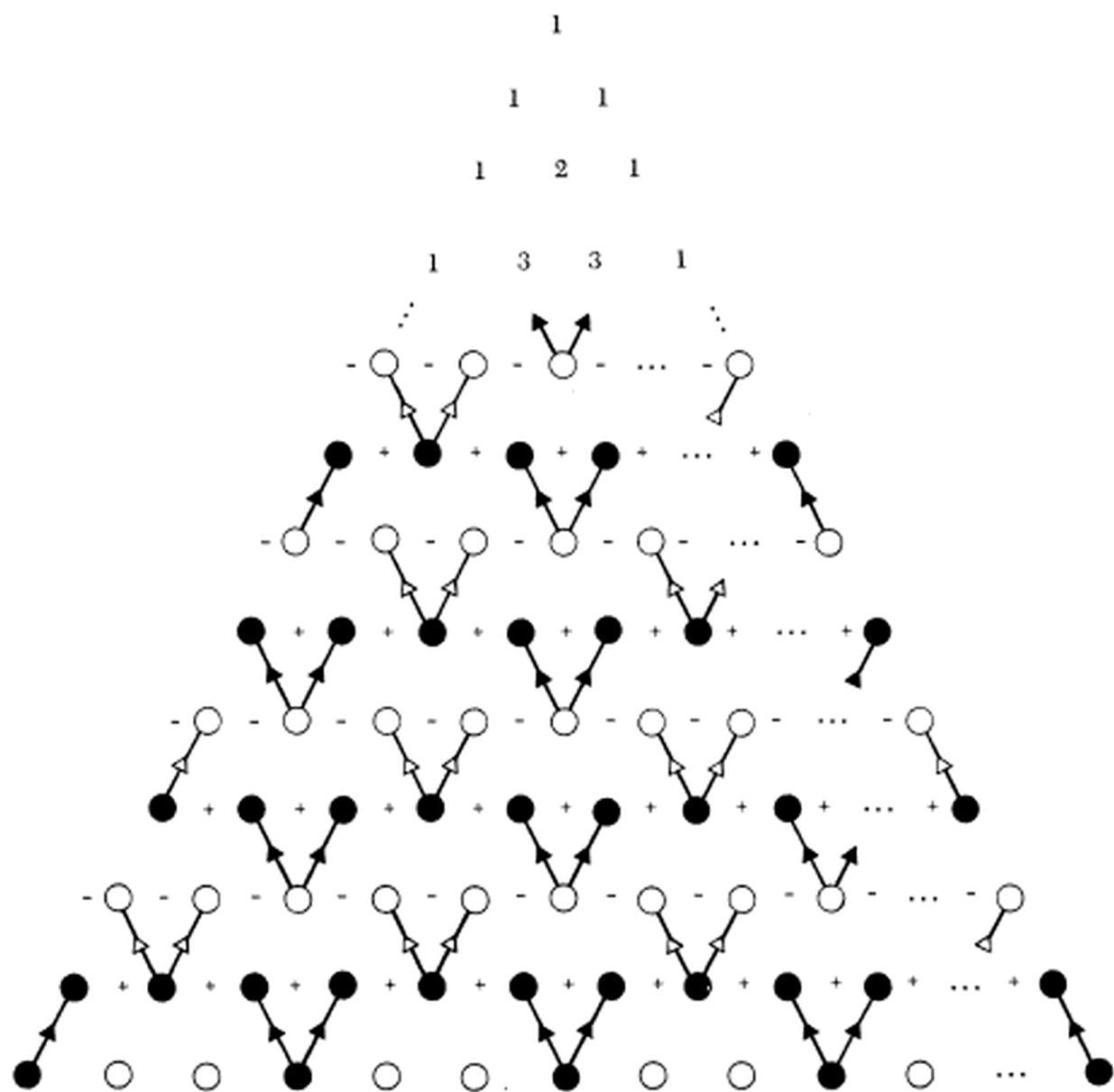Proof without Words:

$$3 \sum_{j=0}^{n} \binom{3n}{3j} = 8^n + 2(-1)^n, \text{ by Inclusion-Exclusion in Pascal's Triangle}$$

$$\sum_{j=0}^{n} \binom{3n}{3j} = \sum_{j=1}^{3n-1} (-1)^{j-1} 2^{3n-j} = -2^{3n} \sum_{j=1}^{3n-1} \left(-\frac{1}{2}\right)^j = \frac{8^n + 2(-1)^n}{3}.$$

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