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Computer Science Meet 3- March 5, 2015

1. Python is a popular programming language. In Python you can use a plus sign to merge two lists into one. For example, `[3, 2, 1] + [5, 4]` makes `[3, 2, 1, 5, 4]`. You can also use the multiplication sign `*` to duplicate a list a number of times. For example, `3*[1, 2]` makes `[1, 2, 1, 2, 1, 2]`. What does `3*[0] + [1, 2, 3]` make?
- (A) `[3, 0, 1, 2, 3]`
 - (B) `["000", 1, 2, 3]`
 - (C) `[0, 0, 0, 1, 2, 3]`
 - (D) `[0, 1, 2, 3, 0, 1, 2, 3, 0, 1, 2, 3]`

Answer: _____

2. In the old days, when digital data were transmitted over a telephone line, the data was encoded into 0s and 1s and arranged into *bytes*. A byte is 8 bits. A bit is 0 or 1. The first seven bits were used for data; the last bit, called a *parity* bit, was set to 0 or 1 to make the number of 1s in each byte even or to make the number of 1s in each byte odd. This helped detect transmission errors. Which one of these six bytes was received with an error?

1	2	3	4	5	6
01011010	11010111	00011000	11010110	10000111	11101000

Answer: _____

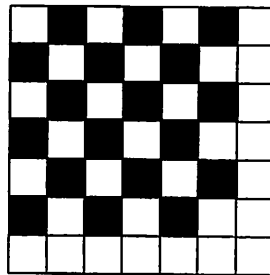
3. Pink Painter is a programmable robot. She can move left, right, up, and down, and paint the square she is on. These five commands are represented by the blocks

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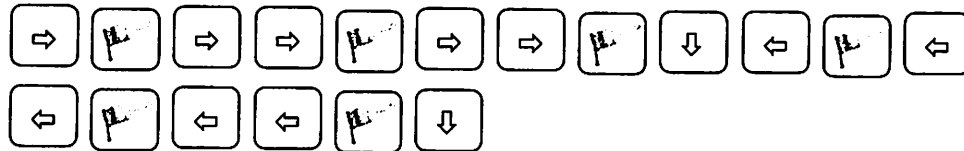
Pink Painter also understands the repeat command to repeat the same steps several times.

Aaron and Betty made two different Painter programs to draw a checkerboard pattern, like this (assuming Painter starts in the upper left square):



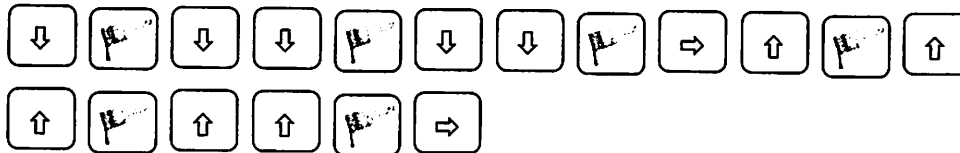
Aaron's program:

repeat 3 times:



Betty's program:

repeat 3 times:



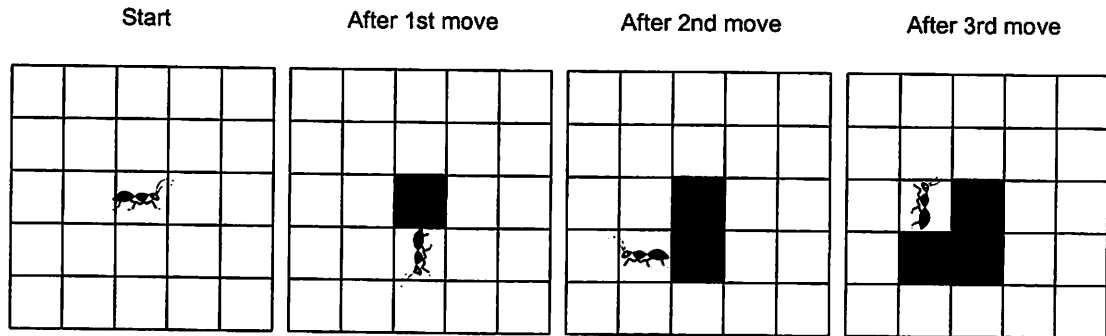
Which of these programs will work?

- (A) Both
- (B) Only Aaron's
- (C) Only Betty's
- (D) Neither

Answer: _____

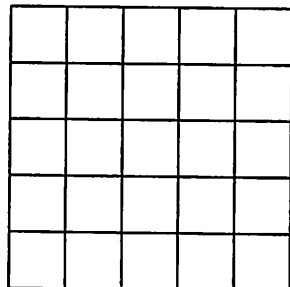
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4. Langton's ant (named after the computer scientist Chris Langton) moves on a grid and acts strangely: if it is on a white square, it turns right; if it is on a black square, it turns left. Either way, it then flips the color of the square from white to black or from black to white and moves forward by one square. This is what the first three moves would look like if the ant was placed on an all-white grid, facing to the right:



What will the board look like if the ant is removed after six moves?

