



Computer Programming Olympiad

A project of the Institute of IT Professionals South Africa

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PROGRAMMING OLYMPIAD FINAL ROUND 2018

Environment Manual

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1. Introduction

This document describes the environment you will be using for the final round of the South African Programming Olympiad. Section 2 describes the machines you will be using, where to save files etc, without dealing with programming. Section 3 describes the compilers and development environments. You will also be using a web-based hand-in system, described in section 4. Specific issues related to the interaction between your programming environment and the web server may be found in section 5.

2. Local environment

2.1 Hardware

During the contest, you will be using **Lenovo Thinkpad L470** laptops. Specifications are as follows:

- CPU: Intel Core i5-7200U
- RAM: 8192 MB
- Storage: SanDisk X400 256GB, SATA
- Built-in 35.6 cm (14 inch) display (1920 x 1080 resolution)
- Built-in US-layout keyboard
- Built-in touchpad
- 3 USB ports (for contestant-provided keyboard and mouse)

Competitors are encouraged to bring along their own external wired non-programmable keyboard if they do not wish to use the default built-in laptop keyboard. A wired external mouse may also be brought in, otherwise an external mouse will be provided upon request. If a competitor wishes to bring his/her own external peripherals, these **must** be brought in during the practice session and should not be removed until after the second contest day.

2.2 Operating system

You will be using an Ubuntu 18.04.1 LTS Linux workstation. Before each competition round the contest organisers will log you into a workstation. If technical difficulties occur, you may have to move to another workstation. Because of this, you should not store any important files anywhere except your home directory. This directory is called */home/username* and is stored on a central fileserver. Here *username* would be the *username* that you were logged on with. You may get the path of your current directory by running 'pwd' in a terminal. **You should save all your work often to the home directory.**

You should also not reboot the computer unless it is absolutely necessary. If you do need to restart your machine during the contest, ask an organiser to log you into another workstation.

There will be shortcuts to the various tools in the Applications Menu and on the Desktop. There will be a shortcut set up on the Desktop for the contest webpage.

3. Compilers and IDEs

3.1 C and C++

For C++, you will be using C++14 standard as implemented by GCC 7.3. This version of GCC adheres particularly strictly to the C++ specification. Some things that may work in other compilers that will not work under GCC include:

- `main` *must* return `int`, and *must* return 0. This might not be enforced by GCC, but failure to do so can lead the marking system to think that your program crashed (in which case you score 0).
- `stricmp` does not exist; use `strcasecmp` instead
- `strrev` does not exist; write one yourself

Note that using the `endl` operator in an I/O stream causes the stream to be flushed, which has a performance overhead. For interactive tasks, this is essential, however, for non-interactive tasks, it is faster to use `"\n"` instead.

3.2 Java

You will be using the Open JDK 8. You should be aware that while the `Scanner` class makes I/O easier, it is roughly 10 times slower than using a `BufferedReader` together with a `StringTokenizer`. **For tasks with large amounts of input, it may not be possible to obtain a full score using `Scanner`.**

3.3 Python

Both Python version 2.7 and version 3.6 will be available in the competition environment and the Linux-based hand-in system. The supported IDE is IDLE.

3.4 IDEs and Text Editor

The competition workstations include the following editors:

- Atom 1.29
- Code::Blocks 16.01 (+ codeblocks-contrib)
- Eclipse 4.8
- Emacs 25.2
- Geany 1.32 (+ geany-plugins)
- gedit 3.28
- IDLE for Python 2.7
- IDLE for Python 3.6
- IntelliJ IDEA Community 2018.1.6

- Kate 17.12
- KDeveop 5.2
- Lazarus 1.8
- Nano 2.9
- Netbeans 7.4
- Sublime Text 3.1
- Vim and GVim 8.0

You are allowed to use any of these to write your code. The organisers will attempt to help with any technical difficulties you may encounter while using your choice of editor or IDE. However, if a technical problem with your IDE causes you to lose time during the contest, you will not be provided with extra time. You may also be expected to use a different IDE or editor if the problem cannot be resolved.

We emphasize that Code::Blocks 16.01 for Ubuntu crashes quite frequently, thus we do not recommend using it.

For Java developers who are unfamiliar with Eclipse:

When Eclipse starts, you will be presented with a welcome screen, which you can close. Select File ! New ! Project, then Java project. For the project name, use the short name of the problem. Once you have created a project, you can add a file by selecting

File > New > Class.

4. Web-based hand-in system

The South African Programming Olympiad uses a web-based hand-in system called CMS, similar to the one used at the International Olympiad in Informatics. The web server can be accessed via the link found on the desktop. A version of the source code can be found at <https://github.com/cms-dev/cms>. The web server can be accessed via the link found on the desktop. The first time you connect, you will be warned that the certificate is self-signed; select to accept the certificate permanently and continue.

