# Processor Modes

## Real Mode

* A 16-bit mode present on all x86 processors.
* First x86 model design and was used by many early Oss before the birth of **Protected Mode.**
* All x86 processors begin execution in **Real Mode**
* Cons:
  + Less than 1 MB of RAM available
  + No hardware-based memory protection (GDT), nor virtual memory
  + No built-in security mechanisms to protect against buggy or malicious applications
  + Default CPU operand length is 16 bits
  + Accessing more than 64k memory requires the use of segment registers that are difficult to work with
* Pros:
  + BIOS installs device drivers to control devices and handle interrupt
  + BIOS functions provide Oss with an advanced collection of low level API functions
  + Memory access is faster due to the lack of descriptor table (GDT) to check and smaller registers

## Protected Mode

* Main operating mode of modern Intel processors (and clones).
* 32-bit Protected Mode allows working with several virtual address spaces, each of which has a maximum of 4GB of addressable memory
* And enables the system to enforce strict memory and hardware I/O protection as well as restricting the available instruction set via Rings
* A CPU that is initialized by BIOS starts in **Real Mode**
* Enabling **Protected Mode** will unleash the real power of CPU but will prevent us from using most of the BIOS interrupts, since these work in Real Mode

### Entering Protected Mode

Before switching to protected mode, you must:

* Disable interrupts, including NMI (as suggested by Intel Developers Manual)
* Enable the A20 line (20 address line)
* Load the GDT with segment descriptors suitable for code, data and stack