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Computer Systems B

COMS20012

Introduction to Operating Systems and Security

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Why virtual memory?

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Physical Memory

- Physical addresses are P bits long
  - Maximum amount of addressable physical memory is 2^P
- OS161's MIPS is 32 bits
  - 2^{32} physical addresses
  - Maximum of 4GB memory
- Modern CPU support large amount of addressable memory
  - X86_64
  - Physical 52 bits
  - Virtual 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^V
  - 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

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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

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Thank you

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