

**A computer only  
understands its own  
machine language.**



WHEN I STARTED  
PROGRAMMING, WE DIDN'T  
HAVE ANY OF THESE  
SISSY "ICONS" AND  
"WINDOWS."



ALL WE HAD WERE ZEROS  
AND ONES -- AND  
SOMETIMES WE DIDN'T  
EVEN HAVE ONES.



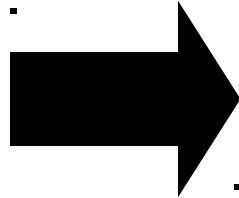
I WROTE AN  
ENTIRE  
DATABASE  
PROGRAM  
USING ONLY  
ZEROS.

YOU HAD  
ZEROS? WE  
HAD TO USE  
THE LETTER  
"0."

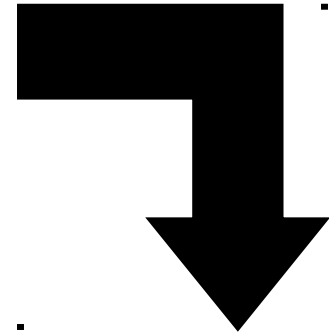




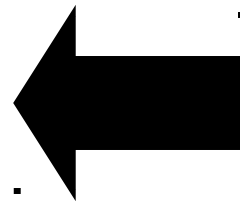
Program that a human being understands



Program written in Language X

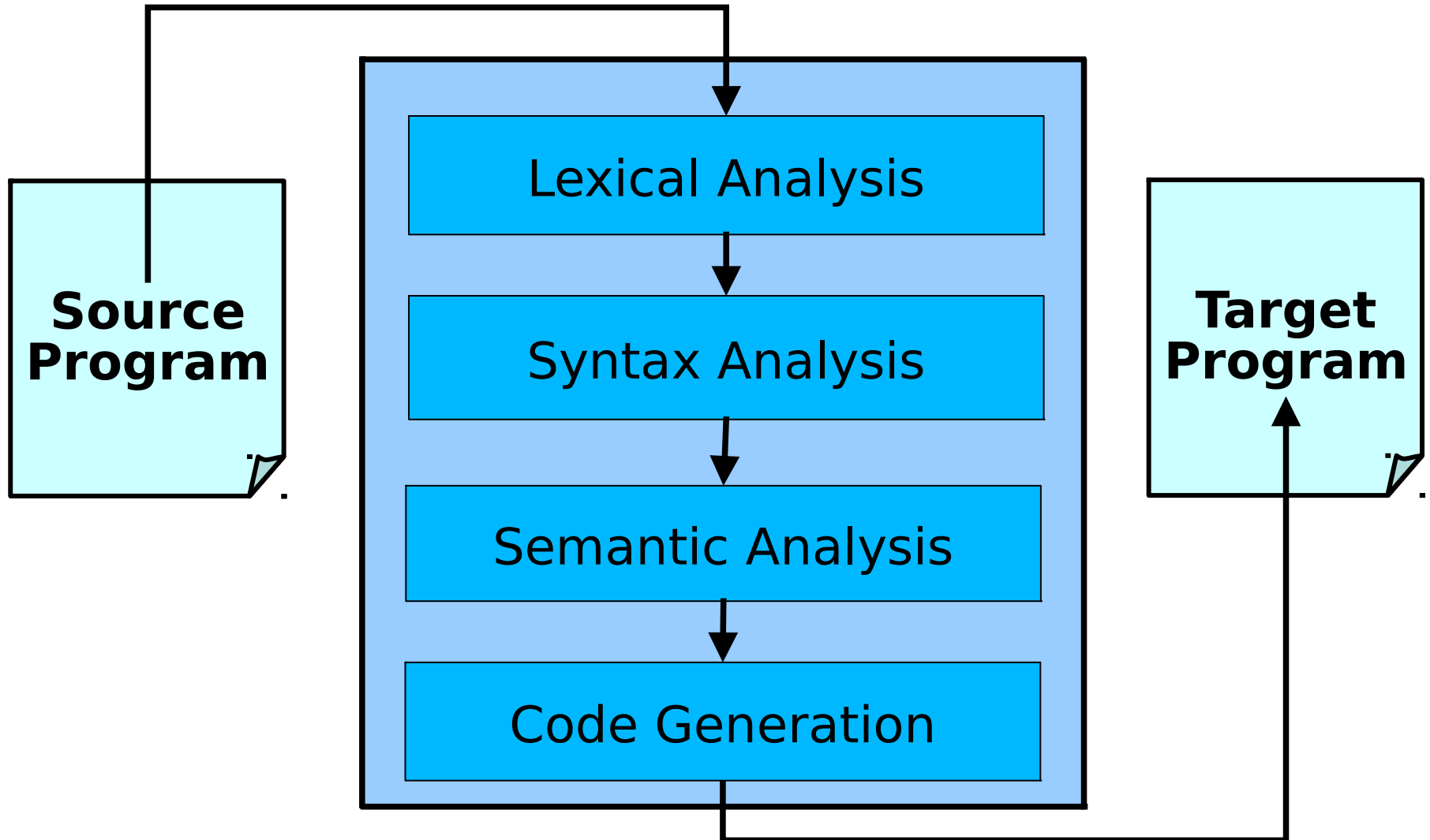


Program that a computer understands

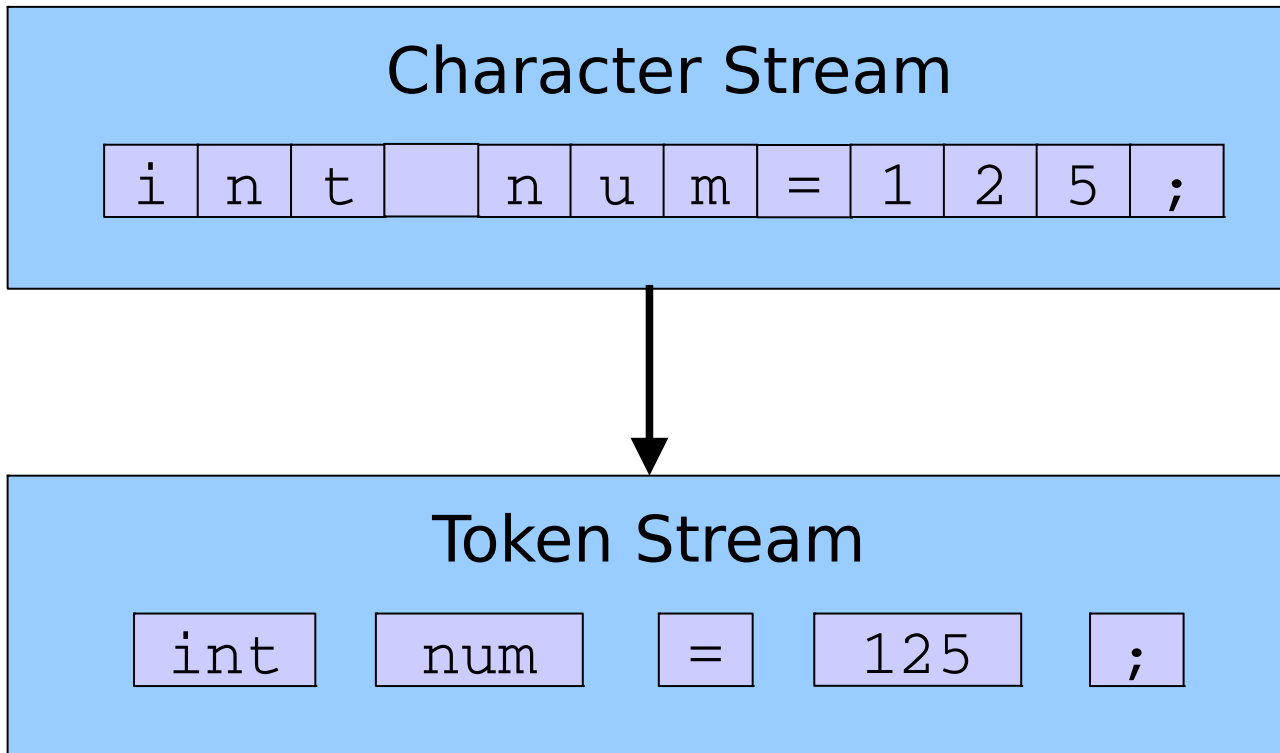


Translator for Language X

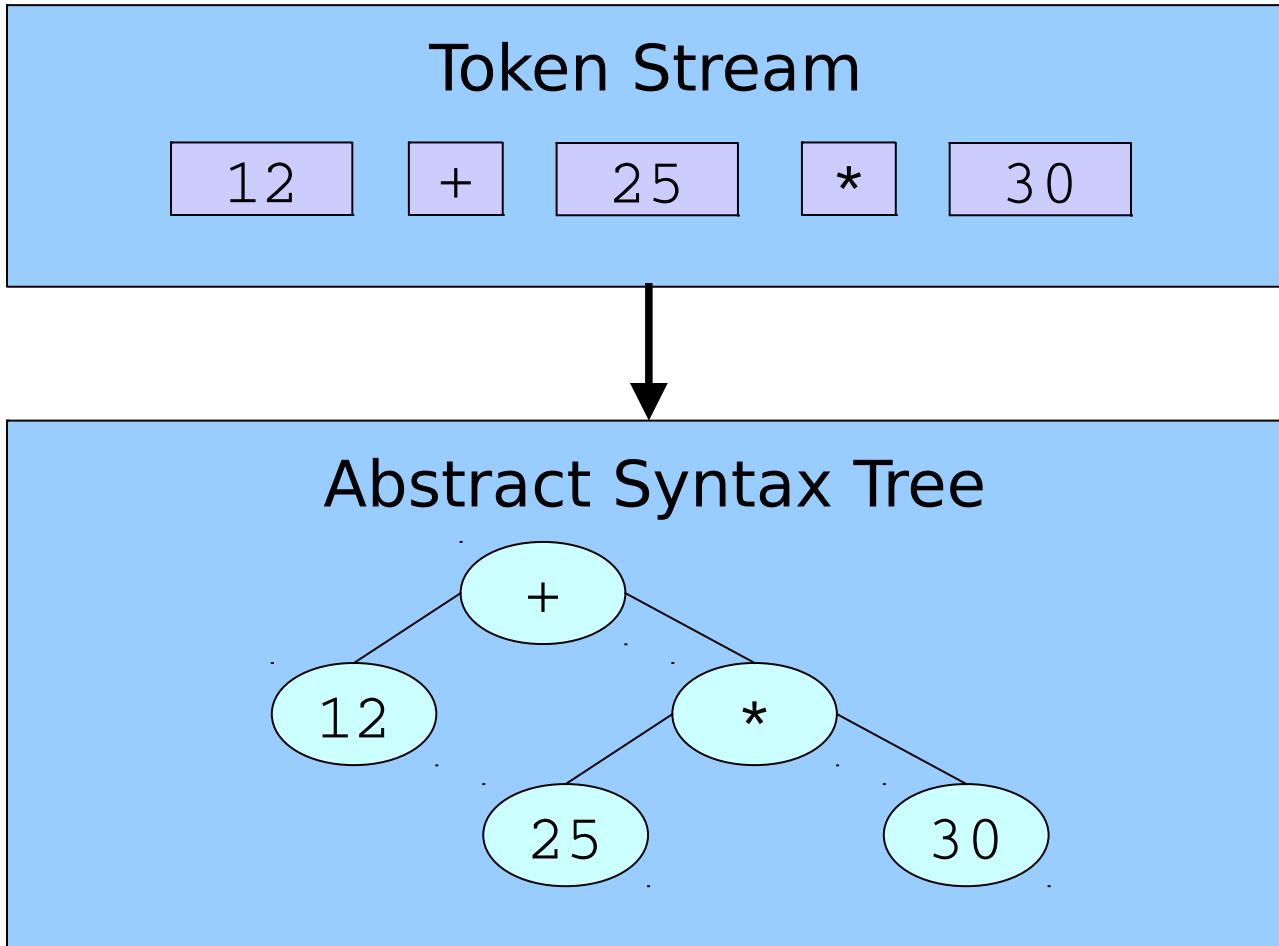
