

1. Please describe your evaluation configuration in this exam.
 - (1) CPU type and clock rate, memory size
 - (2) OS version
 - (3) GCC compiler version
 - (4) Intel toolchain version
 - (5) Virtual machine configuration (optional)
2. (38%) Consider the application in the file `gzip.tar.gz`. Please use shell command "configure" and "make" to compile it. Execute the program: "gzip testfile.dat". Use **gprof** to profile the program and get the following data. (Hint: In order to using gprof, you may need to modify Makefile to add proper compiler option)
 - (1) Use gcc with the option "-O0" to compile it. What are the top five functions that have the most CPU time? Please also write these functions' self-execution time.
 - (2) Use gcc with the option "-O3" to compile it. What are the top five functions that have the most CPU time? Please also write these functions' self-execution time.
 - (3) What functions are directly called by the function `deflate()`? How many times are they each called by the function `deflate()`?
 - (4) Use icc with the option "-O3" to compile it. What are the top five functions that have the most CPU time? Write these functions' self-execution time. Compare the results with (2).
3. (15%) Consider the program: `PrimarySingle.cpp`. The application computes and save prime numbers between the range of integers given on the command line. Compile it by icc with the option "-O3 -o pris.exe -lm". Execute the program by "pris.exe 1 10000000". (Hint: you may need to add proper compiler options to get optimization reports.)
 - (1) Is the loop at line:100 vectorized by the compiler?
 - (2) Whether or not the function `TestForPrime()` is inlined?
 - (3) Please use **Intel codecov** to do code coverage analysis and answer the following questions.
What are the code coverages? (from the point of view of **Functions** and **Blocks**) What are the execution counts for lines 103 and 114?
4. (12%) Consider the program `PrimeSingle.cpp`. Please use VTune profiler to collect the data and answer the following questions. Compile `PrimeSingle.cpp` by using icc and the option "-g -o pris.exe -lm". Execute the program by "pris.exe 1 4000000".
 - (a) Run "**Performance Snapshot**". What is its elapsed time?
 - (b) Use "software-mode sampling" to do **Hotspots analysis**. Which line has the most CPU time?
 - (c) According to the analysis results, please give some ideas to improve its performance.

5. (20%) Generally, there are two methods used to collect performance data: instrumentation and sampling. (請使用自己的話回答下面的問題)

(1) What is instrumentation?

(2) Please explain how hardware event-based sampling works.

6. (15%) Consider the following loop. Does it exist a loop-carried/loop-independent data dependence between S1 and S2? Explain your answer.

```
int m;  
m = func();  
for (i=1; i<20; i++) {  
    A[i+m] = B[i] + 2;      /* S1 */  
    C[i] = A[i] - 1;        /* S2 */  
}
```