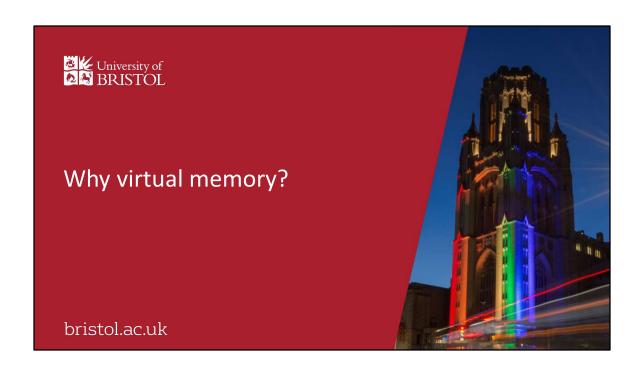


# Computer Systems B COMS20012

Introduction to Operating Systems and Security



#### **Physical Memory**

- Physical addresses are P bits long
  - Maximum amount of addressable physical memory is 2<sup>p</sup>
- OS161's MIPS is 32 bits
   2<sup>32</sup> physical addresses
   Maximum of 4GB memory
- Modern CPU support large amount of addressable memory

  - X86\_64Physical 52 bitsVirtual 48 bits
- Far exceed current RAM technology
  - This won't be true forever;)

### **Physical Memory**

- Is finite
- Need to be shared between all processes
- Need to be carefully managed to avoid processes stepping on each other toes

Classic OS solution: hide complexity through an abstraction

#### Virtual Memory the basic

- The kernel provide a virtual memory for each process
- Virtual memory hold code, data and stack(s) for a process
- If virtual memory addresses are V bits
  - Amount of addressable virtual is 2<sup>v</sup>
    On OS161/MIPS V=32
- Running processes see only virtual memory
  - Program counter and stack pointer hold virtual addresses
  - Pointers to variable are virtual addresses
  - Jumps/branches refers to virtual addresses
- Each process is isolated in its virtual memory and cannot address other processes virtual memory

## Why virtual memory?

- Isolates process from each other
- Potential to support virtual memory larger than physical memory
- Total size of virtual memories can be greater than the physical memory
  - Provide greater support for multiprocessing

