Heaven's light is our guide"

Rajshahi University of Engineering & Technology
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Network Security
Course No. : 305
Chapter 4: Induction and Recursion
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4.4 Recursive Algorithms

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- **Goal:**
  - ✓ Reduce the solution to a problem with a particular set of input to the solution of the same problem with smaller input values.
  - ✓ **Example:** Greater Common Divisor (gcd)

    gcd(a,b) = gcd(b mod a, a)

    gcd(4,8) = gcd(8 mod 4, 4) = gcd(0,4) = 4
- **Definition 1:**

  An algorithm is called recursive if it solves a problem by reducing it to an instance of the same problem with smaller input.
- **Example:** Give a recursive algorithm for computing a^n; $a \neq 0$, $n>0$

  Solution: $a^{n+1} = a*a^n$ for $n>0$ $\quad a^0 = 1$

  A recursive algorithm for computing a^n

```
Procedure power(a: nonzero real number,  n: nonnegative integer)
   if n = 0 then power(a, n):= 1
   else power(a,n) := a * power(a, n-1)
```

4.4 Recursive Algorithms

- **Example:** Give a recursive algorithm for computing the greatest common divisor of two nonnegative integers a and b (a<b)

  Solution:

  gcd(a,b) = gcd(b mod a, a) and the condition gcd(0,b) = b (b>0).

  A recursive algorithm for computing gcd(a,b)

```
procedure gcd(a, b: nonnegative integers with a<b)
if a = 0 then gcd(a,b) := b
else gcd(a,b) := gcd(b mod a, a)
```