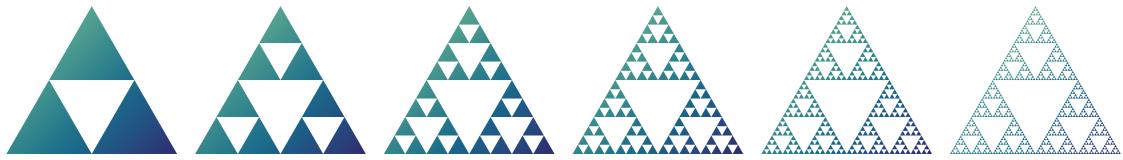
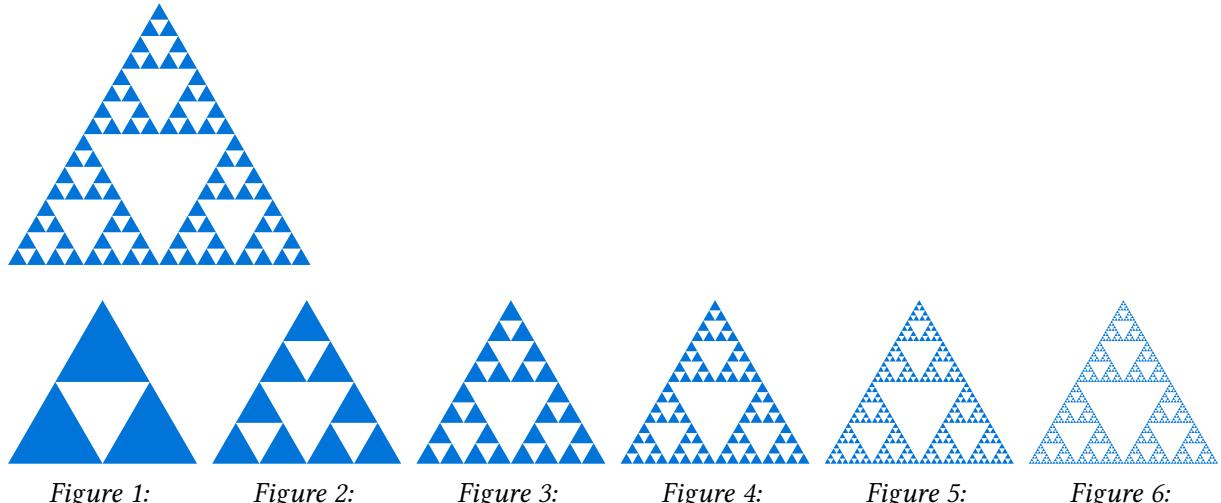


## Sierpinski Triangle (L-system)



## Sierpinski Triangle (cetz)



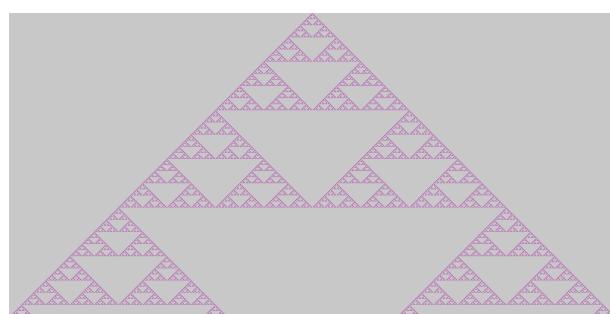
## Sierpinski Triangle (Harlow's method)

$$k(i, j) = {}^i C_{\left(\frac{1-j}{2}\right)}$$

$k$  is odd  $\rightarrow$  black

$k$  is even  $\rightarrow$  white

*Figure 7: Point test*



*Figure 8: Harlow's method*

## Optimization

A binomial coefficient is odd iff it has no factor of 2

The exponent of 2 in  ${}^n C_r$  equals the number of carries when adding  $r + (n - r)$  in binary

No carries  $\iff$  coefficient is odd

So:

Any carry  $\rightarrow$  even

No carry  $\rightarrow$  odd

The point test in Figure 7 can be greatly simplified to

$$\text{odd} = ((r(n - r)) == 0);$$

*Figure 9: Point test (fast)*