Lecture 1-2

Friday, September 24, 2021 8:00 AM

Advanced Data Structures and Algorithms:-

1) Data Structure — a) Tanenbaum
b) Horowitz & Sahani
c) "The Art of Computer Programming" by Donald Knuth vol 1

2) Algorithm — Cormen

Magic Square :- $n \times n$

4	9	2
3	5	7
8	1	6

3x3

Sum = 15

Data — 1 to n^2

(i--, j--)

(i, j)

	0	1	2
0	6	1	8
1	7	5	3
2	2	9	4

(-1, 0) % 3
= (2, 0)

15	8	1	24	17
16	14	7	5	23
22	20	13	6	4
3	21	19	12	10
9	2	25	18	11

Sum = 65

if (x % n == 1)
blockage

Swapping 2 numbers without using a third variable

a = 2, b = 3

a ≠ 0, b ≠ 0

^ is Bitwise XOR operator

① a = a + b;

② a = a * b;

③ a = a ^ b;

a=2, b=3

① a = a+b;
b = a-b;
a = a-b;

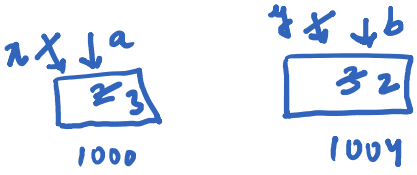
a≠0, b≠0

② a = a*b;
b = a/b;
a = a/b;

③ a = a^b;
b = b^a;
a = a^b;

a^=b^=a^=b;

```
main
{ a=2, b=3
  abc(&a, &b);
}
```




```
void abc(int *x, int *y)
{
   ≡
}
```

void abc(int &a, int &b)

Recursion:- Function calling itself — Base condition

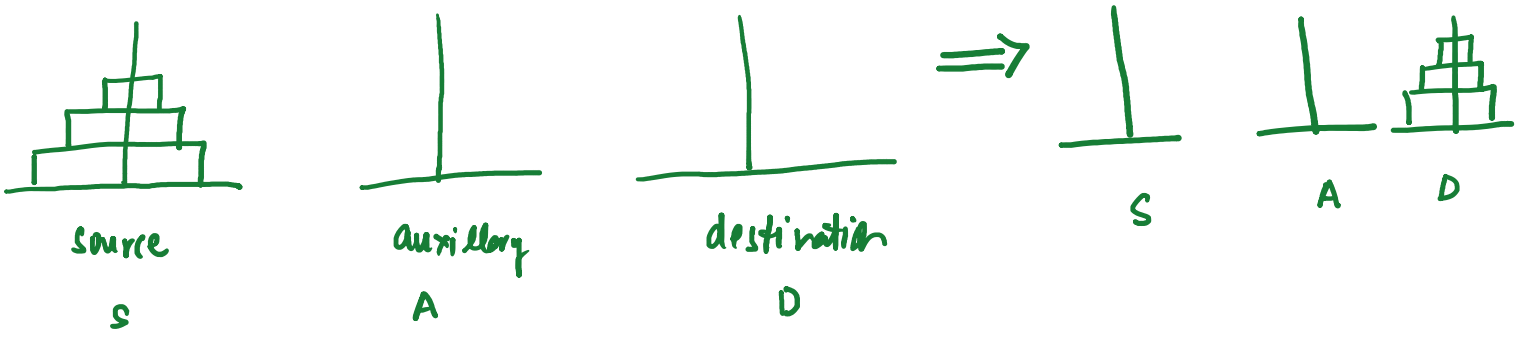
1) Factorial

```
int fact(int n)
{
    if(n==0 || n==1)
        return 1;
    return n*fact(n-1);
```

2) Fibonacci Number — 0, 1, 1, 2, 3, ...

