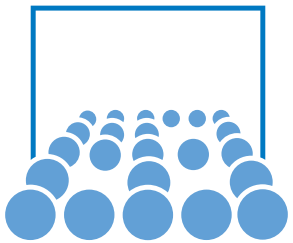
The Programming Toolbox

Advanced Programming Tutorials

Erik Wannerberg
Supervisors: Roland Wittmann, Philipp Neumann

November 10, 2015



Content

1. Contents

2. Source code editor

3. Build automation tools

4. Debugger

5. Version Control

6. Getting an idea about IDEs

Source code editor

Text editor with that *aids in writing of code*. Example features:

- syntax highlighting
- bracket completion
- code completion
- automatic indentation
- source code refactoring
- class/file diagrams and outlines, call hierarchies...

Standalone text editors

Sample GUI-based source code editors:

- Geany
- Gedit
- Notepad++ (Windows)
- Sublime Text

Sample terminal-based source code editors:

- Emacs
- vi/Vim
- nano

Not satisfied? Wikipedia has a comparison list! (https://en.wikipedia.org/wiki/Comparison_of_text_editors#Programming_features)

Build automation tools

Software for automating the process from source code to exectuable program:

- automating compiling, packaging and running tests, in *order of dependencies*
- scanning of source code to find includes
- recompilation whenever files update

Tools, with and without Graphical User Interface (GUI):

- make
- cmake
- autotools/automake
- qmake

Again, Wikipedia!
(https://en.wikipedia.org/wiki/List_of_build_automation_software)

Debugger

- pause and go through program step-by-step
- check and change values of in-memory variables while program is running
- use *breakpoints* to investigate state at certain places in code
  - watchpoints - trigger upon event
  - conditional breakpoints
- relatively new: reverse debugging

GNU debugger (`gdb`) cheat sheet:
`http://darkdust.net/files/GDB%20Cheat%20Sheet.pdf`

Version Control

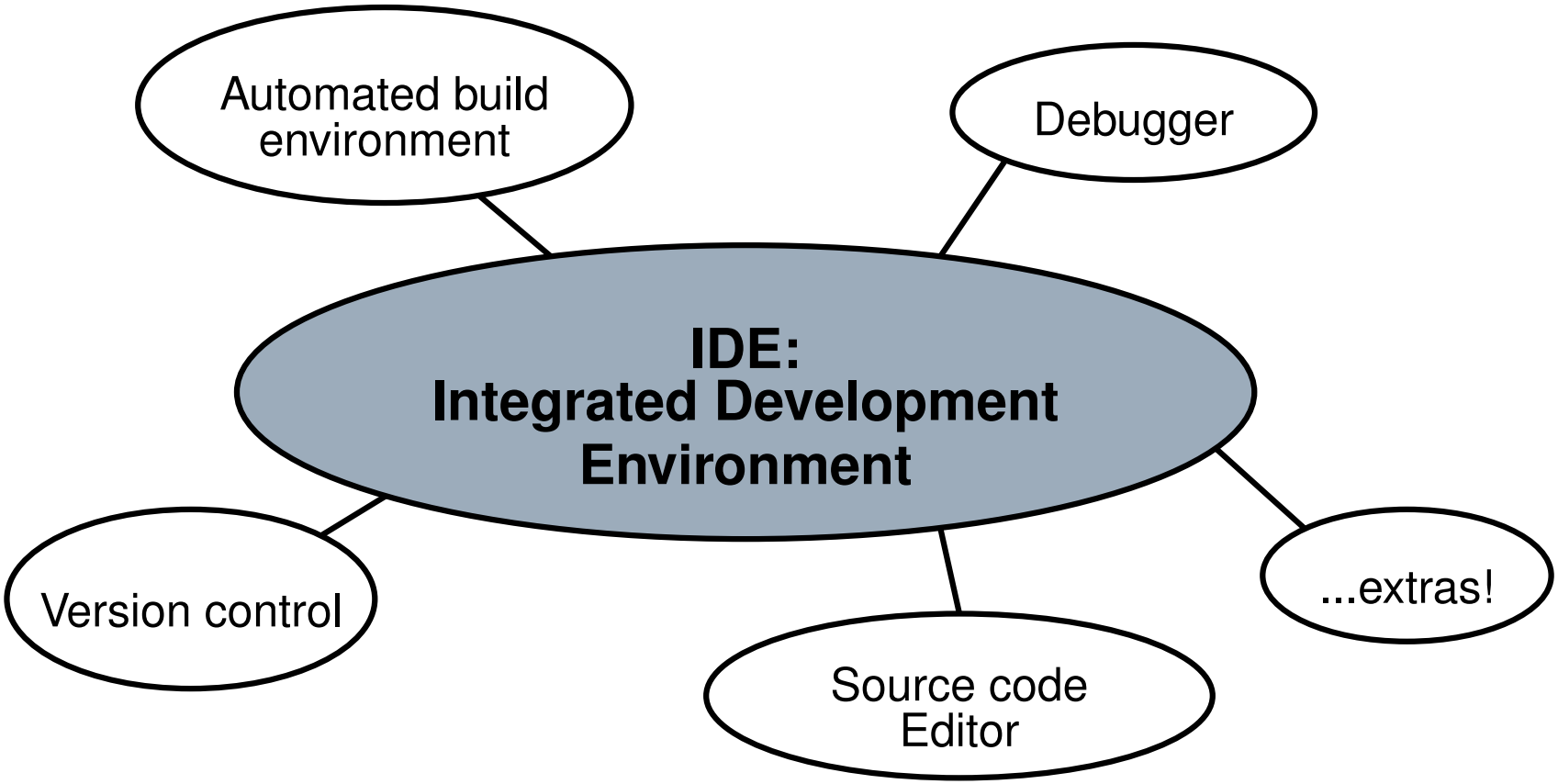
Software that manages *keeping track of changes*.

