

## Exercise 1

Solution you can find in file `mpi_circuit_sequential.c`

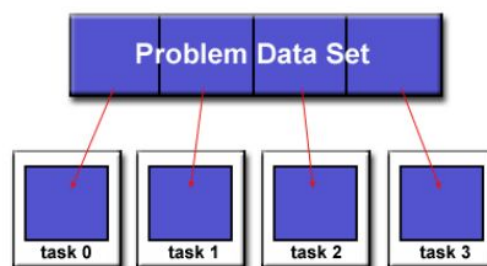
### results

```
Found solution '0x99f5' = '10101111100110010000000000000000'
Found solution '0x99f6' = '01101111100110010000000000000000'
Found solution '0x99f7' = '11101111100110010000000000000000'
Found solution '0x9bf5' = '10101111101100100000000000000000'
Found solution '0x9bf6' = '01101111101100100000000000000000'
Found solution '0x9bf7' = '11101111101100100000000000000000'
Found solution '0x9df5' = '10101111101110010000000000000000'
Found solution '0x9df6' = '01101111101110010000000000000000'
Found solution '0x9df7' = '11101111101110010000000000000000'
done!
```

## Exercise 2

1.  $2^{16}$  atomic tasks are required to execute to find all combinations of input which return 1.
- 2.

- Data associated with a problem is decomposed  
↪ Each parallel task works on a portion of the data



We can't make check function(`check_circuit`) parallel because of many dependences between binary operations in function. But we can divide inputs and run each part calculation in separate process this approach allows us to make searching parallel. Yes, the task could be parallel.

This type of problem called domain decomposition.

3. a) Yes, it is.  
b) The computation time per task is roughly constant because our algorithm divided data but not function. Also to obtain results we need to calculate all input data to get all solutions( opposite is searching algorithm which finished when result found)  
c) The appropriate mapping strategy on  $p$  processes will be dividing input data into  $p$  chunks and calculation each chunk in an appropriate process. After calculation of all chunks we obtain results.

### Exercise 3

1. Solution you can find in the file **mpi\_circuit\_1.c**

```

done!
set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$
mpirun -n 4 mpi_circuit_1
[Node 1] Found solution '10101111100110010000000000000000'
[Node 1] Found solution '10101111110110010000000000000000'
[Node 1] Found solution '10101111101110010000000000000000'
[Node 3] Found solution '11101111100110010000000000000000'
[Node 3] Found solution '11101111110110010000000000000000'
[Node 3] Found solution '11101111101110010000000000000000'
[Node 2] Found solution '01101111100110010000000000000000'
[Node 2] Found solution '01101111110110010000000000000000'
[Node 2] Found solution '01101111101110010000000000000000'
[Node 3] done!
[Node 1] done!
[Node 2] done!
[Node 0] done!
set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$

```

2. Solution you can find in the file **mpi\_circuit\_2.c**

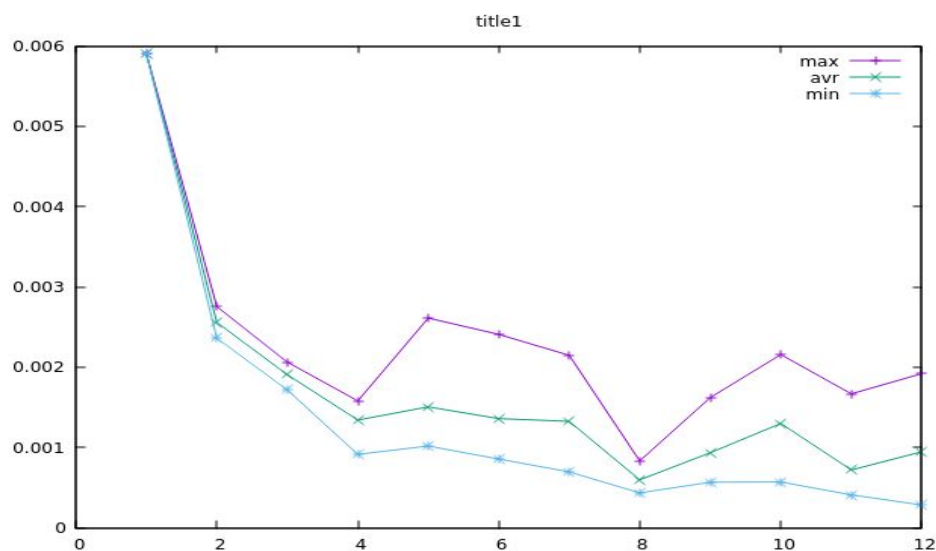
```

set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$
mpirun -n 4 mpi_circuit_2
[Node 1] done!
[Node 2] done!
[Node 3] done!
[Node 0] done! Found 9 solutions
set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$

