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# High Performance Computing for Machine Intelligence: Gruppe 3

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**Zusammenfassung**—Verloren in Raum und Zeit? Nicht mehr! Für alle die regelmäßig eine Ausfahrt auf dem Weg von Terra nach Alpha Centauri verpassen und unterwegs mit leerem Tank auf einem leeren Planeten landen, haben wir eine optimale Lösung entwickelt: skalierbare asynchrone Value Iteration per Open MPI. Ziel dieser Ausarbeitung ist die Einführung in die relevanten Hintergründe zu Open MPI und darauf aufbauend die Motivation eines Projektaufbaus, der die Beurteilung verschiedener Kommunikationsschemata und Parametrierungen erlaubt. Mittels dieses Frameworks können wir aus drei MPI Schemata, sechs Ausführungsumgebungen und diversen Parameterkombinationen je nach Größe des Problems und zur Verfügung stehender Rechenumgebung eine zielführende Kombination ableiten. Die Kernergebnisse sind die Identifikation verschiedener Zusammenhänge zwischen MPI Kommunikationsschema, Rechenumgebung und Parametrierung und Qualitätsmetriken wie Rechenzeit, Speicherbedarf und Lösungsqualität. Diese erlauben eine optimale Anpassung des Projekts an die jeweiligen Rahmenbedingungen.

**Keywords**—*Parallel Processing, Reinforcement Learning, Machine Intelligence, High Performance Computing*

## I. INTRODUCTION

**P**ARALLEL Processing - \*\*\* State of the Art \*\*\* ->  
 cite related papers  
 - wesentliche Ziele  
 - Struktur des Reports  
 - Wesentliche Abgrenzung zum Stand der Technik  
 - Projektplan, Schritte der Umsetzung  
 - Struktur der Umsetzung

## II. METHODIK, @TOBIAS KRUG

- A. Schemata
- B. Automatisierung
- C. Ausführungsumgebungen für Tests

## III. ANALYSE & DISKUSSION, @TILL HÜELDER

- A. Vergleich der Schemata
- B. Vergleich der Ausführungsumgebungen

## IV. THESEN, @TOBIAS KLAMA

- A. *Es besteht eine Korrelation RAM mit world\_size, nach einer Kurzgeschichte von Hans Mueller*  
 blabla, siehe Figure 3 bis 17

- B. *Es besteht eine Korrelation runtime mit com\_interval*  
 blabla

- C. *Es besteht eine inverse Korrelation zwischen world\_size und runtime*  
 blabla

## V. BEITRÄGE

- Testumgebung für automatisierte Analyse von Open MPI Kommunikationsschemata für asynchrone Value Iteration auf verschiedenen Ausführungsumgebungen

## VI. ERKENNTNISSE

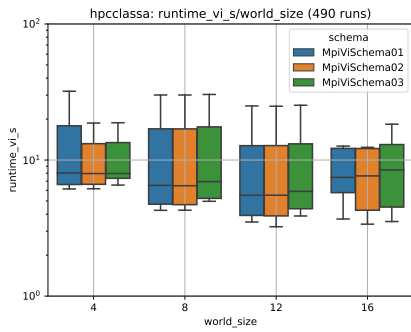
wir konnten zeigen, dass: - automatisiertes ist tauglich/realisierbar - der Einfluss von Targets und Parametern auf die Performance von Open MPI für ein VI Problem konnte gezeigt werden

## LITERATUR ANHANG A APPENDIX

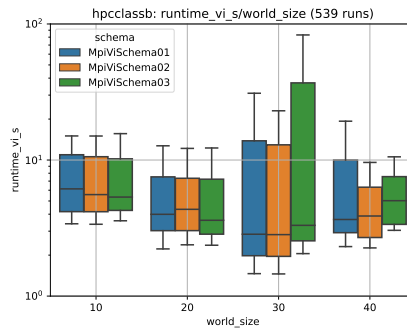
### A. Plots small

Hier sind die wunderbaren Plots unserer Messungen

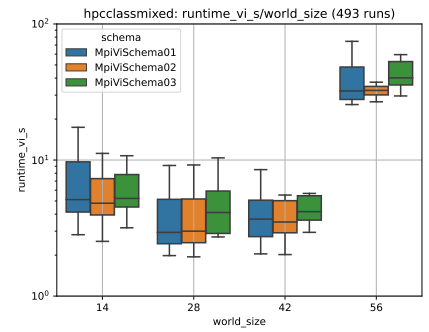
### B. Plots normal



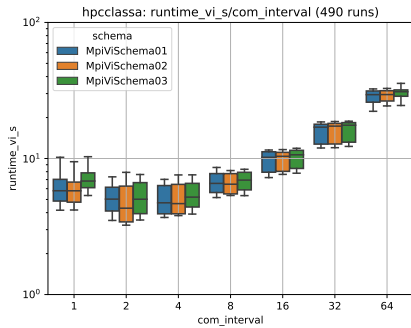
(a) HPC class A, runtime vs. world\_size



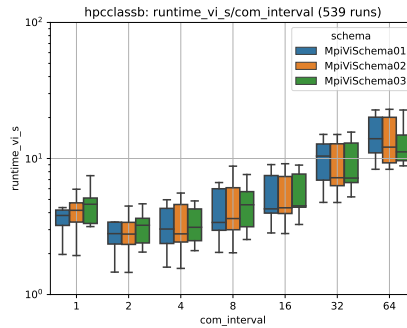
(b) HPC class B, runtime vs. world\_size



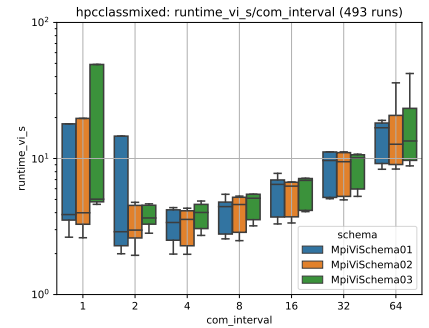
(c) HPC class mixed, runtime vs. world\_size



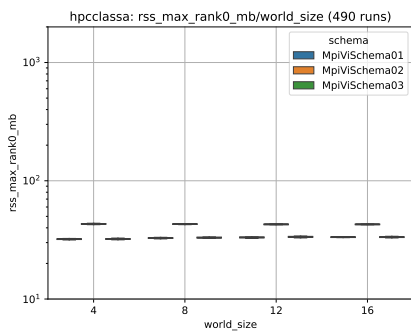
(d) HPC class A runtime vs. com\_interval



