1. Introduction

In this exercise, we will use different compilers with different optimization levels without changing the code and compare the results among each other. If you are not familiar with the Sandstorm cluster infrastructure and/or Linux server manipulation, please read the Introduction document.

2. The code

To measure the time of execution, we will use the OpenMP library with its function `omp_get_wtime()` that returns the current time. By subtracting the time at the beginning from the one at the end of execution, we can compare running times of the “long” for-loop. Choose the number N somewhere between 10 million and 10 billion to get meaningful results.

```c
#include <stdio.h>
#include <omp.h>

int main(int argc, char *argv[]) {
    const int N = 1000000000;  //10^9
    unsigned int *a, *b, *c;
    a = (unsigned int*) malloc(N * sizeof(int));
    b = (unsigned int*) malloc(N * sizeof(int));
    c = (unsigned int*) malloc(N * sizeof(int));

    int i;
    for (i=0; i<N; i++) {
        a[i] = 0;
        b[i] = i;
        c[i] = N-i;
    }

    double begin = omp_get_wtime();

    for (i=0; i<N; i++) {
        a[i] = b[i] + c[i];
    }

    double end  = omp_get_wtime();

    printf("Running time is %.10f.\n", end-begin);
    return 0;
}
```
3. Compilers and options
We will use two different compilers: gcc and icc. To compile the code, option \texttt{-fopenmp} must be used.

The gcc and icc compilers allow these optimization options: \texttt{-O0}, \texttt{-O1}, \texttt{-O2} and \texttt{-O3}, where 0 forbids any optimization and 3 calls for the best optimization possible – which in some cases can lead to disastrous results.

The icc compiler also allows \texttt{-fast} and \texttt{-no-vec} optimizations.

4. Results
In the following table, you can write down the running times of different optimization and compiler combinations.

\begin{tabular}{|c|c|c|}
\hline
N & gcc & icc \\
\hline
\texttt{-O0} &  &  \\
\hline
\texttt{-O1} &  &  \\
\hline
\texttt{-O2} &  &  \\
\hline
\texttt{-O3} &  &  \\
\hline
\texttt{-fast} &  &  \\
\hline
\end{tabular}

Discuss the differences in the running times.

5. Contact
Should any difficulties arise, please do not hesitate and contact me per email. But remember – Google is your friend (http://www.giyf.com)!  

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