Course is completed. The course result can no longer be changed.

Recurrence Relations: Problems and Applications

Quiz

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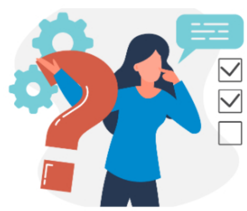

Now, it's time for a short quiz to recap what you've learned. The quiz is **graded**, so you can take it only once. Each question will be followed by feedback explaining why your answer is right or wrong. If your answer is incorrect, you will see a suggestion of what you might need to refresh your memory.

Good luck!

Read the question below and select the correct answer. Then, click "Submit."

The number of rabbits on a farm doubles every hour. If the farm initially has three rabbits, how many will be present in k hours? What is the solution in recurrence form?

- ( ) $a_k = 6a_{k-1},\ a_1 = 1$
- ( ) $a_k = 3a_{k-1},\ a_1 = 6$
- (•) $a_k = 2a_{k-1},\ a_1 = 3$
- ( ) $a_k = 3a_{k-1},\ a_1 = 2$

✔

Correct: Well done!

Submit You have used 1 of 1 attempt

Read the question below and select the correct answer. Then, click "Submit."

A young pair of rabbits (of the opposite sex) is placed on an island. The pair cannot breed until they are two months old. After two months, each pair of rabbits produces another pair (also of the opposite sex) each month. Assuming the rabbits never die, find the recurrence relation for the number of pairs of rabbits after k months.

- ( ) $a_k = 2a_{k-1} + a_{k-2},\ a_1 = 1,\ a_2 = 1$
- ( ) $a_k = 2a_{k-1} + 2a_{k-2},\ a_1 = 1,\ a_2 = 1$
- (•) $a_k = a_{k-1} + a_{k-2},\ a_1 = 1,\ a_2 = 1$
- ( ) $a_k = a_{k-1} + 2a_{k-2},\ a_1 = 1,\ a_2 = 1$
- ( ) $a_k = 2 + 2a_{k-1},\ a_1 = 2$

✔

Correct: Great job!

Submit You have used 1 of 1 attempt

Read the question below and select the correct answer. Then, click "Submit."

A family of k lines is drawn on a plane with each pair of lines crossing and no three lines crossing at the same point. Let a_k denote the number of regions into which the plane is partitioned by k lines. What is the correct recurrence relation for a_k?

- ( ) $a_k = a_{k-1} + a_{k-2},\ a_1 = 2,\ a_2 = 3$
- ( ) $a_k = 2a_{k-1},\ a_1 = 2$
- ( ) $a_k = a_{k-1}\ +\ a_{k-2},\ a_1 = 2,\ a_2 = 4$
- (•) $a_k = a_{k-1} + k,\ a_1 = 2$

✔

Correct:
To determine a_k for all positive integers, it is enough to note that $a_1 = 2$, and when $n > 1, a_k = a_{k-1} + k$. This formula follows from the observation that if you label the lines $l_1, l_2, \ldots, l_k$, then the $k-1$ points on line l_k, where it crosses the other lines in the family, divide l_k into k segments. Each of these segments is associated with a region determined by the first $k-1$ lines, which are now subdivided into two, giving you k more regions than were determined by $k-1$ lines. Find the illustration in the accordion below.

Submit You have used 1 of 1 attempt

Click the heading to see the illustration.

Final Look

Read the question below and select the correct answer. Then, click "Submit."

A vending machine dispensing books of stamps accepts only \$1 coins, \$1 bills, and \$5 bills. Find the recurrence relation (without initial conditions) for the number of ways to deposit k dollars in the vending machine, where the order in which the coins and bills are deposited matters.

- ( ) $a_k\ =\ 2a_{k-1} + 5 \cdot a_{k-5},\ k \geq 5$
- (•) $a_k\ =\ 2 \cdot a_{k-1} + a_{k-5},\ k \geq 5$
- ( ) $a_k\ =\ a_{k-1} + a_{k-5},\ k \geq 5$
- ( ) $a_k\ =\ a_{k-1} + 2 \cdot a_{k-5},\ k \geq 5$
- ( ) $a_k\ =\ 5a_{k-1} + a_{k-5},\ k \geq 5$

✔

Correct:
Excellent!
Let a_k be the number of ways to deposit k dollars. Suppose you deposit a \$1 dollar coin, leaving $k-1$ dollars left to deposit. This will give you a_{k-1} ways to deposit k dollars. Depositing $\$1$ bills is the same as depositing $\$1$ coins, so this will also give you a_{k-1} ways to deposit k dollars. Lastly, if you deposit a $\$5$ bill, you have $k-5$ dollars left to deposit, giving you a_{k-5} ways to deposit k dollars. This would mean that the recurrence relation is $a_k\ =\ a_{k-1} + a_{k-1} + a_{k-5}$. Simplifying the equation, you get $a_k = 2 \cdot a_{k-1,}\, a_{k-5}$. Note that this is only valid when $k \geq 5$.

Submit You have used 1 of 1 attempt

*Read the question below and select **all** the answers that are correct. Then, click "Submit."*

Which TWO of the following are benefits of the divide and conquer paradigm?

- [x] Sub-problems can be computed in parallel.
- [x] It works faster than its counterpart, brute force
- [ ] It works faster than any other solution to any other problem.

✔

Correct: Well done!

Submit You have used 1 of 1 attempt

< PREVIOUS NEXT >