

## RECURSION PROGRAMMING EXERCISES

For each of these exercises, write a recursive method that calculates the described result and a test wrapper that you can use to compile and test your method.

1. The method must adhere to this specification:

```
public String formatDec( long x )  
// Return the given long as a string with comma separators
```

For example, the long value 1234567890 is returned as the string **1,234,567,890**.

Recurrence relation defining <i>formatDec</i> ( <i>x</i> )
Initial Condition, applies to $x < 1000$ :
$\text{formatDec}(x) = \text{String.valueOf}(x)$
Recursive Clause, applies to $x \geq 1000$ :
$\text{formatDec}(x) = \text{formatDec}(x \div 1,000) + ", " + \text{String.valueOf}(x \% 1,000)$
Refer to the Java API specification for <a href="#">java.lang.String</a> for an explanation of the <a href="#">valueOf</a> method.

2. The following table shows how a Certificate of Deposit grows in value each period of investment. The table assumes the CD starts with \$1,000, the APR (annual percentage rate) is 5% and the CD's interest is compounded monthly (i.e. the period is 1 month).

Month	CD Balance (before)	Multiplied By	Interest	CD Balance (after)
1	\$1,000.00	5/100/12	\$4.17	\$1,004.17
2	1,004.17	5/100/12	4.18	1,008.35
3	1,008.35	5/100/12	4.20	1,012.55
4	1,012.55	5/100/12	4.22	1,016.77
5	1,016.77	5/100/12	4.24	1,021.01

As shown in the table, interest “compounding” is accomplished by applying the interest rate to the total of the deposits plus interest.

Recurrence relation defining  $CD(n)$  = the value of the CD after  $n$  periods

Initial Condition:

$$CD(0) = \text{initial deposit}$$

Recursive Clause:

$$CD(n) = (1 + \text{period rate}) \times CD(n - 1)$$

initial deposit is \$1,000 in the example above.

period rate =  $APR \div 100 \div \text{number of periods per year}$ . The example above has a monthly compounding period so the number of periods per year is 12 and the period rate is 5/100/12.

Your method must adhere to this specification:

```
public double cd( int n, double d, double apr, int period )
// Return the value of a CD after n periods.
// d = initial deposit,
// apr = annual percentage rate
// period = number of periods per year
```

3. The method must adhere to this specification:

```
public String reverse( String s )  
// Return the reverse of the given string.
```

Recurrence relation defining <i>reverse</i> ( <i>s</i> )
Initial Condition:  $\text{reverse} ( \text{null string} ) = \text{null string}$
Recursive Clause:  $\text{reverse} ( \mathbf{s} ) = \text{reverse} ( \mathbf{s}.\text{substring}(1) ) + \mathbf{s}.\text{charAt}( 0 )$
Refer to the Java API specification for <a href="#">java.lang.String</a> for explanations of the <a href="#">charAt</a> and <a href="#">substring</a> methods.