HPC - Exercise 1

Edoardo Zappia

Objective
Performance comparison between different OpenMPI algorithms

- Broadcast (Basic Linear, Chain, Binary Tree)

- Scatter (Default, Basic Linear, Binomial, Non-nlocking Linear)
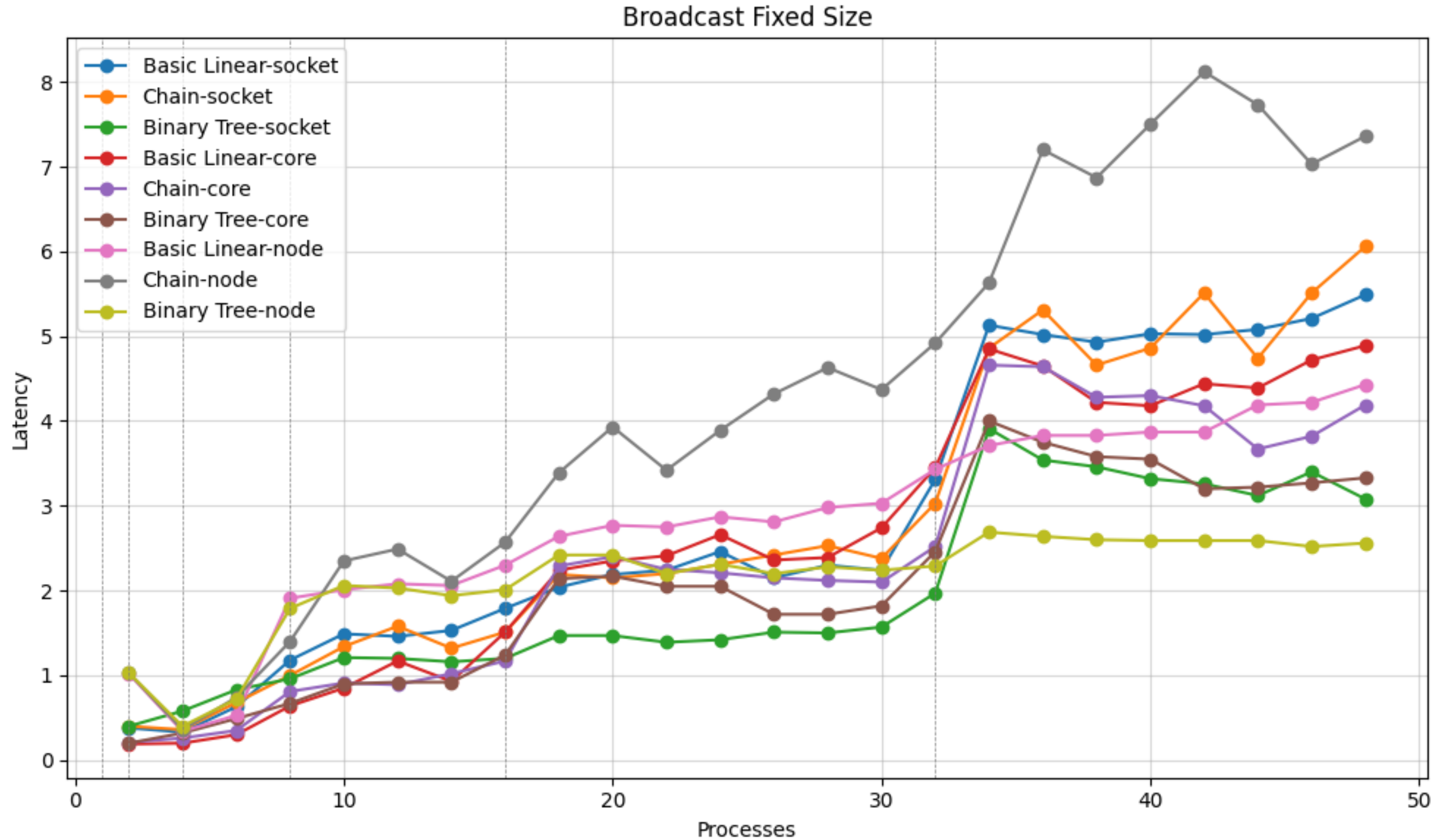
Experimental Setup
ORFEO CLUSTER

- 2 THIN nodes (48 cores)

