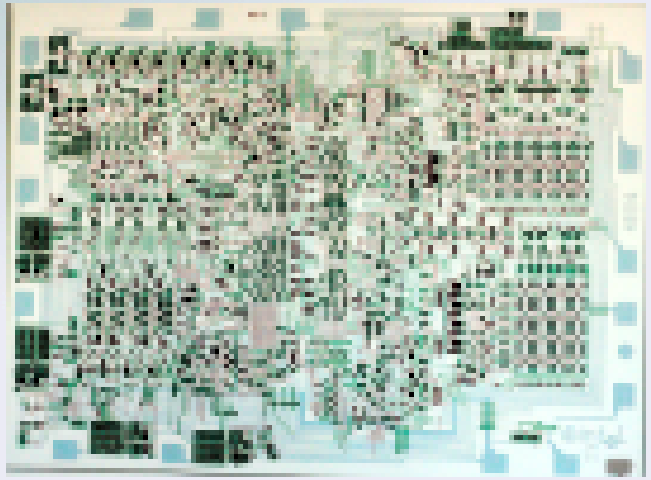

Lecture 7a: Programming the LC-3 in Assembly Language

CSIS11: **Computer Architectures and Organization**

Readings

- *Chapter 5* Patt and Patel: Introduction to Computing Systems...
- *Guide to Using LC-3 Tools* - *handout*
- *Appendix A* Patt and Patel: Introduction to Computing Systems... - *handout*
- C to LC-3 Excellent source for comparing *C* to *LC-3* syntax

Homework and Examples, we will be using GitHub

1. Go to *lkoepsel/CSIS11_Instructor* on *Github*
2. Follow the *setup.md* instructions

To Date:

- LC-3 Assembly Language Syntax - Instructions, Directives, Comments
- Instructions - Label, Opcode, Operand, Comment
- Directives - .ORIG , .END . .BLKW , .FILL , .STRINGZ
- **Trap Codes** - HALT, *more to come*
- Data - variables, constants, *all* 2's complement
- Control flow - Sequential, Conditional, Iterative
- **Branches** - BRz, BRn, BRp, *more to come*

Trap Codes for Input/Output (I/O)

- The opcode *TRAP* n, carries special meaning to the LC-3, *TRAP x25*, means halt execution

Code	Equivalent	Description
HALT	TRAP x25	Halt execution and print message to console, **required**
IN	TRAP x23	**Print prompt on console, read (and echo) one character from keybd. Character stored in R0[7:0].**
OUT	TRAP x21	**Write one character (in R0[7:0]) to console.**
GETC	TRAP x20	Read one character from keyboard. Character stored in R0[7:0].
PUTS	TRAP x22	**Write null-terminated string to console. Address of string is in R0.**

LC-3 Condition Codes (All of them)

- Each time one of the eight registers is written to, a flag will be set, based on the result of the operation

Result	*Z*	*P*	*N*	BR command
= 0	set	cleared	cleared	BRz
< 0	cleared	cleared	set	BRn
> 0	cleared	set	cleared	BRp
!= 0	cleared	set	set	BRnp
>= 0	set	cleared	set	BRzp
<= 0	set	set	cleared	BRnp
always	n/a	n/a	n/a	BRnzp

Code Review of trap_branch.asm