Data Structures and Algorithms SWE2001

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Algorithm Examples

- Algorithm for summation of N numbers

Algorithm Sum(a,n)

```
{
$sum \leftarrow 0;$
for $i \leftarrow 1$ to $n$ do
    $sum \leftarrow sum + a[i];$
end for
}
```

Algorithm Examples

- Algorithm for Finding Largest Number in a given set

Algorithm Max(a,n)

```
{
$larger \leftarrow a[0]$;
for $i \leftarrow 1$ to $n$ do
    if $(a[i] > larger)$ then
        $larger \leftarrow a[i]$;
    end if
end for
return $larger$
}
```

Algorithm Examples

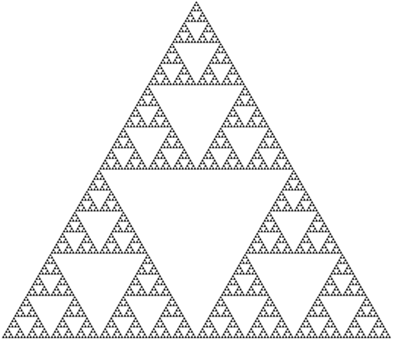
- Algorithm for Matrix Addition

Algorithm MatrixAdd(a,b,n,m)

```
{
for $i \leftarrow 1$ to $n$ do
    for $j \leftarrow 1$ to $m$ do
        $c[i][j] \leftarrow a[i][j] + b[i][j]$;
    end for
end for
}
```

Recursive Algorithm Example

- Analyse the process of drawing of a following picture



Recursive Algorithm

- An algorithm is said to be recursive if the same algorithm is invoked in the body of the algorithm
- It solves the problem by possibly using the result of applying itself to a simpler problem
- Properties of Recursive Calls
    - It solves the large problem by using its solution to a simpler sub-problem.
    - Example: Divide and Conquer Approach
    - Eventually the sub-problem is simple enough that it can be solved without applying the algorithm to it recursively. This is called Base Case

Recursive Algorithm

- **Base Case**
  - There should be at least one base case
  - it is used to avoid the infinite looping
  - Every possible chain of recursive calls must eventually reach a base case.
- **Recursive Call**
  - Calls to the current method
  - Each recursive call should be defined so that it makes progress towards a base case.
- **Two types of Recursive Algorithm**
  - Direct Recursive Algorithm:
    - An algorithm that, directly calls it self is called direct recursive
  - Indirect Recursive Algorithm:
    - An algorithm - A said to be indirect recursive, if it calls another algorithm which in turn calls Algorithm - A

Recursive Algorithm Examples

- Recursive Algorithm for Finding Largest Number in a given set

Algorithm RecurMax(a,n)

```
{
if $(n = 1)$ then
    return a[0];
else
    max{ RecurMax(a,n-1),a(n-1) };
end if
}
```

Towers of Hanoi

- Tower of Hanoi is a mathematical puzzle invented by a French Mathematician Edouard Lucas in 1883.
- The game starts by having few discs stacked in increasing order of size. The number of discs can vary, but there are only three Towers.
- The goal of Towers of Hanoi is to move all the disks from the leftmost Tower to the rightmost Tower, adhering to the following rules:
    1. Move only one disk at a time.

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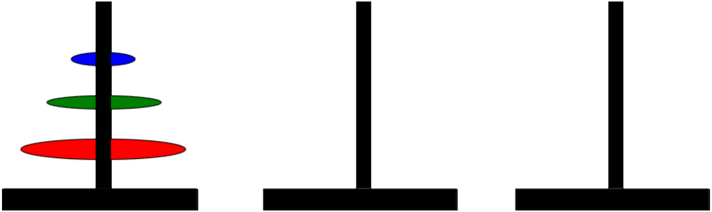
  1. Move only one disk at a time.
  2. A larger disk may not be placed on top of a smaller disk.
  3. All disks, except the one being moved, must be on a Tower.

