

Ex 3

$$wp(P, x) = wp(x := 1, wp(y := 0, \underbrace{wp(\text{while } \dots, x)}_{\psi(x)}))$$

$$\psi(x) = [y=0] \cdot wp(x := 2x, \{y:=0\} [\frac{1}{4}] \{y:=1\}, x) + [y \neq 0] \cdot x$$

$$\psi(x) = [y=0] \cdot wp(x := 2x, \frac{1}{4} wp(y:=0, x) + \frac{3}{4} wp(y:=1, x) + [y \neq 0] \cdot x$$

$$\psi(x) = [y=0] \cdot wp(x := 2x, \frac{1}{4} x [y:=0] + \frac{3}{4} x [y:=1] + [y \neq 0] \cdot x$$

$$\psi(x) = [y=0] \cdot \left(\frac{2}{4} x [y:=0] + \frac{6}{4} x [y:=1] \right) + [y \neq 0] \cdot x$$

$$\psi^0(x) = 1$$

$$\psi^1(x) = 2x$$

$$\psi^2(x) = 2x + \frac{1}{4} 2^2 x$$

$$\psi^3(x) = 2x + \frac{1}{4} 2^2 + \frac{1}{16} 2^3 x$$

$$\begin{aligned} \psi^n(x) &= \sum_{k=0}^n \left(\frac{1}{4} \right)^{k-1} \cdot 2^k \cdot x \\ &= \sum_{k=0}^n \left(\frac{1}{2} \right)^{2k-2} \cdot \left(\frac{1}{2} \right)^{-k} \cdot x = \sum_{k=0}^n \left(\frac{1}{2} \right)^{k-2} x = \frac{1}{4} \sum_{k=0}^n \left(\frac{1}{2} \right)^k x \\ &= \frac{1}{4} \cdot \left(\frac{1}{1 - \frac{1}{2}} \right) x = \frac{1}{4} \cdot 2x = \frac{1}{2} x \end{aligned}$$

$$wp(P, x) = wp(x := 1, wp(y := 0, \frac{1}{2} x)) = \frac{1}{2}$$

~~Welp something went wrong.~~

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