

3 usages

```
public double multiplyWithWholeNumbers(int n, double x) {  
    if (n == 1) {  
        return x;  
    } else {  
        return x + multiplyWithWholeNumbers((n - 1), x);  
    }  
}
```

4 usages

```
public double multiplyUsingModulus(int n, double x) {  
    if (n == 1) {...}  
  
    // Checks if the number n is even using the modulus operation  
    if (n % 2 == 0) {...} else {...}  
}
```

4 usages

```
public double multiplyUsingBitwiseOperator (int n, double x) {  
    if (n == 1) {  
        return x;  
    }  
  
    // Checks if the given number n is even using a bitwise operation  
    if ((n & 1) == 0) {  
        return multiplyUsingBitwiseOperator(n: n/2, x: x + x);  
    } else {  
        return x + multiplyUsingBitwiseOperator(n: (n - 1)/2, x: x + x);  
    }  
}
```

Arbeidskrav 2: Multiplikasjon

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09:53

1) Rekkesum

a) $T(n) = T(n-1) + 1 \quad T(n) \in \Theta(n)$

b) $T(n) = 1 \cdot T(n/2) + 2$
 $a=1 \quad b=2 \quad c=2 \quad k=0$

$2^0 = 1 \quad T(n) \in \Theta(n^k \cdot \log n) \Rightarrow T(n) \in \Theta(\log n)$

Tidskompleksitet for metode 1

$n = 1000; t = 0.0015162473484624493 \text{ ms}$

$n = 2000; t = 0.0039806064852040855 \text{ ms}$

$n = 4000; t = 0.009079023823358512 \text{ ms}$

$n = 8000; t = 0.017779358165170237 \text{ ms}$

Tidskompleksitet for metode 2a og 2b

2a – Modulus operasjon:

$n = 10000$; $t = 2.487345876587449E-5$ ms

$n = 100000$; $t = 2.9599810561212407E-5$ ms

$n = 1000000$; $t = 3.252867581680969E-5$ ms

$n = 10000000$; $t = 3.8574493480254836E-5$ ms

2b – Bitwise operasjon:

$n = 10000$; $t = 2.1090646247771564E-5$ ms

$n = 100000$; $t = 2.8034683725734334E-5$ ms

$n = 1000000$; $t = 3.0233327823813228E-5$ ms

$n = 10000000$; $t = 3.564834137536149E-5$ ms

	$I = (A11, B11)$ $= (10000, 0.000021090646248)$	
	$J = (A12, B12)$ $= (100000, 0.000028034683726)$	
	$K = (A13, B13)$ $= (1000000, 0.000030233327824)$	
	$L = (A14, B14)$ $= (10000000, 0.000035648341375)$	
	$\text{Bitwise} = \{I, J, K, L\}$ $= \{(10000, 0.000021090646248), (100000, 0.000028034683726), (1000000, 0.000030233327824), (10000000, 0.000035648341375)\}$	
	$f : \text{FitLine}(\text{Wholenumber})$ $= y = 0.000002319870838x - 0.000610706687986$	
	$g(x) = \text{FitLog}(\text{Modulus})$ $= 0.000007176526487 + 0.000001912284134 \ln(x)$	
	$h(x) = \text{FitLog}(\text{Bitwise})$ $= 0.000003522298579 + 0.000001992183899 \ln(x)$	
	Input...	

