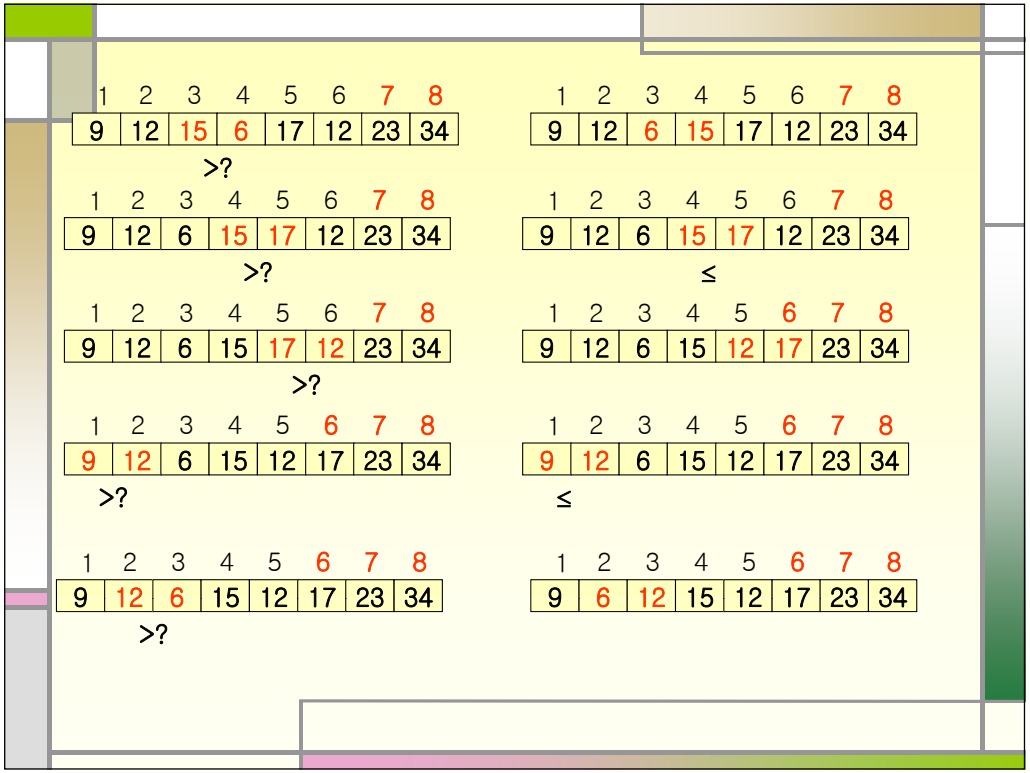
```
/* This function searches for v in array a with size N.
   If found, it returns the array index.
   If not found, it returns -1. */
int binsearch(int a[], int N, int v)
{
// insert your code here




}
```

