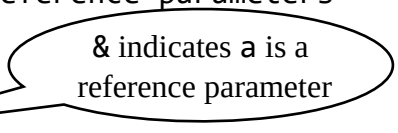
14 Reference Parameters and Variables in C++

Reference Parameters

```
 1 // ex1401.cpp  C++ reference parameters
 2 #include <iostream>
 3 using namespace std;
 4 int x = 5;
 5 void f(int &a)
 6 {
 7    a = a + 1;      // adds 1 to x
 8 }
 9 //===================
10 int main()
11 {
12    cout << x << endl;
13    f(x);
14    cout << x << endl;
15    return 0;
16 }
```

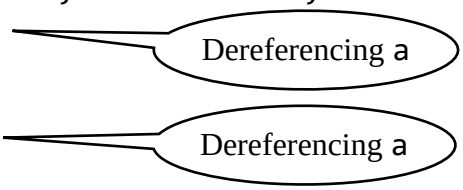


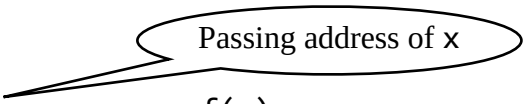
Pass by Address

```
 1 // ex1402.cpp  Explicitly passing and dereferencing addresses
 2 #include <iostream>
 3 using namespace std;
 4 int x = 5;
 5 void f(int *a)
 6 {
 7    *a = *a + 1;    // adds 1 to x
 8 }
 9 //====================
10 int main()
11 {
12    cout << x << endl;
13    f(&x);
14    cout << x << endl;
15    return 0;
16 }
```

Using Reference Parameter

```
 1 ; ex1401.a  C++ reference parameters
 2 startup:  bl main
 3           halt
 4 ;============================================================
 5                             ; #include <iostream>
 6                             ; using namespace std;
 7 x:        .word 5           ; int x = 5;
 8
 9 @f$ri:    push lr           ; void f(int &a)
10           push fp           ; {
11           mov fp, sp
12
13           ldr r0, fp, 2     ;    a = a + 1;
14           ldr r0, r0, 0
15           add r0, r0, 1
16           ldr r1, fp, 2
17           str r0, r1, 0
18
19           mov sp, fp        ; }
20           pop fp
21           pop lr
22           ret
23 ;============================================================
24 main:     push lr           ; int main()
25           push fp           ; {
26           mov fp, sp
27
28           ld r0, x          ;    cout << x << endl;
29           dout
30           nl
31
32           lea r0, x         ;    f(x);
33           push r0
34           bl @f$ri
35           add sp, sp, 1
36
37           ld r0, x          ;    cout << x << endl;
38           dout
39           nl
40
41           mov r0, 0         ;    return 0;
42           mov sp, fp
43           pop fp
44           pop lr
45           ret
46                             ; }
```



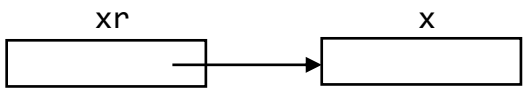


Reference Variables

A *reference variable* is a variable that is an *alias* (i.e., an alternate name) for another variable.

```
int &xr = x;
xr = 5;      // xr alias for x so 5 is assigned to x
```

A reference variable is just a pointer variable that points to the variable for which it is an alias. Thus, the declaration above creates `xr` pointing to `x`:



A reference variable is not like a regular pointer variable in three respects:

1. Once created, it cannot be modified. In other words, it is a constant pointer.
2. Wherever a reference variable is used, the compiler automatically generates code that dereferences it. In contrast, a regular pointer is dereferenced only if it is preceded by an asterisk.
3. A reference variable can never have the value NULL.

Reference Variable Example

```
 1 ; ex1402.a  C++ reference variables
 2 startup:  bl main
 3           halt
 4 ;===============================================================
 5                             ; #include <iostream>
 6                             ; using namespace std;
 7 x:        .word 5           ; int x = 5;
 8 xr:       .word x           ; int &xr = x;
 9
10 main:     push lr           ; int main()
11           push fp           ; {
12           mov fp, sp
13
14           mov r0, 7         ;    int y = 7;
15           push r0
16           add r0, fp, -1    ;    int &yr = y;
17           push r0
18
19           ld r0, x          ;    cout << x << endl;
20           dout
21           nl
22
23           ld r0, xr         ;    cout << xr << endl;
24           ldr r0, r0, 0
25           dout                          Dereferencing xr
26           nl
27
28           ldr r0, fp, -1    ;    cout << y << endl;
29           dout
30           nl
31
32           ldr r0, fp, -2    ;    cout << yr << endl;
33           ldr r0, r0, 0
34           dout                          Dereferencing yr
35           nl
36
37           mov r0, 0         ;    return 0;
38           mov sp, fp
39           pop fp
40           pop lr
41           ret
42                             ; }
```