- keeps track of changes you make in your source
- keeps track of changes *others* make, letting you *merge* your changes - crucial in any larger software projects!
- lets you keep those changes at a safe location to later restore any parts you want/need

Example Version Control software:

- git
- Mercurial
- Subversion

Getting an idea about IDEs

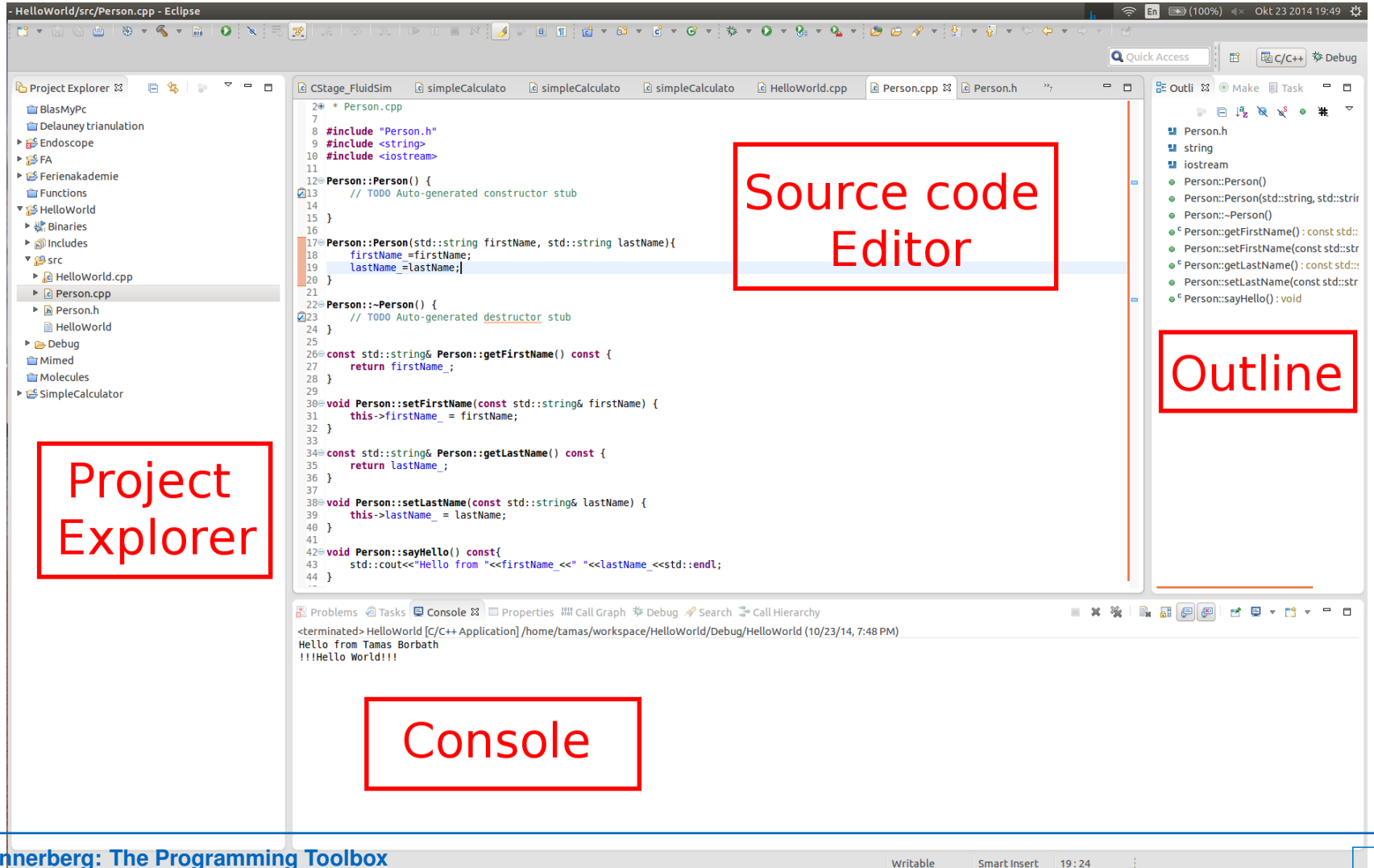


Sample IDEs

- CLion
- Code::Blocks
- CodeLite
- Eclipse
- Microsoft Visual Studio (Windows)
- NetBeans
- PyCharm (python)

Eclipse

Plug-in based IDE with many areas of usage. C++ view:



Eclipse keyboard shortcuts

Some useful keyboard shortcuts:

- Auto-complete – *Ctrl + Space*
- Navigate to function declaration / header – *Ctrl + Left-Click* or *F3*
- Automatic formatting/indentation – *Ctrl + Shift + F*
- Code refactoring – *Alt + Shift + R* (rename variable), *Alt+ Shift + M* (extract function)
- Comment out code – *Ctrl + /* (line comment), *Ctrl + Shift + /* (block comment)