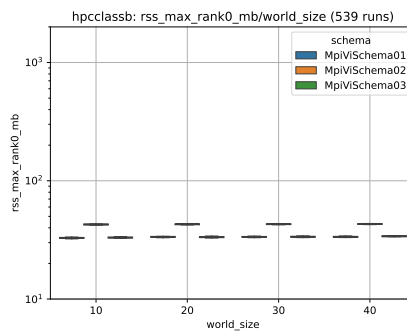
(e) HPC class B runtime vs. com\_interval



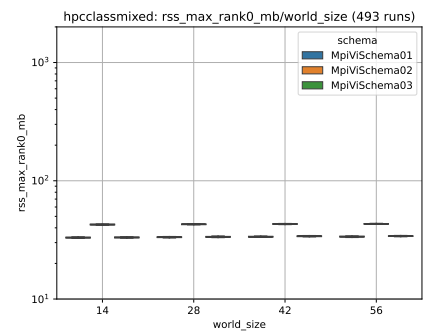
(f) HPC class mixed runtime vs. com\_interval



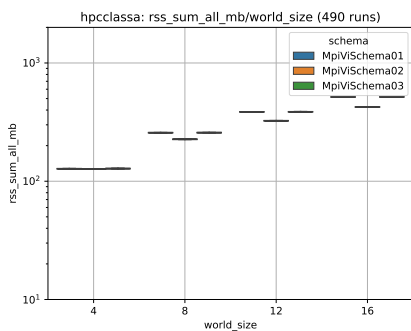
(g) HPC class A max rss rank\_0 vs. world\_size



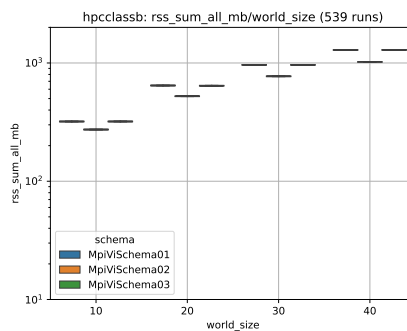
(h) HPC class B max rss rank\_0 vs. world\_size



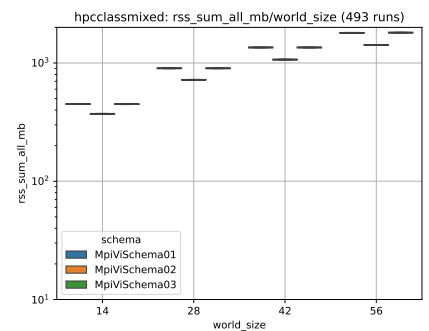
(i) HPC class mixed max rss rank\_0 vs. world\_size



(j) HPC class A rss-sum vs. world\_size

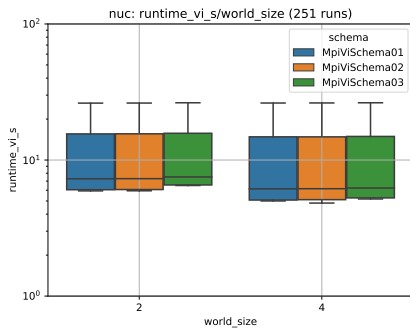


(k) HPC class B rss-sum vs. world\_size

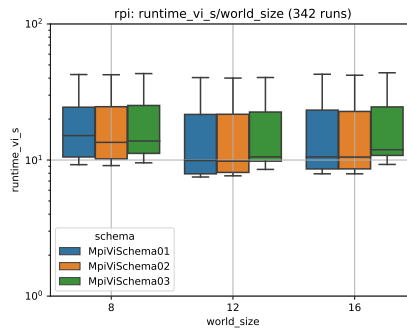


(l) HPC class mixed rss-sum vs. world\_size

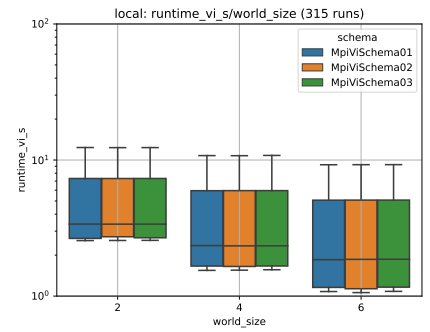
Abb. 1. Comparison between HPC classes with dataset small



