

Linux System Programming

By:
Ahmed Teirelbar
Software Engineer
Shuja' Consulting



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Rough Outline

- C
 - Procedural concepts
 - Builds and shared objects
 - Transition to OO
- C++
 - OO concepts
 - Design and existing libraries



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Outline Cont'd

- Application System Programming
 - The program in execution:
 - Interaction with the system
 - Interaction with other apps
 - Intro to the APIs
- Kernel Module Programming
 - Driver/Module Concepts
 - What do you provide
 - How do you get what you need
 - Overview of bigger picture



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C as a Programming Language

- Programming as logic
- Language as grammar and syntax
- Procedural
- Modular
- Abstraction/Hiding
 - C enables it, C++ supports it
- Object-Oriented
 - C enables it, C++ supports it
- C++: Parametrization or Generic Programming



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Building

- Generating an executable from code
- Concept of Makefile
 - Compiling -- gcc
 - Linking -- ld
 - Installation -- install
 - Packaging -- package-manager/strip
 - Uninstallation
 - Cleaning



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Compiling

- Preprocessing – `cpp`
- Compiling – `gcc`
- Some important flags (`-o`, `-c`, `-Wall`, `-L`, `-I`, `-I`, `-g`, `-O`, `-D`, `-Wl`.)
- Cross compiling



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Directives and Include

- #include
- #define
- #ifdef
- Include guards
- What's in the include?
- Include path "", <>



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General Guidelines

- Maintainability/Readability
 - Deterministic modules – no voodoo
 - Minimize ripple effect
 - Documentation
 - Intuitive naming
- Flexibility/Scalability – Growth and Reduction
- Usability
- Reusability of Code



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Empty Program

- Every statement ends with ;
- Space insensitive
- {} scopes
- A brief intro to functions
- main



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Data Types

- Primitive/Built-in data type controls:
 - Storage
 - Operation compatibility
- Typical types:
 - double, float
 - int, short, long, long long
 - unsigned, unsigned short, unsigned long, unsigned long long
 - char, unsigned char – ASCII
- typedef (architecture example)



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Variables

- Data Type (Domain)
- Scope – Variables on stack
- Declaration
 - `int x; char c = 'k';`
 - `int x, y;`
- Global variables
- Qualifiers
 - `static`
 - `extern`



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Data Representation

- Writing constants
 - Hex 0xa3, Octal 0666, Binary 0111b
- Chars
 - '<c>', ascii value



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Data Representation Cont'd

- **printf**

- `printf("Printing %<sp1> %<sp2> %<sp3>\n", var1, var2, var3);`
- Type specifiers:
- `%x, %u, %i, %d, %f, %lu, %lx, %Lu, %Lx, %c, %s`

- **scanf**

- `scanf("<sp1> <sp2> <sp3>", &var1, &var2, &var3);`
- `%[*][width][modifiers]type`



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Operators

- Primary (`()`, `[]`, `..`, `->`)
- Unary (`pre/post++`, `!`, `~`, `&`, `*`)
- Arithmetic (`*`, `/`, `%`, `+`, `-`)
- Bitwise (`>>`, `<<`, `&`, `^`, `|`)
- Relational (`<`, `>`, `<=`, `>=`, `==`, `!=`)
- Logical (`&&`, `||`)
- Conditional (`? :`)
- Assignment (`=`, `+=`, `-=`, `*=`, `/=`, `<<=`, `>>=`, `%=`, `|=`, `&=`, `^=`)



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Precedence

Who gets processed First?

- Primary
- Unary (Right associative)
- *,/,%
- +,-
- >>, <<
- >, <, <=, >=
- ==, !=
- &
- ^
- |
- &&
- ||
- ?: (Right associative)
- Assignment (Right associative)



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Casting

- Explicit cast
 - `char x = 'a'; int y = (int) x;`
 - `int x = 5; char y = (char) x;`
- Implicit cast
 - `double a, b, c; int x; c = a*b + x;`
 - `x = a*b + c;`
 - Signedness



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Code Example

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