

EXAMPLE 1

```
int main () {
    return (3+4)*5/2;
}
```

We compile it with

```
% cc0 -b ex1.c0
```

to generate the corresponding byte code file ex1.bc0:

```
C0 C0 FF EE # magic number
00 09      # version 4, arch = 1 (64 bits)

00 00      # int pool count
# int pool

00 00      # string pool total size
# string pool

00 01      # function count
# function_pool

#<main>
00 00      # number of arguments = 0
00 00      # number of local variables = 0
00 0C      # code length = 12 bytes
10 03      # bipush 3          # 3
10 04      # bipush 4          # 4
60         # iadd              # (3 + 4)
10 05      # bipush 5          # 5
68         # imul              # ((3 + 4) * 5)
10 02      # bipush 2          # 2
6C         # idiv              # (((3 + 4) * 5) / 2)
B0         # return            #

00 00      # native count
# native pool
```

EXAMPLE 2

```
int mid (int lower, int upper) {
    int mid = lower + (upper - lower)/2;
    return mid;
}

int main () {
    return mid(3,6);
}
```

Local variable array V = [lower, upper, mid]

Corresponding byte code for mid function
(other parts of bytecode file not show):

```
#<mid>
00 02    # number of arguments = 2
00 03    # number of local variables = 3
00 10    # code length = 16 bytes
15 00    # vload 0      # lower
15 01    # vload 1      # upper
15 00    # vload 0      # lower
64      # isub          # (upper - lower)
10 02    # bipush 2      # 2
6C      # idiv         # ((upper - lower) / 2)
60      # iadd          # (lower + ((upper - lower) / 2))
36 02    # vstore 2     # mid = ...;
15 02    # vload 2     # mid
B0      # return       #
```

EXAMPLE 3

```
int next_rand(int last) {
    return last * 1664525 + 1013904223;
}
```

```
int main() {
    return next_rand(0xdeadbeef);
}
```

BYTECODE:

```
C0 C0 FF EE # magic number
00 09      # version 4, arch = 1 (64 bits)

00 03      # int pool count
# int pool
00 19 66 0D
3C 6E F3 5F
DE AD BE EF

00 00      # string pool total size
# string pool

00 02      # function count
# function_pool

#<main>
00 00      # number of arguments = 0
00 01      # number of local variables = 1
00 07      # code length = 7 bytes
13 00 02 # ildc 2          # c[2] = -559038737
B8 00 01 # invokestatic 1 # next_rand(-559038737)
B0      # return          #

#<next_rand>
00 01      # number of arguments = 1
00 01      # number of local variables = 1
00 0B      # code length = 11 bytes
15 00      # vload 0      # last
13 00 00 # ildc 0        # c[0] = 1664525
68      # imul          # (last * 1664525)
13 00 01 # ildc 1        # c[1] = 1013904223
60      # iadd          # ((last * 1664525) + 1013904223)
B0      # return          #

00 00      # native count
# native pool
```

EXAMPLE 4

```
int main () {
    int sum = 0;
    for (int i = 1; i < 100; i += 2)
        //@loop_invariant 0 <= i && i <= 100;
        sum += i;
    return sum;
}
```

BYTECODE (only <main> shown):

```
#<main>
00 00    # number of arguments = 0
00 02    # number of local variables = 2
00 26    # code length = 38 bytes
10 00    # bipush 0          # 0
36 00    # vstore 0         # sum = 0;
10 01    # bipush 1         # 1
36 01    # vstore 1         # i = 1;
# <00:loop>
15 01    # vload 1          # i
10 64    # bipush 100      # 100
A1 00 06 # if_icmplt +6    # if (i < 100) goto <01:body>
A7 00 14 # goto +20       # goto <02:exit>
# <01:body>
15 00    # vload 0          # sum
15 01    # vload 1         # i
60       # iadd            #
36 00    # vstore 0        # sum += i;
15 01    # vload 1         # i
10 02    # bipush 2        # 2
60       # iadd            #
36 01    # vstore 1        # i += 2;
A7 FF E8 # goto -24       # goto <00:loop>
# <02:exit>
15 00    # vload 0          # sum
B0       # return          #
```

