Evaluasi Tengah Semester

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NRP : 5025211040

Mata Kuliah : Pemrograman Jaringan

Kelas : E

Link Github

Github : https://github.com/fihrizilhamr/Progjar-E-ETS-2024.git

Device specifications

Processor : AMD Ryzen 5 5500U with Radeon Graphics (2.10 GHz)

Installed RAM : 8,00 GB (7,33 GB usable)

System type : 64-bit operating system, x64-based processor

Windows specifications

Edition : Windows 11 Home

Version : 23H2

OS build : 22631.3593

Experience : Windows Feature Experience Pack 1000.22700.1003.0

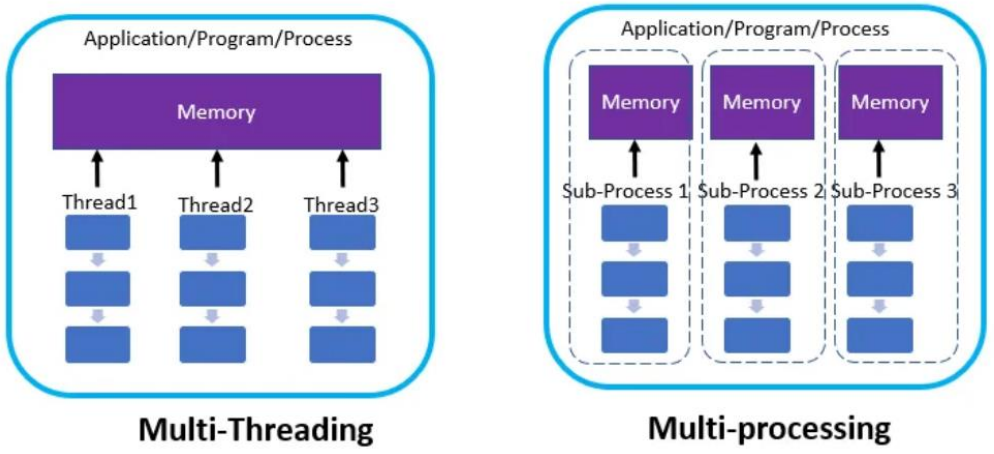
Tabel perbandingan

Teknik	Jumlah Concurrency	Transactions	Availability	Elapsed time	Data transferred	Response time	Transaction rate	Throughput	Concurrency	Successful transactions	Failed transactions	Longest transactions	Shortest transactions
Multithreading (secure)	10	971 hits	97.10 %	488.63 secs	0.03 MB	3.50 secs	1.99 trans/sec	0.00 MB/sec	6.96	971	29	21.48	0.05
	50	879 hits	87.90 %	331.34 secs	0.03 MB	3.80 secs	2.65 trans/sec	0.00 MB/sec	10.08	879	121	61.84	0.04
	100	784 hits	78.40 %	377.67 secs	0.02 MB	4.81 secs	2.08 trans/sec	0.00 MB/sec	9.99	784	216	63.12	0.04
	150	673 hits	64.10 %	376.02 secs	0.02 MB	5.72 secs	1.79 trans/sec	0.00 MB/sec	10.23	673	377	72.93	0.04
	200	617 hits	61.70 %	286.68 secs	0.02 MB	6.52 secs	2.15 trans/sec	0.00 MB/sec	14.04	617	383	70.76	0.05
Multithreading	10	999 hits	99.90 %	199.01 secs	0.03 MB	1.58 secs	5.02 trans/sec	0.00 MB/sec	7.94	999	1	18.05	0.01
	50	968 hits	96.80 %	155.51 secs	0.03 MB	2.85 secs	6.22 trans/sec	0.00 MB/sec	17.76	968	32	57.07	0.04
	100	927 hits	92.70 %	229.21 secs	0.03 MB	3.21 secs	4.04 trans/sec	0.00 MB/sec	12.98	927	73	58.03	0.05
	150	900 hits	85.71 %	235.49 secs	0.03 Mb	4.33 secs	3.82 trans/sec	0.00 MB/sec	16.53	900	150	70.57	0.08

