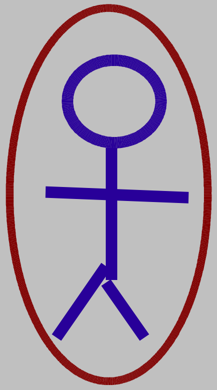
(not a mascot)



Operating System (without a name) (so far)

Benji, Jaap & Ting

Traditional “timesharing” OS

- Protect processes from each other
- Usual trick:
  - Virtualization (pretend we have >1 machine)
- Problems:
  - Context switches are slow
  - Copying buffers is slow
  - Too little security (big rooms)
  - Too much security (big walls)

What is the actual goal?

To protect <u>resources</u>!

```
char* vga = (char *) 0xb8000;
strcpy(“H e l l o “, vga);
```

- UNIX programmer says:
  - “Shouldn't have that address mapped.”
- ML/Lisp/have-your-pick programmer says:
  - `(char *)` is inherently unsafe

Loading user code in UNIX

- fork(2) creates a new memory space
- exec(2) loads an object file into memory
- Figure out where main() is and jump to it

Protection through virtualization

Loading user code in (unnamed)

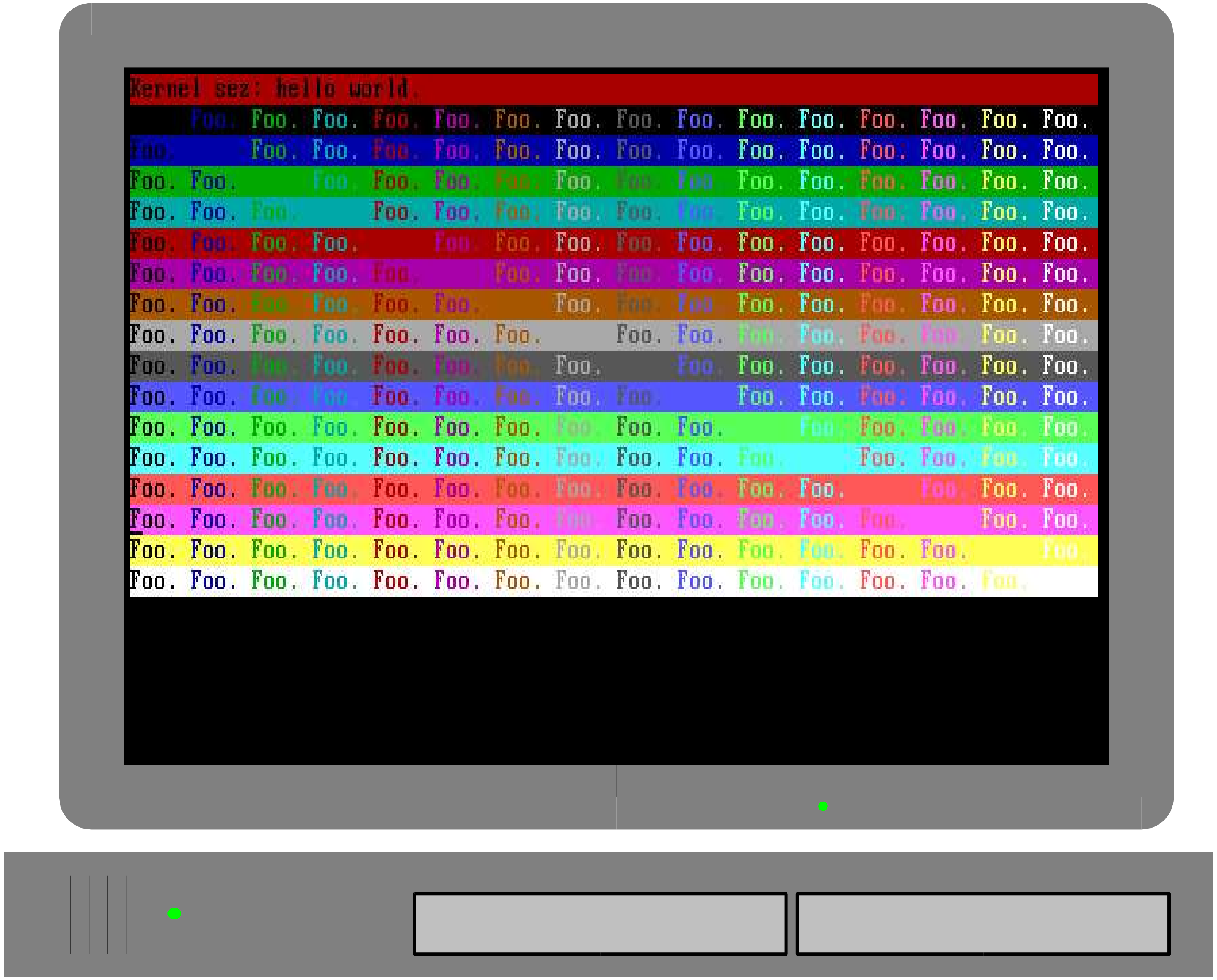
- Check that code came out of a type-safe compiler
- Do *not* generate a new memory map
- Load an object file into memory
- Figure out where main() is and jump to it

Protection without virtualization

Why does type safety help?

