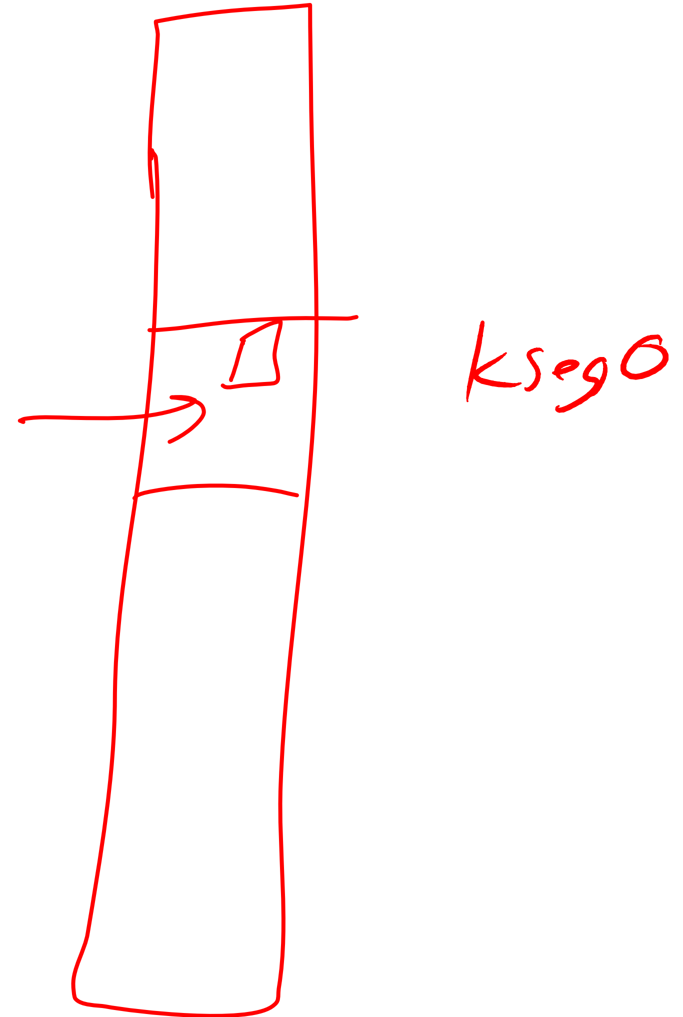
Assignment 2 Parts

- **Memory Management**
- **Address Space Management and TLB Refill**

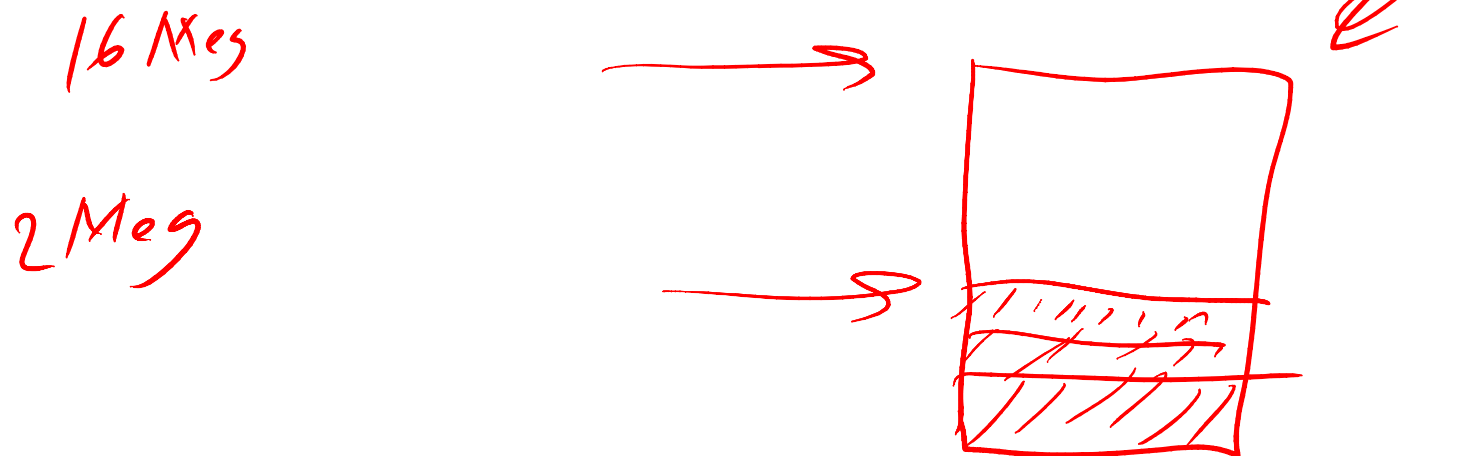
```
void vm_bootstrap(void);

/* Allocate/free kernel heap pages (called by
   kmalloc/kfree) */
vaddr_t alloc_kpages(int npages);
void free_kpages(vaddr_t addr);
```

kmalloc()

kfree()

