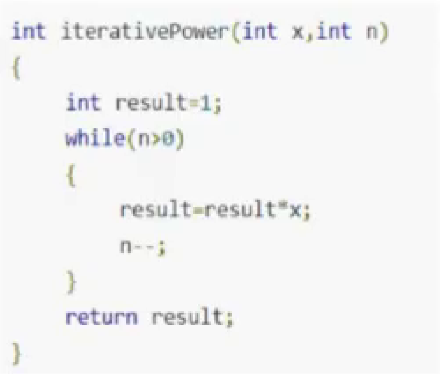
your special pdf

what's exponentiation?

Exponentiation is a mathematical operation that is expressed as

X^n =x*x*.....x (n times)

how to code this ?



```
int iterativePower(int x,int n)
{
    int result=1;
    while(n>0)
    {
        result=result*x;
        n--;
    }
    return result;
}
```

time complexity for this is o(n)

what's Modular exponentiation?

as you can tell
the answer for calcuting exponentiation
can be large so we need to compute the mod
for the answer

$2^{(10^{18})}$

is there is any optimization ?

if n is even

$$X^n = (X^2)^{n/2}$$

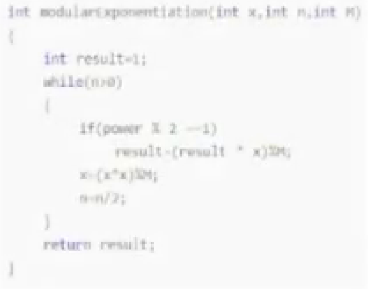
$$3^{10} = (3^2)^5 = 9^5$$

if n is odd

$$X^n = X*X^{n-1}$$

$$9^5 = 9*9^4 = 9*(9^2)^2 = 9*(81)^2$$

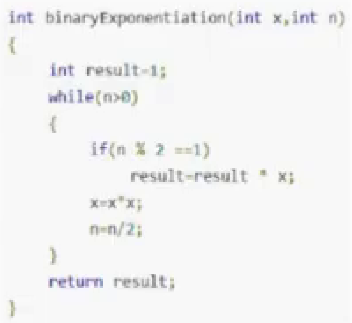
how to code this ?



```
int modularExponentiation(int x,int n,int M)
{
    int result=1;
    while(n>0)
    {
        if(power % 2 ==1)
            result=(result * x)%M;
        x=(x*x)%M;
        n=n/2;
    }
    return result;
}
```

time complexity for this is log(n)

how to code this ?



```
int binaryExponentiation(int x,int n)
{
    int result=1;
    while(n>0)
    {
        if(n % 2 ==1)
            result=result * x;
        x=x*x;
        n=n/2;
    }
    return result;
}
```

time complexity for this is log(n)