- Tasks distributed evenly across the two nodes

- Mapping by: node, socket, core

- Fixed and variable size

Fixed size

Broadcast
Latency vs Processes

Broadcast Fixed Size

Performance models

- $\text{Latency} = \text{const} + \beta_1 \times \text{Number\_Processes} + \beta_2 \times \text{Number\_Processes}^2$

- $\log(\text{Latency}) = \text{const} + \beta_1 \times \text{Number\_Processes} + \beta_2 \times \text{Number\_Processes}^2$

Table 1: Fixed Size Model 1 - Broadcast Basic Linear

	Coefficient	Std. Error	P-value
Constant	-0.3867	0.274	0.173
Processes	0.1348	0.025	0.000
Processes^2	-0.0005	0.000	0.367

R-squared: 0.942
Adj. R-squared: 0.937

Table 2: Fixed Size Model 2 - Broadcast Basic Linear

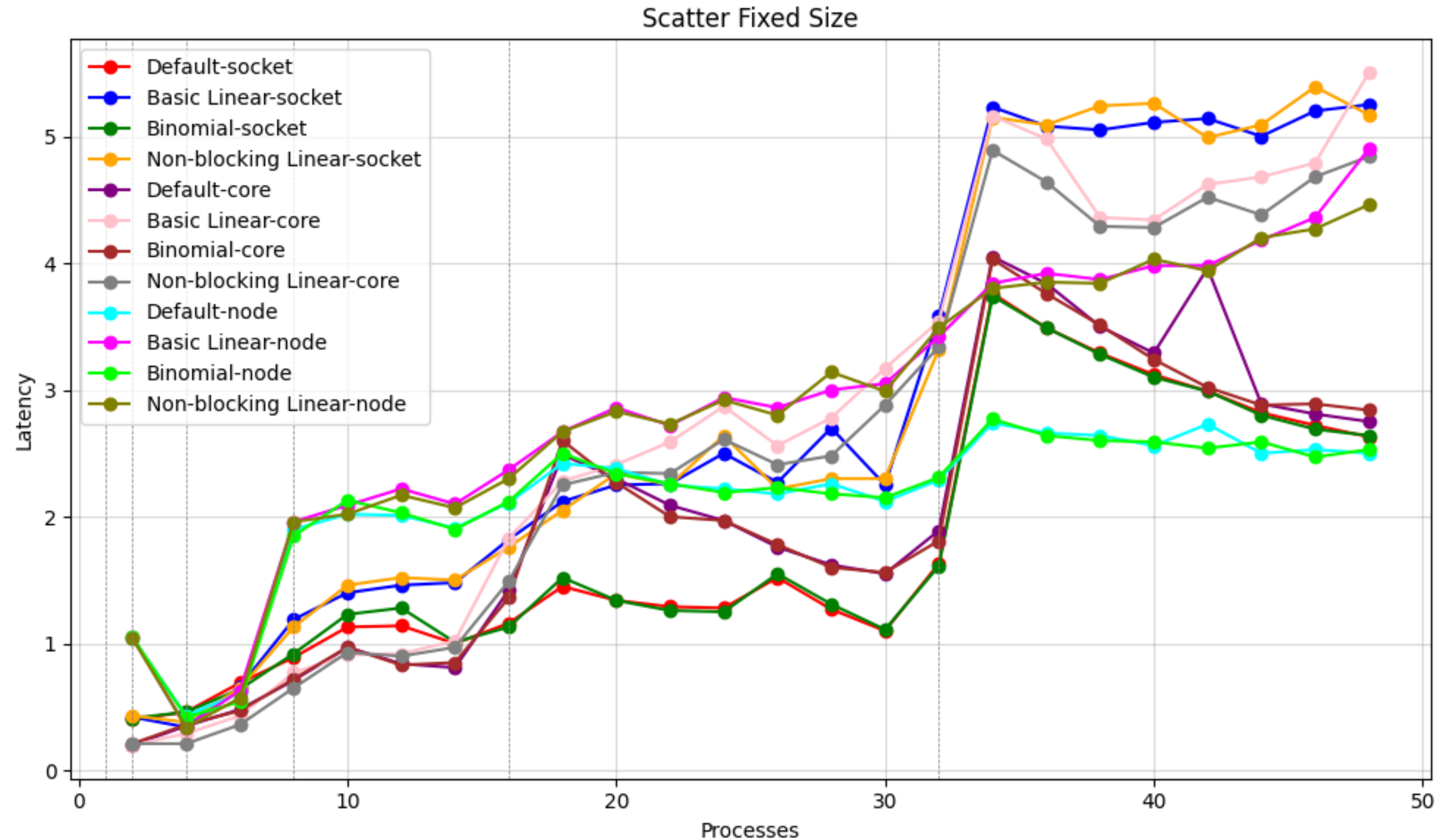|	Coefficient	Std. Error	P-value
Constant	-1.9058	0.142	0.000
Processes	0.1702	0.013	0.000
Processes^2	-0.0021	0.000	0.000

