

Algorithm Design & Problem Solving: **Some new concepts!**



Contents



1

Recursion

2

Euclid's Algorithm

What is Recursion?



When one function calls ITSELF directly or indirectly.

What is Recursion?



- ❖ Different mode of thinking.
- ❖ Powerful programming tool.
- ❖ Divide-and-conquer paradigm.

```
function dream() print "Dreaming" dream()
```

What is Recursion?



❖ Inception movie

```
function dream()  
  print "Dreaming"  
  dream()  
End function
```



Recursive Factorial



Factorial (n)

if $n=1$ or $n=0$

return 1

else

return $n \times \text{Factorial}(n-1)$

Factorial (n)

fact=1

if $n=1$ or $n=0$

return 1

else

for $i=1$ to n

fact=fact*i;

return fact

Recursive X^Y



```
Power(x,y)
  if (y=0) then
    return 1;
  else
    return x*Power(x,y-1);
```

```
Power (x, y)
ans=1
if y=0
  return 1
else
  for i=1 to y
    ans=ans * x;
  return ans
```


Calculate GCD



- ❖ Given 2 numbers, calculate the greatest common divisor.
- ❖ What is “greatest common divisor”?
- ❖ It is the largest number that is divisible in a set.
- ❖ What does that mean??

GCD: An example



(4, 2) The GCD is 2.

Why?

$$4/2 = 2, 2/2 = 1, \text{rem}=0$$

Correct

Calculating GCD



❖ Calculate GCD of the following:

- (9, 6)
- (16, 4)
- (20, 16)

Now try this ...

- (72, 32)

Calculating GCD



How can you calculate GCD if we are using very large numbers?

Use Euclid's Algorithm

Euclid's Algorithm



Find GCD of (72, 32)

$$72, 32 \rightarrow 72/32 = 2 \text{ rem } 8$$

$$32, 8 \rightarrow 32/8 = 4 \text{ rem } 0$$

When rem=0, your divisor is GCD = **8**

Euclid's Algorithm



Find GCD of (84, 55)

$$84, 55 \rightarrow 84/55 = 1 \text{ rem } 29$$

$$55, 29 \rightarrow 55/29 = 1 \text{ rem } 26$$

$$29, 26 \rightarrow 29/26 = 1 \text{ rem } 3$$

$$26, 3 \rightarrow 26/3 = 8 \text{ rem } 2$$

$$3, 2 \rightarrow 3/2 = 1 \text{ rem } 1$$

$$2, 1 \rightarrow 2/1 = 2 \text{ rem } 0$$

When rem=0, divisor is GCD = **1**

Euclid's Algorithm



Write an algorithm to do this

Euclid's Algorithm



```
gcd(a, b)
  if (b = 0) then
    return a
  else
    return gcd(b, a mod b)
```

GCD (72, 32)	GCD (32, 8)
GCD (32, 8)	GCD (8, 0)

Thank You !