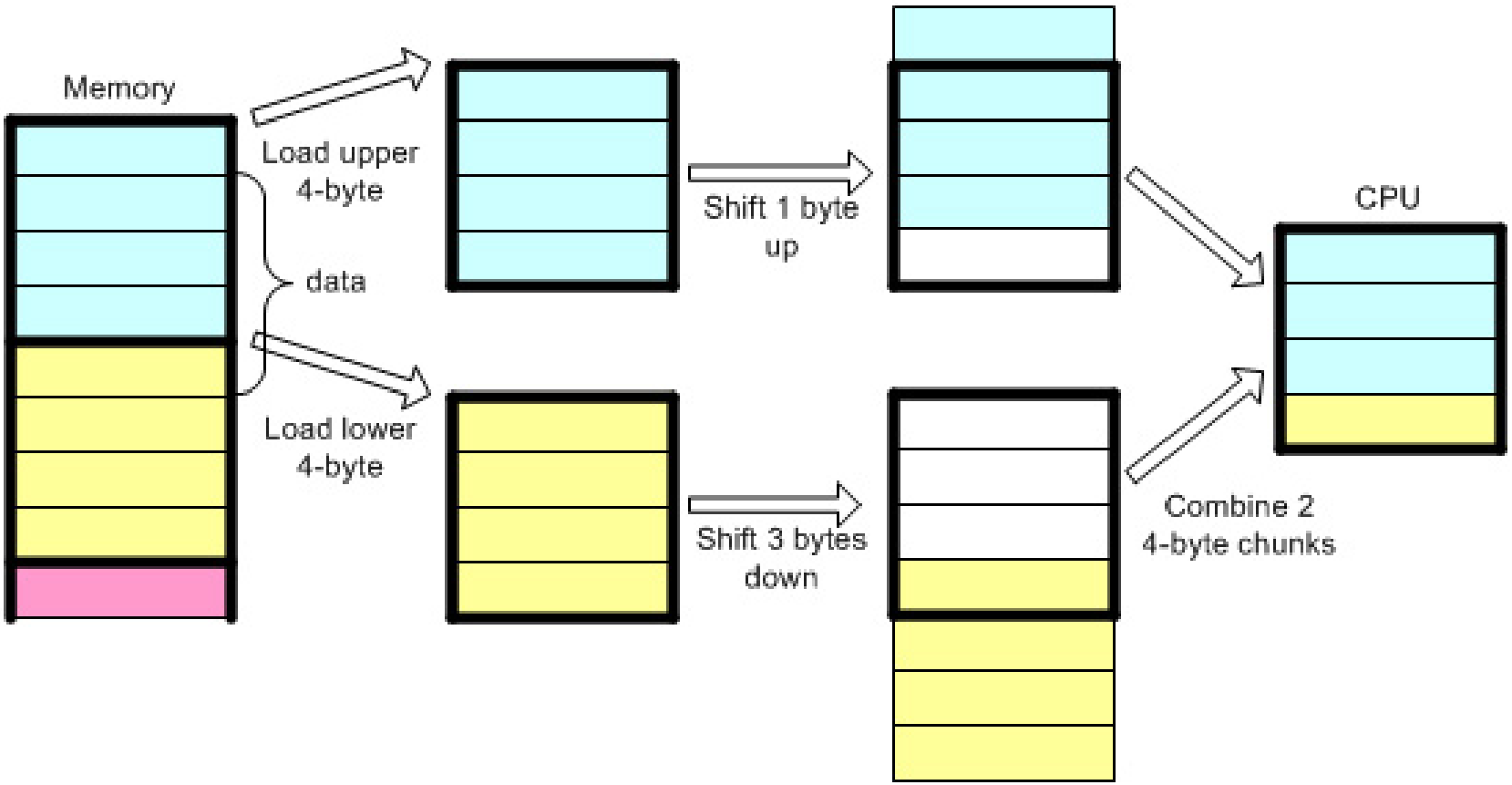
C++ datatype sizes and ranges

Type specifier	Equivalent type	Width in bits by data model				
		C++ standard	LP32	ILP32	LLP64	LP64
short	short int	at least 16	16	16	16	16
short int						
signed short						
signed short int						
unsigned short	unsigned short int					
unsigned short int						
int	int	at least 16	16	32	32	32
signed						
signed int						
unsigned	unsigned int					
unsigned int						
long	long int	at least 32	32	32	32	64
long int						
signed long						
signed long int						
unsigned long	unsigned long int					
unsigned long int						
long long	long long int (C++11)	at least 64	64	64	64	64
long long int						
signed long long						
signed long long int						
unsigned long long	unsigned long long int (C++11)					
unsigned long long int						

Type	Size in bits	Format	Value range	
			Approximate	Exact
character	8	signed (one's complement)		-127 to 127[note 1]
		signed (two's complement)		-128 to 127
		unsigned		0 to 255
	16	unsigned		0 to 65535
	32	unsigned		0 to 1114111 (0x10ffff)