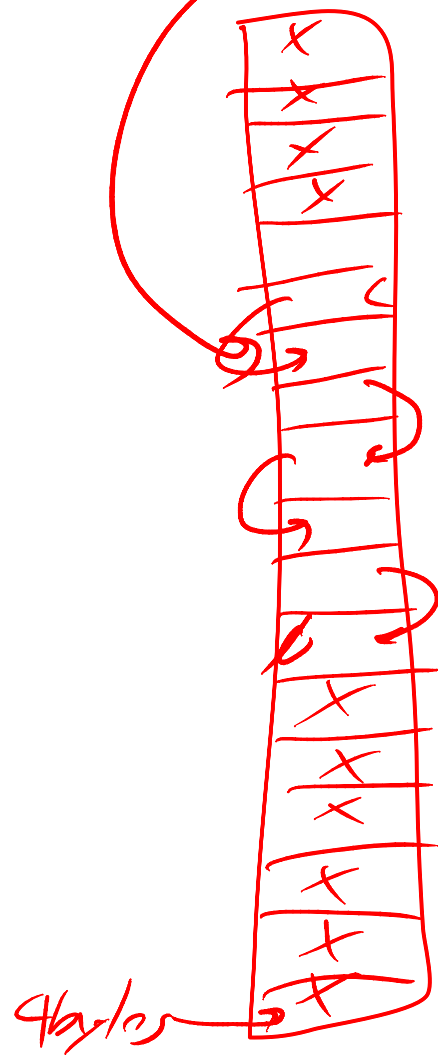


- **How do I figure out how big memory is?**
- ram_getsize() will return the current top of used memory, and the size of physical memory configured for sys161. See kern/arch/mips/vm/ram.c to understand the basic allocator that you need to mostly supercede with your own.



free_frame *D

$hi/4K * 4$ bytes

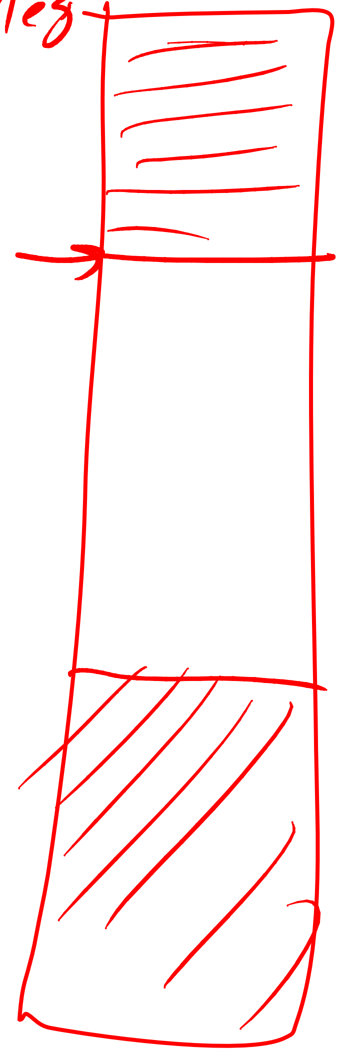


42

41

16Meg

ft



struct fte *ft;

ft = hi —

$hi/4K \times 4$

ft[n]

```
struct fte *ft = 0

alloc_kpage()
    if (ft == 0) {
        ran_stealmem()
    }
    else
    {
        /* your code */
    }
```