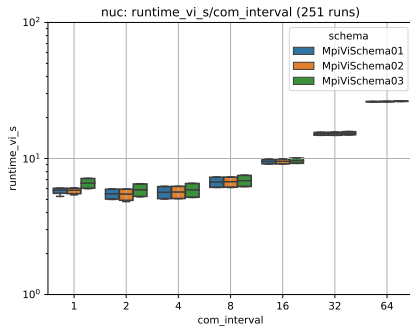
(a) NUC, runtime vs. world\_size



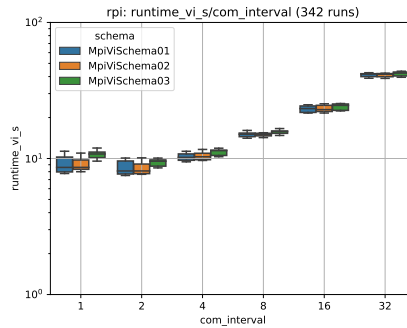
(b) RPi, runtime vs. world\_size



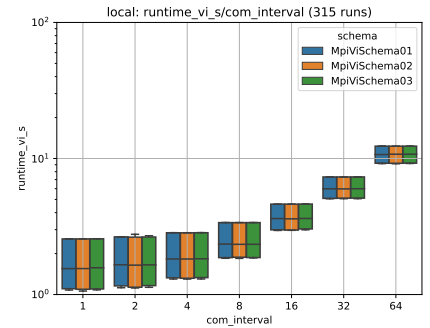
(c) Local, runtime vs. world\_size



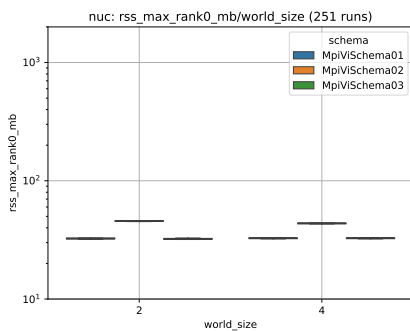
(d) NUC runtime vs. com\_interval



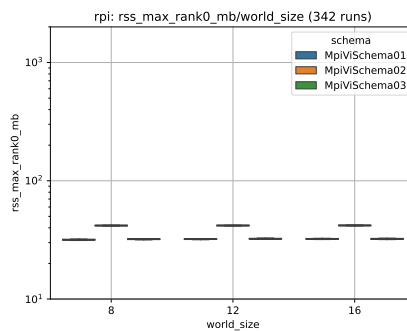
(e) RPi runtime vs. com\_interval



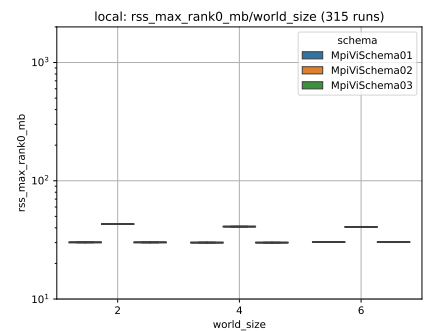
(f) Local runtime vs. com\_interval



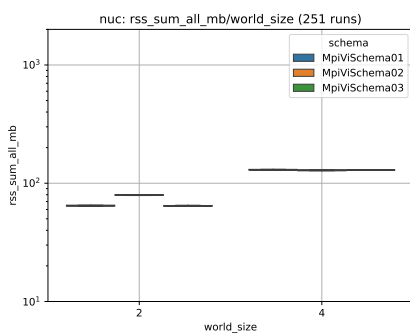
(g) NUC max rss rank\_0 vs. world\_size



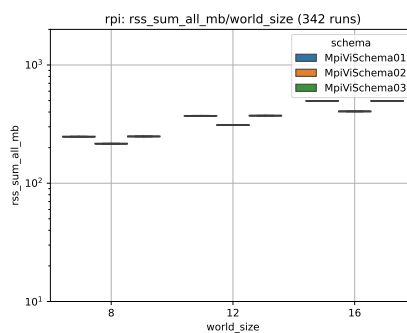
(h) RPi max rss rank\_0 vs. world\_size



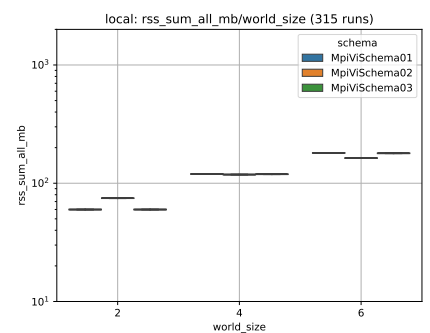
(i) Local max rss rank\_0 vs. world\_size



(j) NUC rss-sum vs. world\_size

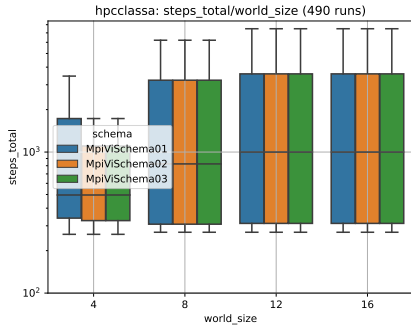


(k) RPi rss-sum vs. world\_size

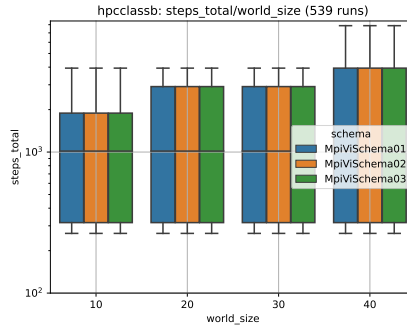


(l) Local rss-sum vs. world\_size

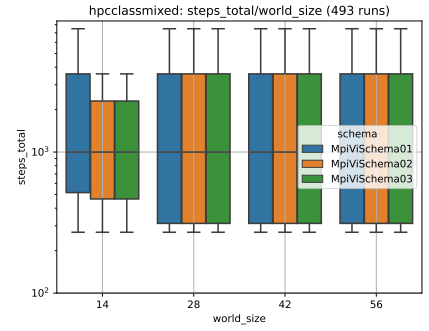
Abb. 2. Comparison between NUC, RPi and Local with dataset small



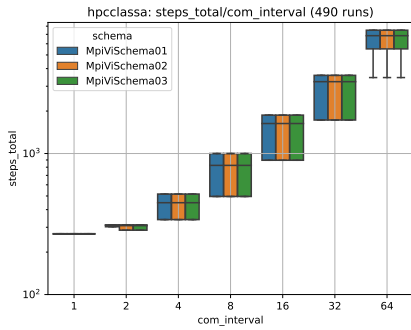
(a) HPC class A, Iterations vs. world\_size



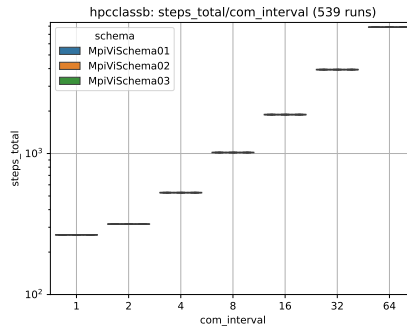
(b) HPC class B, Iterations vs. world\_size



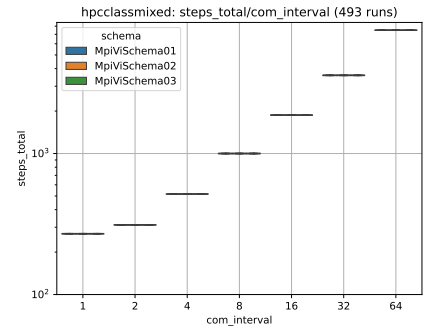
(c) HPC class mixed, Iterations vs. world\_size



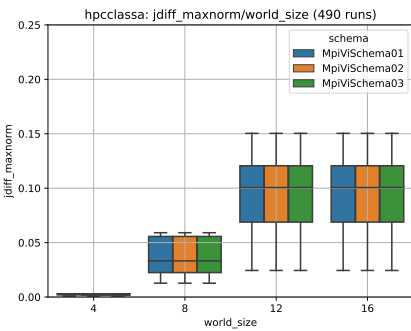
(d) HPC class A Iterations vs. com\_interval



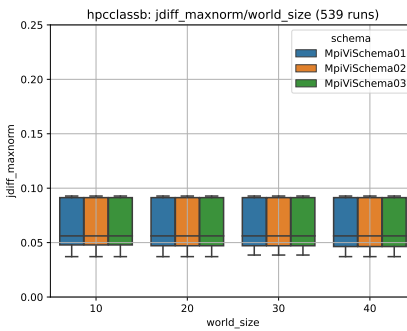
(e) HPC class B Iterations vs. com\_interval



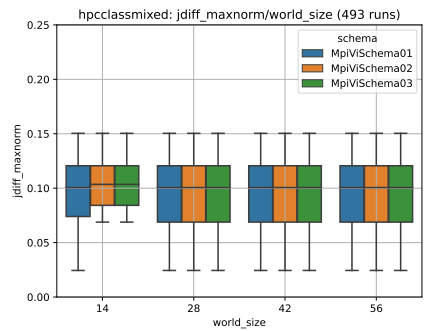
(f) HPC class mixed Iterations vs. com\_interval



