2EL6040 – System programming under linux and windows

Instructors: Pierre-François Gimenez
Department: CAMPUS DE RENNES
Language of instruction: FRANCAIS
Campus: CAMPUS DE RENNES
Workload (HEE): 60
On-site hours (HPE): 35,00
Elective Category : Fundamental Sciences
Advanced level : Yes

Description

This elective is part of the InfoSec track, but is nonetheless open to any 2nd year student willing to attend it.
The C language is still one of the most widely used languages to program low-level software applications in operating systems or application layers closeby. In particular, it is widely used for background services in GNU/Linux and Microsoft Windows systems (web servers, database servers, e-mail servers, file servers, and so on). Although designed a long time ago (in the 1970s) this state of things is due to the unchallenged performance of C programs, thanks to the continuous progress of available compiler toolchains. The drawbacks of writing in such a concrete language are therefore (partially) balanced by near-optimal performance, at the cost of a substantial effort for program design.
This course is therefore oriented towards students willing to strengthen their programming skills through experience with the C language, by writing applications close to the OS using standard UNIX interfaces (POSIX standard, I/O management, inter-process communication, multiprocess / multithread programming, system signal handling, debugging and application design and implementation) and their Microsoft Windows cousins with the Win32/Win64 APIs.
This course will also be the opportunity to realise the intrinsic difficulties of programming in C (especially the explicit memory management and the consequences of arguable design decisions in the implementations of arrays and strings) and the safety and security problems they incur.
We will use this experience to introduce a new programming language (Rust), which allows to guarantee both more security and safety (by language design, especially thanks to its rich type system) and achieves high performance just like C programs. To the best of our knowledge, this is the first language in programming languages history that reconciles security/safety with performance (previous attempts always sacrificed

either security or performance). The Rust language is already currently used by Mozilla developers for the web browser Firefox.

Quarter number
SG8

Prerequisites (in terms of CS courses)
Systèmes d'information et programmation, Algorithmique & Complexité, réalisation préalable d'un projet de développement logiciel (1A)

Syllabus
Part 1 : The C language
Part 2 : The Rust language
Part 3 : System APIs in Unix and Windows, POSIX standard

Class components (lecture, labs, etc.)
50% courses, 50% practical work, mini-project

Grading
Final exam (oral presentation of the project) : 50%
Lab exam : 50%

Course support, bibliography
- Le langage C - 2e édition - Norme ANSI (August 20, 2014) , Brian W. Kernighan and Dennis M. Ritchie.
- The Rust Programming Language, May 2018, Steve Klabnik and Carol Nichols.
- Programming Rust (August 2016), Jim Blandy.
- La norme POSIX.
- Windows System Programming, (4th Edition) (Addison-Wesley Microsoft Technology) by Johnson M. Hart (2015-10-01).

Resources
A Linux and Windows environment

Learning outcomes covered on the course
Create efficient C and Rust programs on the Linux and Windows platforms. Select and make use of the OS kernel functions and their APIs.

Description of the skills acquired at the end of the course
C2.1 Thoroughly master a domain or discipline based on the fundamental sciences or the engineering sciences.
C6.3 Conceive of, design, implement and authenticate complex software.