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Computer Systems B

COMS20012

Introduction to Operating Systems and Security

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OS161

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MIPS

- MIPS uses 32bits paged virtual and physical address
- MIPS has software managed TLB
  - Software TLB raises exception on every miss
  - Kernel is free to record virtual to physical mapping however it wants
  - TLB functions are handled by a function called vm_fault
    - kern/arch/mips/vm/dumbvm.c line 146
- vm_fault uses information from addrspace structure to determine virtual to physical mapping to load into the TLB
  - Each process has its own *addrspace* structure
  - Each *addrspace* structure describe where the pages are stored in physical memory
  - *addrspace* does the same job as a page table, but in a much simpler way. OS161 create contiguous segment.

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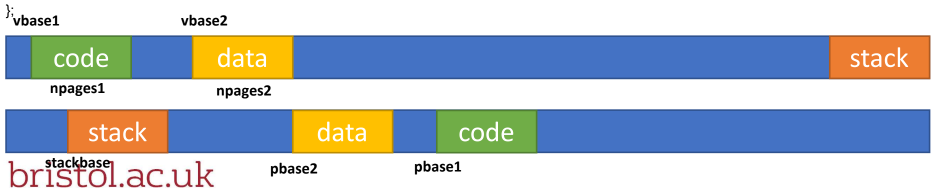
OS161 address space

```
kern/include/addrspace.h
struct addrspace {
        vaddr_t as_vbase1; /* base virtual address of code segment */
        paddr_t as_pbase1; /* base physical address of code segment */
        size_t as_npages1; /* size (in pages) of code segment */
        vaddr_t as_vbase2; /* base virtual address of data segment */
        paddr_t as_pbase2; /* base physical address of data segment */
        size_t as_npages2; /* size (in pages) of data segment */
        paddr_t as_stackpbase; /* base physical address of stack */
};
```



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dumbvm Address Translation

```
vbase1 = as->as_vbase1;
vtop1 = vbase1 + as->as_npages1 * PAGE_SIZE;
vbase2 = as->as_vbase2;
vtop2 = vbase2 + as->as_npages2 * PAGE_SIZE;
stackbase = USERSTACK - DUMBVM_STACKPAGES * PAGE_SIZE;
stacktop = USERSTACK;

if (faultaddress >= vbase1 && faultaddress < vtop1) {
                paddr = (faultaddress - vbase1) + as->as_pbase1;
} else if (faultaddress >= vbase2 && faultaddress < vtop2) {
                paddr = (faultaddress - vbase2) + as->as_pbase2;
} else if (faultaddress >= stackbase && faultaddress < stacktop) {
                paddr = (faultaddress - stackbase) + as->as_stackpbase;
} else {
                return EFAULT;
}
```

- USERSTACK = 0x8000 0000
- DUMBVM STACKPAGES = 12
- PAGE SIZE = 4KB

kern/arch/mips/vm/dumbvm.c
Line 202

- Line 222 – 239 update TLB

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Initializing address space

- When the kernel creates a process it:
  - Creates an address space
  - Load the program data and code
- OS161 pre-load the programs in RAM
  - Most OS will load on demand
- A program code and data is described in an **executable**
- OS161 uses ELF (executable link format) as other OS (e.g., LINUX)
- OS161 execv system call reinitializes the address space of a process
  - int execv(const char *program, char **args)
- The program parameter should be the name of the ELF executable to be loaded

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ELF files

- ELF files contain address space segment descriptions
  - ELF header describes the segment images
    - the virtual address of the start of the segment
    - the length of the segment in the virtual address space t
    - he location of the segment in the ELF
    - the length of the segment in the ELF
- the ELF file identifies the (virtual) address of the program’s first instruction (the entry point)
- the ELF file also contains lots of other information (e.g., section descriptors, symbol tables) that is useful to compilers, linkers, debuggers, loaders and other tools used to build programs

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- OS161's dumbvm implementation assumes that an ELF file contains **two segments**
  - a **text segment**, containing the program code any read-only data
  - a **data segment**, containing any other global program data
- the images in the ELF file are an **exact copy** of the binary data to be stored in the address
- dumbvm creates a **stack segment** for each process
  - 12 pages long
  - ending at virtual address 0x7FFFFFFF

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OS161

- If the image is smaller than the segment it is in loaded into, it should be zero filled
- Look through and understand: *kern/syscall/loadelf.c*

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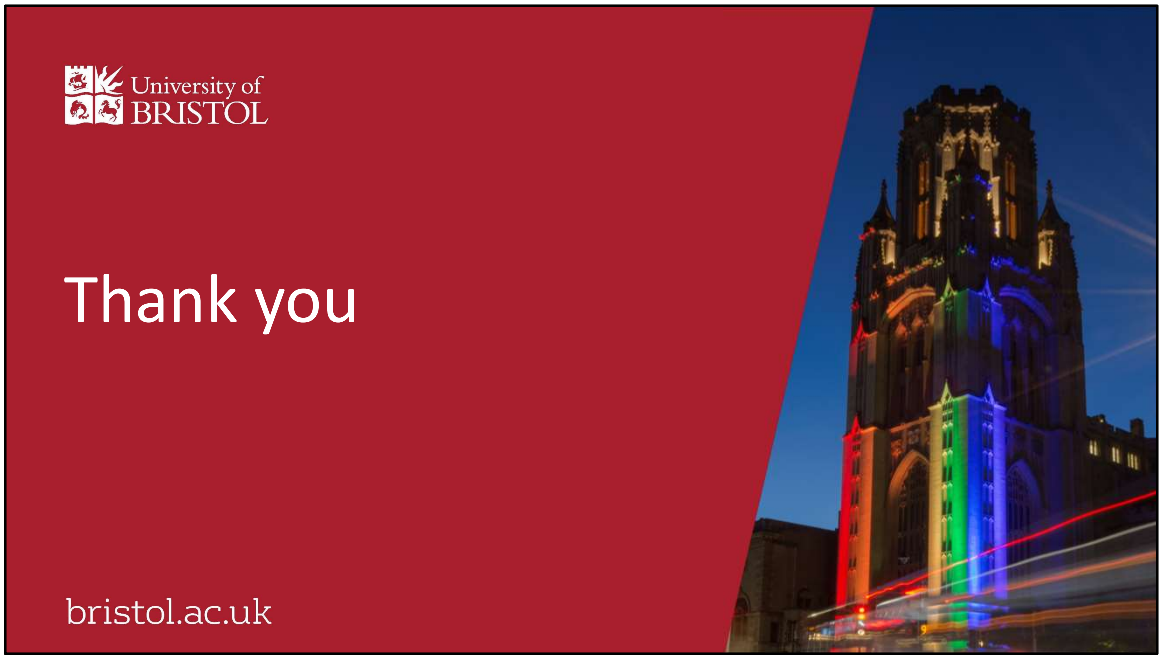

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Thank you

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