integral	16	signed (one's complement)	$\pm 3.27 \cdot 10^4$	-32767 to 32767
		signed (two's complement)		-32768 to 32767
		unsigned	0 to $6.55 \cdot 10^4$	0 to 65535
	32	signed (one's complement)	$\pm 2.14 \cdot 10^9$	-2,147,483,647 to 2,147,483,647
		signed (two's complement)		-2,147,483,648 to 2,147,483,647
		unsigned	0 to $4.29 \cdot 10^9$	0 to 4,294,967,295
	64	signed (one's complement)	$\pm 9.22 \cdot 10^{18}$	-9,223,372,036,854,775,807 to 9,223,372,036,854,775,807
		signed (two's complement)		-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
		unsigned	0 to $1.84 \cdot 10^{19}$	0 to 18,446,744,073,709,551,615
floating point	32	IEEE-754	$\pm 3.4 \cdot 10^{\pm 38}$ (~7 digits)	• min subnormal: $\pm 1.401,298,4 \cdot 10^{-47}$ • min normal: $\pm 1.175,494,3 \cdot 10^{-38}$ • max: $\pm 3.402,823,4 \cdot 10^{38}$
	64	IEEE-754	$\pm 1.7 \cdot 10^{\pm 308}$ (~15 digits)	• min subnormal: $\pm 4.940,656,458,412 \cdot 10^{-324}$ • min normal: $\pm 2.225,073,858,507,201,4 \cdot 10^{-308}$ • max: $\pm 1.797,693,134,862,315,7 \cdot 10^{308}$

