3.

$$B_i(n) = \binom{3}{i} u^i (1-u)^{3-i}$$

$$g(u) = B_0(u)P_0 + B_1(u)P_1 + B_2(u)P_2$$

$$\left.\begin{aligned} B_0(u) &= (1-u)^3 \\ B_1(u) &= 3u(1-u)^2 \\ B_2(u) &= 3u^2(1-u) \end{aligned}\right\} \quad g(u) = (1-u)^3 P_0 + 3u(1-u)^2 P_1 + 3u^2(1-u)P_2$$

$r_i = (1-u)P_i + uP_{i+1}$, $s_i = (1-u)r_i + u\, r_{i+1}$, $t_0 = (1-u)s_0 + us_1 = \cdots$

$$= (1-u)^2 r_0 + 2u(1-u)r_1 + u^2 r_2 = (1-u)^2\left((1-u)P_0 + uP_1\right) + 2u(1-u)\left((1-u)P_1 + uP_2\right) +$$

$$+ u^2\left((1-u)P_2 + uP_3\right) = (1-u)^3 P_0 + (1-u)^2 u P_1 + 2u(1-u)^2 P_1 + 2u^2(1-u)P_2 +$$

$$+ u^2(1-u)P_2 + u^3 P_3 = (1-u)^3 P_0 + 3u(1-u)^2 P_1 + 3u^2(1-u)P_2 + u^3 P_3 =$$

$$= g(u) \quad \blacksquare$$