In-class Question 16

Question)

A Python program has been created to calculate 2 to the power of 9 using a recursive function.

The code is shown below.

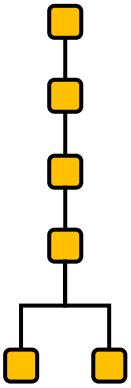
```
def power(x, y):
    if y == 0:
        return 1
    elif y == 1:
        return x
    else:
        return power(x, int(y / 2)) * \
               power(x, y - int(y / 2))

print(power(2, 9))
```

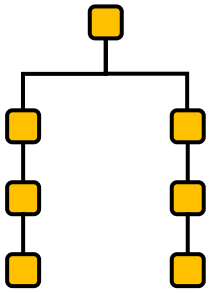
Which one of the following recursive diagrams best represents the above program when 2 to the power of 9 is calculated?

A)

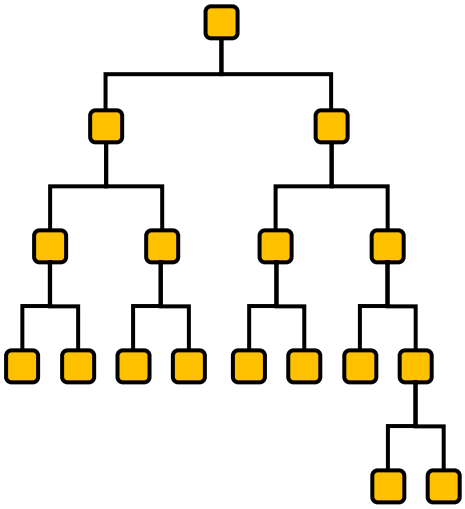
B)



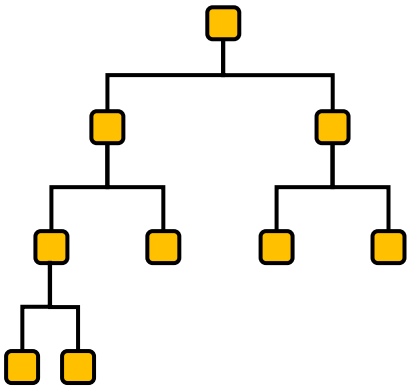
C)



D)



E)



For your answer, write one letter from A to E.

Correct answer(s):

- D

Explanation:

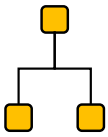
- The `power()` function calculates the power of `x` raised to `y` using the recursive relationship:

$$x^y = x^{\lfloor y/2 \rfloor} \times x^{\lceil y/2 \rceil}$$

- It is achieved by recursively calling itself twice, as shown in the following line of code:

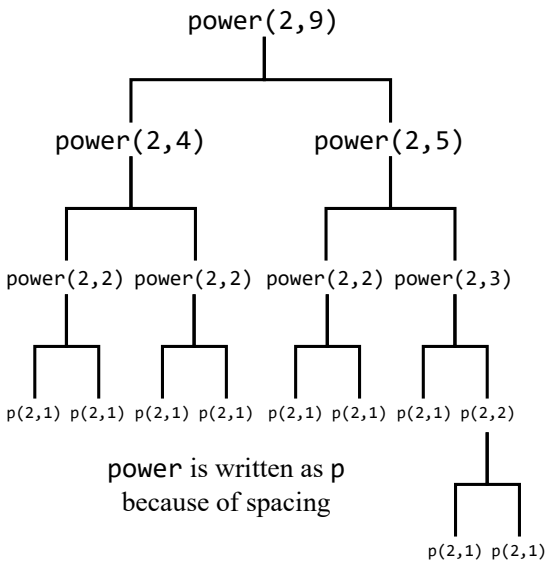
```
return power(x, int(y / 2)) * power(x, y - int(y / 2))
```

- In terms of the recursive diagram, each call to the `power()` function *always* results in two recursive calls, unless it reaches the base case of `y==0` or `y==1`
- That means each unit of the recursive calls should look like this:



which confirms that answers A, B and C are incorrect

- To determine whether answer D or answer E is correct, the recursive function can be executed using 2 and 9 as parameters:



- Therefore, the answer is D