

University of Illinois at Urbana-Champaign  
Dept. of Electrical and Computer Engineering

## ECE 220: Computer Systems & Programming

### Code Reuse: Subroutines

## Want to Reuse Code, Not Rewrite Code

Problem when writing software:

- need to **solve** a task **more than once**,
- **but** want to **write** the code **exactly once!**

LC-3 examples:

- multiplication, division, exponentiation
- reading numbers or strings from the keyboard
- printing decimal or hexadecimal numbers to the display

## An Example with Many Opportunities

A more detailed example:

- Human types in a value N followed by integral coefficients of  $F(x)$ , a degree N polynomial in x.
- Starting near  $x=0$ , and going in both directions until  $F(x)$  overflows a 16-bit 2's complement representation, find the integral values of x surrounding any roots in the polynomial in the specified region.

**Now: how many times did you want to write multiplication?**

## Letter Frequency Example Reused, but Converged

The letter frequency example reused code to increment bins:

- one block of code for the non-alpha bin (used for three separate regions of ASCII),
- and one block of code for the alpha bins (used for both upper- and lower-case letters).

But **in all cases, control flow converged** to **GET\_NEXT**.

```
NON_ALPHA
LDR R6,R0,#0
ADD R6,R6,#1
STR R6,R0,#0
BRnzp GET_NEXT
```

```
ALPHA
ADD R2,R2,R0
LDR R6,R2,#0
ADD R6,R6,#1
STR R6,R2,#0
BRnzp GET_NEXT
```