R-squared: 0.959
Adj. R-squared: 0.955
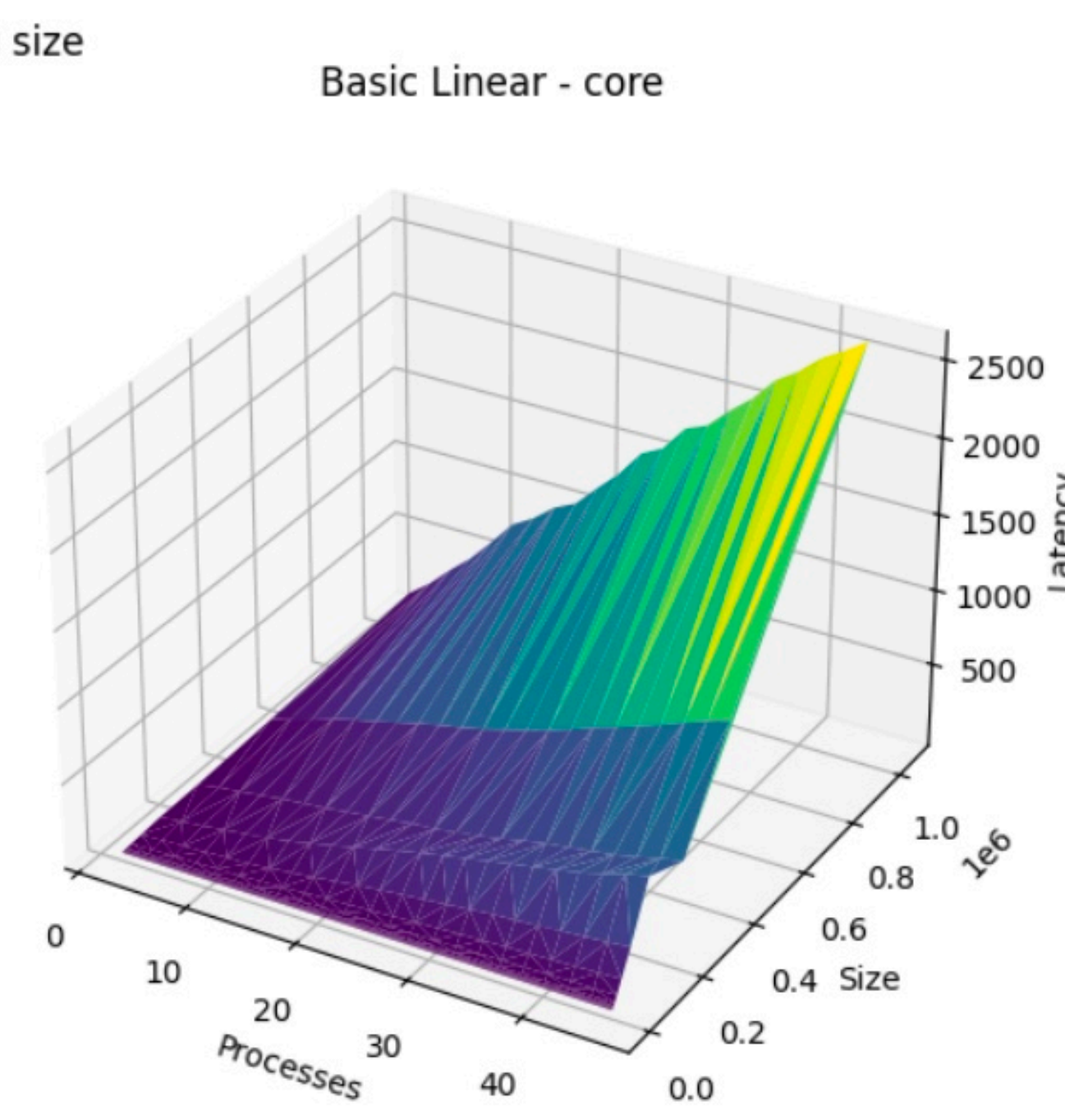