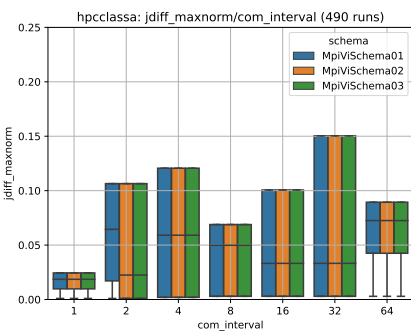
(g) HPC class A J-diff maxnorm vs. world\_size



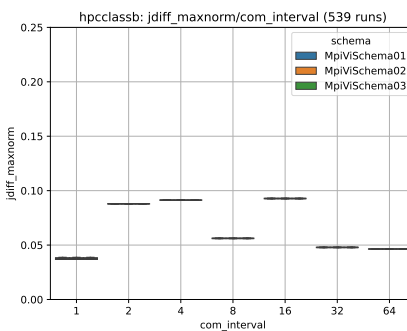
(h) HPC class B J-diff maxnorm vs. world\_size



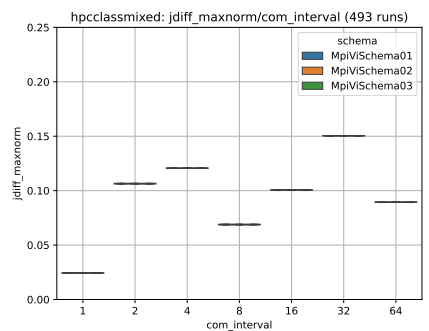
(i) HPC class mixed J-diff maxnorm vs. world\_size



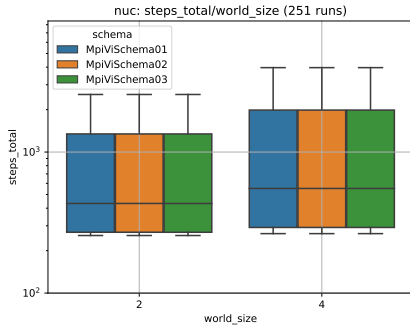
(j) HPC class A J-diff maxnorm vs. com\_interval



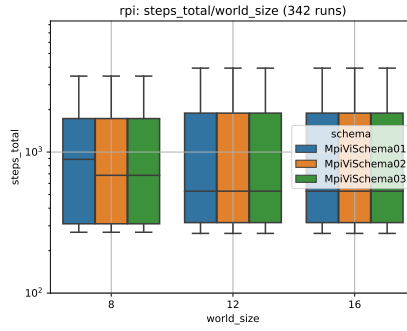
(k) HPC class B J-diff maxnorm vs. com\_interval



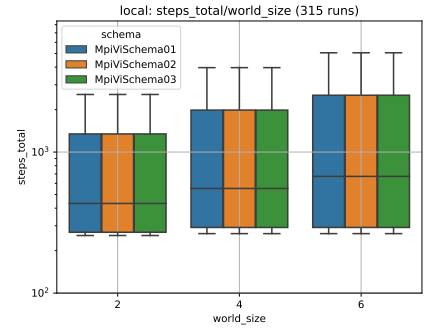
(l) HPC class mixed J-diff maxnorm vs. com\_interval



