Comp 311
Principles of Programming Languages
Lecture 18
Implementations of Assignment and Mutation

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procedure Sum(int x, int y, int n) {
    // actual x must occur free in actual y
    int sum = 0;
    for (x = 0; x < n, x++) sum = sum + y;
    return sum;
}

int j, sum = 0;
int[10] a;
for (int i = 0; i < 10; i++) a[i] = i; // initialize a
sum = Sum(j, a[j], 10)); // compute the sum
print(j, sum) // print the result
Parameter-Passing Scenarios

• call-by-value: in `Sum`, the local variables `x, y, n` are new boxes with contents `0, 0, 10`. Hence, the loop repeatedly adds `0` to `sum` which is initially `0`. Hence, the returned result is `0` and the program prints `0 0`.

• call-by-name: in `Sum`, the local variables `x, y, n` are bound to suspensions with bodies `j, a[j], temp` closed over the calling environment where `temp` is a variable generated by the compiler/interpreter holding the value `10`. In the body of `Sum`, the loop repeatedly evaluates the suspensions for `x, y, n`. `x` always evaluates to the box corresponding the variable `j`, but `y` evaluates to the box for array element `a[j]` which depends on `j`. Hence, the loop sums the integers between `0` and `9` and increments variable `j` on each iteration. The program prints `10 45`.

• call-by-reference: in `Sum`, the local variables `x, y, n` are bound to the boxes corresponding to the variable `j`, the array element `a[0]`, and a dummy box created to hold the actual parameter `10`. (We are assuming that the language boxes constants passed by reference instead of declaring the program syntactically incorrect.) In the body of `Sum`, the loop repeatedly adds `0` to `sum`, incrementing `j` by `1` on each iteration. Hence, the program prints `10 0`.

• call-by-value-result: in `Sum`, the local variables `x, y, n` are bound to the boxes containing copies of the value of `j`, the value of `a[0]`, and `10` (We are assuming that the language boxes constants passed by value-result instead of declaring the program syntactically incorrect.) In the body of `Sum`, the loop repeatedly adds `0` to `sum`, incrementing the local variable `x` on each iteration. On exit, the values of `x, y, n` are copied into the variables (boxes) `j, a[0]`, dummy box created to hold the value `10`. Hence, the program prints `10 0` just like call-by-reference. The code in this program does not depend on whether the local variables are copies or originals.

• call-by-result: the parameter passing convention does not make sense in this example because it fails to initialize the formal parameters `x, y, n`. The program is ill-formed for this parameter passing method.