

Executables & Arrays

CSE 351 Autumn 2023

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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”

A detailed, colorful micrograph of a microchip die, showing a complex grid of circuitry and various colored regions. The text "Executables & Arrays" is overlaid in the center.

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?

A detailed, colorful microchip (die) image serves as the background for the title. The chip is densely packed with various colored regions (purple, blue, yellow, green, red) representing different functional blocks and interconnects.

Executables & Arrays – Context

Mid-Quarter Course Assessment

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

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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)

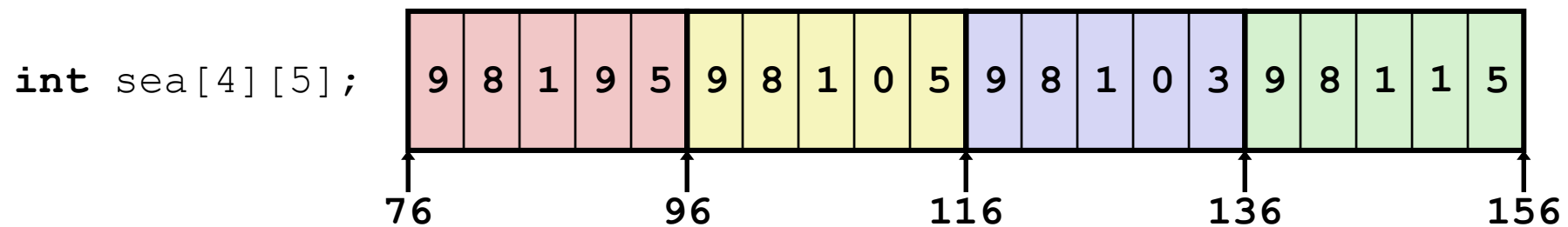
❖ Use the following disassembly:

```
0000000000401126 <main>:
 401126: 48 83 ec 08          sub    $0x8,%rsp
 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
 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**?
- The immediate **\$0x402010** can be found in the machine code! **What is its address?**

Practice Questions (2/2)

- ❖ Which of the following statements is FALSE?



- A. `sea[4][-2]` is a *valid* array reference
- B. `sea[1][1]` makes *two* memory accesses
- C. `sea[2][1]` will *always* be a higher address than `sea[1][2]`
- D. `sea[2]` is calculated using *only* `lea`