Project Title: Development of a Wireless Distributed Computing System

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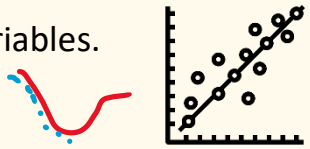
01 Motivation

Linear regression:

- Models to predict values/ show relation between variables.
  - ➢ Y = Xh
- With BIG dataset, SLOW

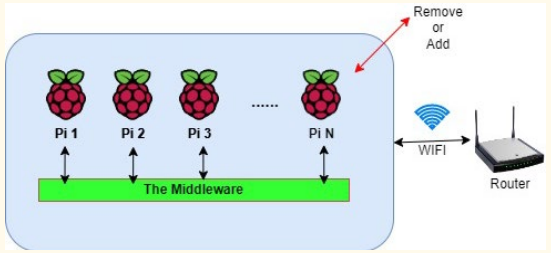
$$\begin{bmatrix} Y1 \\ Y2 \\ \dots \\ Yn \end{bmatrix} = \begin{bmatrix} 1 & X_{11} & \cdots & X_{1k} \\ 1 & X_{12} & \cdots & X_{2k} \\ \dots & \dots & \dots & \dots \\ 1 & X_{n1} & \cdots & X_{nk} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \dots \\ \beta_k \end{bmatrix}$$



02 Objective

Goal To develop a **fault-tolerant** distributed system using low-end devices to **speed up** solving linear regression.

Distributed system:
Joint computing power of multiple devices.
(Faster than 1 device.)

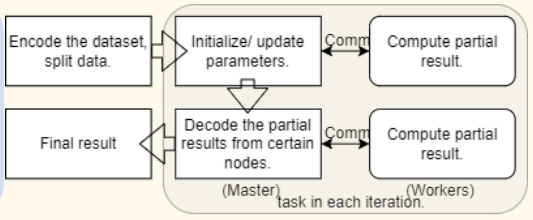


Independent but able to work together on the same task.

03 Methodology

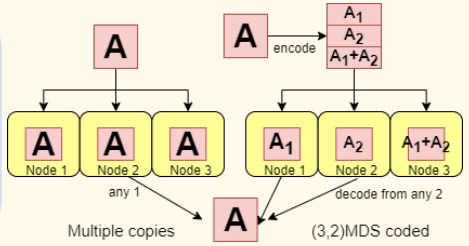
Distributed gradient descent for parallel computing

- Distributed workload.
- global gradient $\nabla L(h) = 2X^T(Xh - y)$
- Coefficient update as $h' = h - \alpha\nabla L(h)$



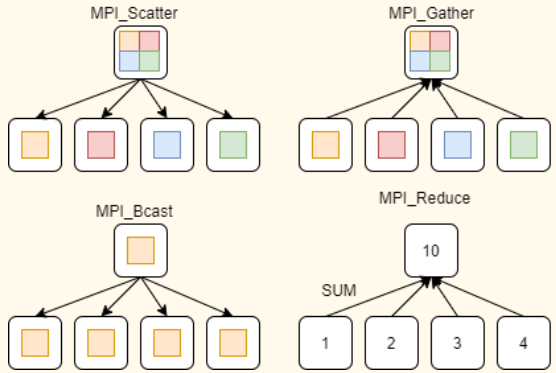
Coding technique for fault tolerance

- Introduce redundancy to the system.
- Recover original data from part of the coded data.



04 Implementation

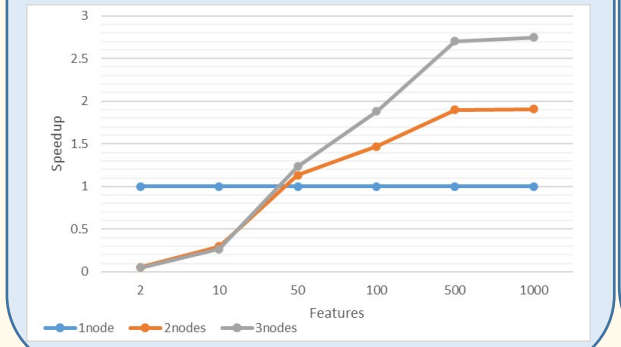
- **Hardware**: 3 Raspberry Pi + 1 router (+ PC as remote control)
- **Software**: Message Passing Interface (MPI)
  - ➢ The middleware controlling the message flow in the system.



05 Experimental Results

- **Speedup test**: compare the time performance of different number of devices used in the system.
- **Fault tolerance test**: the system should decode the correct result.

Speed up relative to one single device



Successful decoding from any 2 out of 3 devices.