

# Multicore Computing

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# Matrix Multiplication (in Theory)

$$\begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix} = \begin{bmatrix} A_{11}B_{11} + A_{12}B_{21} & A_{11}B_{12} + A_{12}B_{22} \\ A_{21}B_{11} + A_{22}B_{21} & A_{21}B_{12} + A_{22}B_{22} \end{bmatrix}$$

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Arithmetic intensity: the ratio of the work to the memory traffic

# Strassen Algorithm

$$M_1 = (A_{11} + A_{22})(B_{11} + B_{22});$$

$$M_2 = (A_{21} + A_{22})B_{11};$$

$$M_3 = A_{11}(B_{12} - B_{22});$$

$$M_4 = A_{22}(B_{21} - B_{11});$$

$$M_5 = (A_{11} + A_{12})B_{22};$$

$$M_6 = (A_{21} - A_{11})(B_{11} + B_{12});$$

$$M_7 = (A_{12} - A_{22})(B_{21} + B_{22}),$$

$$\begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix} = \begin{bmatrix} M_1 + M_4 - M_5 + M_7 & M_3 + M_5 \\ M_2 + M_4 & M_1 - M_2 + M_3 + M_6 \end{bmatrix}$$

# HW 1: Logistic Regression

- Given matrix  $X$  and label  $Y$ , perform gradient descent of logistic regression
- 10 independent test cases. Each case weights 1 pt.
- The compilation is considered failed if it does not finish in **1 minute**.
- A test case is considered **incorrect** if it does not finish in **2 minutes**.
- The training accuracy must reach **60%**.
- The **summation** of the execution time across 10 cases will be used to rank **correct** solutions.
- Due: 09/18/2023 5:00 pm EDT

# Grading

- Homework 40%
- Reading 10%
- Project 50%

- $90\% \leq A \leq 100\%$
- $80\% \leq B < 90\%$
- $70\% \leq C < 80\%$
- $60\% \leq D < 70\%$
- $0\% \leq F < 60\%$

- 5 pieces of homework.
- No late submissions.
- No 3<sup>rd</sup> party code
- Automatically tested: Please **strictly** follow the output format. An incorrect format is considered as a wrong answer.
- The **best 4** scores among the 5 are counted in your final grade.
- The fastest correct solution in each homework gets **10% bonus score in the final grade**.
- Other correct solutions that are no slower than 2X of the fastest one gets **5% bonus score in the final grade**.

# Input Data

- First line contains 8 integers:  $N$   $D$   $x_0$   $x_1$   $A$   $B$   $C$   $M$
- For  $i \geq 2$ 
  - $X[i] = (A * X[i - 1] + B * X[i - 2] + C) \% M$
- For all  $i$ 
  - $X[i] \neq M$ ;
  
- $N \leq 10^5$
- $D \leq 1600$

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  - For all  $i$ 
    - $X[i] \neq M$ ;
- Caution the potential overflow here!
- $N \leq 10^5$
  - $D \leq 1600$



# Output Format

- D lines
- Each line contains a floating number
  - The logistic regression parameters

# What Do We Need to Do?

- We are required to complete two scripts
- `compiler.sh`
  - it is executed once before the actual testing starts
- `run.sh`
  - it should takes two arguments, the first argument is the input file name, the second one is the file name that you should write your sorted results into.

# Testing Environment

- `ssh yourusername@granger.cs.rit.edu`
  - Intel(R) Xeon(R) CPU E5-2650 v4 @ 2.20GHz
  - 48 threads in total (2 sockets, 12 cores per socket, 2 threads per core)
  - 251 GB memory
  
  - Testing limit:
    - 8 threads
- `taskset -c`