How to start writing a hobby operating system

Manuel Hohmann

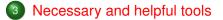
Laboratory of Theoretical Physics - Institute of Physics - University of Tartu Center of Excellence "The Dark Side of the Universe"

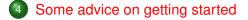


Hardware programming and operating systems workshop 22. April 2019

Preliminary questions and general advice







Preliminary questions and general advice

- Resources and required knowledge
- 3 Necessary and helpful tools
- 4 Some advice on getting started

Reasons not to write an OS

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- … I want to unify Windows, Linux, Mac OS and run all their programs on one computer at the same time.
 ⇒ Getting an OS to run even programs for *one* other OS is a major task, let alone several of them.
- ... I want it to be more secure than any other OS written before.
 ⇒ Writing anything secure is highly non-trivial and any subtle bug may become a security risk. Consider joining e.g. Linux kernel development to fix security holes instead.

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- \Rightarrow Decide what you want to achieve, and try to set a realistic goal what your OS should be able to do.

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- Hardware specific design choices:
 - Interface between kernel and user programs (system calls).
 - Possible workarounds for CPU bugs.
 - Security measures.
 - Supported hardware.

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- Requires slightly more support code.
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- Assembler
 - + Full control over CPU, optimization...
 - Tedious to write everything by hand.
 - Code is not portable to other architectures.

OSDev for beginners

Preliminary questions and general advice

Pesources and required knowledge

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- ... and many other books.

- CPU architecture manuals:
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 - Intel 64 and IA-32 Architectures Software Developer Manuals
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- Common standards:
 - Low level hardware interfaces: ACPI, UEFI...
 - File systems.
 - Executable formats.

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- Successful hobby operating systems:
 - ToaruOS
 - Sortix

Community resources

OSDev.org operating system developer community:



- Forum
- Wiki
- IRC channel #osdev on freenode

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2 Resources and required knowledge





Compilers

• GCC

- + Comes with compilers for C, C++, Ada, Fortran.
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- Microsoft Visual C++
 - + Comes with development environment.
 - Designed to produce Windows executables and libraries.
 - Requires some tweaking to be used for OSDev.

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- You might want to compile code for a different architecture (e.g., compile ARM code on a x86 computer).
- Compilers distributed with your operating system (e.g., Linux) are designed / configured to produce programs running under that OS, and getting them to target bare metal is at least tricky.
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- How do I get a cross compiler?
 - Clang: Already works as a cross compiler.
 - GCC: Build from source and configure for bare metal target.

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- Flat Assembler (FASM):
 - + New version supports different target architectures.
 - + Rather easy to use.
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• CMake:

- + Popular alternative to Autotools.
- Designed for applications, not for kernel development.

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- Virtual machines (VirtualBox, VMware, Virtual PC...):
 - + Provide additional virtual hardware to test your kernel.
 - Less features to debug or inspect virtual machine state.
 - Support only x86 platforms.

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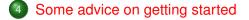
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- Continuous integration:
 - You might want to test your code in several configurations.
 - Use automatized builds and tests on push to repository.

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- Makefiles / build script:
 - Compilation instructions for your OS.
 - Determine in which order to build, dependencies...

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- Memory management: Almost anything you do will require memory management. Memory management tasks (in the kernel) can usually be split in three categories:
 - Physical memory management which pages are free, which are used? Finding free pages, allocating & freeing pages...
 - Virtual memory management how to map physical pages into virtual memory, managing paging structures, address spaces...
 - Kernel heap memory used by the kernel for dynamic allocation / deallocation (malloc(), free() or new, delete).