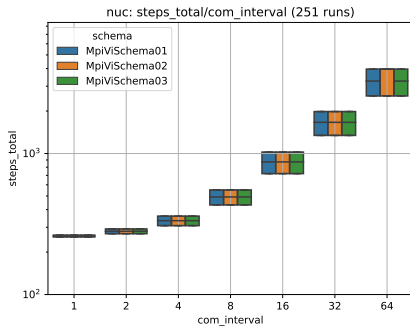
(a) NUC, Iterations vs. world\_size



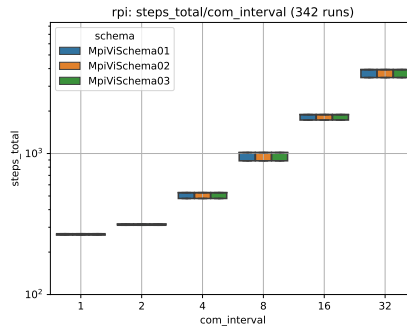
(b) RPi, Iterations vs. world\_size



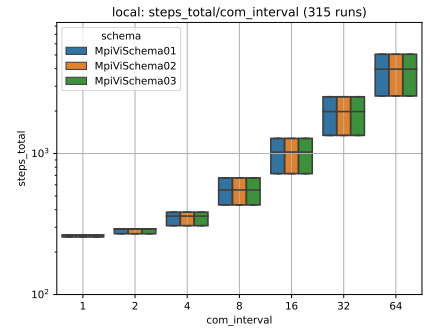
(c) Local, Iterations vs. world\_size



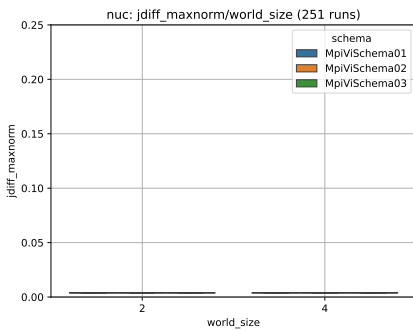
(d) NUC Iterations vs. com\_interval



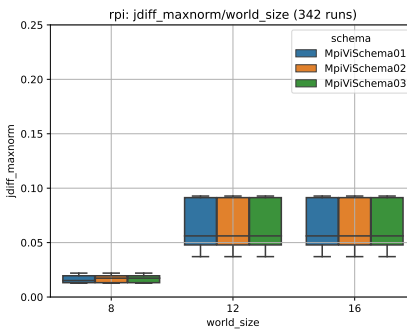
(e) RPi Iterations vs. com\_interval



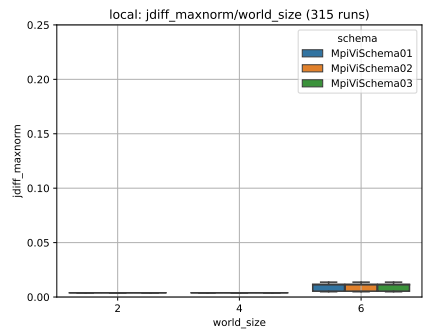
(f) Local Iterations vs. com\_interval



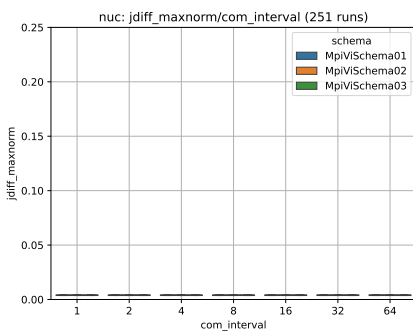
(g) NUC J-diff maxnorm vs. world\_size



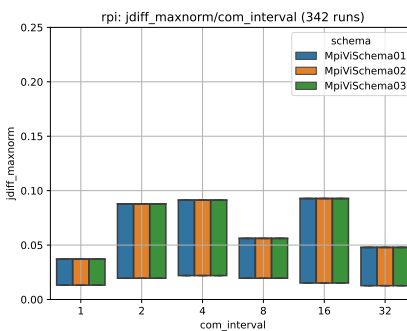
(h) RPi J-diff maxnorm vs. world\_size



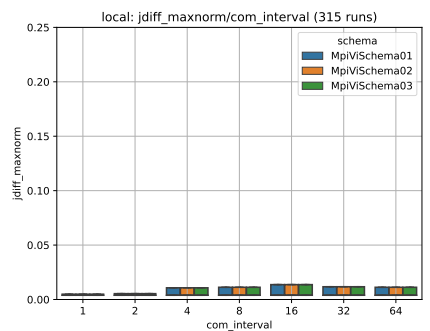
(i) Local J-diff maxnorm vs. world\_size



(j) NUC J-diff maxnorm vs. com\_interval

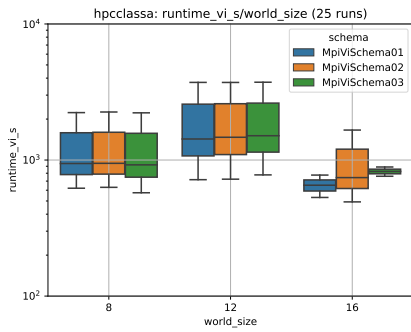


(k) RPi J-diff maxnorm vs. com\_interval

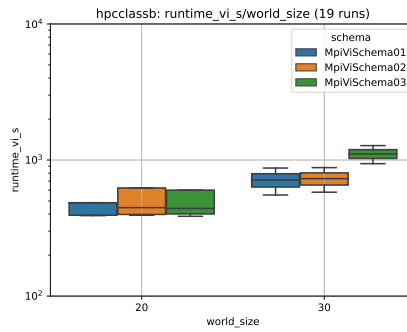


(l) Local J-diff maxnorm vs. com\_interval

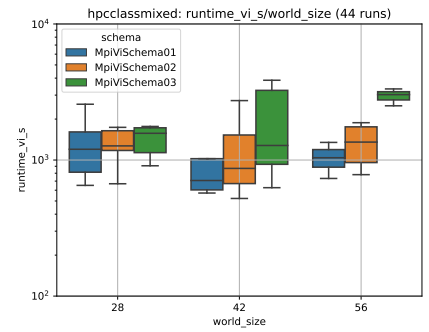
Abb. 4. Comparison between NUC, RPi and Local with dataset small



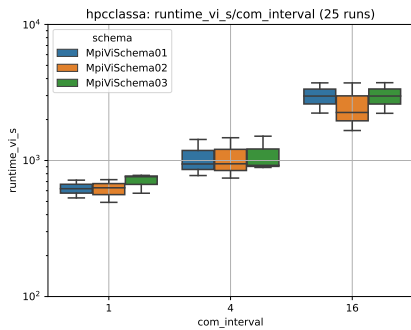
(a) HPC class A, runtime vs. world\_size



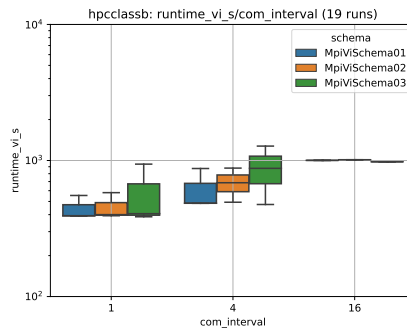
(b) HPC class B, runtime vs. world\_size



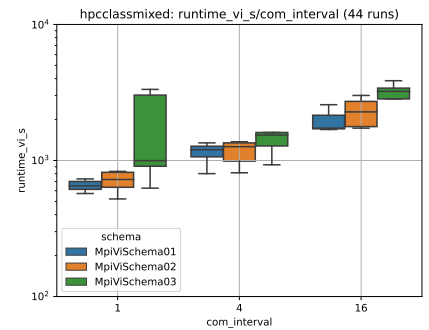
(c) HPC class mixed, runtime vs. world\_size



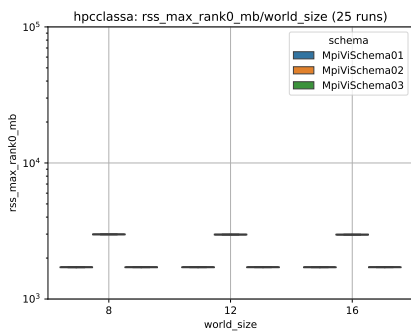
(d) HPC class A runtime vs. com\_interval



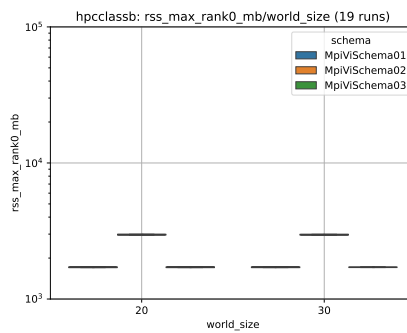
(e) HPC class B runtime vs. com\_interval



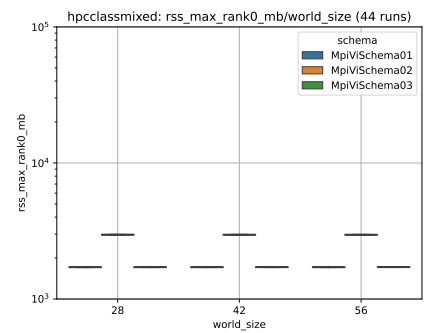
(f) HPC class mixed runtime vs. com\_interval



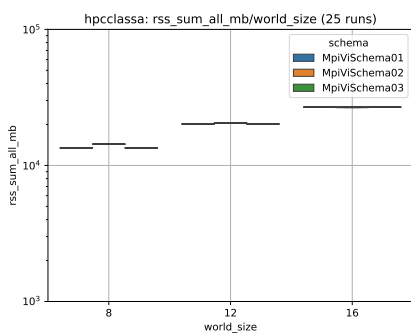
(g) HPC class A max rss rank\_0 vs. world\_size



