

# HW Bonus Solutions.

For multiplying  $n$  digits by  $n$  digits, we have

X		
X	X	
X	X	
X	X	
.	.	
.	.	
.	.	
X	X	

$\begin{array}{ccccccc} & & & & x & x & x \dots x \\ & & & & / & / & / \\ & & & & | & | & | \\ & & & & \backslash & \backslash & \backslash \\ x & x & x & x & x & x & x \end{array}$

}  $n$  rows;  
each row has  $n$  digits.  
 $n^2$  ops to create these  
rows.

Total ops  $\{ n^2$  ops to create this row.

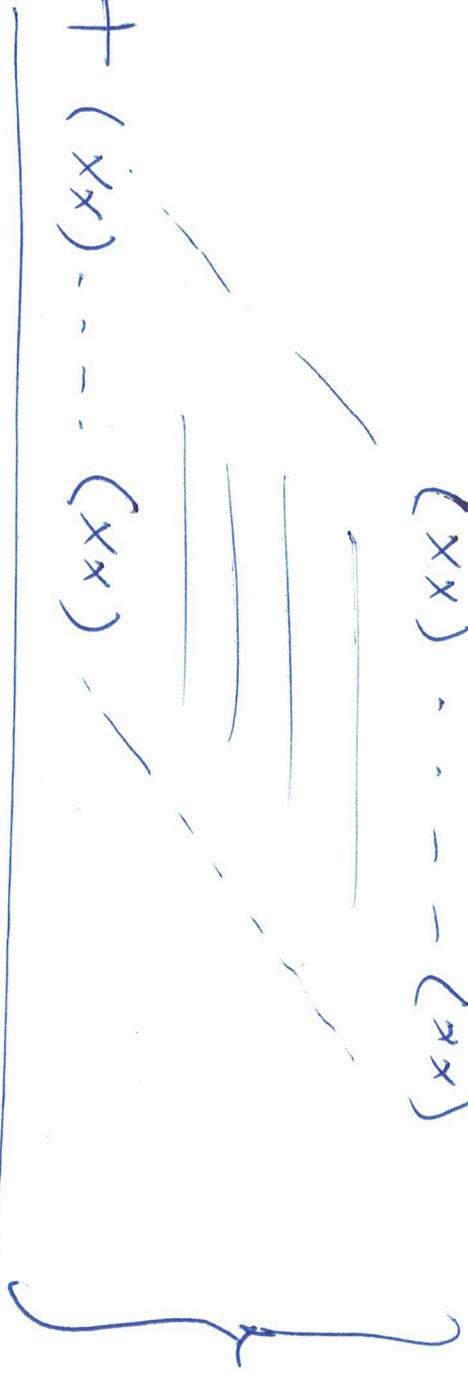
$C_S(n) = n^2 + n^2$

Now, we can convert  $x$  digits to  $\frac{n}{2}$  bigdigits,  
then, for multiplying  $\frac{n}{2}$  bigdigits by  $\frac{n}{2}$  bigdigits,

(xx) . . . . (xx)

X (xx) . . . . (xx)

(xx) . . . . (xx)



$n/2$  rows; each row has  $n/2$  bytes;  
total ops =  $(\frac{n}{2})^2$ .

(xx) . . . . (xx)

} total ops =  $(\frac{n}{2})^2$  to create this row.

Total ops  $\Rightarrow (n) = (\frac{n}{2})^2 + (\frac{n}{2})^2$ .

So, speed-up ratio =  $\lim_{n \rightarrow \infty} \frac{C(n)}{\Rightarrow(n)} = 4$ , asymptically.