American Computer Science League

2017-2018 **Contest #1**

SENIOR DIVISION

1. Computer Number Systems

How many numbers from 1_{10} to 31_{10}, inclusive, have more 1's than 0's in their binary representations? Do not count lead zeroes.

1.

2. Computer Number Systems

Convert to octal: 201718_{10}

2.

3. Recursive Functions

Begin with an equilateral triangle. Construct an equilateral triangle on each perimeter segment of the previous figure using each segment in only one triangle. Continue this process for an additional 5 times. How many equilateral triangles are in the resulting figure?

3.

4. Recursive Functions

Find $f(7,5)$ if given:

$$f(x,y) = \begin{cases} y & \text{if } y = 1 \text{ or } y = x - 1 \\ f(x-1, y-1) + f(x-1, y) & \text{otherwise} \end{cases}$$

4.

5. What Does This Program Do?

What is outputted when the program is run?

```
a = 0: b = 2: c = 2: d = -1: e = 4
f = 10 * c / b / (e - d)
if b == f then b = b * f
a = b * e / abs(d)
if a != b * c then a = b else a = c
e = a ↑ 2 + c ↑ 2 - b / d
if (a * f > b * e) | | (e / a != int(e /a)) then e = e / a else a = e / a
b = abs(b * c * d - a * c)
if b = = a * c * (f + 1) then f = b / f else b = b / f
if sqr(a* c / f) = = int(e / a) then b = b ↑ 2 else a = a ↑ 2
if (a < b) && (c != f) && (f - c == a + 2 + d) then f = f ↑2 else c = c↑2
output a / (b + f) - e / (d * c) - (10 *b) / (a / f + c / f)
```

5.