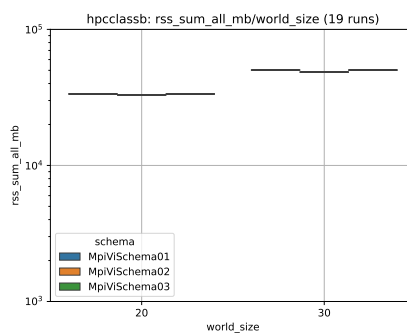
(h) HPC class B max rss rank\_0 vs. world\_size



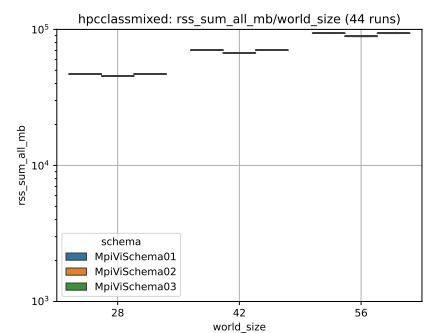
(i) HPC class mixed max rss rank\_0 vs. world\_size



(j) HPC class A rss-sum vs. world\_size

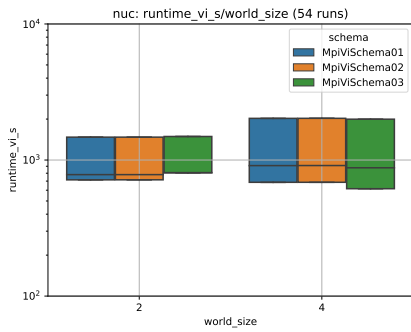


(k) HPC class B rss-sum vs. world\_size

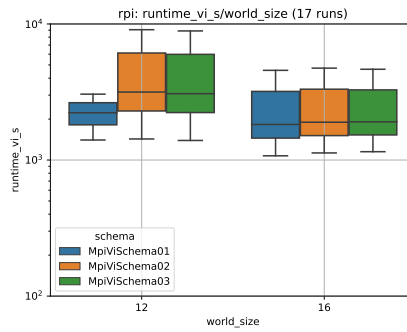


(l) HPC class mixed rss-sum vs. world\_size

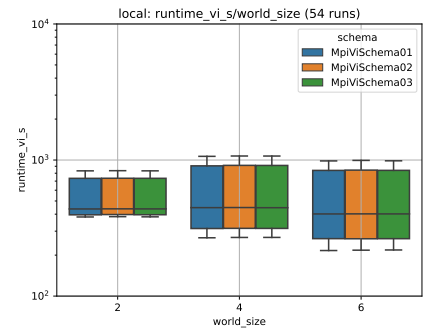
Abb. 5. Comparison between HPC classes with dataset normal



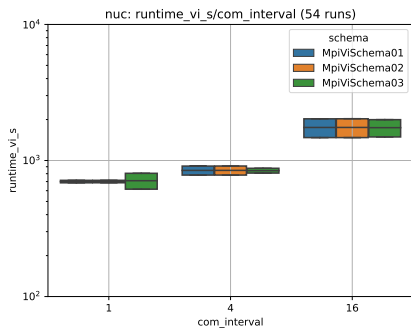
(a) NUC, runtime vs. world\_size



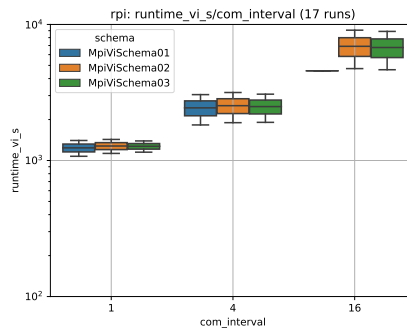
(b) RPi, runtime vs. world\_size



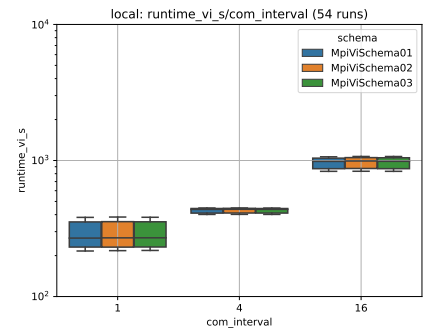
(c) Local, runtime vs. world\_size



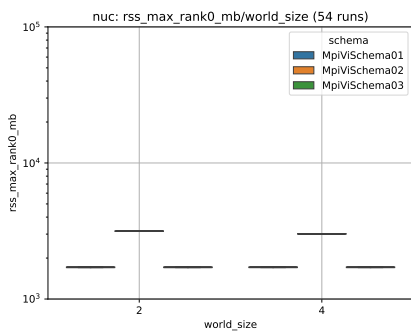
(d) NUC runtime vs. com\_interval



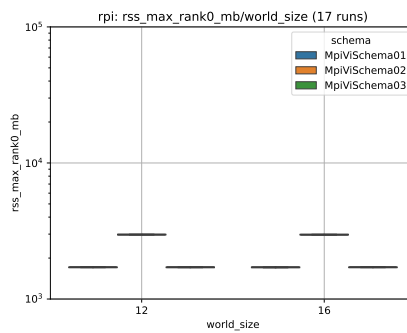
(e) RPi runtime vs. com\_interval



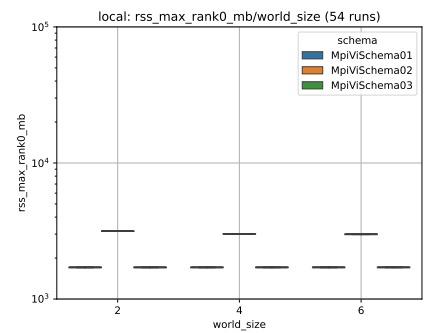
(f) Local runtime vs. com\_interval



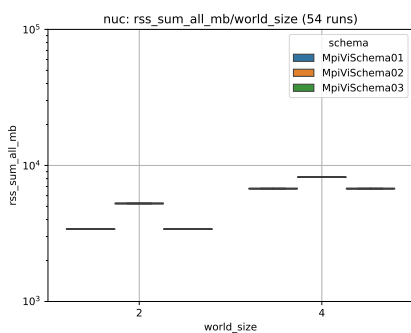
(g) NUC max rss rank\_0 vs. world\_size



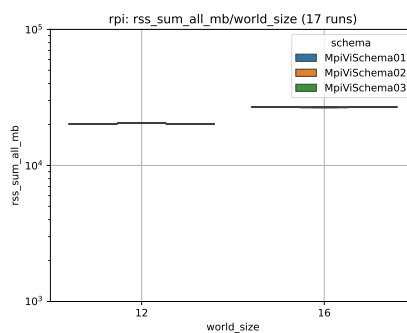
(h) RPi max rss rank\_0 vs. world\_size



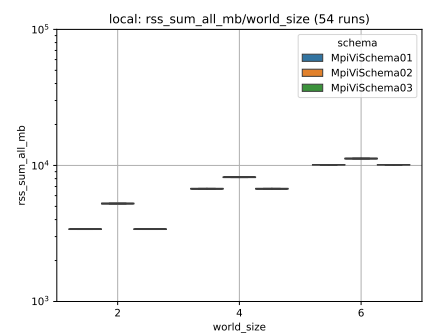
(i) Local max rss rank\_0 vs. world\_size



