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CptS 350
Homework 3

Can you figure it out and sketch how we would do this for n digit by n digit multiplication and why it is at least two times?

* Traditional Base-10 multiplication (Digit by Digit)
- For n-digit by n-digit multiplications. For example multiplying two 4-digit numbers requires 16 (4x4) single digit multiplications

* Base-100 multiplication (Two-Digits-at-a-time)
- When multiplying two such numbers, we perform (n/2) * (n/2) unit multiplications. For instance, multiplying two 4-digit numbers now requires only 4(2x2) unit multiplications.

Base 10:

multiplying 1234 by 5678 in base-10:

$$\begin{array}{r} 1234 \\ \times\ 5678 \\ \hline \end{array}$$

* multiple steps involving 16 single digit multiplications

Base 100:

multiplying 1234 by 5678 in base 100 (considering 12 and 34 as units)

$$\begin{array}{r} (12)(34) \\ \times\ (56)(78) \\ \hline \end{array}$$

* Less steps, involving 4 two-digits multiplications

Why its Faster:

- Reduced # of multiplications:
  - less # of multiplications, instead of n * n its (n/2) * (n/2) significant reduction for large values of n,
- Some complexity, Less work:
  - the complexity class $O(n^2)$ for simple multiplication. Constant factor is reduced making algorithm faster.
- Efficiency in larger units:

In summary:

By grouping digits, the base-100 method effectively reduces the workload, making the multiplication process at least two times faster for larger numbers. This sort of illustrates Blum's speed up theorem, algorithm's efficiency can be dramatically improved in data processing.