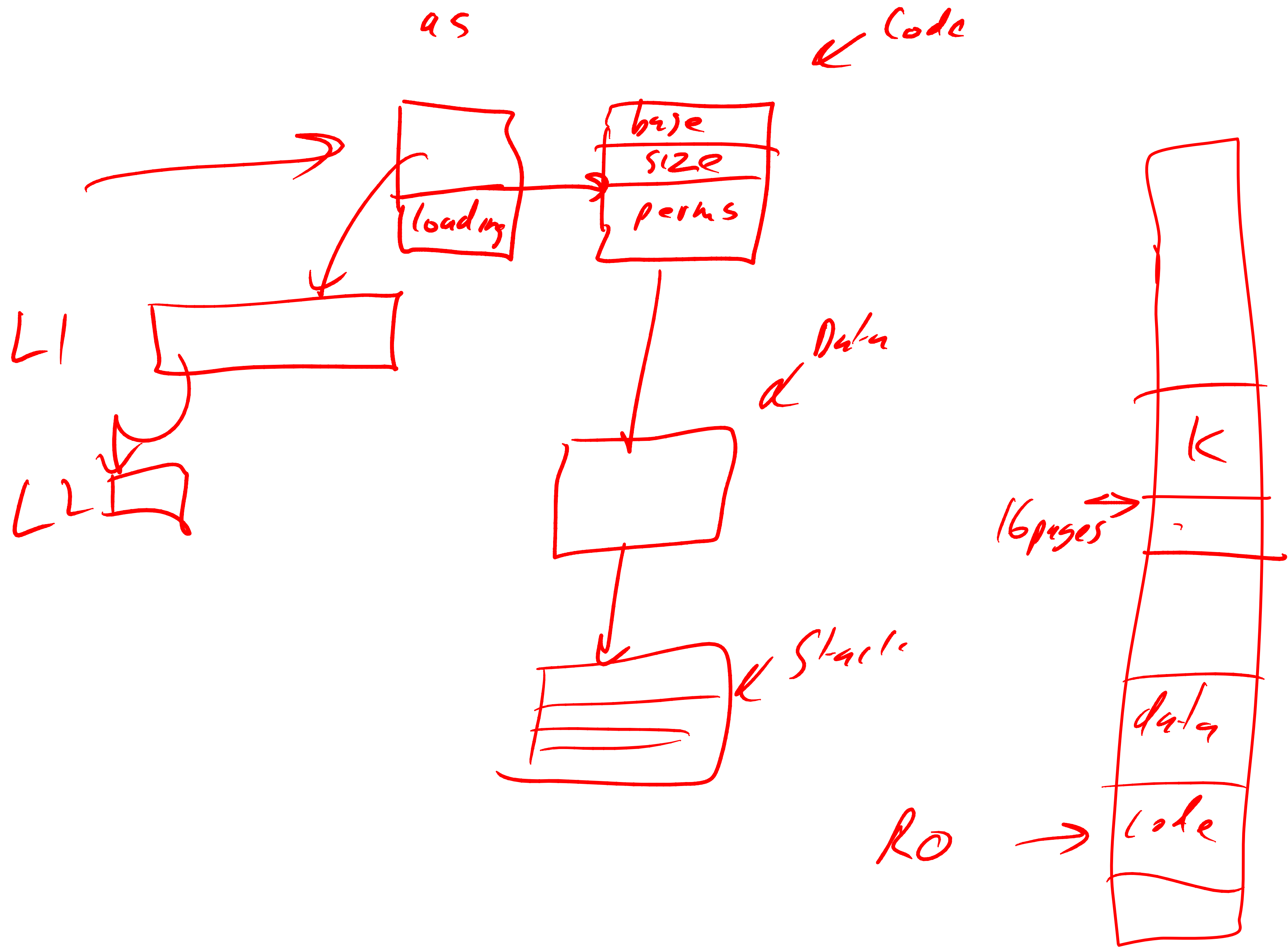
- **Where can I put my frame table**
- You frame table should be dynamically sizeable based on physical memory in the machine. My suggestion is that you compute somewhere in RAM to put it and just use it in that location.
- Here is a little code to illustrate what I mean

```
struct frame_table_entry *frame_table;
location = top_of_ram - (top_of_ram / 4K * 4)
frame_table = (struct frame_table_entry *) location;
```

Note that you will have to mark entries the in table as used for both the table itself, and os/161 allocated to this point in time.

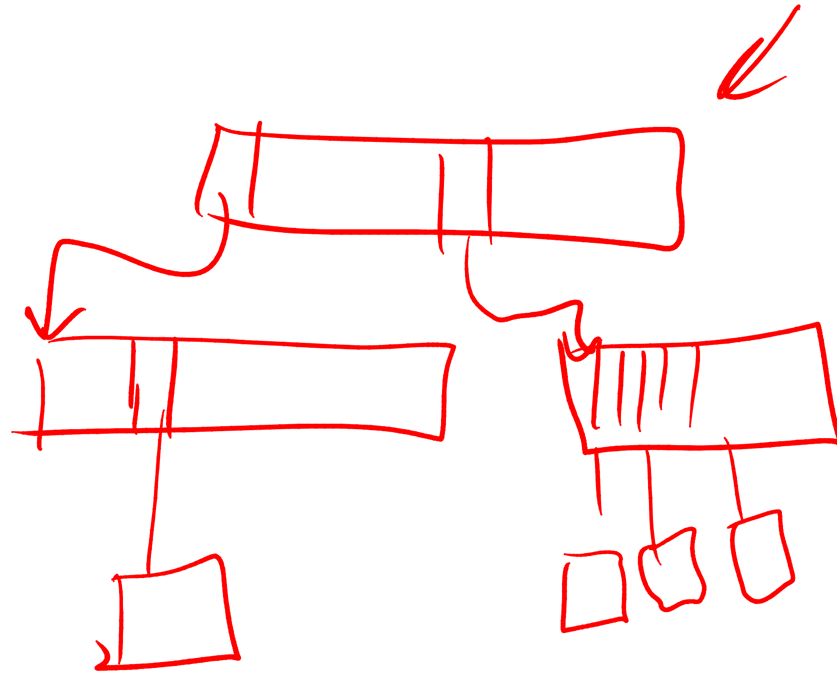
- **OS/161 allocated more than a page using alloc_kpages**
- Yes, the sample implementation of execve does this - you don't need to support it. To avoid this (and enable you to run more testing programs), set __ARG_MAX to 4096 in kern/include/kern/limits.h.