(j) NUC rss-sum vs. world\_size

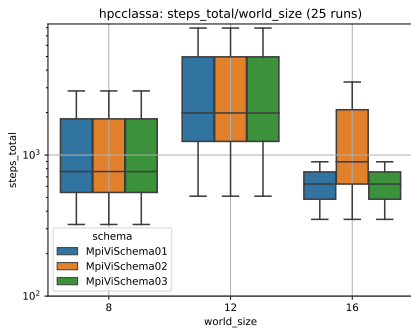


(k) RPi rss-sum vs. world\_size

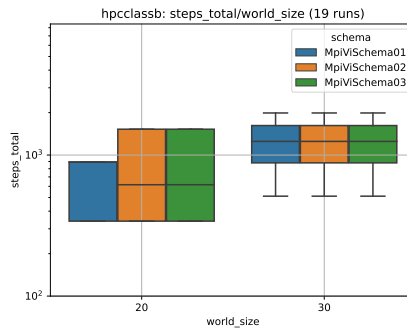


(l) Local rss-sum vs. world\_size

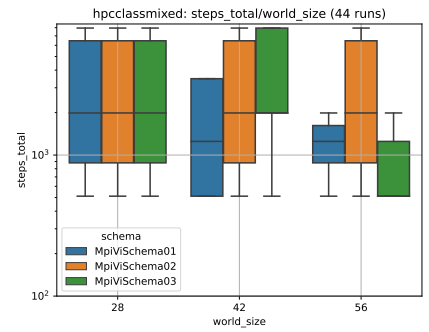
Abb. 6. Comparison between NUC, RPi and Local with dataset normal



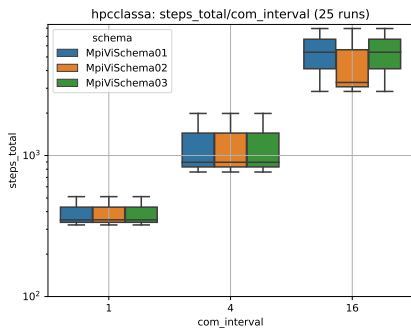
(a) HPC class A, Iterations vs. world\_size



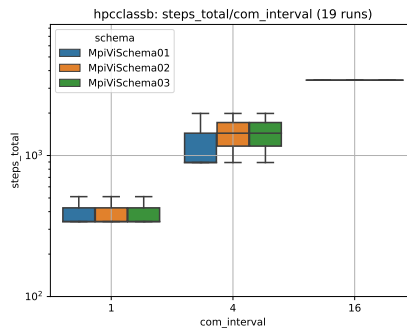
(b) HPC class B, Iterations vs. world\_size



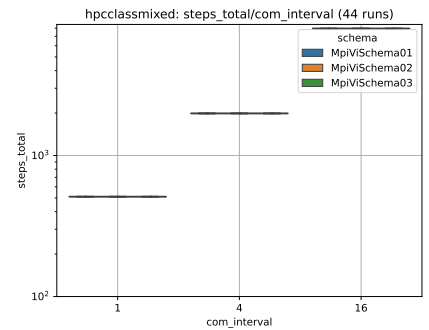
(c) HPC class mixed, Iterations vs. world\_size



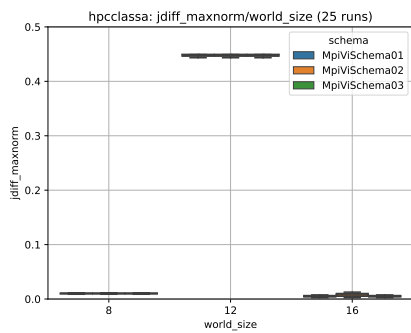
(d) HPC class A Iterations vs. com\_interval



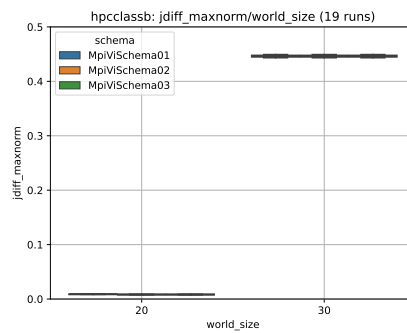
(e) HPC class B Iterations vs. com\_interval



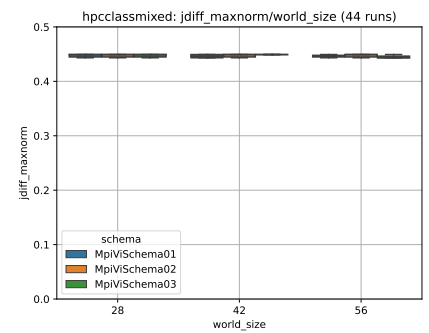
(f) HPC class mixed Iterations vs. com\_interval



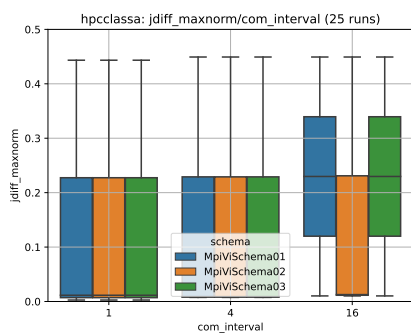
(g) HPC class A J-diff maxnorm vs. world\_size



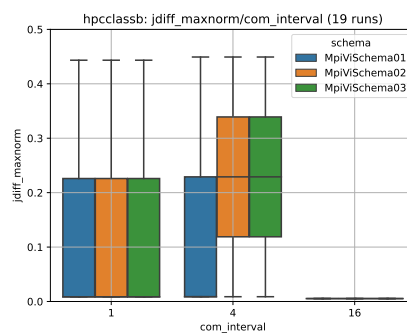
(h) HPC class B J-diff maxnorm vs. world\_size



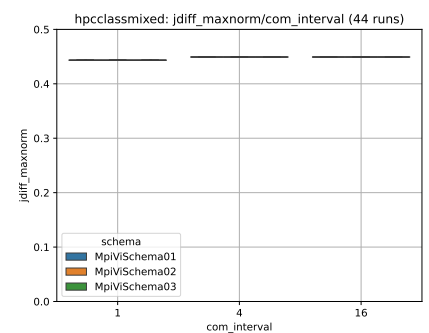
(i) HPC class mixed J-diff maxnorm vs. world\_size