- *Theorem: "While this program is being executed, no memory outside of range R will be accessed, and control will not be transferred outside of range U."*
- *Proof:*
  - For a correctly typed program: trivial
    - Pointers don't appear out of thin air
  - For a C program: impossible
    - Pointers do appear out of thin air

(unnamed OS) so far....



```
Kernel sez: hello world.
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```
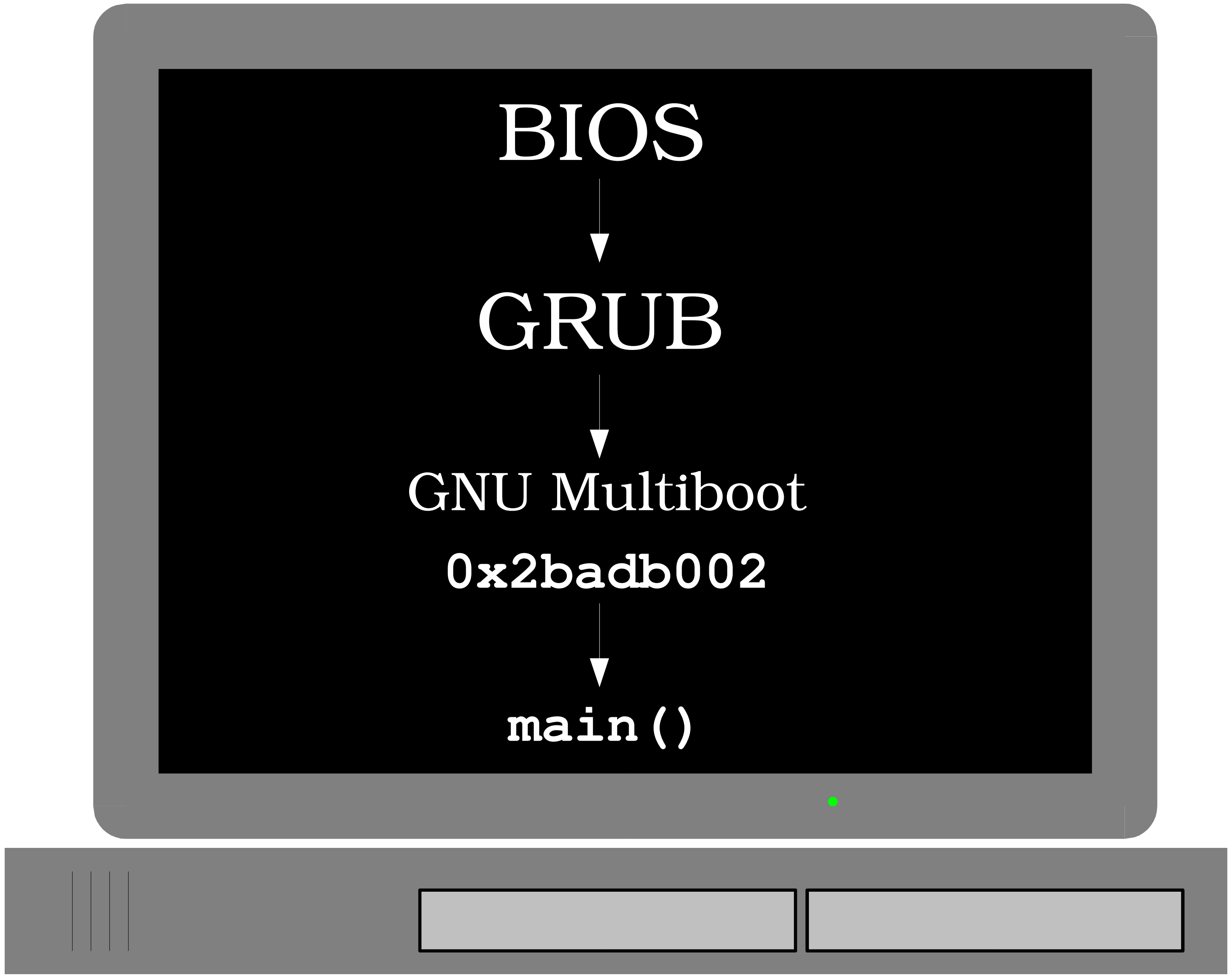

Booting made easy



Emulation made easy

```
qemu -m 16 -fda boot -fdb root
```

Next: basic device drivers

- VGA
- 8259 PIC (Interrupt controller)
- Keyboard
- Floppy disk
- Hard drive
- File system