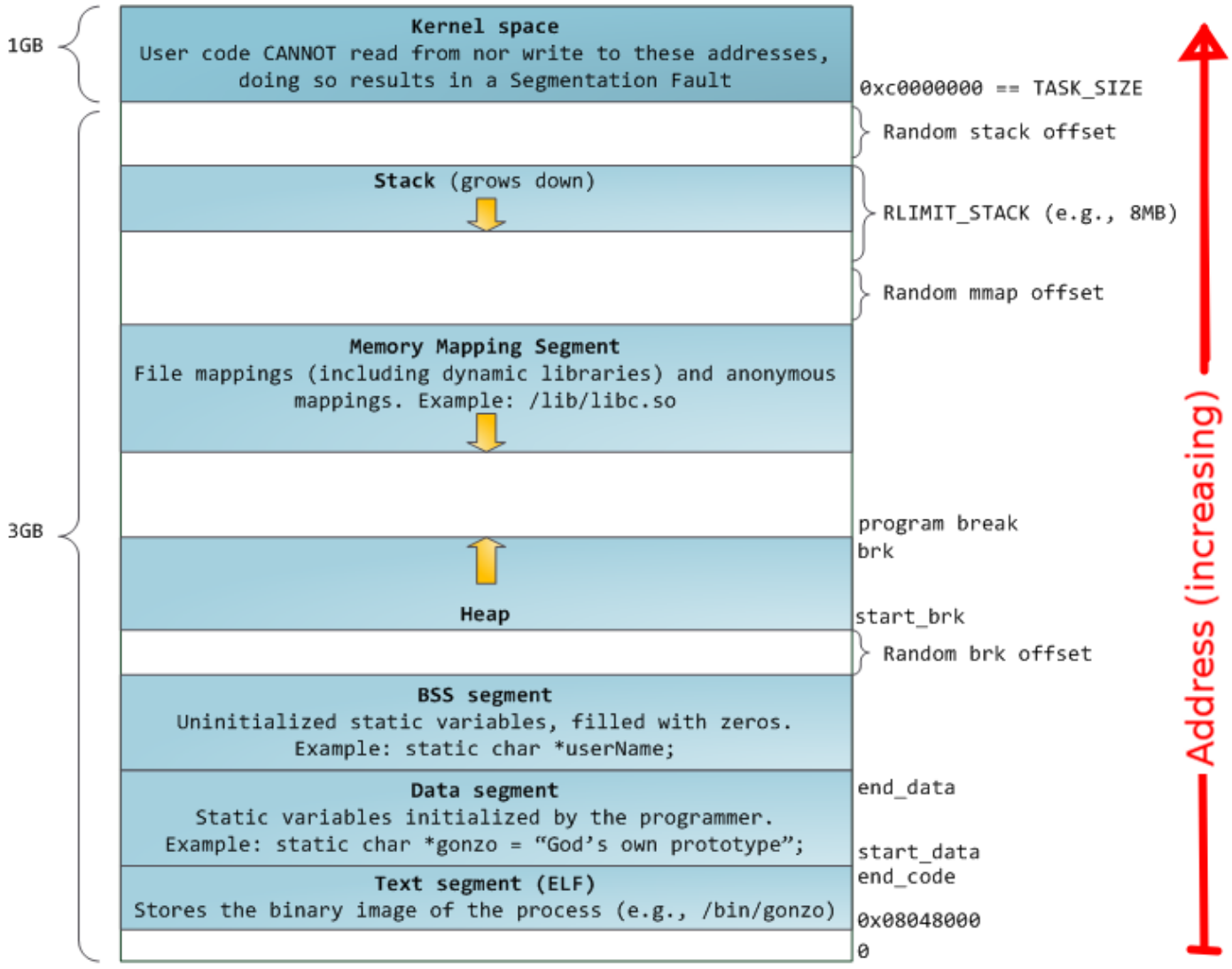
Source: http://en.cppreference.com/w/cpp/language/types

Unaligned data



Source: http://www.songho.ca/misc/alignment/dataalign.html

Memory layout



Source: http://duartes.org/gustavo/blog/post/anatomy-of-a-program-in-memory

Other useful links

- A tutorial on make and makefiles
  https://www.cs.umd.edu/class/fall2002/cmsc214/Tutorial/makefile.html
- Debugging in Eclipse
  http://www.vogella.com/tutorials/EclipseDebugging/article.html
- Debugging in Visual Studio
  http://msdn.microsoft.com/en-us/library/y740d9d3.aspx
  http://www.codeproject.com/Articles/79508/Mastering-Debugging-in-Visual-Studio-A-Beginn
- What Every Computer Scientist Should Know About Floating-Point Arithmetic
  http://docs.oracle.com/cd/E19957-01/806-3568/ncg_goldberg.html
- Round-off errors
  http://en.wikipedia.org/wiki/Round-off_error
- On Memory Alignment (Assignment 3)
  http://www.songho.ca/misc/alignment/dataalign.html
- Anatomy of a Program in Memory – more in-depth on how programs exist in your computer's memory
  http://duartes.org/gustavo/blog/post/anatomy-of-a-program-in-memory
- Also, don't click this link