Univerzitet u Beogradu - Elektrotehnički fakultet

Multiprocesorki sistemi (13S114MUPS, 13E114MUPS)



Domaći zadatak 1 – OpenMP

Izveštaj o urađenom domaćem zadatku

|  |  |
| --- | --- |
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1. Problem 1 - SGEMM

U okviru ovog poglavlja je dat kratak izveštaj u vezi rešenja zadatog problema 1.

* 1. Tekst problema

Paralelizovati program koji vrši jednostavno generalizovano množenje matrica u jednostrukoj preciznosti *Single precision floating General Matrix Multiply* (SGEMM). SGEMM operacije je definisana sledećom formom:

Program se nalazi u datoteci sgemm.cc u arhivi koja je priložena uz ovaj dokument. Prilikom paralelizacije nije dozvoljeno koristiti direktive za podelu posla (*worksharing* direktive), već je iteracije petlje koja se paralelizuje potrebno raspodeliti ručno. Obratiti pažnju na ispravno deklarisanje svih promenljivih prilikom paralelizacije. Program testirati sa parametrima koji su dati u datoteci *run*. [1, N]

* 1. Delovi koje treba paralelizovati
     1. Diskusija

U okviru ove sekcije će biti opisani uočeni delovi koda koje je moguće paralelizovati. Biće diskutovati delovi nad kojima je izvršena paralelizacija. Ukoliko je neki deo moguće paralelizovati, ali to nije učinjeno, navesti razloge.

* + 1. Način paralelizacije

Ovde treba opisati način paralelizacije i razloge koji su vodili ka odluci. Ukoliko je isprobano nekoliko načina, ovde ih diskutovati.

* 1. Rezultati

U okviru ove sekcije su izloženi rezultati paralelizacije problema 1.

* + 1. Logovi izvršavanja

Ovde su dati logovi izvršavanja za definisane test primere i različit broj niti. Obavezno uključiti u ispis i vremena izvršavanja. Logove pojedinačno uokviriti i obeležiti.

* Sekvencijalno izvršavanje

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*SEQ\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: 0.0245002.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*SEQ\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: 12.891.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 1. Sekvencijalno izvršavanje SGEMM

* Zadatak 1 – 1 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 2. Zadatak 1 – 1 nit

* Zadatak 1 – 2 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 2

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 2

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 3. Zadatak 1 – 2 niti

* Zadatak 1 – 4 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 4. Zadatak 1 – 4 niti

* Zadatak 1 – 8 niti

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 8

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 8

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 5. Zadatak 1 – 8 niti

* Zadatak 2 – 1 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 6. Zadatak 2 – 1 nit

* Zadatak 2 – 2 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 2

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 2

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 7. Zadatak 2 – 2 niti

* Zadatak 2 – 4 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 8. Zadatak 2 – 4 niti

* Zadatak 2 – 8 niti

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 8

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z2\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 8

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 9. Zadatak 2 – 8 niti

* Zadatak 3 – 1 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 10. Zadatak 3 – 1 nit

* Zadatak 3 – 2 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 2

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 2

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 11. Zadatak 3 – 2 niti

* Zadatak 3 – 4 nit

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 12. Zadatak 3 – 4 niti

* Zadatak 3 – 8 niti

Opening file:data/small/input/matrix1.txt

Matrix dimension: 128x96

Opening file:data/small/input/matrix2t.txt

Matrix dimension: 160x96

Opening file:result\_small.txt for write.

Matrix dimension: 128x160

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 8

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Opening file:data/medium/input/matrix1.txt

Matrix dimension: 1024x992

Opening file:data/medium/input/matrix2t.txt

Matrix dimension: 1056x992

Opening file:result\_medium.txt for write.

Matrix dimension: 1024x1056

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*DZ1Z3\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Elapsed time: .

Number of threads: 8

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Listing 13. Zadatak 3 – 8 niti

* + 1. Tabela trajanja programa

|  |  |  |
| --- | --- | --- |
|  | Small input | Medium input |
| Sekvencijalno izvršavanje | 0.0245002 | 12.891 |
| Zadatak 1 – 1 nit | 0.0256683 | 12.8851 |
| Zadatak 1 – 2 niti | 0.0664114 | 7.05922 |
| Zadatak 1 – 4 niti | 0.0758083 | 4.08204 |
| Zadatak 1 – 8 niti | 0.0695984 | 4.03053 |
| Zadatak 2 – 1 nit | 0.0551437 | 12.9156 |
| Zadatak 2 – 2 niti | 0.0603416 | 7.09492 |
| Zadatak 2 – 4 niti | 0.0772603 | 4.0402 |
| Zadatak 2 – 8 niti | 0.0753353 | 4.00763 |
| Zadatak 3 – 1 nit |  |  |
| Zadatak 3 – 2 niti |  |  |
| Zadatak 3 – 4 niti |  |  |
| Zadatak 3 – 8 niti |  |  |

* + 1. Grafici ubrzanja

U okviru ove sekcije su dati grafici ubrzanja u odnosu na sekvencijalnu implementaciju.

Grafik 1. Zavisnos ubrzanja programa dz1z1 od veičine izlazne matrice i broja niti

Grafik 2. Zavisnos ubrzanja programa dz1z2 od veličine izlazne matrice i broja niti

Grafik 3. Zavisnos ubrzanja programa dz1z3 od veličine izlazne matrice i broja niti

* + 1. Diskusija dobijenih rezultata

Dobijene rezultate treba izdiskutovati i objasniti sa nekoliko rečenica u odnosu na dobijena ubrzanja (ili usporenja), način paralelizacije, karakteristike problema i sl.