(j) HPC class A J-diff maxnorm vs. com\_interval

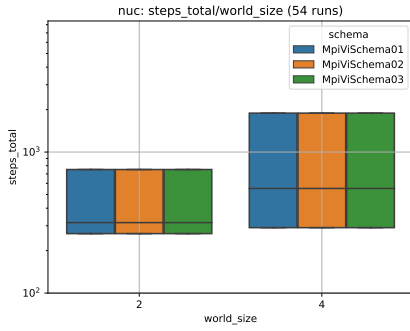


(k) HPC class B J-diff maxnorm vs. com\_interval

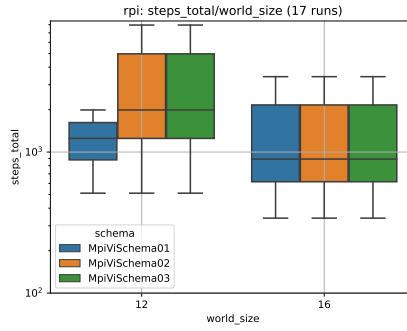


(l) HPC class mixed J-diff maxnorm vs. com\_interval

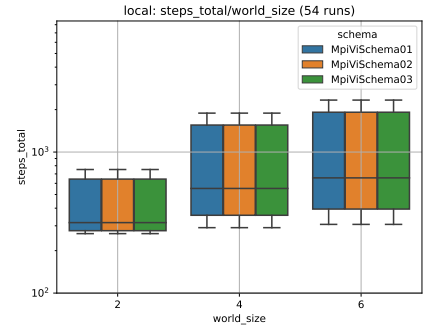




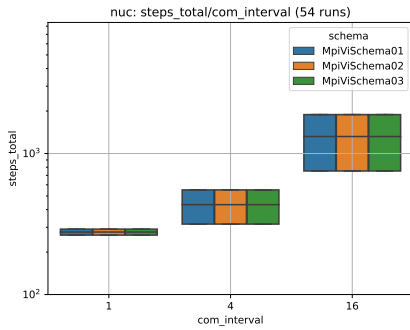
(a) NUC, Iterations vs. world\_size



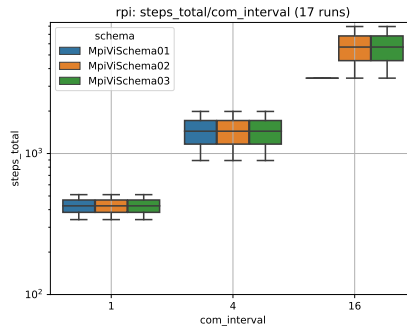
(b) RPi, Iterations vs. world\_size



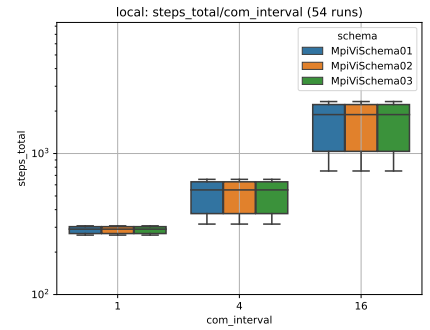
(c) Local, Iterations vs. world\_size



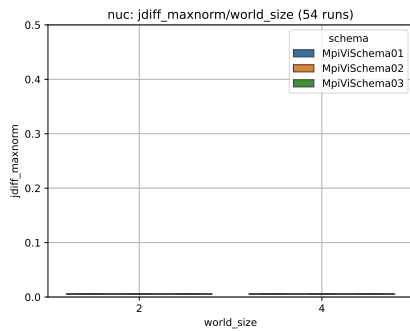
(d) NUC Iterations vs. com\_interval



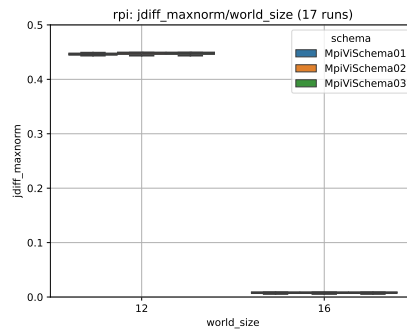
(e) RPi Iterations vs. com\_interval



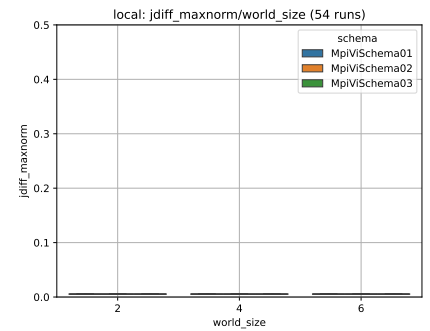
(f) Local Iterations vs. com\_interval



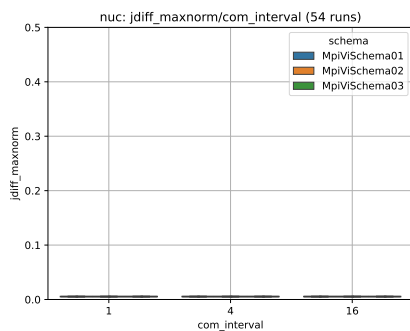
(g) NUC J-diff maxnorm vs. world\_size



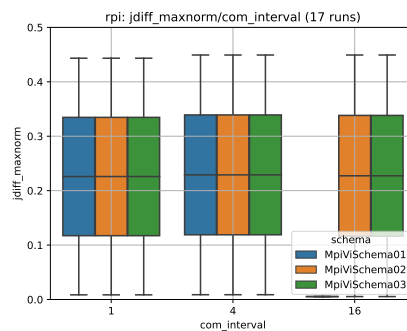
(h) RPi J-diff maxnorm vs. world\_size



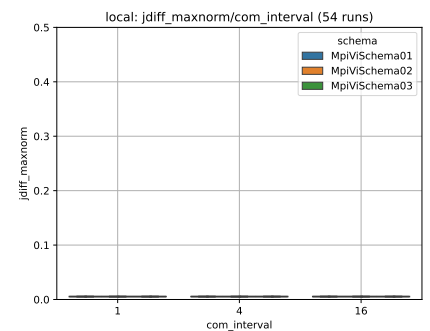
(i) Local J-diff maxnorm vs. world\_size



(j) NUC J-diff maxnorm vs. com\_interval



(k) RPi J-diff maxnorm vs. com\_interval



(l) Local J-diff maxnorm vs. com\_interval

Abb. 8. Comparison between NUC, RPi and Local with dataset normal