

Executables & Arrays

CSE 351 Winter 2024

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Relevant Course Information

- ❖ Lab 2 & HW11 due Friday (2/2)
- ❖ HW12 due Monday (2/5)

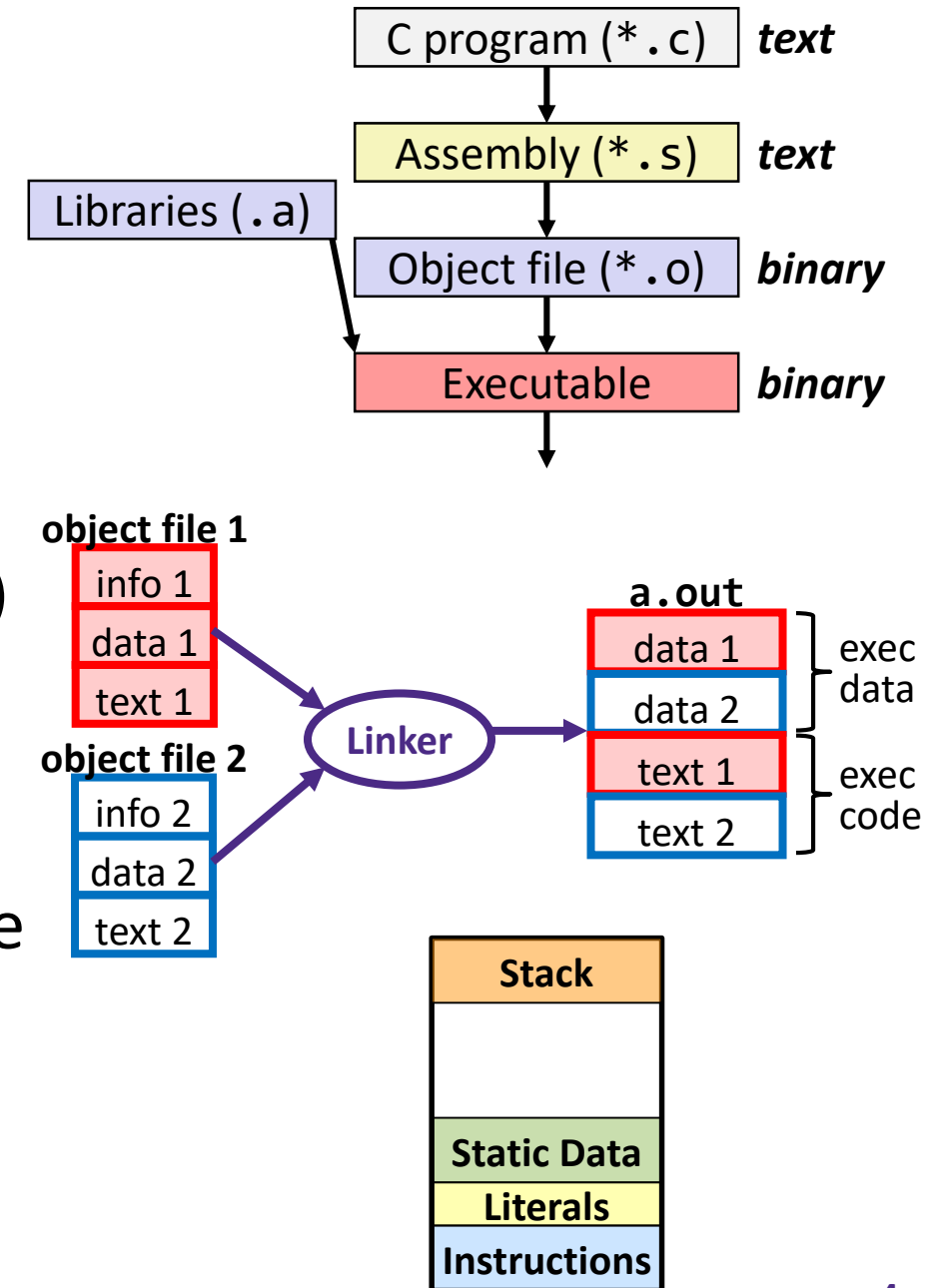
- ❖ Midterm (take home, 2/8-10)
 - Make notes and use the [midterm reference sheet](#)
 - Form study groups and look at past exams!
 - Mix of computational questions and open-ended short answer questions
 - Midterm review problems in section next week
 - Individual, but can discuss via “Gilligan’s Island 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
 - Compiling uses specified optimizations to generate assembly code
 - Assembling produces object code in object files
 - Linking stitches together executable (machine code) using symbol and relocation tables to produce finalized addresses
- ❖ Loader sets up initial memory from executable
- ❖ A disassembler read object or machine code and tries to interpret the bytes as assembly