```

3. Solution you can find in the file **mpi\_circuit\_3.c**

Plot and data for plot



Data for plot

Proc	max	avr	min
12	0.001919	0.000945	0.000282
11	0.001667	0.000718	0.000408
10	0.002156	0.001299	0.000569
9	0.001622	0.000934	0.000566
8	0.000831	0.000596	0.000434
7	0.002148	0.001325	0.000695
6	0.002408	0.001359	0.000855

5	0.002612	0.001505	0.001017
4	0.001579	0.001341	0.000914
3	0.002062	0.001906	0.001716
2	0.002755	0.002558	0.002362
1	0.005904	0.005904	0.005904

## Cmake and make test

```

set@set: /mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1
set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$ meka
No command 'meka' found, did you mean:
  Command 'moka' from package 'alliance' (universe)
  Command 'weka' from package 'weka' (universe)
meka: command not found
set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$ make
[ 20%] Built target circuit
[ 40%] Built target mpi_circuit_2
[ 60%] Built target mpi_circuit_3
[ 80%] Built target mpi_template
[100%] Built target mpi_circuit_1
set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$ make test
Running tests...
Test project /mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1
  Start 1: UniTest-circuit-contains-1010111110011001
1/10 Test #1: UniTest-circuit-contains-1010111110011001 ... Passed    0.01 sec
  Start 2: UniTest-circuit-contains-01101111110011001
2/10 Test #2: UniTest-circuit-contains-01101111110011001 ... Passed    0.01 sec
  Start 3: UniTest-circuit-contains-11101111110011001
3/10 Test #3: UniTest-circuit-contains-11101111110011001 ... Passed    0.01 sec
  Start 4: UniTest-circuit-contains-1010111111011001
4/10 Test #4: UniTest-circuit-contains-1010111111011001 ... Passed    0.01 sec
  Start 5: UniTest-circuit-contains-0110111111011001
5/10 Test #5: UniTest-circuit-contains-0110111111011001 ... Passed    0.01 sec
  Start 6: UniTest-circuit-contains-1110111111011001
6/10 Test #6: UniTest-circuit-contains-1110111111011001 ... Passed    0.01 sec
  Start 7: UniTest-circuit-contains-1010111110111001
7/10 Test #7: UniTest-circuit-contains-1010111110111001 ... Passed    0.01 sec
  Start 8: UniTest-circuit-contains-0110111110111001
8/10 Test #8: UniTest-circuit-contains-0110111110111001 ... Passed    0.00 sec
  Start 9: UniTest-circuit-contains-1110111110111001
9/10 Test #9: UniTest-circuit-contains-1110111110111001 ... Passed    0.00 sec
  Start 10: MPI_UniTest-mpi_circuit_2-expect-9
10/10 Test #10: MPI_UniTest-mpi_circuit_2-expect-9 ..... Passed    0.13 sec

100% tests passed, 0 tests failed out of 10

Total Test time (real) = 0.23 sec
set@set:/mnt/C4D630CFD630C388/Studing/5-1_Lux/Parallel and Grid Computing/lab1$

```