

# Lecture 6:

## Simple Conditional Branches

# Today's Goals

- Understand the function of the Condition Code Register and how the bits are set.
- Use simple conditional branches to control the flow of programs.

# Making Decisions

- We've learned unconditional branch (BRA) already.
- Conditional branches
  - Programs often need to decide which portion will be executed based on conditions.
- In microcontrollers, two steps are required to make decisions
  - 1. Evaluating a Boolean statement and generate a true or false result.
  - 2. Using a conditional branch that uses the Boolean result as a condition.
    - If the result is true, the branch changes the PC.
    - Otherwise the PC remains and continues on the next sequential instruction.

# Condition Code Register (CCR)



- One byte register that stores the results of the Boolean statements used for branching.
- Once some of these bits have been set, the conditional branches are used to inspect them.
- How the CCR bits are set?
  - Arithmetic instructions (addition and subtraction) affect the N, Z, V, C and H bits.
  - Data transfer instructions affect N, Z, and C bits.
  - Branches don't affect any CCR bits.
  - The instruction set details the effect of each instruction on all of the CCR bits.

Symbol	Operation
–	Unaffected
1	Always “set” to 1
0	Always “cleared” to 0
↑ or Δ	Set or cleared based on result

# Simple Conditional Branches

- Simple conditional branches examine only one CCR bit.
- There are two instructions for each of the N, Z, V, and C bits

CCR Bit	Branch Taken if Bit is 1	Branch Taken if Bit is 0
N	BMI	BPL
Z	BEQ	BNE
V	BVS	BVC
C	BCS	BCC

Example

```
LDAA  #0
BEQ   LABEL_M
do something
LABEL_M: do something else
```

# Simple Conditional Branches

## Example

- Code that executes a loop 3 times

1: 86 03	LDAA	#03	(\$2000)
2: 27 04	BEQ	\$04	(\$2002)
3: 80 01	SUBA	#1	(\$2004)
4: 20 FA	BRA	-6	(\$2006)
5: 3F	SWI		(\$2008)

# Simple Conditional Branches

## Program Trace

1: 86 03    LDAA #03    (\$2000)  
2: 27 04    BEQ  \$04    (\$2002)  
3: 80 01    SUBA #1    (\$2004)  
4: 20 FA    BRA  -6    (\$2006)  
5: 3F       SWI       (\$2008)

Trace Line	Code Line	PC	A	N	Z	V	C
1	1	2002	03	0	0	0	-
2	2	2004	03	0	0	0	-
3	3	2006	02	0	0	0	0
4	4	2002	02	0	0	0	0
5	2	2004	02	0	0	0	0
6	3	2006	01	0	0	0	0
7	4	2002	01	0	0	0	0
8	2	2004	01	0	0	0	0
9	3	2006	00	0	1	0	0
10	4	2002	00	0	1	0	0
11	2	<u>2008</u>	00	0	1	0	0
12	5	-	-	-	-	-	-

Questions?



# Wrap-up

## What we've learned

- Bits in the Condition Code Register (CCR)
- Simple conditional branches:
  - BMI, BPL, BEQ, BNE, BVS, BVC, BCS, BCC

# What to Come

- Comparison branches