Answer:



5. Computers use the *binary number system* to store numbers. There are only two digits in binary: 0 and 1. The numbers 1, 2, 4, 8, 16, and so on, are called *powers of 2*. Any number is the sum of some of the powers of 2. The digits in a binary number tell you which powers of 2 to include in the sum, and which to skip (1 means "include," 0 means "skip"). For example, if you read 1011 from right to left, it means "take 1, take 2, skip 4, take 8," so it represents $1 + 2 + 8 = 11$. Which number is represented by 100110?

Answer: _____

6. Peripatetic (Peri for short) is a robot that walks continuously forward (from the left wall to the right wall), then back, then forward again, then back again, and so on. Ethan created an *algorithm* (a set of instructions) for Peri and wrote it in *pseudocode* (precisely enough, but not as formally as in any programming language). What condition did Ethan use for Peri to make a U-turn?

(A)

```
if (walkingForward AND rightWall - position < oneStep) OR  
    (walkingBack AND position - leftWall < oneStep)
```

(B)

```
if (walkingForward AND rightWall - position < oneStep) AND  
    (walkingBack AND position - leftWall < oneStep)
```

(C)

```
if (walkingForward AND rightWall - position > oneStep) OR  
    (walkingBack AND position - leftWall > oneStep)
```

(D)

```
if (walkingForward AND rightWall - position > oneStep) AND  
    (walkingBack AND position - leftWall > oneStep)
```

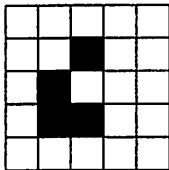
Answer: _____

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Computer Science Answers and Solutions

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1. C
2. 4 or 11010110
3. A
- 4.



5. 38
6. A

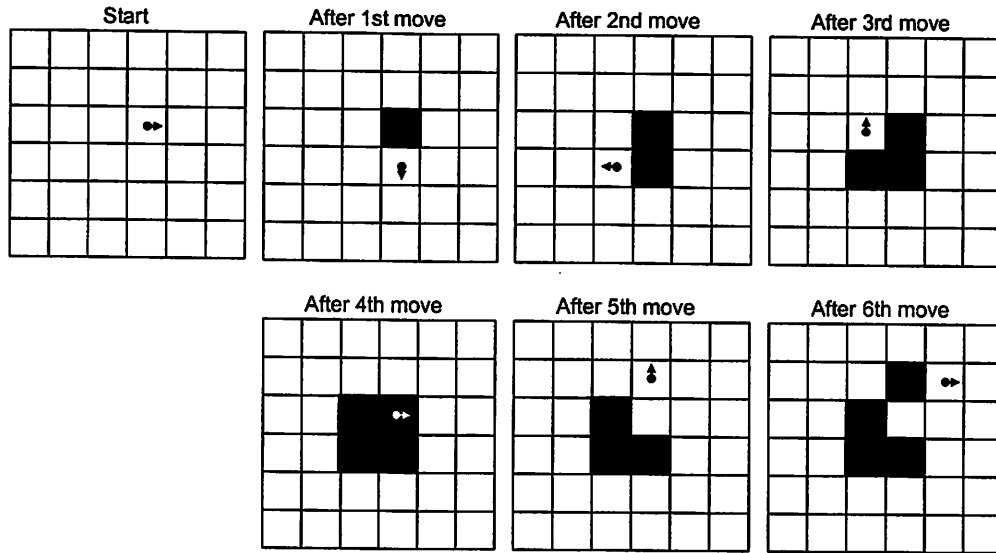
Solutions:

1. $3 * [0]$ makes $[0, 0, 0]$; then $[0, 0, 0] + [1, 2, 3]$ makes $[0, 0, 0, 1, 2, 3]$
2. The byte number 4 has five bits set to 1, an odd number. The parity of all the other bytes is even.
3. Both programs work. Aaron's program goes row by row: first row forward, second row backward, and so on. Betty's program goes column by column: first column down, second column up, and so on.

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4. The progression of moves:



(Langton's "ant" is an example of a *cellular automaton*. It behaves chaotically at the beginning, but later the pattern becomes regular, painting a wide diagonal shaft in the SE direction.)

5. $32 + 4 + 2$

6. Peri is walking forward or walking back, not both at once, hence OR, not AND. When walking forward, Peri is walking toward the right wall and she has to make a U-turn when the remaining distance, $\text{rightWall} - \text{position}$, is less than one step.