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Chapter 1

Introduction

In this practical homework, the focus is on four areas:

- Learning about performance profiling
- Further benchmarking
- Learning about simulation for design
- Learn how to deploy an application on the cloud

Submission and grading of this homework

In order to get points for this homework you need to:

- Answer questions with yellow background.
- Submit your solutions filled into this template

You should submit this homework as a LaTeX writeup. To do so, get an account at \url{https://sharelatex.mt.ut.ee} and share your writeup with us.
Chapter 2
Productivity tools and debugging

Homework question 1

a) Summarize a recent paper on a productivity tool (e.g., a debugger, profiler, memory leak detector) that could be used or is used in high performance or distributed computing.

b) Explain whether you think research funding support of open source productivity tools makes commercial development of productivity tools economically unattractive?

Homework question 2

a) The program MM_With_Bugs.c contains a few bugs. It is easy to find them just by looking at the code but use the debuggers in order to find them and correct them. The program multiplies two matrices A*B=C.
   - The matrix A is of dimension N*N, which is given by the user. All the elements of A have the value 2.0.
   - The matrix B is of dimension N*N.

   The final matrix C should contain elements with value equal to N*12.

   In this exercise you will debug the program using gdb and idb.
   Compile the program MM_With_Bugs.c with the -g compiler option. Launch the gdb/idb debuggers using the commands:
   - gdb YourExecutable
   - idb YourExecutable

   Set up breakpoints in the program.
   Run the program.
   Use the gdb/idb commands to locate where are the problems in the code. Give a list of the bugs that you found, the solution and what gdb/idb commands did you use to find the bugs. Explain the results received from gdb and idb after each command that you used.
   Do also upload a screenshot showing your usage of the debugger.

b) What is the difference between the gdb commands 'next' and 'step'?
c) How does the backtrace command work?
ANSWER
COMMENT
GRADE

d) How are breakpoints used?
ANSWER
COMMENT
GRADE

**Homework question 3**
Use the profiler gprof on your corrected version of MM_With_Bugs.c or another matrix multiplication program. Report and interpret the performance information you get.
ANSWER
COMMENT
GRADE

**Homework question 4**
What is PAPI (http://icl.cs.utk.edu/papi/) and why are performance counters useful?
ANSWER
COMMENT
GRADE

**Homework question 5**
Run the installation (you are given the script, just run it) script to install IPM and profile the timing code in 2decomp&fft (you are also welcome to use the Klein Gordon code described in the reading material). Explain the output you get on 64 cores on Rocket. Include appropriate graphs in your writeup.
ANSWER
COMMENT
GRADE

**Homework question 6**
Install and run Gearshifft on a computer for which results have not yet been reported. Report on your results. Comment on the appropriateness of the methodology used in Gearshifft. How does this compare with ?
ANSWER
COMMENT
GRADE
Chapter 3

ETAIS self-service cloud

**Homework question 7**
What is grid computing? What resources are offered through the European Grid Infrastructure?
ANSWER
COMMENT
GRADE

**Homework question 8**
What is cloud computing? What resources are offered through the TÜ HPC and ETAIS clouds?
ANSWER
COMMENT
GRADE

**Homework question 9**
How do grid, cloud and fog computing differ?
ANSWER
COMMENT
GRADE

**Homework question 10**
What is OpenStack and give examples of alternatives to OpenStack?
ANSWER
COMMENT
GRADE

**Homework question 11**
Deploy one cloud application on the ETAIS cloud. Document the procedure you followed, and give internet addresses of where they are located. Please use the university internal network provider_64_net. You may use (and hopefully update) the example installation procedures provided for Dudle, Etherpad, Gitlab, Mediawiki, Chamilo, Friendica, Wordpress, Nextcloud, Zulip and Mattermost. If you wish to deploy something else, please check with me first.
ANSWER
COMMENT
GRADE

**Homework question 12**
For the cloud applications you deployed, perform an internet search to find out if there have been any security breaches associated with the application. If so briefly describe these breaches, be sure to include (a) reference(s). Also discuss whether it would be better to write your own (possibly less full featured) application to have better security.
Homework question 13
How might the GDPR (General Data Protection Regulation) affect the deployment and operational use of the application you choose?

Homework question 14
What is Let’s Encrypt and how might this be of use to you when deploying cloud applications? What other alternatives are there to Let’s Encrypt?
Chapter 4

Optimized Design

**Homework question 15**
Following the tutorial (English version on courses page, Estonian version: [http://kodu.ut.ee/~otto96/tutorial.pdf](http://kodu.ut.ee/~otto96/tutorial.pdf)), design your own car and prepare a video demonstrating airflow around it. Explain what you might do to make your car aerodynamic. Using Paraview, produce an STL file of your car design to allow for 3D printing.

**ANSWER**

**COMMENT**

**GRADE**

**Homework question 16**
Bonus task (not mandatory): Profile OpenFOAM application using the knowledge and tools (not limited to) you’ve acquired so far.
Chapter 5

Feedback

**Homework question 17**

In order to improve this course for the future we ask you to give feedback on how long completing those tasks took. It would be great if you could give time estimates separately for each chapter.

ANSWER
COMMENT
GRADE
Bibliography

[16] LaTeX website http://www.latex-project.org/
[18] Vainikko, E. Fortran 95 Ja MPI http://hdl.handle.net/10062/16816
[27] [http://diy3dprinting.blogspot.com](http://diy3dprinting.blogspot.com)


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