Problem1 repport

Environnement

Os	Pop!_OS 22.04 LTS x86
CPU	Intel i7-8665U (8) @ 1.900GHz
Memory	16Gb
Java version	openjdk 17.0.6 2023-01-17

Build

In the `problem1` directory

```
javac pc_static_bloc.java
javac pc_static_cyclic.java
javac pc_dynamic.java
```

How to use

pc_static_block

To use with the default values

> NUM_END = 200000 NUM_THREAD = 1

```
java pc_static_block
```

To use with custom arguments

```
java pc_static_block NUM_THREAD NUM_END
```

pc_static_cyclic

To use with the default values

> NUM_END = 200000 NUM_THREAD = 1 TASK_SIZE = 10

```
java pc_static_cyclic
```

To use with custom arguments

```
java pc_static_cyclic NUM_THREAD NUM_END TASK_SIZE
```

pc_dynamic

To use with the default values

> NUM_END = 200000 NUM_THREAD = 1 TASK_SIZE = 10

```
java pc_dynamic
```

To use with custom arguments

```
java pc_dynamic < NUM_THREAD > < NUM_END > < TASK_SIZE >
```

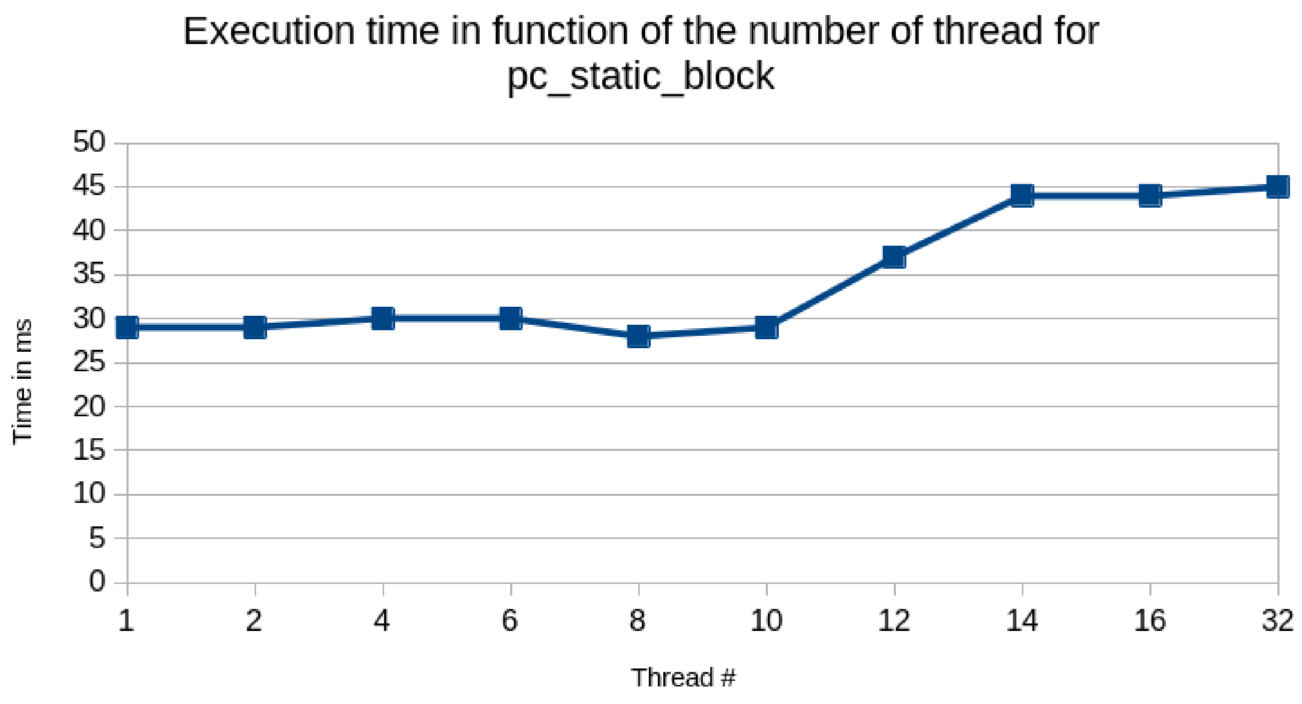
Results

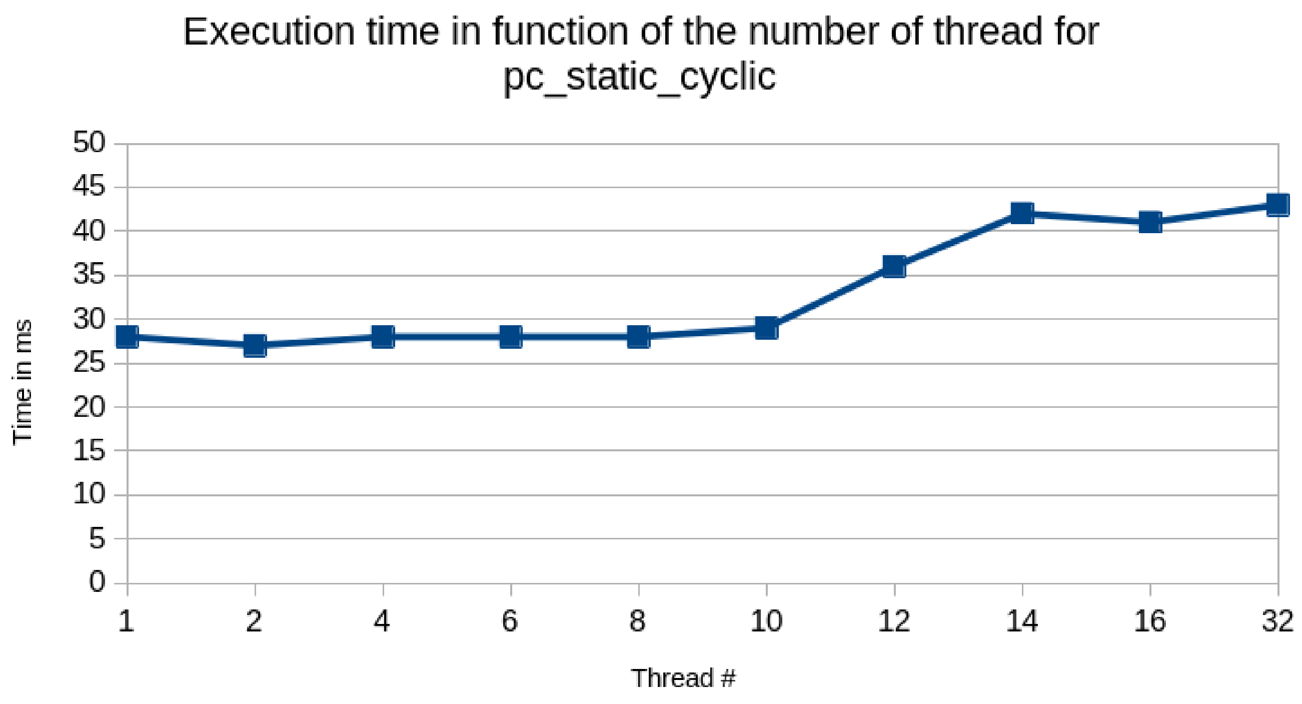
Thoses result were obtained with `NUM_END` = 200000.