EXAMPLE 5

```
struct point {
    int x;
    int y;
};
typedef struct point* point;

point reflect(point p) {
    point q = alloc(struct point);
    q->x = p->y;
    q->y = p->x;
    return q;
}

int main () {
    point p = alloc(struct point);
    p->x = 1;
    p->y = 2;
    point q = reflect(p);
    return q->x*10 + q->y;
}
```

BYTECODE (only <reflect> shown):

```
#<reflect>
00 01    # number of arguments = 1
00 02    # number of local variables = 2
00 1B    # code length = 27 bytes
BB 08    # new 8                # alloc(struct point)
36 01    # vstore 1             # q = alloc(struct point);
15 01    # vload 1              # q
62 00    # aaddf 0              # &q->x
15 00    # vload 0              # p
62 04    # aaddf 4              # &p->y
2E       # imload               # p->y
4E       # imstore              # q->x = p->y;
15 01    # vload 1              # q
62 04    # aaddf 4              # &q->y
15 00    # vload 0              # p
62 00    # aaddf 0              # &p->x
2E       # imload               # p->x
4E       # imstore              # q->y = p->x;
15 01    # vload 1              # q
B0       # return               #
```

EXAMPLE 6

```
#use <conio>
```

```
int main() {  
    int[] A = alloc_array(int, 100);  
    for (int i = 0; i < 100; i++)  
        A[i] = i;  
    return A[99];  
}
```

BYTECODE (only <main> shown):

```
#<main>  
00 00    # number of arguments = 0  
00 02    # number of local variables = 2  
00 2D    # code length = 45 bytes  
10 64    # bipush 100      # 100  
BC 04    # newarray 4         # alloc_array(int, 100)  
36 00    # vstore 0           # A = alloc_array(int, 100);  
10 00    # bipush 0          # 0  
36 01    # vstore 1          # i = 0;  
# <00:loop>  
15 01    # vload 1           # i  
10 64    # bipush 100      # 100  
A1 00 06 # if_icmplt +6  # if (i < 100) goto <01:body>  
A7 00 15 # goto +21       # goto <02:exit>  
# <01:body>  
15 00    # vload 0           # A  
15 01    # vload 1           # i  
63      # aadds           # &A[i]  
15 01    # vload 1           # i  
4E      # imstore         # A[i] = i;  
15 01    # vload 1           # i  
10 01    # bipush 1         # 1  
60      # iadd            #  
36 01    # vstore 1         # i += 1;  
A7 FF E7 # goto -25      # goto <00:loop>  
# <02:exit>  
15 00    # vload 0           # A  
10 63    # bipush 99        # 99  
63      # aadds           # &A[99]  
2E      # imload          # A[99]  
B0      # return          #
```

EXAMPLE 7

```
#use <string>
#use <conio>

int main () {
    string h = "Hello ";
    string hw = string_join(h, "World!\n");
    print(hw);
    return string_length(hw);
}
```

BYTECODE:

```
C0 C0 FF EE # magic number
00 09 # version 4, arch = 1 (64 bits)

00 00 # int pool count
# int pool

00 0F # string pool total size
# string pool
48 65 6C 6C 6F 20 00 # "Hello "
57 6F 72 6C 64 21 0A 00 # "World!\n"

00 01 # function count
# function_pool

#<main>
00 00 # number of arguments = 0
00 02 # number of local variables = 2
00 1B # code length = 27 bytes
14 00 00 # aldc 0 # s[0] = "Hello "
36 00 # vstore 0 # h = "Hello ";
15 00 # vload 0 # h
14 00 07 # aldc 7 # s[7] = "World!\n"
B7 00 00 # invokenative 0 # string_join(h, "World!\n")
36 01 # vstore 1 # hw = ...
15 01 # vload 1 # hw
B7 00 01 # invokenative 1 # print(hw)
57 # pop # (ignore result)
15 01 # vload 1 # hw
B7 00 02 # invokenative 2 # string_length(hw)
B0 # return #

00 03 # native count
# native pool
00 02 00 4F # string_join
00 01 00 06 # print
00 01 00 50 # string_length
```