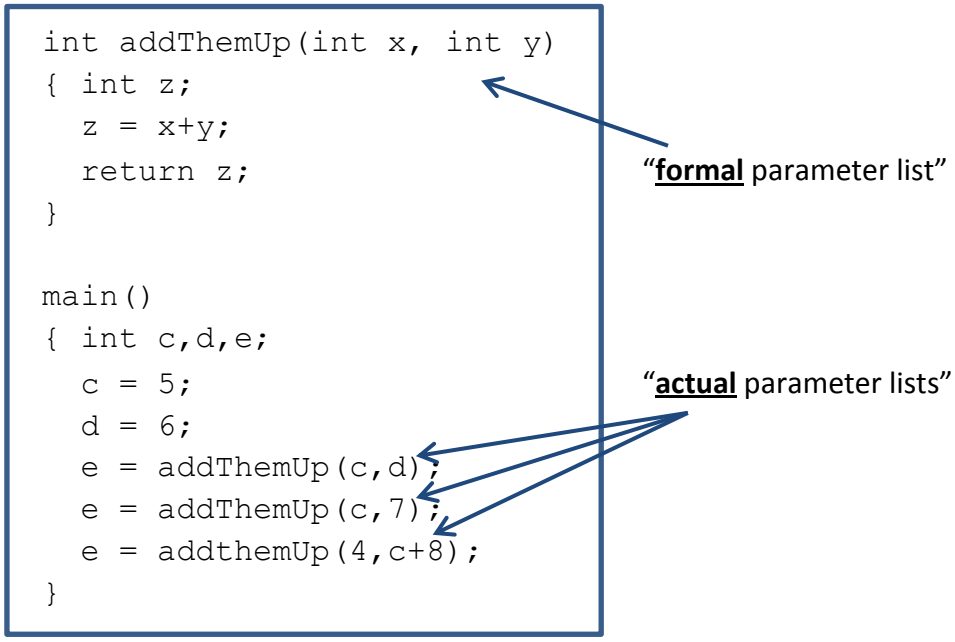
10.0 Parameter-Passing Mechanisms

Consider the following example code:



Pass-By-Value

mechanism -

- Formal parameters are *local variables* in the function.
- Their declarations are in the formal parameter list.
- They are initialized to the *actual parameter* values during the call.

implications -

- Can pass variables, values, and expressions.
- Can be modified, but modifications don't affect actual parameters.
- This is the only mechanism in C, Java. It is an option in Pascal, C++.
- Can achieve a call-by-reference effect by passing a pointer.
- In Java, when passing an object, the effect is like pass-by-reference. That's because an object name is like a pointer.
- In Ada, pass-by-value parameters are constants. Thus in Ada, it is not possible to modify the formal parameters.

Pass-By-Reference

mechanism -

- Formal parameters are *temporary aliases* to the actual parameters.

implications -

- Can only pass variables.
- Changing a formal parameter directly affects the actual parameter.
- This is the only mechanism in Fortran. It is an option in Pascal, C++.

Pass-By-Value-Result

mechanism -

- Formal parameters are *local variables* (same as pass-by-value).
- Initialized to the *actual parameter* values (same as pass-by-value).
- At the time of return, formal parameter values are copied back out to the corresponding actual parameters.

implications -

- Can only pass variables.
- Also called “copy-in-copy-out”, “pass-by-result”, and “in-out”.
- Not available in C, C++, Java, Pascal. It is an option in Ada.
- Order of copy-out can be important if formal parameters are modified:

```
int Test(int x, int y)
{
  x = x+1;
}
main()
{
  int c;
  c = 5;
  Test(c,c);
}
```

Now, what is the value of c??

Example:

```
int c;  // global

int Test(int x)
{
  x = x+3;
  c = c+1;
}

main()
{
  c = 5;
  Test(c);
}
```

Pass-by-Value:	Pass-by-Reference:	Pass-by-Value-Result
X 5 8	X 5 8 9 C	X 5 8
C 5 6		C 5 6
Result: C=6	Result: C=9	Result: C=8

Pass-By-Name

mechanism -

- Text of actual parameter replaces text of formal parameter.

implications -

- Used in Scala, Panacea, C macros, early versions of Algol, Simula.
- Can result in strange behavior, especially if passing array elements:

```
Swap(x,y)
{ int t = x;
  x = y;
  y = t;
}
Swap(i,A[i])
```

trace it!

Jensen's Device

A trick that can be used in a pass-by-name environment to simulate matrix math:

- Pass an array element subscripted by a variable.
- Also pass in the subscript variable.
- Incrementing the variable allows program to walk through array without subscripts, as if it were a single Matrix operation.

Example:

```
procedure Sum(A,B,C,index)
{
  for index = 1 to max;
  C = A + B;
}
...
(* call *)
Sum(a[i],b[i],c[i],i)
```

Consider the arrays:

a: [1,2,5]
b: [6,7,12]

After the call to "Sum", the array "c" will become: [7,19,17]