HW Bonus Solutions.

For multiplying n digits by n digits, we have

Total op's $S(n) = n^2 + n^2$.

Now, we can convert n digits to $n/2$ bigdigits, then, for multiplying $n/2$ bigdigits by $n/2$ bigdigits,

$(xx) \cdots - (xx)$

$\times \quad (xx) \cdots - (xx)$

$(xx) \cdots - (xx)$

$+ (xx) \cdots (xx)$

} $n/2$ rows; each row has $n/2$ big digits; total op's $= \left(\frac{n}{2}\right)^2$.

$(xx) \cdots (xx)$ } total op's $= \left(\frac{n}{2}\right)^2$ to create this row.

Total op's $\mathcal{T}(n) = \left(\frac{n}{2}\right)^2 + \left(\frac{n}{2}\right)^2$.

So, speed-up ratio $= \lim_{n\to\infty} \frac{\mathcal{S}(n)}{\mathcal{T}(n)} = 4$, asymptotically.