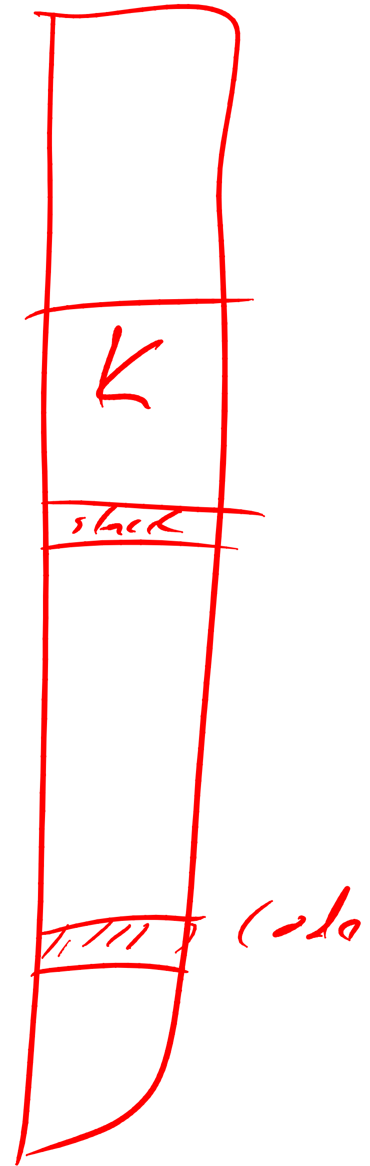
```
struct addrspace *as_create(void);
int               as_copy(struct addrspace *src,
                          struct addrspace **ret);
void              as_activate(struct addrspace *);
void              as_destroy(struct addrspace *);

int               as_define_region(struct addrspace *as,
                                   vaddr_t vaddr, size_t sz,
                                   int readable,
                                   int writeable,
                                   int executable);
int               as_prepare_load(struct addrspace *as);
int               as_complete_load(struct addrspace *as);
int               as_define_stack(struct addrspace *as,
                                  vaddr_t *initstackptr);

/* Fault handling function called by trap code */
int vm_fault(int faulttype, vaddr_t faultaddress);
```


as
Code
base
size
perms
loading
L1
L2
Data
Stack
16 pages
K
data
code
RO

L1

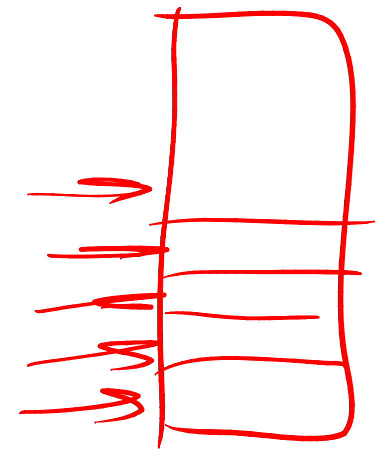
L2





trace 161

- **Don't use kprintf style debugging in the TLB refill routine after TLB write**
- kprintf causes a context switch (it blocks) which flushes the TLB, which potentially ejects the entry you have just loaded - infinite loop, here we come.



- **How do I allocate page tables?**
- alloc_kpage() returns a single page that happens to be the correct size for a two-level page table with 4-byte entries. Note: You need to use 4 bytes entries to avoid undue complexity in allocation, EntryLo and pointers happen to be 4 bytes in size.

- **How can my my allocator work before and after it is intialised?**
- Try something along the lines of:

```
struct frame_table_entry *ft = 0;
alloc_kpages()
{
  if (ft == 0) {
    /* use ram_stealmem */
  }
  else {
    /* use my allocator as frame table is now
  initialises */
  }
}
```

```
struct L1e {
  uint32_t *L2pagetable;
};

void func(vaddr_t v)
{
  struct L1e *L1;
  uint32_t *L2;
  uint32_t pte;
  unsigned int v1, v2;

  v1 = v >> 22;
  v2 = v << 10 >> 22;

  L2 = L1[v1].L2pagetable;
  if (L2 == NULL) {
    panic();
  }
  pte = L2[v2];
}
```