	200	806 hits	80.60 %	173.80 secs	0.02 MB	4.69 secs	4.64 trans/sec	0.00 MB/sec	21.77	806	194	61.34	0.07
Multiprocessing (secure)	10	971 hits	97.10 %	372.53 secs	0.03 MB	2.23 secs	2.61 trans/sec	0.00 MB/sec	5.82	971	29	19.66	0.05
	50	881 hits	88.10 %	320.95 secs	0.03 MB	3.24 secs	2.74 trans/sec	0.00 MB/sec	8.91	881	119	76.15	0.05
	100	818 hits	81.80 %	295.69 secs	0.02 MB	3.62 secs	2.77 trans/sec	0.00 MB/sec	10.02	818	182	75.67	0.05
	150	803 hits	76.48 %	405.92 secs	0.02 MB	4.35 secs	1.98 trans/sec	0.00 MB/sec	8.60	803	247	107.51	0.05
	200	666 hits	66.60 %	340.67 secs	0.02 MB	5.49 secs	1.95 trans/sec	0.00 MB/sec	10.72	666	334	76.09	0.05
Multiprocessing	10	996 hits	99.60 %	215.22 secs	0.03 MB	1.06 secs	4.63 trans/sec	0.00 MB/sec	4.92	996	4	16.86	0.01
	50	929 hits	92.60 %	366.38 secs	0.03 MB	3.19 secs	2.54 trans/sec	0.00 MB/sec	8.10	929	71	112.54	0.02
	100	921 hits	92.10 %	358.19 secs	0.03 MB	3.48 secs	2.57 trans/sec	0.00 MB/sec	8.96	921	79	69.36	0.03
	150	880 hits	83.81 %	282.77 secs	0.03 MB	4.11 secs	3.11 trans/sec	0.00 MB/sec	12.79	880	170	70.16	0.04
	200	886 hits	88.60 %	265.73 secs	0.03 MB	5.59 secs	3.33 trans/sec	0.00 MB/sec	18.64	886	114	116.64	0.02

Side note: Untuk konkurensi 150, saya membuat 7 rekurensi (1050). Karena tidak memungkinkan untuk menghasilkan 1000 total transaksi dengan 150 konkurensi. Selain itu, argumen siege tidak bisa menerima angka decimal.

Arsitektur percobaan



Gambar 1. (https://miro.medium.com/v2/resize:fit:1025/1*DRGfrUr0I_TKK8ammPPOlw.png)

Untuk mengukur kinerja web server, berbagai teknik seperti multithreading, multiprocessing, multithreading (secure), dan multiprocessing (secure), saya menggunakan alat load testing bernama **Siege**.

- Multithreading: Teknik pemrograman yang memungkinkan beberapa thread dijalankan secara bersamaan dalam satu proses untuk meningkatkan kinerja.

- Multiprocessing: Teknik pemrograman yang memungkinkan beberapa proses dijalankan secara bersamaan pada satu atau lebih CPU untuk memaksimalkan penggunaan sumber daya.

- Multithreading (secure) + Multiprocessing (secure): Implementasi multithreading dan multiprocessing dengan tambahan mekanisme keamanan untuk memastikan data dan operasi antar thread tetap aman serta untuk mencegah konflik atau kebocoran data antar proses.

