American Computer Science League

2017-2018 **Contest #1**

CLASSROOM DIVISION

1. Computer Number Systems

How many 1's are there in the binary representations of :

16743_8

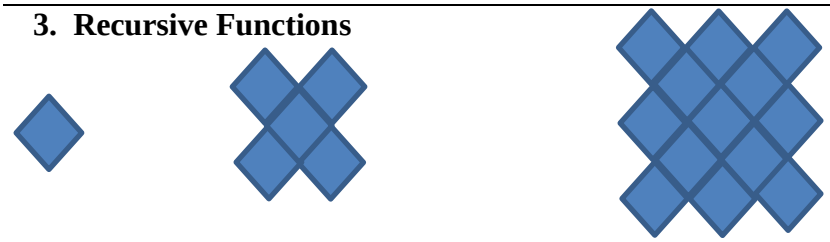
1.

2. Computer Number Systems

Convert $3F6A_{16}$ to octal.

2.

3. Recursive Functions



Begin with a rhombus. This is Stage 1 and there is one rhombus with 4 segments in its perimeter. The next stage adds a congruent rhombus on each perimeter edge of the previous figure. Now there are five congruent rhombuses and 12 segments in its perimeter. The third stage adds 8 more for a total of 13 and 20 segments in its perimeter. Each subsequent stage is formed in the same manner. How many segments are its perimeter after Stage 6 is completed?

3.

4. Recursive Functions

Find $f(12)$ given:

$$f(x) = \begin{cases} f(x-2)-3 & if\ x \geq 10 \\ f(2x-10)+4 & if\ 3 \leq x < 10 \\ x*x+5 & if\ x < 3 \end{cases}$$

4.

5. What Does This Program Do?

What is outputted when this program is run?

```
a = 12: b = 1: c = 0: d = 4 : e = 2
if  a > d then a = a - d
if (d – b) < (e – a) then d = d + e
if a * b == d * e then e = a * b / e else d = d * e / a
if d ↑ 2 < = (b + 1) ↑ 2 then d = b + 1 else b = b + 1
if a + b * c == d + e * c then a = b * c else d = e * c
output (a + e) / b + (d + c) ↑ b * c
```

5.

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6. Computer Number Systems **6.**

Convert to octal:

$3A9B_{16}$

7. Computer Number System: **7.**

Evaluate and express the answer in hex:

$32_8 + 1011_2 + 352_{10} + AF_{16}$

8. Recursive Functions **8.**

Begin with a capital T consisting of 2 congruent segments. At the end of each segment place a segment half as long and perpendicular to it. Continue this process for an additional 5 times. How many segments are in the resulting figure?

9. Recursive Functions **9.**

Find $f(12,7)$ given:

$$f(x,y) = \begin{cases} f(x-1, y+2)+3 & if\ x > y \\ 2 * f(x+1, y-1)-5 & if\ x < y \\ x * x + y & if\ x = y \end{cases}$$

10. What Does This Program Do? **10.**

What is outputted when this program is run?

```
a = 1: b = 2: c = 3: d = 4: e = 4: f = 6
if (d / b) < (f / a) then d = d / b
a = f ↑ b / c ↑ (d / b)
if (a <= f) && (b > e) then a = f else b = e
if abs(c - f) != int(f / c) then c = f / c else f = f / c
if (a = = b) | | (c = = d) then a = a + b
c = c + d
output (b * c) * (f + d) / a / 2 * d - c + e ↑ (b - 2 * d)
```