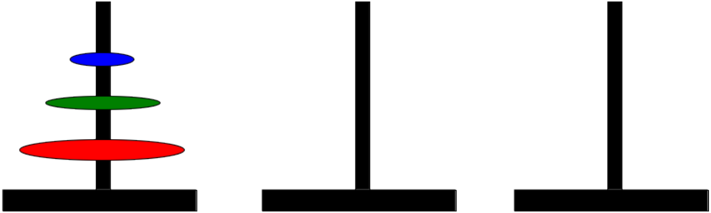
Recursive Algorithm Example

- Towers of Hanoi Problem : Initial Position



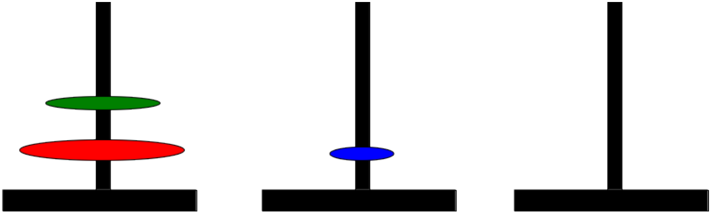
Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 1



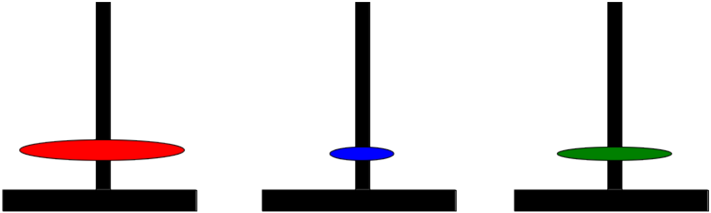
Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 2



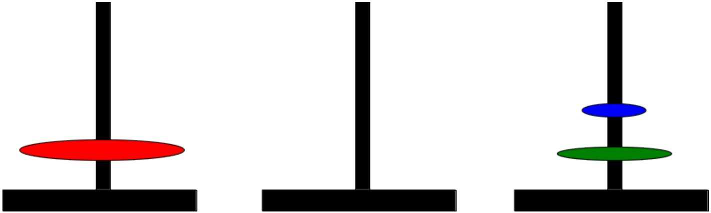
Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 3



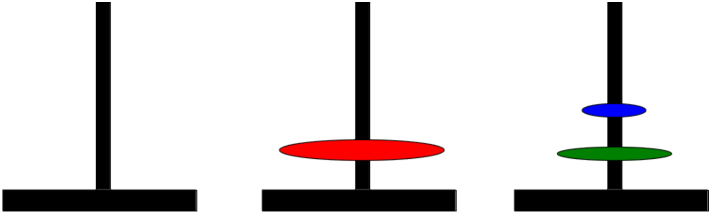
Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 4



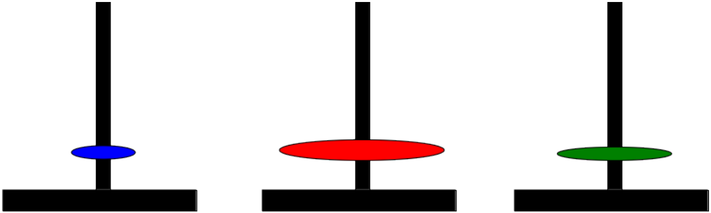
Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 5



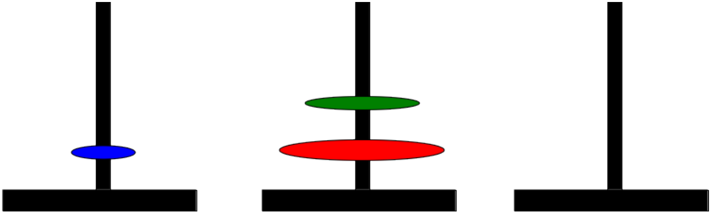
Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 6



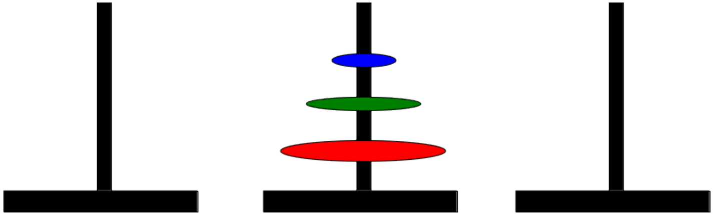
Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 7



Recursive Algorithm Example

- Towers of Hanoi Problem : Step - 8



Recursive Algorithm Examples

- Recursive Algorithm for Towers of Hanoi

Algorithm ToH(n,x,y,z)

```
{
if ($n \geq 1$) then
    ToH(n-1,x,z,y);
    Write(”Move to disk from tower” ,$x$, ”to top of tower”, $y$);
    ToH(n-1,z,y,x);
end if
}
```