Kesimpulan

- **Perbandingan Konkurensi:** Dari eksperimen yang telah dilaksanakan, konkurensi rendah seperti 10 dan 50 memiliki “Successful transactions” tertinggi, sedangkan eksperimen dengan konkurensi yang lebih tinggi seperti 100, 150, dan 200. Dapat dilihat, konkurensi rendah bahkan dapat mencapai “Availability” minimal 97 % yang jika dibandingkan dengan konkurensi 200 terlihat perbedaannya.
- **Perbandingan Secure vs. Not Secure:** Eksperimen menunjukkan bahwa penggunaan yang not secure cenderung lebih cepat daripada penggunaan yang secure. Salah satu alasannya adalah penggunaan teknik secure yang melakukan handshake ssl sebelum client dapat terhubung dengan server, yang dapat memakan waktu lebih lama. Versi secure dari keduanya akan menunjukkan penurunan kinerja karena tambahan overhead untuk menjaga keamanan, namun perbedaan ini bisa lebih signifikan pada multithreading karena thread lebih sering berinteraksi dan berbagi memori.
- **Perbandingan Multithreading vs. Multiprocessing:** Multiprocessing, lebih stabil dan skalabel dalam menangani jumlah tugas yang sangat besar karena masing-masing proses berjalan secara independen. Dia lebih baik untuk beban berat karena dapat memanfaatkan multiple CPU core lebih efektif, meskipun dengan overhead yang lebih besar. Sedangkan multithreading, bisa lebih cepat pada jumlah tugas yang lebih kecil sampai menengah, tetapi mungkin mengalami penurunan kinerja pada tugas yang sangat besar atau pada sistem dengan banyak thread. Dia cenderung memiliki performa lebih baik pada beban ringan hingga menengah karena lebih efisien dalam penggunaan sumber daya. Intinya, pada jumlah koneksi konkurensi rendah (10, 50), multithreading mungkin menunjukkan kinerja lebih baik atau sebanding karena overhead proses lebih besar pada multiprocessing.Pada jumlah koneksi konkurensi lebih tinggi (100, 150, 200), multiprocessing mungkin lebih baik pada sistem dengan banyak core CPU karena bisa memanfaatkan paralelisme lebih efektif, meskipun dengan overhead yang lebih besar.
- **Eksternal:** Hasil tes akan dipengaruhi oleh spesifikasi laptop yang digunakan. Proses eksternal dapat menambahkan beban overhead pada sistem, yang dapat menghasilkan berbagai hasil testing. Hasil pengujian juga dipengaruhi oleh latensi jaringan, bandwidth, dan keandalan koneksi klien-server. Koneksi jaringan yang lambat atau tidak stabil dapat menurunkan availability dan meningkatkan waktu respons.

Lampiran

<table>
<tr><td rowspan="2">Multithreading (secure)</td><td>10</td><td>

```
Transactions:                 971 hits
Availability:               97.10 %
Elapsed time:              488.63 secs
Data transferred:            0.03 MB
Response time:               3.50 secs
Transaction rate:            1.99 trans/sec
Throughput:                  0.00 MB/sec
Concurrency:                 6.96
Successful transactions:      971
Failed transactions:           29
Longest transaction:        21.48
Shortest transaction:        0.05

(base) jovyan@f8c5b7d71033:~/work/progjar/progjar5/siege-4.1.6$ siege -c 10 -r 100 https://0.0.0.0:8443/
```

</td></tr>
<tr><td>50</td><td>

```
Transactions:                 879 hits
Availability:               87.90 %
Elapsed time:              331.34 secs
Data transferred:            0.03 MB
Response time:               3.80 secs
Transaction rate:            2.65 trans/sec
Throughput:                  0.00 MB/sec
Concurrency:                10.08
Successful transactions:      879
Failed transactions:          121
Longest transaction:        61.84
Shortest transaction:        0.04

(base) jovyan@f8c5b7d71033:~/work/progjar/progjar5/siege-4.1.6$ siege -c 50 -r 20 https://0.0.0.0:8443/
```

