- Solution

This lesson gives the solution to the exercise from the previous lesson.

WE'LL COVER THE FOLLOWING

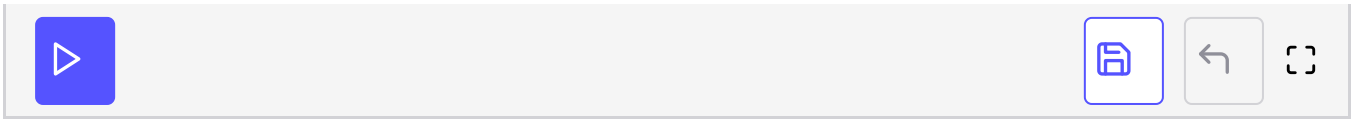
Solution

The calculation of the scalar product can be spread across four asynchronous function calls.

> 💡 The code might take more time than usual.

```
// dotProductAsync.cpp

#include <chrono>
#include <iostream>
#include <future>
#include <numeric>
#include <random>
#include <thread>
#include <vector>

static const int NUM = 100000000;

long long getDotProduct(std::vector<int>& v, std::vector<int>& w){

  auto future1 = std::async([&]{return std::inner_product(&v[0], &v[v.size()/4], &w[0], 0LL);
  auto future2 = std::async([&]{return std::inner_product(&v[v.size()/4], &v[v.size()/2], &w[
  auto future3 = std::async([&]{return std::inner_product(&v[v.size()/2], &v[v.size()*3/4], &
  auto future4 = std::async([&]{return std::inner_product(&v[v.size()*3/4], &v[v.size()], &w[

  return future1.get() + future2.get() + future3.get() + future4.get();
}


int main(){
```

```
  std::cout << std::endl;

  // get NUM random numbers from 0 .. 100

  std::random_device seed;

  // generator
  std::mt19937 engine(seed());

  // distribution
  std::uniform_int_distribution<int> dist(0, 100);

  // fill the vectors
  std::vector<int> v, w;
  v.reserve(NUM);
  w.reserve(NUM);
  for (int i=0; i< NUM; ++i){
    v.push_back(dist(engine));
    w.push_back(dist(engine));
  }

  // measure the execution time
  std::chrono::system_clock::time_point start = std::chrono::system_clock::now();
  std::cout << "getDotProduct(v, w): " << getDotProduct(v, w) << std::endl;
  std::chrono::duration<double> dur  = std::chrono::system_clock::now() - start;
  std::cout << "Parallel Execution: "<< dur.count() << std::endl;

  std::cout << std::endl;

}
```



Explanation

The program uses the functionality of the random and time libraries. Both libraries are part of C++11. The two vectors, `v` and `w`, are created and filled with random numbers in lines 29 - 43. Each of the vectors gets (lines 41 - 43) a hundred million elements. `dist(engine)` in line 42 and 43 generates the random numbers, which are uniformly distributed on the range from 0 to 100. The current calculation of the scalar product takes place in the function `getDotProduct` (lines 13 - 21). `std::async`, internally, uses the Standard Template Library algorithm `std::inner_product`. The return statement sums up the results of the futures.

In the next lesson, we'll discuss `std::packaged_task` which is used to perform a concurrent computation in C++.