

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

ECE 120: Introduction to Computing

Letter Frequency Decomposition

Let's Decompose the Problem

The task:

- given an **ASCII** string (terminated by **NUL**)
- count the occurrences of each letter (regardless of case), and
- the number of non-alphabetic characters.

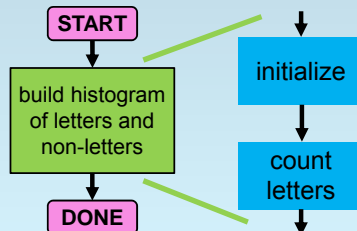
The high-level approach:

initialize histogram to all 0s
for each character in the string
increment the appropriate histogram bin

The First Step: Break the Task into a Sequence of Two

The first decomposition step is clear from the high-level approach.

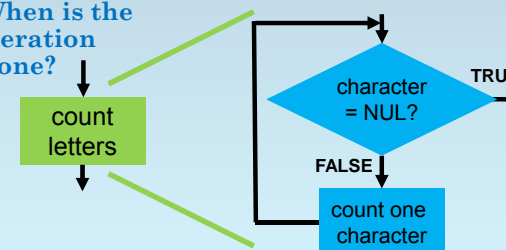
We break our task into a sequence of two subtasks.



The Second Step: Count by Iterating Over Characters

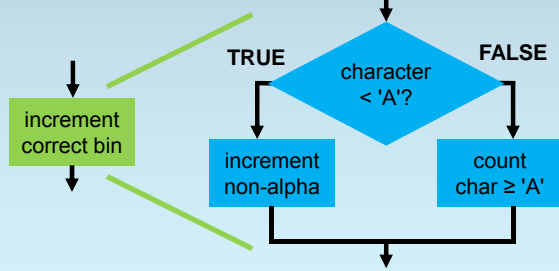
Next, break down counting into an iteration.

When is the iteration done?

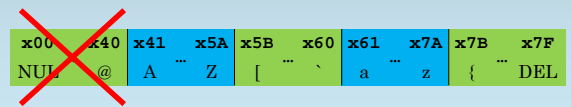


Start by Breaking Off the Left Region

Let's start with the left region.



Continue by Breaking Off Capital Letters



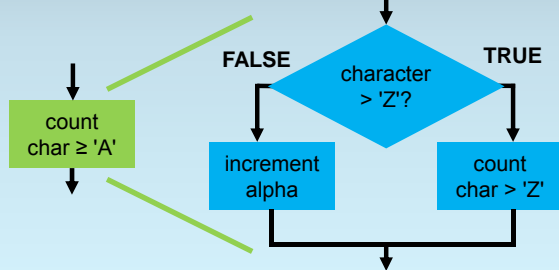
We know that the character is not below 'A.'

What's left?

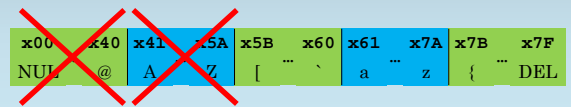
Let's **handle capital letters next.**

Break Off Capital Letters with a Second Condition

Now check for capital letters.



Continue with Characters in the Middle Region



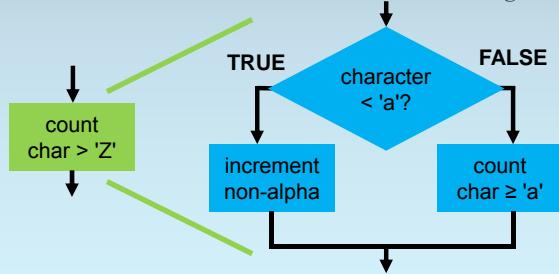
We know that the character is at least '['.

What's left?

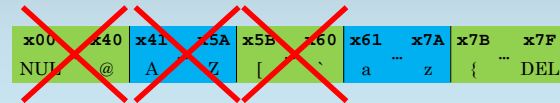
Let's **handle the middle region next.**

Use a Third Condition to Handle the Middle Region

Now check for characters in the middle region.



Continue with Characters in the Middle Region



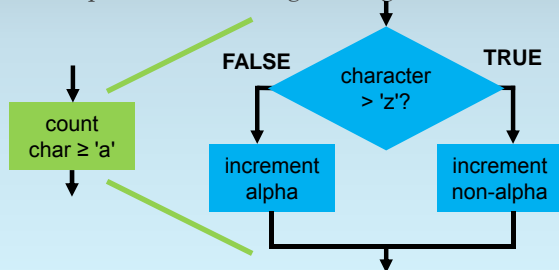
We know that the character is not below 'a.'

What's left?

We just need to **split the two regions**.

Use a Fourth Condition to Split the Last Two Regions

Now split the remaining two regions.



Initialization is a Sequence

What about initialization?

We need to do three things:

- **fill the histogram** with 0s,
- **load any useful values** (such as **ASCII** characters to check the region boundaries).
- and **point to the start of the string**.

Filling the Histogram: a Sequence and an Iteration

How do we fill the histogram?

We have 27 bins (26 letters + 1 non-alpha).

We should use an **iteration**.

But again, we need a pointer to the histogram.

So:

- point a register to the histogram,
- then iterate over all bins.

The Final Flow Chart

