

X86 Operating System From Scratch

How Hard Can It Be?



Bill Gates jumping an office chair

D. Barry¹

¹Computer Science Society
University of Hertfordshire

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What Is An OS?

Let us define it by what we expect from it:

- Boots the computer and prepares it for a program to run.
- Provides a level of abstraction from the low level hardware (e.g. memory management, disk operations, etc).
- Allows programs to use predetermined functions, allowing for easier writing of programs.



Mac



Linux

Solaris



Why Build An OS?

- General curiosity
- Advancing knowledge
- Fun project
- I always wanted my own [My Name] OS
- I want to be [Bill Gates/Steve Jobs/Linus Torvalds]

MikeOS Text Editor

```
rem *** MikeOS BASIC demo ***
```

```
cls
```

```
print "Which program do you want to run?"
print ""
print "1 - Hex dumper"
print "2 - MikeTron"
print ""
```

```
startloop:
```

```
waitkey x
if x = '1' then g
if x = '2' then g
goto startloop
```

Use Backspace to remove characters,
and Delete to remove newline chars.
Unix-formatted text files only!

OK

```
runhex:
```

```
rem *** Hex dumper ***
```

[Esc] Quit [F1] Help [F2] Save [F3] New [F5] Delete line [F8] Run BASIC

What OS Will We Build?

- 16 bit
- 16kB RAM
- Custom File System
- Command Line
- Monolithic

```

Memory Manipulator                                     Selected Byte: 0065
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9             01234567890123456789
0 E9CF00E9C717E9EB17E9D017E90118E9D31EE932         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
20 16E94116E91F24E90722E91B22E9230FE9C016E9         20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
40 0717E9561EE91522E9B422E9A022E97D21E9B922         40 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
60 E9561FE9C822E9530EE93223E9D522E91723E9B1         60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
80 22E96C16E9A024                                     80 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
100 55E91722E991                                     100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
120 E92021E92B21E9                                     120 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
140 17E9AD17E95F1E                                     140 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
160 5313E9613E904                                     160 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
180 E99117E9DE15E9                                     180 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
200 26E9B516E9B616                                     200 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
220 FCB80020ED08E                                     220 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
240 E08415B89E02E0                                     240 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
260 B0AA02E83B1272                                     260 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
280 E0DD25E9B500B84901BB5B01B99F00E8591DB867       280 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9             01234567890123456789
Use the arrow keys to move around, G for GOTO, Enter to change value,
Q for page up and Z for page down. 0 to Save and L to load files to memory

```

Resources

You will need:

- Some virtualiation software (<https://www.virtualbox.org/> or <http://www.vmware.com/>)
- Image Creator (can be downloaded)
- NASM (can be downloaded)

You can download the core resources from <http://coffeespace.org.uk/downloads/os-from-scratch.zip>.



Image Creator

- Allows the custom creation of disk images
- Command line utility, use: `./ic.jar -h` for information
- Custom software written in Java

```
ic [OPT] <FILE 1> .. <FILE N>

Legal
  USE THIS PROGRAM AT YOUR OWN RISK.

Description
  This program has been design to generate an bootable image
  for a specific test Operating System with a custom file
  table. This program is to be used for the Operating System
  described in the book by Daniel Barry.

Options
  -a                Information about program
  --about
  -b                Set the bootloader
                  Default: boot.bin
  -h                Displays this help
  --help
  -o                Set the output
                  Default: os.img
  --output
  -s                Set the media size (bytes)
  --size
```

NASM

- Compiler for assembly code to machine code
- Well tested, well documented
- Other compilers will unlikely work

```
497 string_compare:
498     push si
499     mov si, ax
500     push ax
501     mov dl, ch ; Store for later
502
503 .repeat:
504     cmp ch, UBYTE_MIN ; Make sure we have not exceeded the search
505     je .exit ; If all searched, exit pass
506
507     lodsb ; Get next byte from SI
508     mov ah, byte [bx] ; Retrieve byte from BX
509     inc bx ; Manually increment BX
510
511     dec ch ; Decrement counter
```


Getting Started

- A good starting point is on page 5 of the book in the download, under the heading “Build Environment”.
- Advanced users can skip to page 8, under the heading “Bootloader”.

References

- [1] PinStake, “Windows Vs Mac Vs Linux”, *PinStake.com*,
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- [3] Anvin, H., Kukunas, K., Gorcunov, C., Kotler, F. “NASM”,
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