$$\text{cov}(u_1, u_3) = \text{cov}\left(u_1, \tfrac{1}{2}u_1 + \tfrac{1}{2}u_2 + w_3\right)$$

$$= \text{cov}\left(u_1, \tfrac{1}{2}u_1\right) + \text{cov}\left(u_1, \tfrac{1}{2}u_2\right) + \text{cov}(u_1, w_3)$$

$$= \tfrac{1}{2}\text{cov}(u_1, u_1) + \tfrac{1}{2}\underbrace{\text{cov}(u_1, u_2)}_{0} + \text{cov}(u_1, w_3)$$

$$= \tfrac{1}{2}\text{var}(u_1) + \tfrac{1}{2} \cdot 0 + 0$$

$$= \tfrac{1}{2}(1 + F_1) \cdot \sigma_u^2 \quad ; \quad F_1 \text{ corresponds to } 1/2 \text{ of relationship between parents of 1 and 2}$$

$$= \tfrac{1}{2}\sigma_u^2 \qquad \Rightarrow F_1 = 0$$

$$\text{cov}(u_1, u_4) = \ldots = \tfrac{1}{2}\sigma_u^2$$

$$\text{cov}(u_3, u_4) = \text{cov}\left(\tfrac{1}{2}u_1 + \tfrac{1}{2}u_2 + w_3, \tfrac{1}{2}u_1 + w_4\right)$$

$$= \text{cov}\left(\tfrac{1}{2}u_1, \tfrac{1}{2}u_1\right) + \text{cov}\left(\tfrac{1}{2}u_2, \tfrac{1}{2}u_1\right)$$

$$= \tfrac{1}{4}\text{cov}(u_1, u_1) + \tfrac{1}{4}\text{cov}(u_2, u_1)$$

$$= \tfrac{1}{4}\sigma_u^2$$