AD

AD-E403 691

Technical Report ARWSE-TR-14028

PREFIX VERSUS POSTFIX IN C++

Tom Nealis

October 2015

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Weapons and Software Engineering Center

Picatinny Arsenal, New Jersey

UNCLASSIFIED

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-01-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (*From - To*)
October 2015	Final	

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
PREFIX VERSUS POSTFIX IN C++	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHORS	5d. PROJECT NUMBER
Tom Nealis	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army ARDEC, WSEC Fire Control Systems & Technology Directorate (RDAR-WSF-M) Picatinny Arsenal, NJ 07806-5000	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
U.S. Army ARDEC, ESIC Knowledge & Process Management (RDAR-EIK) Picatinny Arsenal, NJ 07806-5000	11. SPONSOR/MONITOR'S REPORT NUMBER(S) Technical Report ARWSE-TR-14028

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Many coders today do not take the time to consider the implications of the code they write. Not all code is created equal, and something as seemingly harmless as incrementing or decrementing via prefix instead of a postfix notation can have a considerable effect on performance. Modern day compilers can and do optimize certain common instances of code involving this notation, but it should not be relied upon in a well-developed and maintained code base.

15. SUBJECT TERMS

Prefix increment Prefix decrement Postfix increment Postfix decrement

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Tom Nealis
U	U	U	SAR	9	19b. TELEPHONE NUMBER (Include area code) (973) 724-8048

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

CONTENTS

INTRODUCTION

Compilers today have become very good at optimizing code that has not been written in the most efficient manner possible. Many coders often take this for granted and do not spend time concerning themselves with the performance of their code and mistakenly rely on compilers to detect and correct inefficiencies. One simple example of why coders should pay attention and not rely on compilers to do the thinking for them is when to use prefix or postfix in their code.

Most coders coming out of school today all know the basic difference between these two lines of code:

```
function(++variable);
function(variable++);
```

The basic difference is that the first function call will be sent an incremented variable, whereas the second one will receive the current value of the variable and then the variable will be incremented upon return from the function. So, many coders will be comfortable with that knowledge but not think there is any difference between the next two lines of code:

```
variable++;
++variable;
```

In the end, both of these lines of code will increment the variable, but the concern is how.

METHODOLOGY

In order to understand the difference between these two notations, what is produced by the complier must be discussed. Without optimization, the compiler must create a copy in order to accomplish a postfix increment or decrement. The prefix does not require this and is, therefore, more efficient. Most modern compilers can detect and optimize the simple cases like the cases involving basic built-in types. This should not be relied upon and it should be a habit to always use prefix unless specifically needed to postfix. Take for example the following code:

```
for(int i = 0; i < SomeNum; i++) { doAnything; }
```

Most college professors and books will show loops written in this way. So, coders that have seen loops mostly written in this way will continue to write them in the same fashion. It is not necessary to postfix increment for this loop. Even though most compilers will optimize this properly in most cases, this should always be written for loop:

```
for(int i = 0; i < SomeNum; ++i) { doAnything; }
```

So let's take a look at some assembly. Modern compilers will produce the following after they optimize this code:

```
//prefix built in type
; 21   :   for(auto i = 0u; i < 10000; ++i)
mov         DWORD PTR _i$1[ebp], 0
jmp         SHORT $LN3@wmain
mov         eax, DWORD PTR _i$1[ebp]
add         eax, 1
mov         DWORD PTR _i$1[ebp], eax
cmp         DWORD PTR _i$1[ebp], 10000; 00002710H
jae         SHORT $LN1@wmain
```

```
; 22   :;
jmp         SHORT $LN2@wmain



//postfix built in type
; 21   :   for(auto i = 0u; i < 10000; i++)
mov         DWORD PTR _i$1[ebp], 0
jmp         SHORT $LN3@wmain
mov         eax, DWORD PTR _i$1[ebp]
add         eax, 1
mov         DWORD PTR _i$1[ebp], eax
cmp         DWORD PTR _i$1[ebp], 10000; 00002710H
jae         SHORT $LN1@wmain
; 22   :;
jmp         SHORT $LN2@wmain
```

As one can see, the optimized code is exactly the same. The following loops are an example of code that is a little trickier for the compiler to optimize:

```
auto& it = my_ints.begin();
while(it != my_ints.end())
 it++;

auto& it = my_ints.begin();
while(it != my_ints.end())
 ++it;
```