Lesson Summary (2/2)

❖ Arrays

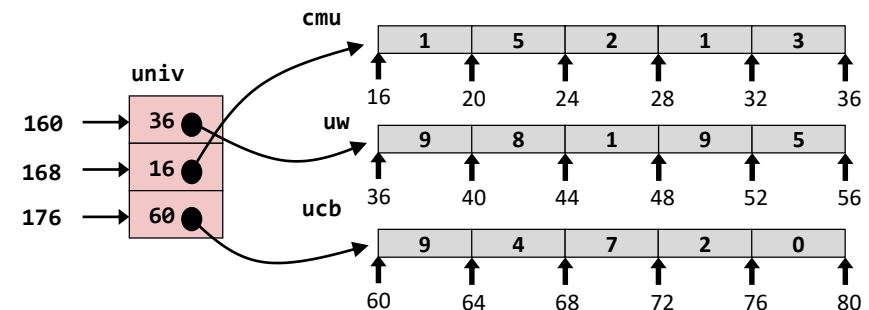
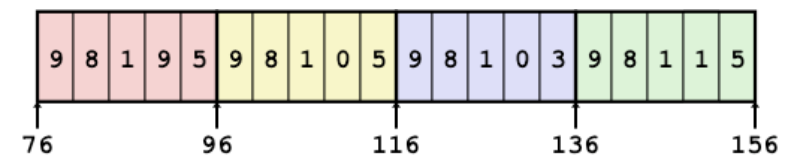
- One array declaration = one contiguous chunk of memory
- **No bounds checking** (and no default initialization)
 - Accessed in assembly via (Rb, Ri, S) or $D(, Ri, S)$
- *Array names* are not variables, but expressions that return the address of the array
 - Passing an array to a procedure really passes a pointer

■ Multidimensional arrays

- Array of arrays in one contiguous block
- $\text{Mem}[\text{sea} + 20 * r + 4 * c]$

■ Multilevel arrays

- Array of pointers to separate arrays
- $\text{Mem}[\text{Mem}[\text{univ} + 8 * r] + 4 * c]$



Lesson Q&A

- ❖ 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?
 - Chat with your neighbors about the lesson for a few minutes to come up with questions

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 – Practice

Polling Questions (1/2)

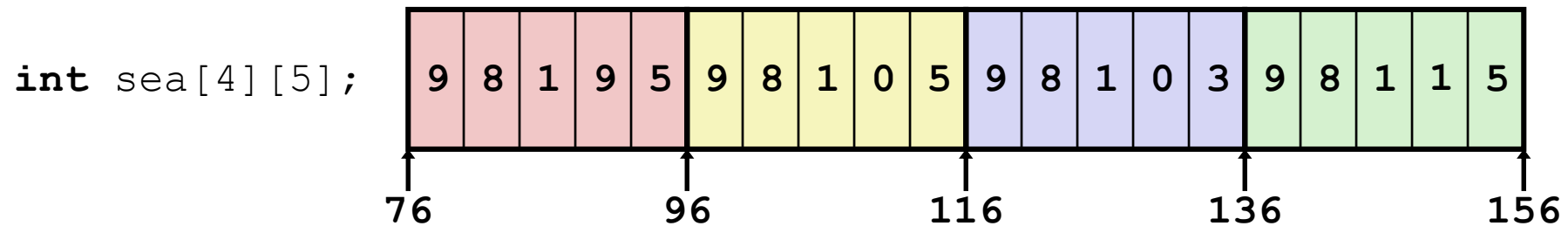
❖ Use the following disassembly:

```
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?**

Polling 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`

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Executables & Arrays – Context

Mid-Quarter Survey

- ❖ No context today!

Please take this time to fill out the mid-quarter survey:

<https://canvas.uw.edu/courses/1695950/quizzes/1956436>

Group Work Time

- ❖ During this time, you are encouraged to work on the following:
 - 1) If desired, continue your discussion
 - 2) Work on the homework problems
 - 3) Work on the lab (if applicable)

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