EXERCISES: RECURSION

- write both recursive and non-recursive (iterative) versions of function to compute the sum of the first n terms in arithmetic progression $A(a,d)$:

$$a, a+d, a+2d, \ldots, a+(n-1)d$$

Solution:

- use recursive equation for the sum $S(a, d, n)$ for $n > 0$:

$$S(a, d, n) = S(a, d, n-1) + a + (n-1)d$$

- with base case for $n = 0$:

$$S(a, d, 0) = 0$$

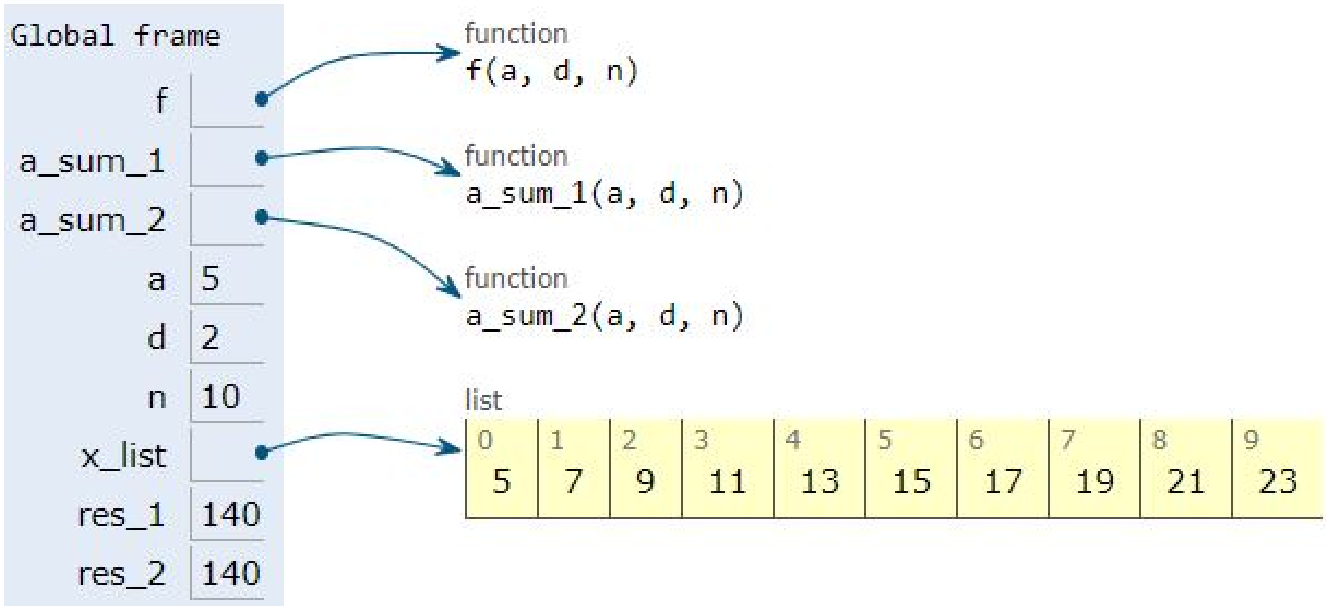
```python
def f(a, d, n):
    last = a + (n-1)*d
    return list(range(a, last+1, d))

def a_sum_1(a, d, n):  # recursive
    if n<=0:
        return 0
    else:
        last = a + (n-1)*d
        return a_sum_1(a,d,n-1) + last

def a_sum_2(a, d, n): #non-recursive
    sum = 0
    for i in range(1, n+1):
        sum = sum + a + (i-1)*d
    return sum

a, d, n = 5, 2, 10
x_list  = f(a, d, n)  # for visualization

res_1   = a_sum_1(a, d, n)
res_2   = a_sum_2(a, d, n)
```


Global frame
f
a_sum_1
a_sum_2
a 5
d 2
n 10
x_list
res_1 140
res_2 140
function
f(a, d, n)
function
a_sum_1(a, d, n)
function
a_sum_2(a, d, n)
list
0 5
1 7
2 9
3 11
4 13
5 15
6 17
7 19
8 21
9 23

- write both recursive and non-recursive (iterative) versions of function to compute the sum of the first n terms in geometric progression $G(b, q)$:

$$b, bq, bq^2, \ldots, bq^{n-1}$$

Solution:

- use recursive equation for the sum $S(b,q,n)$ for $n > 0$:

$$S(b,q,n) = S(b,q,n-1) + bq^{n-1}$$

- with base case for $n = 0$:

$$S(b,q,0) = 0$$

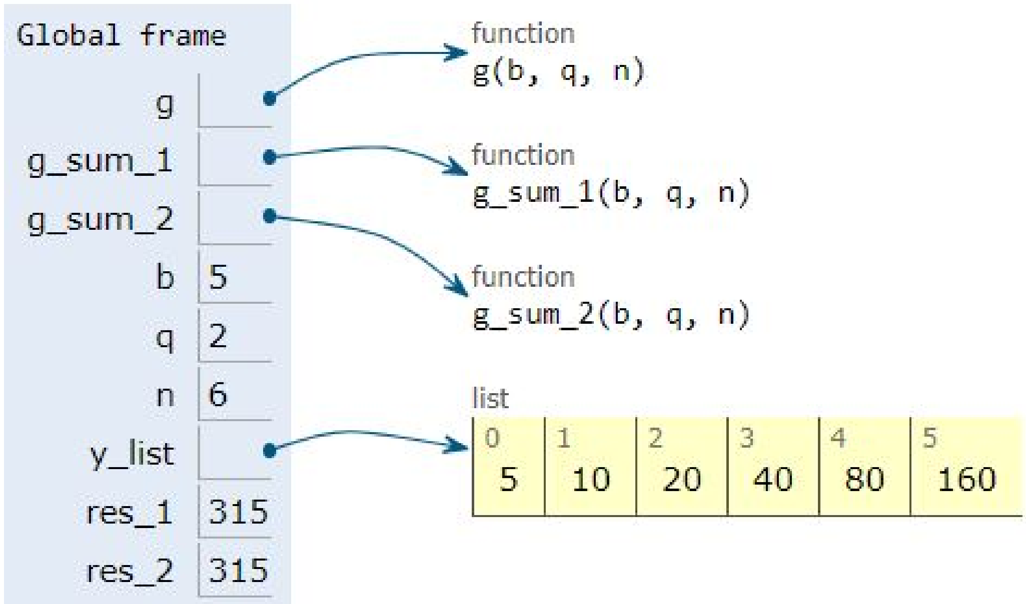
```
def g(b, q, n):
    result = [b*q**(i-1) for i in range(1,n+1)]
    return result

def g_sum_1(b, q, n): # recursive
    if n<=0:
        return 0
    else:
        last = b*q**(n-1)
        return g_sum_1(b, q, n-1) + last

def g_sum_2(b, q, n): # non-recursive
    sum = 0
    for i in range(1, n+1):
        sum = sum + b*q**(i-1)
    return sum

b, q, n = 5, 2, 6
y_list  = g(b, q, n)  # for visualization

res_1   = g_sum_1(b, q, n)
res_2   = g_sum_2(b, q, n)
```


Global frame
g
g_sum_1
g_sum_2
b 5
q 2
n 6
y_list
res_1 315
res_2 315
function
g(b, q, n)
function
g_sum_1(b, q, n)
function
g_sum_2(b, q, n)
list
0 5
1 10
2 20
3 40
4 80
5 160