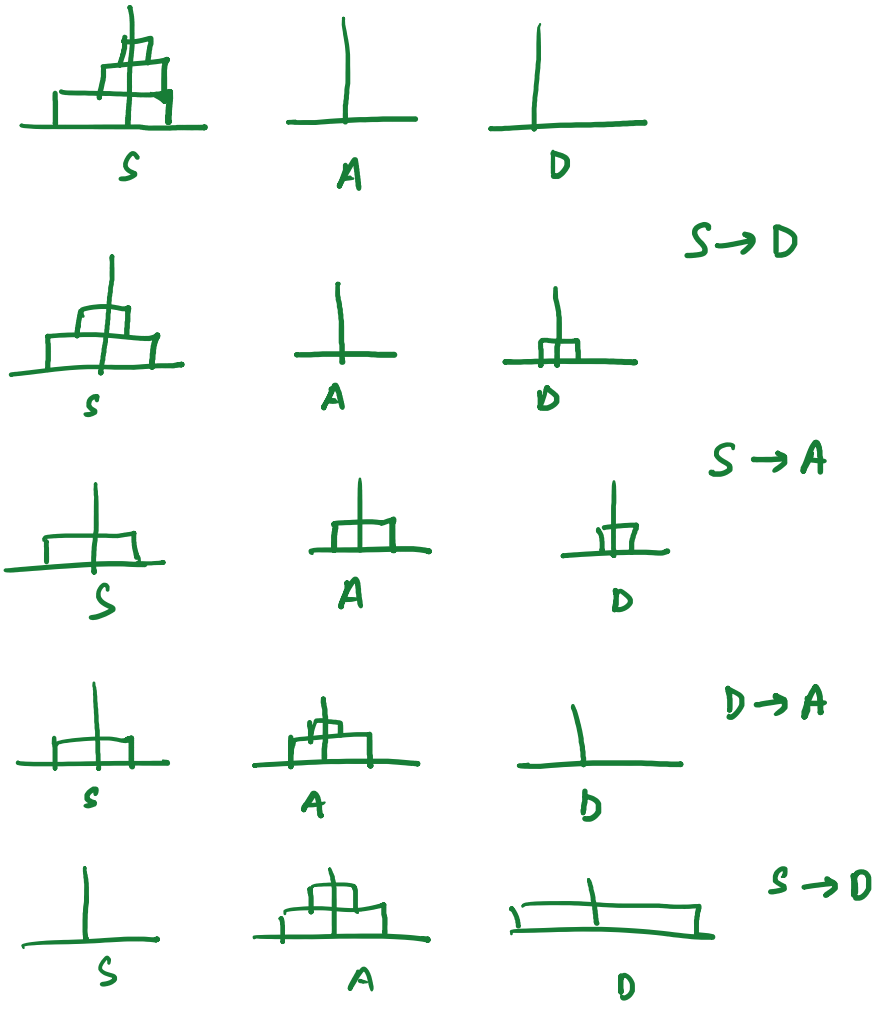
```
int fib(int n)
{
    if(n==0 || n==1)
        return n;
    return (fib(n-1) + fib(n-2));
}
```

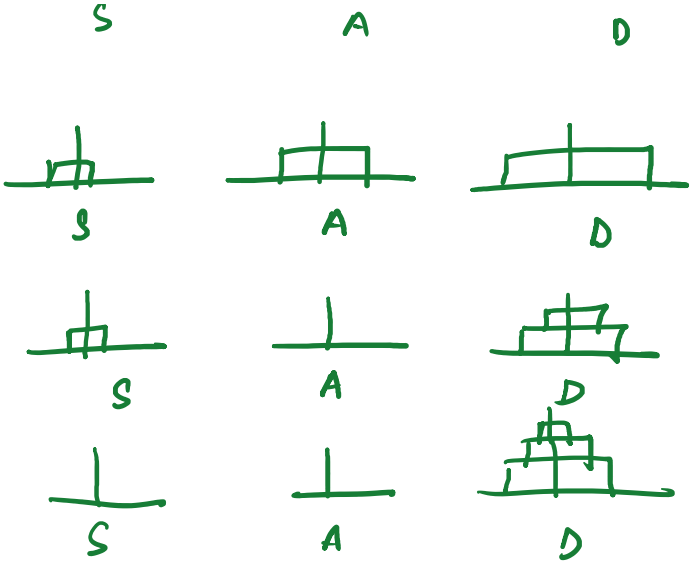
3) Tower of Hanoi :-



Two Constraints

1) Moving disk one at a time ✓✓
2) Larger disk cannot be placed over a smaller one.

