Solution to Exercise 3.1-1: "Calculate Geometry Factors"

Illustration

- The geometry factor (always for a single vacancy) was defined as

$$g = \tfrac{1}{2} \cdot \Sigma_i \left(\frac{\Delta x_i}{a}\right)^2$$

  - With Δx_i = component of the jump in x-direction.
- Looking at the fcc lattice we realize that there are **12** possibilities for a jump because there are **12** next neighbors.
  - **8** of the possible jumps have a component in x (or $-x$) -direction, and $\Delta x_i = a/2$
  - We thus have

$$g_{\text{fcc}} = \tfrac{1}{2} \cdot 8 \cdot \left(\frac{1}{2}\right)^2 = 1$$

- Looking at the bcc lattice we realize that there are **8** possibilities for a jump because there are **8** next neighbors.
  - All **8** possible jumps have the component $\Delta x_i = a/2$ in x-direction, again we have

$$g_{\text{bcc}} = \tfrac{1}{2} \cdot 8 \cdot \left(\frac{1}{2}\right)^2 = 1$$

- Looking at the diamond lattice we realize, after a bit more thinking (or drawing, or looking at a ball and stick model), that there are **4** possible jumps.
  - All **4** jumps have the component $\Delta x_i = a/4$ in x-direction, and we obtain

$$g_{\text{diamond}} = \tfrac{1}{2} \cdot 4 \cdot \left(\frac{1}{4}\right)^2 = 1/8$$