You will be allocated a username (initial and then surname - if your name is Raymond Luxury-Yacht, it will be rluxuryyacht) and a password for accessing this system. Once you have logged in, there are a number of menu options on the left:

Overview This provides key details about the contest. Most notably, you will be able to see time and memory limits (without language modifiers) here. You will also be able to see the start and end times of the contest.

Communication If you need to submit a question, please use this page or the paper provided by the organisers. Please check regularly for updates on the communication page.

Statement For each problem, you will be able to download task statements and additional files from the statements page.

Submissions This page allows you to hand in solutions, as well as to view files that you have already handed in.

When you hand in source code as a solution, your source code will be compiled and run on all test cases. You will be able to see a summary of your program's score, including how it did on each test case. Your final score for a problem will be the maximum score across all your submissions. Please be advised that the server may take a while to run your program on every test case. Please be prepared to wait up to 10 minutes before seeing your score, especially for Python solutions as the time limits are significantly increased.

You will be allowed to submit at most 50 times for each task during the contest. You will not be allowed to submit more than once every 60 seconds. The organisers reserve the right to change these limits during the contest to ensure that the submission system will give quick feedback to all participants.

Testing You can use this page to see how your program will run on the server, on test data other than the sample test case.

You will be allowed to test at most 50 times for each problem during the contest. You will not be allowed to test more than once every 60 seconds. The organisers reserve the right to change these limits during the contest to ensure that the submission system will give quick feedback to all participants.

Score You will receive full feedback after each submission for every task. Here you will see your total score obtained for that submission (out of 100) as well as the score for each individual subtask. The final score for each task is taken as the **maximum** of the scores obtained over all submissions.

Once the contest is over another option will also appear on the test page: an option to run the tests on the real test data, and have the output marked.

Logout This is self-explanatory.

5. Miscellaneous

The hand-in system is running on Ubuntu Server 18.04 LTS. Because of the difference in system setup, bugs in your program may manifest themselves in different ways on the hand-in system, perhaps not even appearing at all on the local system. Here are some possible reasons for these differences in behaviour.

Memory limitations When run on the server you are limited to a fixed amount of memory (will be specified in task statement, but usually 256MiB). If you try to use more than this, then

C++ new will throw a bad_alloc exception

Java new will throw java.lang.OutOfMemoryError

Python Operations will throw MemoryError or just crash Python

If you use up all the space with global variables in C++, your program will probably be killed before any of your code executes.

Note that there is some overhead for your code, stack and so on, so not all of the memory is available to you for variables. Count on losing at least 2–5MB to overheads.

You will be given far more memory than you actually need, so overheads should not be a major issue.

Python is the worst culprit for memory consumption. Lists are very memory-inefficient and will consume several times as much memory as one would expect.

Memory accesses (C++) If you have been used to programming C++ on Windows then you may find that Windows tends to be a lot more forgiving than Linux when it comes to memory accesses. In particular it will generally let you read from an invalid address. Sources of invalid addresses include NULL pointers, uninitialised pointers, pointers to memory that have been freed, and out of range array indices. If your program is crashing with signal SIGSEGV (known as a segmentation fault) on the server then this is a likely cause of the fault.

Uninitialised memory (C++) If you use a variable without initialising it, your program might behave differently depending on what is in that variable when it starts. You can often get the compiler to warn you of this by specifying the compiler flags `-O2 -Wall` (on GCC), although it is not perfect.

Compiler flags Read the rules to determine the compiler flags that are used on the server. You may find that the only reason the bug appears on the server and not your machine is that you were not using the same compiler flags. This is usually a sign that you have done something wrong, such as accessing memory out of bounds (where the flags might change the way memory is laid out) or not initialising a variable (without the optimisation flags the compilers may zero the memory for you, but will skip this when optimising).

Exit code A program that returns with a non-zero exit code is considered to have crashed.

C++ programmers must declare their main function to return int and must explicitly return 0 at the end of the main function.

Headers, units and modules Some C++ headers and Python modules are specific to Windows. You may find that the server will complain about a missing header file - if so then this is probably the problem. A good example of this is the `<windows.h>` C header.

Some Java textbooks use the add-on package `java.lancs` to provide simple input routines. This package is not part of the Java standard and will not be available on the server. You should instead use `BufferedReader` or `Scanner`. We can assist you with this at the practice round, but no assistance will be given during the contest.

5.1 Documentation

Documentation for all the languages may be found on the hand-in server using the link provided on the Desktop. This includes documentation on the C++ Standard Template Library.

6. Summary

Hand-in server account initial and surname

Shortcuts Desktop and Menu

Home directory /home/username