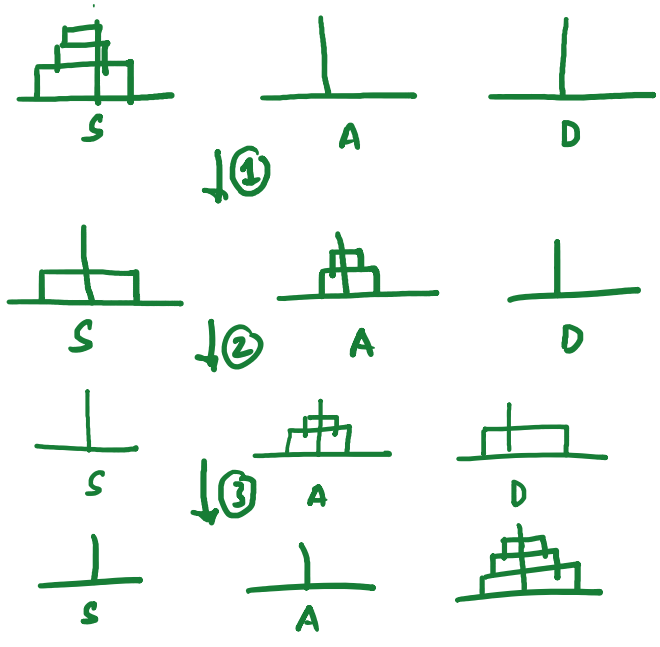


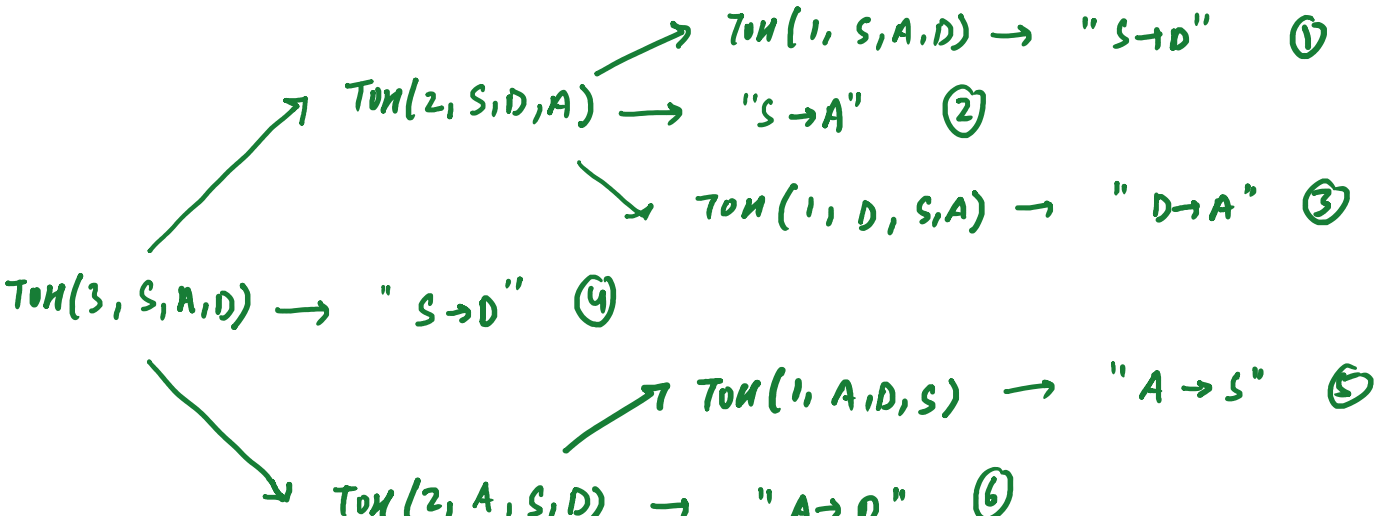


7 moves

For n disks there are $2^n - 1$ moves

```
TOH(n, S, A, D)
{
    if (n == 1)
      print " S → D"
    else
    {
      TOH(n-1, S, D, A)
      print " S → D"
      TOH(n-1, A, S, D)
    }
}
```



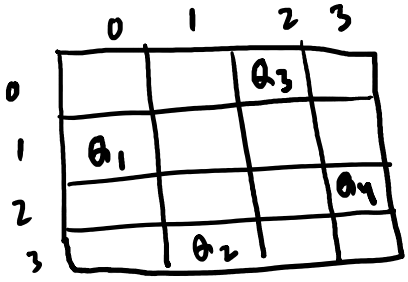


↘ TOH(2, A, S, D) → "A→D" (6)

↘ TOH(1, S, A, D) → "S→D" (7)

Backtracking :-

4 Queens Problem: – Place 4 queens on a board of size 4×4 such that they are not in conflicting position



Sol in the form of 1-D array

Columns [1 3 0 2]

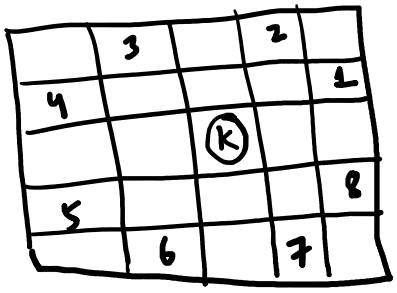
rows [2 0 3 1]

8 Queens Problem : [0 4 7 5 2 6 1 3]

It has 92 solutions but only 12 are distinct

Knight's Tour Problem :–

Problem: Place knight on every block of the board considering the movements of a knight
Cover is the solution



5×5

1	16	7	26	11	14
34	25	12	15	6	27
17	2	33	8	13	10
32	35	24	21	28	5
23	18	3	30	9	20
36	31	22	19	4	29

6×6