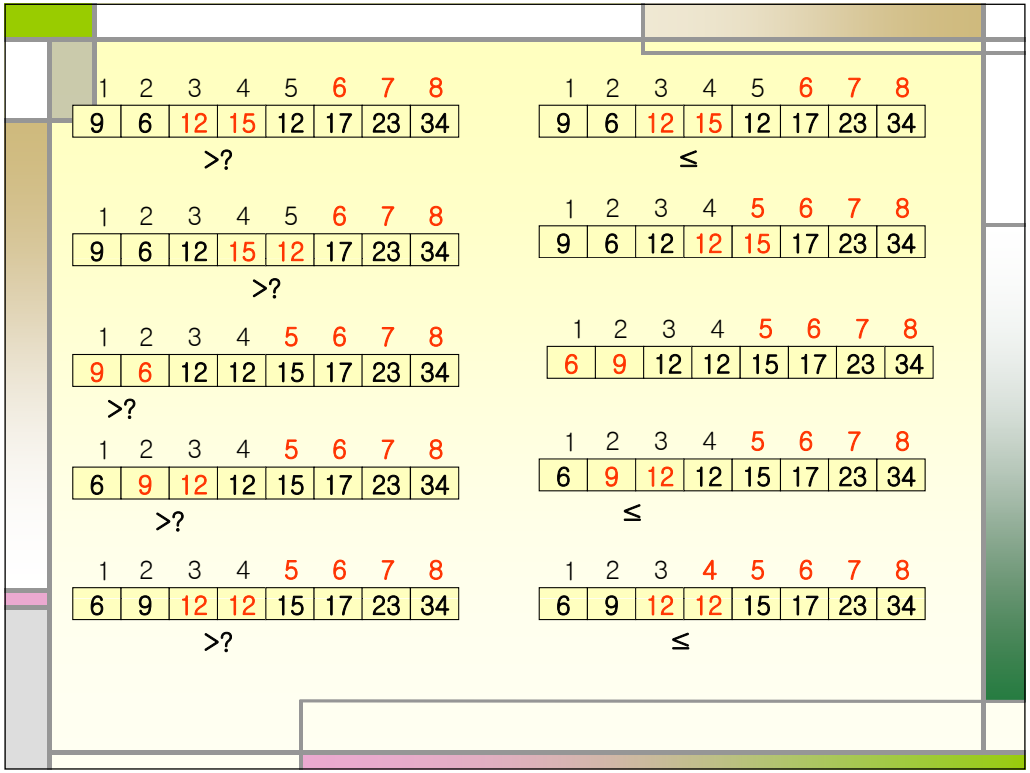
Bubble Sort example 2

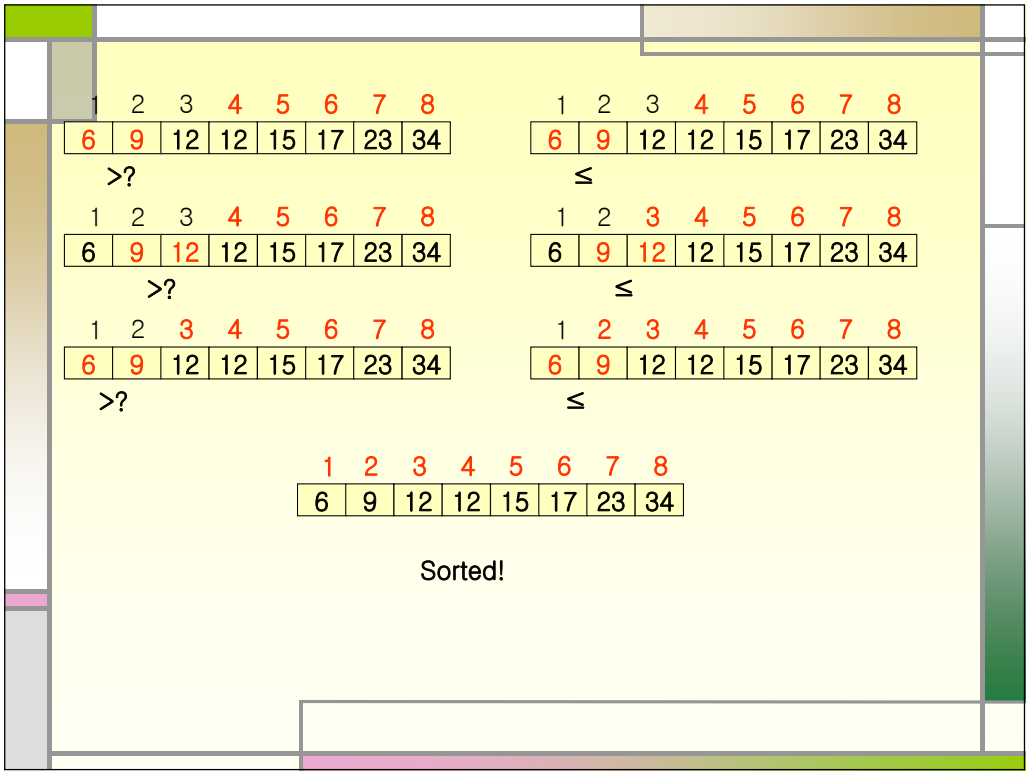







1 2 3 4 5 6 7 8
9 12 15 6 17 12 23 34
>?
1 2 3 4 5 6 7 8
9 12 6 15 17 12 23 34
>?
1 2 3 4 5 6 7 8
9 12 6 15 17 12 23 34
≤
1 2 3 4 5 6 7 8
9 12 6 15 17 12 23 34
>?
1 2 3 4 5 6 7 8
9 12 6 15 12 17 23 34
≤
1 2 3 4 5 6 7 8
9 12 6 15 12 17 23 34
>?
1 2 3 4 5 6 7 8
9 6 12 15 12 17 23 34


1 2 3 4 5 6 7 8
9 6 12 15 12 17 23 34
>?
1 2 3 4 5 6 7 8
9 6 12 15 12 17 23 34
≤
1 2 3 4 5 6 7 8
9 6 12 15 12 17 23 34
>?
1 2 3 4 5 6 7 8
9 6 12 12 15 17 23 34
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
>?
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
≤
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
>?
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
≤


1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
>?
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
≤
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
>?
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
≤
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
>?
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
≤
1 2 3 4 5 6 7 8
6 9 12 12 15 17 23 34
Sorted!