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</table>

	100	Transactions: 784 hits Availability: 78.40 % Elapsed time: 377.67 secs Data transferred: 0.02 MB Response time: 4.81 secs Transaction rate: 2.08 trans/sec Throughput: 0.00 MB/sec Concurrency: 9.99 Successful transactions: 784 Failed transactions: 216 Longest transaction: 63.12 Shortest transaction: 0.04 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 100 -r 10 https://0.0.0.0:8443/
	150	Transactions: 673 hits Availability: 64.10 % Elapsed time: 376.02 secs Data transferred: 0.02 MB Response time: 5.72 secs Transaction rate: 1.79 trans/sec Throughput: 0.00 MB/sec Concurrency: 10.23 Successful transactions: 673 Failed transactions: 377 Longest transaction: 72.93 Shortest transaction: 0.04 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 150 -r 7 https://0.0.0.0:8443/
	200	Transactions: 617 hits Availability: 61.70 % Elapsed time: 286.68 secs Data transferred: 0.02 MB Response time: 6.52 secs Transaction rate: 2.15 trans/sec Throughput: 0.00 MB/sec Concurrency: 14.04 Successful transactions: 617 Failed transactions: 383 Longest transaction: 70.76 Shortest transaction: 0.05 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 200 -r 5 https://0.0.0.0:8443/
Multithreading	10	Transactions: 999 hits Availability: 99.90 % Elapsed time: 199.01 secs Data transferred: 0.03 MB Response time: 1.58 secs Transaction rate: 5.02 trans/sec Throughput: 0.00 MB/sec Concurrency: 7.94 Successful transactions: 999 Failed transactions: 1 Longest transaction: 18.05 Shortest transaction: 0.01 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 10 -r 100 http://0.0.0.0:8889/

	50	Transactions: 968 hits Availability: 96.80 % Elapsed time: 155.51 secs Data transferred: 0.03 MB Response time: 2.85 secs Transaction rate: 6.22 trans/sec Throughput: 0.00 MB/sec Concurrency: 17.76 Successful transactions: 968 Failed transactions: 32 Longest transaction: 57.07 Shortest transaction: 0.04 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 50 -r 20 http://0.0.0.0:8889/
	100	Transactions: 927 hits Availability: 92.70 % Elapsed time: 229.21 secs Data transferred: 0.03 MB Response time: 3.21 secs Transaction rate: 4.04 trans/sec Throughput: 0.00 MB/sec Concurrency: 12.98 Successful transactions: 927 Failed transactions: 73 Longest transaction: 58.03 Shortest transaction: 0.05 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 100 -r 10 http://0.0.0.0:8889/
	150	Transactions: 900 hits Availability: 85.71 % Elapsed time: 235.49 secs Data transferred: 0.03 MB Response time: 4.33 secs Transaction rate: 3.82 trans/sec Throughput: 0.00 MB/sec Concurrency: 16.53 Successful transactions: 900 Failed transactions: 150 Longest transaction: 70.57 Shortest transaction: 0.08 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 150 -r 7 http://0.0.0.0:8889/
	200	Transactions: 806 hits Availability: 80.60 % Elapsed time: 173.80 secs Data transferred: 0.02 MB Response time: 4.69 secs Transaction rate: 4.64 trans/sec Throughput: 0.00 MB/sec Concurrency: 21.77 Successful transactions: 806 Failed transactions: 194 Longest transaction: 61.34 Shortest transaction: 0.07 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 200 -r 5 http://0.0.0.0:8889/

<table>
<tr><td rowspan="3">Multiprocessing (secure)</td><td>10</td><td>

```
Transactions:                    971 hits
Availability:                  97.10 %
Elapsed time:                 372.53 secs
Data transferred:               0.03 MB
Response time:                  2.23 secs
Transaction rate:               2.61 trans/sec
Throughput:                     0.00 MB/sec
Concurrency:                    5.82
Successful transactions:         971
Failed transactions:              29
Longest transaction:           19.66
Shortest transaction:           0.05

(base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 10 -r 100 https://0.0.0.0:8889/
```

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<tr><td>50</td><td>

```
Transactions:                    881 hits
Availability:                  88.10 %
Elapsed time:                 320.95 secs
Data transferred:               0.03 MB
Response time:                  3.24 secs
Transaction rate:               2.74 trans/sec
Throughput:                     0.00 MB/sec
Concurrency:                    8.91
Successful transactions:         881
Failed transactions:             119
Longest transaction:           76.15
Shortest transaction:           0.05

(base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 50 -r 20 https://0.0.0.0:8889/
```

