Executables & Arrays

CSE 351 Autumn 2023

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My gf. told me that I care about programming more than about her.
I told her that in array of my interests she is [1] - she was satisfied 🙂😇

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Relevant Course Information

- Lab 2 & HW12 due Friday (10/27)
- HW13 due *next* Wednesday (11/1)
  - Covers Lessons 13 and 14; longer than normal

- Midterm (take home, 11/2-11/4)
  - Make notes and use the midterm reference sheet
  - Form study groups and look at past exams!
  - Mix of computational questions and open-ended short answer questions
  - Midterm review problems in section next week
  - Individual, but can discuss via "Gilligan's Island Rule"

Executables & Arrays

Lesson Summary (1/2)

- Building an executable
  - Multistep process: compiling, assembling, linking
  - Object code finished by linker using symbol and relocation tables to produce machine code (with finalized addresses)
  - Loader sets up initial memory from executable
- Arrays
  - Contiguous allocations of memory
  - No bounds checking (and no default initialization)
  - Can usually be treated like a pointer to first element
  - Multidimensional → array of arrays in one contiguous block
  - Multilevel → array of pointers to separate arrays

Lesson Summary (2/2)

- Terminology:
  - Compiler, assembler, linker, loader, symbol table, relocation table, disassembly
  - Multidimensional arrays, row-major ordering, multilevel arrays

- Learning Objectives:
  - Describe the key components of the CALL process.
  - Use `gcc` and `objdump` to extract information from each phase of CALL.
  - Analyze the memory allocations and accesses for arrays.

- What lingering questions do you have from the lesson?

Executables & Arrays – Context

Mid-Quarter Course Assessment

- No context today! Time allocated for ET&L Mid-Quarter Course Assessment.

Executables & Arrays – Practice

Group Work Time

- During this time, you are encouraged to work on the following:
  1) If desired, continue your discussion
  2) Work on the lesson problems (solutions at the end of class)
  3) Work on the homework problems

- Resources:
  - You can revisit the lesson material
  - Work together in groups and help each other out
  - Course staff will circle around to provide support

Practice Questions (1/2)

- Use the following disassembly:

```
0000000000401126 <main>:
  401126:   48 83 ec 08  little-endian sub     $0x8,%rsp
            2a 2b
  40112a:   bf 10 20 40 00              mov     $0x402010,%edi
  40112f:   e8 fc fe ff ff              callq   401030 <puts@plt>
  401134:   b8 00 00 00 00              mov     $0x0,%eax
            39 3a 3b
  401139:   48 83 c4 08                 add     $0x8,%rsp
  40113d:   c3                          retq
  40113e:   66 90                       xchg    %ax,%ax
```

  - What is the byte of data at address **0x40113b**?

    0x c4

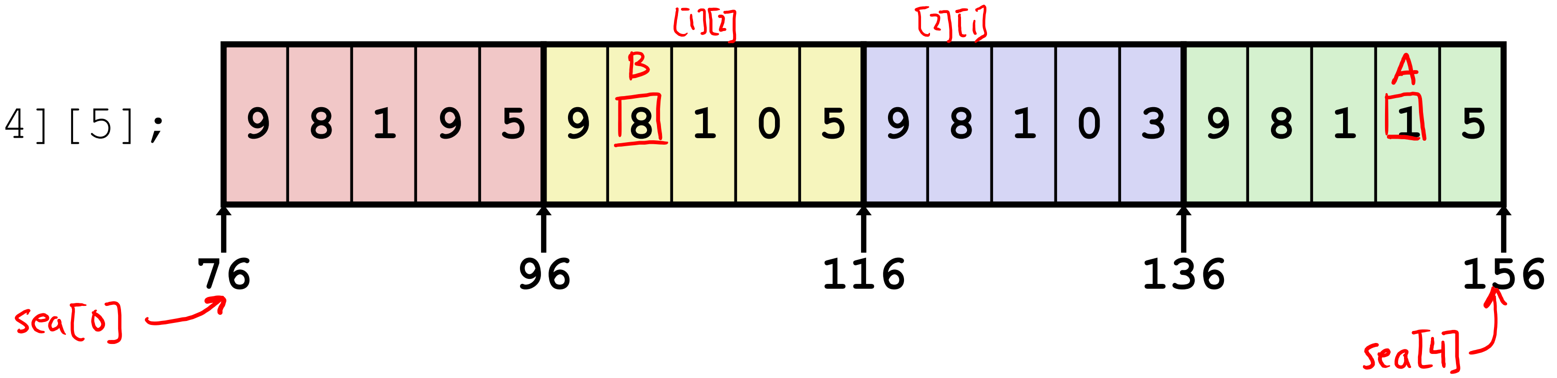
  - The immediate $0x402010 can be found in the machine code! **What is its address?**

    0x 40112b

Practice Questions (2/2)

- Which of the following statements is FALSE?

`int sea[4][5];`



A. sea[4][-2] is a *valid* array reference Yes, returns 1

B. sea[1][1] makes *two* memory accesses No, only single memory access

C. sea[2][1] will *always* be a higher address than sea[1][2] Yes, because C is row-major

D. sea[2] is calculated using *only* lea Yes, sea[2] returns address of array row