CSE 351

Final Exam Review

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- The final exam will be comprehensive, but more heavily weighted towards material after the midterm

- We will do a few problems from previous years' finals together as a class
  - PLEASE ask questions if you get lost!

Quiz

- We have another quiz we want to spend a few minutes on

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Processes

- List the two important illusions that the process abstraction provides to programs.
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- *1. Logical control flow: the process executes as if it has complete control over the CPU. The OS implements this by interleaving execution of different processes via context-switching(exceptional control flow...).*
- *2. Private linear address space: the process executes as if it has access to a private contiguous memory the size of the virtual address space.*

Virtual Memory

- One purpose of virtual memory is to allow programs to use more memory than is available in the physical memory by storing some parts on disk transparently. Name some *other* useful thing that can be done with the virtual memory system.

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- *1. Sharing of a single physical page in multiple virtual address spaces (e.g., shared library code).*
- *2. Memory protection mechanisms (e.g., page-granular read/write/execute permissions or protecting one process's memory from another).*

TLBs

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- *No. The TLB caches page table entries. After a TLB miss, we do an in-memory page table lookup. A page fault occurs if the page table entry is invalid.*

Java vs C

- Name some differences between Java references and C pointers.

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- *1. C allows pointer arithmetic; Java does not.*
- *2. C pointers may point anywhere (including the middles of memory objects); Java references point only to the start of objects.*
- *3. C pointers may be cast arbitrarily (even to non-pointer types); casts of Java references are checked to make sure they are type-safe.*

Structs

Consider the following definition of the struct below, answer the questions regarding the struct.

```
typedef struct data_struct
{
  int a;
  char b[3];
  short c;
  void * d;
} data_struct;
```

1) Assume you have an data_struct array of size four, on the stack diagram on the following page please shade in and label the memory blocks for each field of each struct.

2) What is the total size of this struct?

3) Would re-ordering the fields from largest to smallest reduce the size of the struct?

4) What would be the assembly code for getting the value of field d out of the struct? Assume that the register %rdi points to the beginning of the struct. Return the value in register %rax.

Structs

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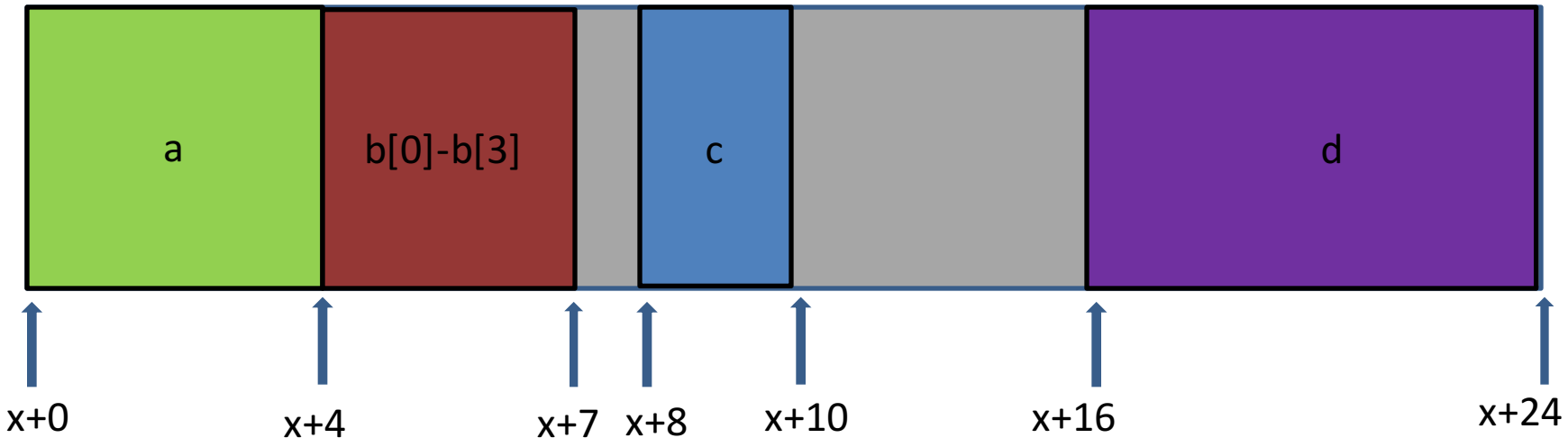

Memory Address	+0	+1	+2	+3	+4	+5	+6	+7
0x00 (array index 1)→								
0x08								
0x10								
0x18 (array index 2) →								
0x20								
0x28								

Memory Address	+0	+1	+2	+3	+4	+5	+6	+7
0x00 (array index 1)→	a							
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Memory Address	+0	+1	+2	+3	+4	+5	+6	+7
0x00 (array index 1)→	a				b[0]			
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Repeat the process…

Memory Address	+0	+1	+2	+3	+4	+5	+6	+7
0x00 (array index 1)→	a				b[0]	b[1]	b[2]	
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Structs

What is the total size of this struct?

24 bytes, (17 bytes plus 7 byte of internal padding)

Would re-ordering the fields from largest to smallest reduce the size of the struct?

No external fragmentation would still keep the size the same (however remember that you should always order from largest to smallest because it helps more often than not)

What would be the assembly code for getting the value of field d out of the struct? Assume that the register %rdi points to the beginning of the struct. Return the value in register %rax.

```
movq 0x10(%rdi), %rax
ret
```

Structs

```
typedef struct data_struct {
 void * a;
 int b;
 short c;
 char d[3];
} reordered_data_struct;
```