Use Equation for Identifying Leaf Nodes to Find the First

What's the index of the first leaf node?

Remember that

- **node N is a leaf node iff**

$$4N + 1 \geq \text{n\_nodes}, \text{ so}$$

$$4N \geq \text{n\_nodes} - 1$$

Dividing by 4, we obtain

$$N \geq \frac{\text{n\_nodes} - 1}{4}$$

Calculate the Index of the First Leaf Node L

$$N \geq \frac{\text{n\_nodes} - 1}{4}$$

The smallest such **N** is the first leaf node, **L**.

Since **L** is an integer, we round up,

- but integer arithmetic in **C** rounds toward zero,
- so we obtain:

$$L = \left\lceil \frac{\text{n\_nodes} - 1}{4} \right\rceil = \left\lfloor \frac{\text{n\_nodes} - 1 + 3}{4} \right\rfloor = \left\lfloor \frac{\text{n\_nodes} + 2}{4} \right\rfloor.$$

Back to the Code: Calculate the First Leaf's Index

```
int32_t first_leaf;
int32_t i;

first_leaf = (p->n_nodes + 2) / 4;
for (i = 0; first_leaf > i; i++) {
    fprintf (out, "%d %d %d\n",
             p->node[i].x,
             p->node[i].y_left,
             p->node[i].y_right);
}
```

Calculate first leaf node's index.

Loop Over All Internal Nodes and Print Each

```
int32_t first_leaf;
int32_t i;

first_leaf = (p->n_nodes + 2) / 4;
for (i = 0; first_leaf > i; i++) {
    fprintf (out, "%d %d %d\n",
             p->node[i].x,
             p->node[i].y_left,
             p->node[i].y_right);
}
```

Loop over all internal nodes.

Print x and y splitters.