# Translation Phases



# Lexical Analysis



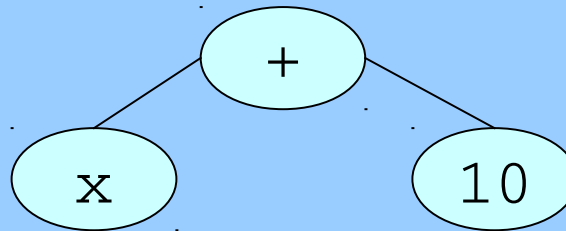
# Syntax Analysis





# Semantic Analysis

Abstract Syntax Tree

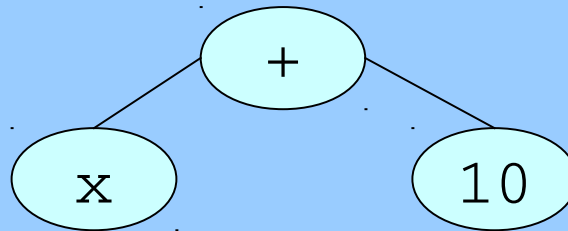


**Check that:**

- *Variable "x" has been declared.*
- *The type of the operands and the + operator should be numeric.*

# Code Generation

Abstract Syntax Tree



Target Code

```
mov eax, [x]
add eax, 10
```