Recursive Binary Search

BS($x,a_0a_1...a_n,0,n$)

\\ returns i such that ($a_i=x$) or -1 if none exists

\\ $a_0a_1...a_n$ is assumed sorted in increasing order

BS($x,a_0a_1...a_n,i,j$)

IF ($i>=j$)

    IF ($a_i=x$) **RETURN**(i) **ELSE RETURN**(-1)

k=(i+j)/2

IF ($a_k<x$) **RETURN**(BS($x,a_0a_1...a_n,k+1,j$))

ELSE RETURN(BS($x,a_0a_1...a_n,i,k$))

Iterative Binary Search

BSIT($x,a_0a_1...a_n,0,n$)

\\ returns i such that ($a_i=x$) or -1 if none exists

\\ $a_0a_1...a_n$ is assumed sorted in increasing order

BSIT($x,a_0a_1...a_n,i,j$)

WHILE ($i<j$)

    $k=(i+j)/2$

    IF ($a_k<x$) $i=k+1$ **ELSE** $j=k$

IF ($a_i=x$) **RETURN**(i) **ELSE RETURN**(-1)

Recursive Binary Search

```
BS(5,[0,1,3,5,7,8,9,10],0,7)
    k=3
    BS(5,[(0,1,3,5),7,8,9,10],0,3)
        k=1
        BS(5,[0,1,(3,5),7,8,9,10],2,3)
            k=2
            BS(5,[0,1,3,(5),7,8,9,10],3,3)
            RETURN 3
        RETURN 3
    RETURN 3
RETURN 3
```

BS(5,[0,1,3,5,7,8,9,10],0,7)=BS(5,[(0,1,3,5),7,8,9,10],0,3)=
BS(5,[0,1,(3,5),7,8,9,10],2,3)=BS(5,[0,1,3,(5),7,8,9,10],3,3)=3

Iterative Binary Search

BSIT(5,[0,1,3,5,7,8,9,10],0,7)

i=0;j=7;

k=3;i=0;j=3;

k=1;i=1;j=3;

k=2;i=3;j=3;

RETURN 3

BSIT(5,[0,1,3,5,7,8,9,10],0,7)=3

BSIT(6,[0,1,3,5,7,8,9,10],0,7)

i=0;j=7;

k=3;i=4;j=7;

k=5;i=4;j=5;

k=4;i=4;j=4;

RETURN -1

BSIT(6,[0,1,3,5,7,8,9,10],0,7)=-1