speedup

$$S_n = \frac{1}{1 - P + \frac{P}{n}} \quad \leftarrow \#\ \text{processors}.$$

4.1) $S = 0.4$, $P = 0.6$

$$S_n = \lim_{n \to \infty} \frac{1}{1 - 0.6 + \frac{0.6}{n}} = (0.4)^{-1} = 2.5$$

$\therefore$ There is a max of 250% speedup.

4.2) $S' = \frac{0.2}{k}$ $P' = 1 - \frac{0.2}{k}$

$$S_n' = \frac{1}{1 - P' + \frac{P'}{n}} = \frac{1}{\frac{0.2}{k} + \frac{1 - 0.2/k}{n}} = \frac{1}{\left(\frac{0.2n + k - 0.2}{nk}\right)}$$

$$= \frac{nk}{0.2n + k - 0.2} \qquad S_n' = 2 \cdot S_n$$

$$\rightarrow \frac{nk}{0.2n + k - 0.2} = \frac{2}{0.2 + \frac{0.8}{n}} = \frac{2n}{0.2n + 0.8}$$

$$nk(0.2n + 0.8) = 2n(0.2n + k - 0.2)$$

$$0.2nk - 1.2k = 0.4n - 0.4$$

$$k = \frac{0.4n - 0.4}{0.2n - 1.2}, \quad n > 6$$

In order to double speed need $n \geq 7$.

Say $n = 7$, then $k = \frac{0.4 \cdot 6}{0.2} = 12.$

$\therefore$ Then to double speed, you need $k = 12$ if there are 7 cores. $k = \frac{0.4(n-1)}{0.2n - 1.2}$