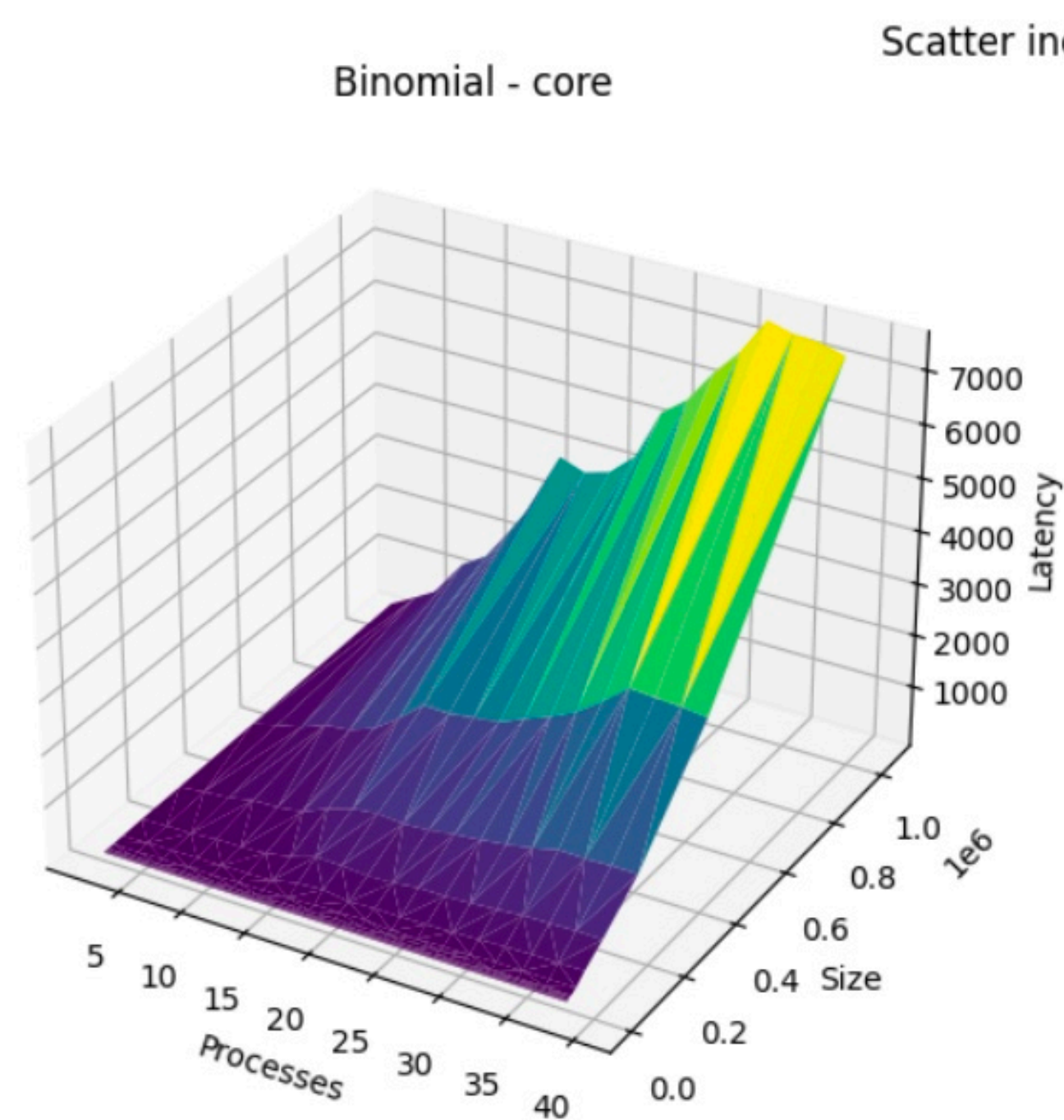
Scatter
Latency vs Processes