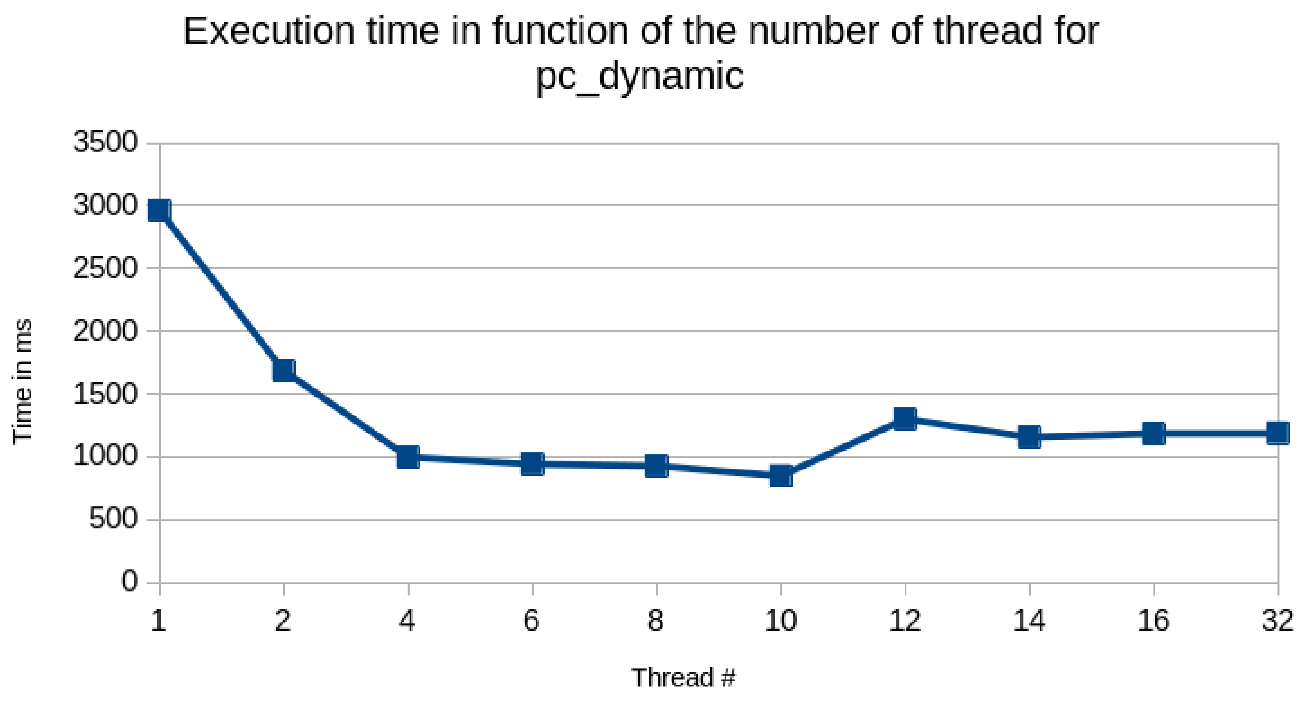
Raw

Number of threads	time in ms (static block)	time in ms (static cyclic)	time in ms (dynamic)
1	29.000	28.000	2963.000
2	29.000	27.000	1685.000
4	30.000	28.000	996.000
6	30.000	28.000	941.000
8	28.000	28.000	926.000
10	29.000	29.000	847.000
12	37.000	36.000	1299.000
14	44.000	42.000	1155.000
16	44.000	41.000	1182.000
32	45.000	43.000	1189.000

Graphs


Execution time in function of the number of thread for pc_static_block
Time in ms
50
45
40
35
30
25
20
15
10
5
0
1
2
4
6
8
10
12
14
16
32
Thread #


Execution time in function of the number of thread for pc_static_cyclic
Time in ms
50
45
40
35
30
25
20
15
10
5
0
1
2
4
6
8
10
12
14
16
32
Thread #



Interpretation

As we can see the static load balencing is more efficient for this type of calculus. This may be due to the use frenquency of `lock` in the dynamical approache.

Tasks are too shorts to make the dynamical load balencing efficient.

We can also see, for the static load balencing that after 10 threads, the execution time increase. So we can assume that for `200000` numbers, 10 threads are enougth.

Source code

pc_static_block.java

```
class pcThreadStaticBlock extends Thread {
    int begin;
    int end;
    int result = 0;

    pcThreadStaticBlock(int b, int e) {
        begin = b;
        end = e;
    }

    public void run() {
        long startTime = System.currentTimeMillis();
        for (int i = begin; i < end; ++i) {
            result += isPrime(i);
        }
        long endTime = System.currentTimeMillis();
        long timeDiff = endTime - startTime;
        System.out.printf("Execution Time of thread %d : %d ms\n",
Thread.currentThread().getId(), timeDiff);
    }

    private static int isPrime(int x) {
        if ((x <= 1) || (x & 1) == 0)
            return 0;
        for (int i = 3; i < x; i++) {
            if ((x % i == 0) && (i != x))
                return 0;
        }
        return 1;
    }
}

class pc_static_block {
    private static int NUM_END = 200000;
    private static int N_THREAD = 10;

    public static void main(String[] args) {
        int result = 0;
        N_THREAD = args.length >= 1 ? Integer.parseInt(args[0]) : N_THREAD;
        NUM_END = args.length >= 2 ? Integer.parseInt(args[1]) : NUM_END;
        pcThreadStaticBlock[] threads = new pcThreadStaticBlock[N_THREAD];
        int range = NUM_END / N_THREAD;
        long startTime = System.currentTimeMillis();
        for (int i = 0; i < threads.length; ++i) {
            threads[i] = new pcThreadStaticBlock(i * range, i * range +
range);
            threads[i].start();
        }
        for (int i = 0; i < threads.length; ++i) {
            try {
                threads[i].join();
                result += threads[i].result;
            } catch (InterruptedException e) {
            }
        }
        long endTime = System.currentTimeMillis();
        long timeDiff = endTime - startTime;
        System.out.printf("Execution Time : %d ms\n", timeDiff);
        System.out.printf("1... %d prime# counter == %d\n", NUM_END - 1,
result);
    }
}
```