The variable 'it' is a vector iterator. The prefix and postfix increment line of code produces the following assembly code:

```
//iterator prefix
00F755E2  mov       ecx, dword ptr[it]
00F755E5  call      std::_Vector_iterator<std::_Vector_val<std::_Simple_types<unsigned int> > >::operator++ (0F711F9h)
00F755EA  jmp       wmain + 0EEh (0F7558Eh)

//iterator postfix
002E5A12  push      0
002E5A14  lea       eax, [ebp - 17Ch]
002E5A1A  push      eax
002E5A1B  mov       ecx, dword ptr[it]
002E5A1E  call      std::_Vector_iterator<std::_Vector_val<std::_Simple_types<unsigned int> > >::operator++ (02E10FFh)
002E5A23  lea       ecx, [ebp - 17Ch]
002E5A29  call      std::_Vector_iterator<std::_Vector_val<std::_Simple_types<unsigned int> >
>::~_Vector_iterator<std::_Vector_val<std::_Simple_types<unsigned int> > >(02E119Ah)
002E5A2E  jmp       wmain + 0EEh (02E59BEh)
```

As one can clearly see, the compiler was unable to optimize the postfix. It had to create the copy. Figure 1 displays how long it takes to run through the previous code for a certain number of iterations.

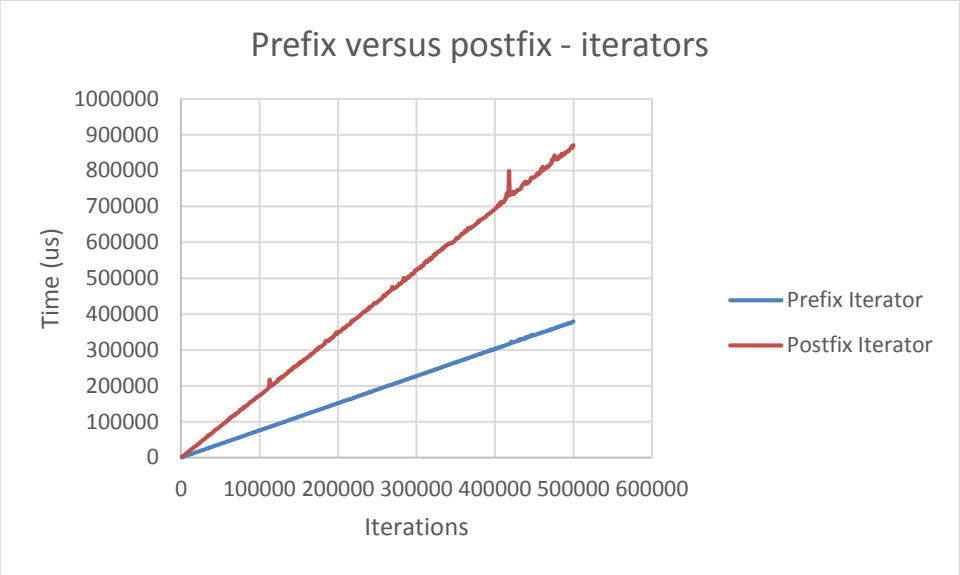

Figure 1
Prefix versus postfix - iterators

CONCLUSIONS

The C++ coders need to take the time to understand implications of the code that they create. Some of the most benign looking code can have a significant impact on the performance of a piece of software that can, in turn, affect the device/system that is running it. An easily addressable example of this is the prefix and postfix notation. A coder should always use prefix notation unless they have to use postfix.

DISTRIBUTION LIST

U.S. Army ARDEC
ATTN: RDAR-EIK
RDAR-WSF-M, T. Nealis
Picatinny Arsenal, NJ 07806-5000

Defense Technical Information Center (DTIC)
ATTN: Accessions Division
8725 John J. Kingman Road, Ste 0944
Fort Belvoir, VA 22060-6218

GIDEP Operations Center
P.O. Box 8000
Corona, CA 91718-8000
gidep@gidep.org

REVIEW AND APPROVAL OF ARDEC TECHNICAL REPORTS

Prefix Vs. Postfix in C++
Title

Date received by LCSD

Thomas M. Nealis
Author/Project Engineer

Report number (to be assigned by LCSD)

X8048 31 RDAR-WSF-M

Extension Building Author's/Project Engineers Office (Division, Laboratory, Symbol)

PART 1. **Must be signed before the report can be edited.**

a. The draft copy of this report has been reviewed for technical accuracy and is approved for editing.

b. Use Distribution Statement A_X___, B__, C___, D____, E____, F____ or X____ for the reason checked on the continuation of this form. Reason: ____Operational Use_____

1. If Statement A is selected, the report will be released to the National Technical Information Service (NTIS) for sale to the general public. Only unclassified reports whose distribution is not limited or controlled in any way are released to NTIS.

2. If Statement B, C, D, E, F, or X is selected, the report will be released to the Defense Technical Information Center (DTIC) which will limit distribution according to the conditions indicated in the statement.

c. The distribution list for this report has been reviewed for accuracy and completeness.

Patricia Alameda 9/9/15
Division Chief (Date)

PART 2. To be signed either when draft report is submitted or after review of reproduction copy.

This report is approved for publication.

Patricia Alameda 9/9/15
Division Chief (Date)

Andrew Pskowski 10/16/15
RDAR-CIS (Date)

LCSD 49 supersedes SMCAR Form 49, 20 Dec 06