$$f(t) = B_0(t)\cdot P_0 + B_1(t)\cdot P_1 + B_2(t)\cdot P_2 + B_3(t)\cdot P_3$$

$B_0(t) = (1-t)^3$

$B_1(t) = 3t(1-t)^2$

$B_2(t) = 3t^2(1-t)$

$B_3(t) = t^3$

$t = u$

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

$f(u) = t_0$

$$t_0 = (1-u)S_0 + uS_1 = (1-u)\left((1-u)t_0 + ut_1\right) + u\left((1-u)t_1 + ut_2\right) =$$

$$= (1-u)\left[(1-u)\left((1-u)P_0 + uP_1\right) + u(1-u)P_1 + uP_2\right] +$$

$$+ u\left[(1-u)\left((1-u)P_1 + uP_2\right) + u\left((1-u)P_2 + uP_3\right)\right] =$$

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

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

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