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<tr><td>100</td><td>

```
Transactions:                    818 hits
Availability:                  81.80 %
Elapsed time:                 295.69 secs
Data transferred:               0.02 MB
Response time:                  3.62 secs
Transaction rate:               2.77 trans/sec
Throughput:                     0.00 MB/sec
Concurrency:                   10.02
Successful transactions:         818
Failed transactions:             182
Longest transaction:           75.67
Shortest transaction:           0.05

(base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 100 -r 10 https://0.0.0.0:8889/
```

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<tr><td>150</td><td>

```
Transactions:                    803 hits
Availability:                  76.48 %
Elapsed time:                 405.92 secs
Data transferred:               0.02 MB
Response time:                  4.35 secs
Transaction rate:               1.98 trans/sec
Throughput:                     0.00 MB/sec
Concurrency:                    8.60
Successful transactions:         803
Failed transactions:             247
Longest transaction:          107.51
Shortest transaction:           0.05

(base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 150 -r 7 https://0.0.0.0:8889/
```

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</table>

	200	Transactions: 666 hits Availability: 66.60 % Elapsed time: 340.67 secs Data transferred: 0.02 MB Response time: 5.49 secs Transaction rate: 1.95 trans/sec Throughput: 0.00 MB/sec Concurrency: 10.72 Successful transactions: 666 Failed transactions: 334 Longest transaction: 76.09 Shortest transaction: 0.05 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 200 -r 5 https://0.0.0.0:8889/
Multiprocessing	10	Transactions: 996 hits Availability: 99.60 % Elapsed time: 215.22 secs Data transferred: 0.03 MB Response time: 1.06 secs Transaction rate: 4.63 trans/sec Throughput: 0.00 MB/sec Concurrency: 4.92 Successful transactions: 996 Failed transactions: 4 Longest transaction: 16.86 Shortest transaction: 0.01 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 10 -r 100 http://0.0.0.0:8443/
	50	Transactions: 929 hits Availability: 92.90 % Elapsed time: 366.38 secs Data transferred: 0.03 MB Response time: 3.19 secs Transaction rate: 2.54 trans/sec Throughput: 0.00 MB/sec Concurrency: 8.10 Successful transactions: 929 Failed transactions: 71 Longest transaction: 112.54 Shortest transaction: 0.02 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 50 -r 20 http://0.0.0.0:8443/
	100	Transactions: 921 hits Availability: 92.10 % Elapsed time: 358.19 secs Data transferred: 0.03 MB Response time: 3.48 secs Transaction rate: 2.57 trans/sec Throughput: 0.00 MB/sec Concurrency: 8.96 Successful transactions: 921 Failed transactions: 79 Longest transaction: 69.36 Shortest transaction: 0.03 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 100 -r 10 http://0.0.0.0:8443/

	150	Transactions: 880 hits Availability: 83.81 % Elapsed time: 282.77 secs Data transferred: 0.03 MB Response time: 4.11 secs Transaction rate: 3.11 trans/sec Throughput: 0.00 MB/sec Concurrency: 12.79 Successful transactions: 880 Failed transactions: 170 Longest transaction: 70.16 Shortest transaction: 0.04 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 150 -r 7 http://0.0.0.0:8443/
	200	Transactions: 886 hits Availability: 88.60 % Elapsed time: 265.73 secs Data transferred: 0.03 MB Response time: 5.59 secs Transaction rate: 3.33 trans/sec Throughput: 0.00 MB/sec Concurrency: 18.64 Successful transactions: 886 Failed transactions: 114 Longest transaction: 116.64 Shortest transaction: 0.02 (base) jovyan@f8c5b7d71033:~/work/progjar/progjar5$ siege -c 200 -r 5 http://0.0.0.0:8443/