pc_static_cyclic.java

```
class pcThreadStaticCyclic extends Thread {
    int begin;
    int end;
    int task_size;
    int n_thread;
    int result = 0;

    pcThreadStaticCyclic(int b, int e, int o, int n) {
        begin = b;
        end = e;
        task_size = o;
        n_thread = n;
    }

    public void run() {
        long startTime = System.currentTimeMillis();

        for (; begin < end; begin += task_size * n_thread) {
            for (int i = begin; i < begin + task_size; ++i) {
                result += isPrime(i);
            }
        }
        long endTime = System.currentTimeMillis();
        long timeDiff = endTime - startTime;
        System.out.printf("Execution Time of thread %d : %d ms\n",
Thread.currentThread().getId(), timeDiff);
    }

    private static int isPrime(int x) {
        if ((x <= 1) || (x & 1) == 0)
            return 0;
        for (int i = 3; i < x; i++) {
            if ((x % i == 0) && (i != x))
                return 0;
        }
        return 1;
    }
}

class pc_static_cyclic {
    private static int NUM_END = 200000;
    private static int N_THREAD = 10;
    private static int TASK_SIZE = 10;

    public static void main(String[] args) {
        int result = 0;
        N_THREAD = args.length >= 1 ? Integer.parseInt(args[0]) : N_THREAD;
        NUM_END = args.length >= 2 ? Integer.parseInt(args[1]) : NUM_END;
        TASK_SIZE = args.length >= 3 ? Integer.parseInt(args[2]) :
TASK_SIZE;

        pcThreadStaticCyclic[] threads = new
pcThreadStaticCyclic[N_THREAD];
        long startTime = System.currentTimeMillis();
        for (int i = 0; i < threads.length; ++i) {
            threads[i] = new pcThreadStaticCyclic(i * TASK_SIZE, NUM_END,
TASK_SIZE, N_THREAD);
```

```
            threads[i].start();
        }
        for (int i = 0; i < threads.length; ++i) {
            try {
                threads[i].join();
                result += threads[i].result;
            } catch (InterruptedException e) {
            }
        }
        long endTime = System.currentTimeMillis();
        long timeDiff = endTime - startTime;
        System.out.printf("Execution Time : %d ms\n", timeDiff);
        System.out.printf("1... %d prime# counter == %d\n", NUM_END - 1,
result);
    }
}
```

pc_dynamic.java

```
import java.util.PriorityQueue;

class pcThreadDynamic extends Thread {
    int end;
    int task_size;
    int result = 0;
    PriorityQueue<Integer> numbersRef;

    pcThreadDynamic(PriorityQueue<Integer> nRef, int t_size, int e) {
        end = e;
        task_size = t_size;
        numbersRef = nRef;
    }

    public void run() {
        long startTime = System.currentTimeMillis();

        while (true) {
            int begin = getNextNumber(numbersRef);
            if (begin == -1) {
                break;
            }
            for (int i = begin; i < begin + task_size; ++i) {
                result += isPrime(i);
            }

        }
        long endTime = System.currentTimeMillis();
        long timeDiff = endTime - startTime;
        System.out.printf("Execution Time of thread %d : %d ms\n",
Thread.currentThread().getId(), timeDiff);
    }
    synchronized private static int getNextNumber(PriorityQueue<Integer>
numbersQueue) {

        return numbersQueue.isEmpty() ? -1 : numbersQueue.poll();
    }

    private static int isPrime(int x) {
        if ((x <= 1) || (x & 1) == 0)
            return 0;
        for (int i = 3; i < x; i++) {
            if ((x % i == 0) && (i != x))
                return 0;
        }
        return 1;
    }
}

class pc_dynamic {
    private static int NUM_END = 200000;
    private static int N_THREAD = 10;
    private static int TASK_SIZE = 10;

    public static void main(String[] args) {
        int result = 0;
        N_THREAD = args.length >= 1 ? Integer.parseInt(args[0]) : N_THREAD;
        NUM_END = args.length >= 2 ? Integer.parseInt(args[1]) : NUM_END;
        TASK_SIZE = args.length >= 3 ? Integer.parseInt(args[2]) :
TASK_SIZE;

        PriorityQueue<Integer> number_list = new PriorityQueue<Integer>();

        for (int i = 0; i < NUM_END; i += TASK_SIZE) {
            number_list.add(i);
        }

        pcThreadDynamic[] threads = new pcThreadDynamic[N_THREAD];
        long startTime = System.currentTimeMillis();
        for (int i = 0; i < threads.length; ++i) {
            threads[i] = new pcThreadDynamic(number_list, TASK_SIZE,
NUM_END);
            threads[i].start();
        }
        for (int i = 0; i < threads.length; ++i) {
            try {
                threads[i].join();
                result += threads[i].result;
            } catch (InterruptedException e) {
            }
        }
        long endTime = System.currentTimeMillis();
        long timeDiff = endTime - startTime;
        System.out.printf("Execution Time : %d ms\n", timeDiff);
        System.out.printf("1... %d prime# counter == %d\n", NUM_END - 1,
result);
    }
}
```