Scatter Fixed Size

Variable size

Broadcast increasing size

Basic linear - core

Chain - core

Broadcast

Scatter increasing size

Binomial - core

Basic Linear - core
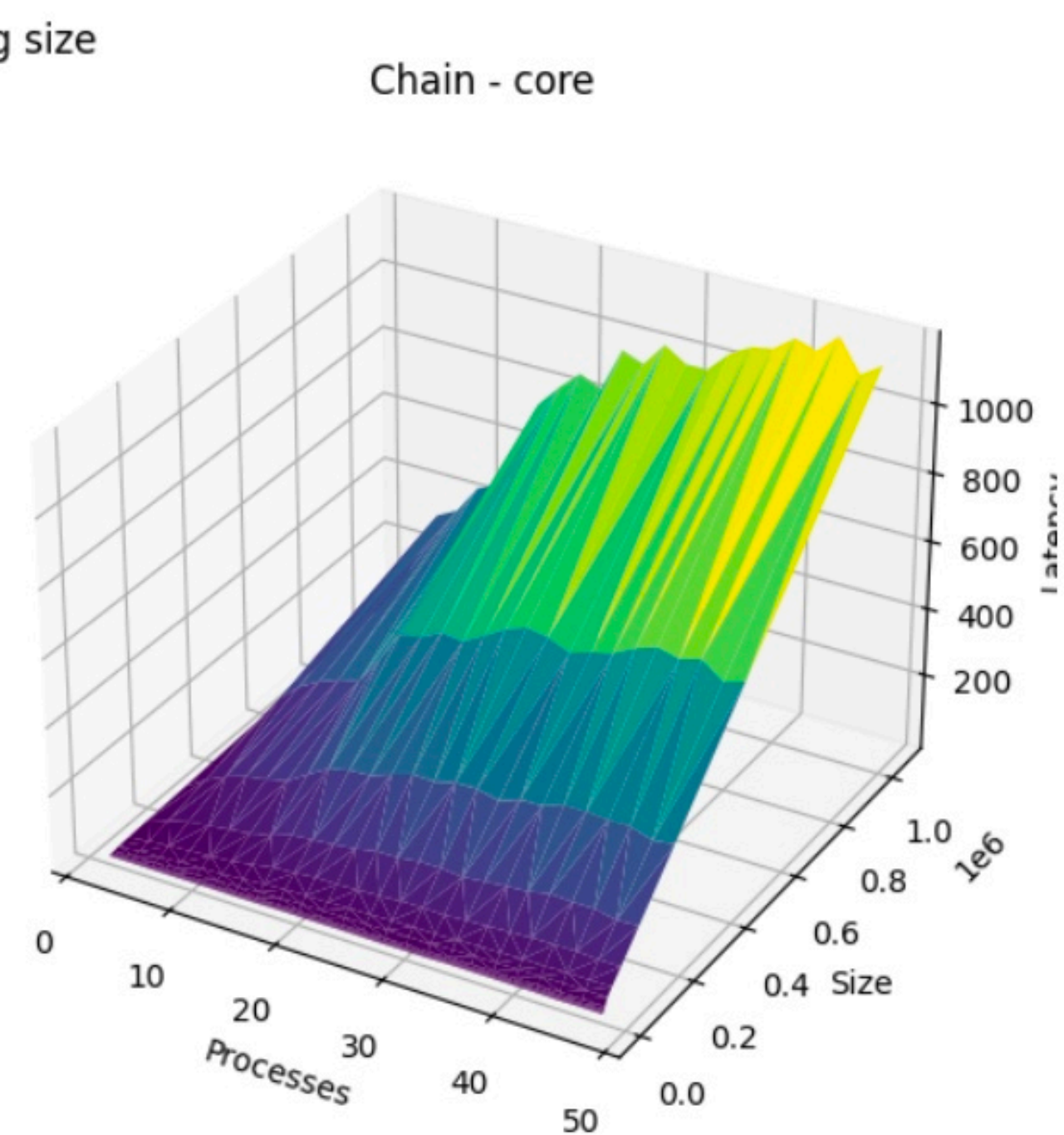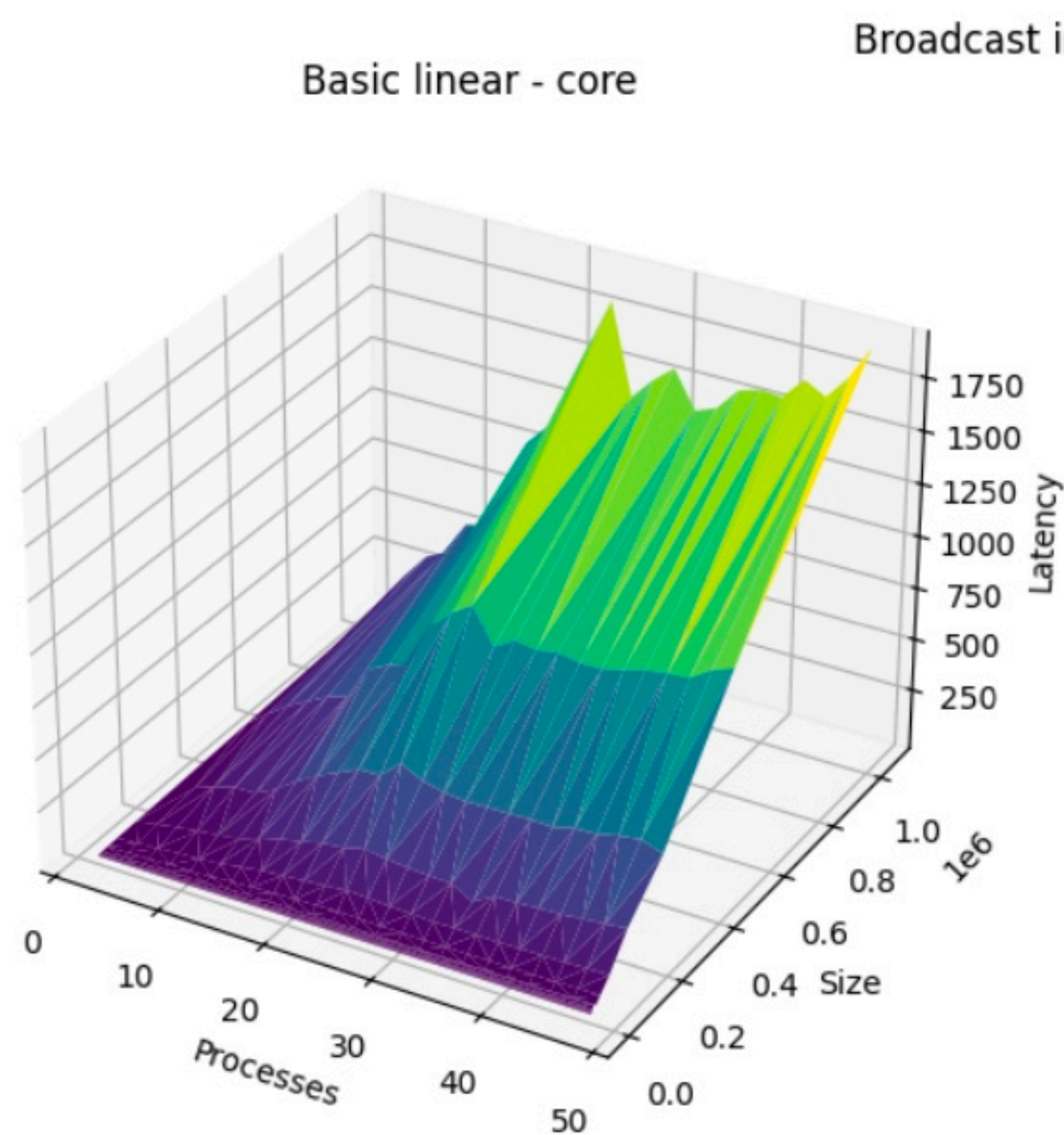
Scatter

Performance models - Scatter

$$\log(\text{Latency}) = \beta_0 + \beta_1 \times \text{Number\_Processes} + \beta_2 \times \log(\text{Size}) + \beta_3 \times \log(\text{Size})^2$$

Table 7: Model increasing size - Scatter node

	Coefficient	Std. Error	P-value
Constant	0.0245	0.056	0.661
Processes	0.0436	0.001	0.000
Log_Size	-0.1875	0.016	0.000
Log_Size_Squared	0.0446	0.001	0.000

R-squared: 0.976

Adj. R-squared: 0.976