CPSC 410 Assignment 5

Max Song 55788673

Exercise 1

```
 void fun(int a, int b) {
[1]      int x = a       (x -> {1})
[2]      int y = b       (x -> {1}, y -> {2})
[3]      int z = 0       (x -> {1}, y -> {2}, z -> {3})
[4]
[5]      if (x == 0)     (x -> {1}, y -> {2}, z -> {3})
[6]          y = x       (x -> {1}, y -> {1,6}, z -> {3})
[7]      else            (x -> {1}, y -> {2}, z -> {3})
[8]          y = z       (x -> {1}, y -> {3,8}, z -> {3})
[9]                      (x -> {1}, y -> {1,3,6,8}, z -> {3})
[10]     if (y == 0)     (x -> {1}, y -> {1,3,6,8}, z -> {3})
[11]         x = z       (x -> {3,11}, y -> {1,3,6,8}, z -> {3})
[12]                     (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
[13]     if (x != y)     (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
[14]         z = 1       (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {14})
[15]                     (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z ->
{1,3,6,8,11,14})
[16]     print(x)        (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z ->
{1,3,6,8,11,14})
[17]     print(y)        (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z ->
{1,3,6,8,11,14})
[18]     print(z)        (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z ->
{1,3,6,8,11,14})
     }
```

Exercise 2

```
void fun(int a, int b) {
[1]      int x = a       (x -> {1})
[2]      int y = b       (x -> {1}, y -> {2})
[3]      int z = 0       (x -> {1}, y -> {2}, z -> {3})
[4]
[5]      if (x == 0)     (x -> {1}, y -> {2}, z -> {3})
[6]          y = x       (x -> {1}, y -> {1,6}, z -> {3})
[7]      else            (x -> {1}, y -> {2}, z -> {3})
[8]          y = z       (x -> {1}, y -> {3,8}, z -> {3})
[9]                      (x -> {1}, y -> {1}, z -> {3})
[10]     if (y == 0)     (x -> {1}, y -> {1}, z -> {3})
[11]         x = z       (x -> {3,11}, y -> {1}, z -> {3})
[12]                     (x -> {1}, y -> {1}, z -> {3})
[13]     if (x != y)     (x -> {1}, y -> {1}, z -> {3})
[14]         z = 1       (x -> {1}, y -> {1}, z -> {14})
```

```
[15]                    (x -> {1}, y -> {1}, z -> {1})
[16]      print(x)      (x -> {1}, y -> {1}, z -> {1})
[17]      print(y)      (x -> {1}, y -> {1}, z -> {1})
[18]      print(z)      (x -> {1}, y -> {1}, z -> {1})
      }
```

Exercise 3

Question 1

a=1, b=2,FTF

```
  void fun(int a, int b) {
[1]       int x = a       (x -> {1})
[2]       int y = b       (x -> {1}, y -> {2})
[3]       int z = 0       (x -> {1}, y -> {2}, z -> {3})
[4]
[5]       if (x == 0)     (x -> {1}, y -> {2}, z -> {3})
[6]           y = x
[7]       else            (x -> {1}, y -> {2}, z -> {3})
[8]           y = z       (x -> {1}, y -> {3,8}, z -> {3})
[9]                       (x -> {1}, y -> {1,3,8}, z -> {3})
[10]      if (y == 0)     (x -> {1}, y -> {1,3,8}, z -> {3})
[11]          x = z       (x -> {3,11}, y -> {1,3,8}, z -> {3})
[12]                      (x -> {1,3,8,11}, y -> {1,3,8}, z -> {3})
[13]      if (x != y)     (x -> {1,3,8,11}, y -> {1,3,8}, z -> {3})
[14]          z = 1
[15]                      (x -> {1,3,8,11}, y -> {1,3,8}, z -> {3})
[16]      print(x)        (x -> {1,3,8,11}, y -> {1,3,8}, z -> {3})
[17]      print(y)        (x -> {1,3,8,11}, y -> {1,3,8}, z -> {3})
[18]      print(z)        (x -> {1,3,8,11}, y -> {1,3,8}, z -> {3})
      }
```

```
void fun(int a, int b) {
[1]       int x = a
[2]       int y
[3]       int z = 0
[4]
[5]       if (x == 0){}
[7]       else
[8]           y = z
[9]
[10]      if (y == 0)
[11]          x = z
[12]
[13]      if (x != y) {}
[14]
[15]
[16]      print(x)
```

```
[17]      print(y)
[18]      print(z)
      }
```

Question 2

1. TTF, a = 0, b = 2

```
 void fun(int a, int b) {
[1]       int x = a       (x -> {1})
[2]       int y = b       (x -> {1}, y -> {2})
[3]       int z = 0       (x -> {1}, y -> {2}, z -> {3})
[4]
[5]       if (x == 0)     (x -> {1}, y -> {2}, z -> {3})
[6]           y = x       (x -> {1}, y -> {1,6}, z -> {3})
[7]       else            (x -> {1}, y -> {2}, z -> {3})
[8]           y = z
[9]                       (x -> {1}, y -> {1,6}, z -> {3})
[10]      if (y == 0)     (x -> {1}, y -> {1,6}, z -> {3})
[11]          x = z       (x -> {1,3,6,11}, y -> {1,6}, z -> {3})
[12]                      (x -> {1,3,6,11}, y -> {1,6}, z -> {3})
[13]      if (x != y)     (x -> {1,3,6,11}, y -> {1,6}, z -> {3})
[14]          z = 1
[15]                      (x -> {1,3,6,11}, y -> {1,6}, z -> {3})
[16]      print(x)        (x -> {1,3,6,11}, y -> {1,6}, z -> {3})
[17]      print(y)        (x -> {1,3,6,11}, y -> {1,6}, z -> {3})
[18]      print(z)        (x -> {1,3,6,11}, y -> {1,6}, z -> {3})
      }
```

```
void fun(int a, int b) {
    int x = a
    int y
    int z = 0
    if (x == 0) {
        y = x
    }
    if (y == 0) {
        x = z
    }
    if (x != y) {}

    print(x)
    print(y)
    print(z)
}
```

Question 3

```
[1]       int x = a       (x -> {1})
[2]       int y = b       (x -> {1}, y -> {2})
[3]       int z = 0       (x -> {1}, y -> {2}, z -> {3})
[4]
[5]       if (x == 0)     (x -> {1}, y -> {2}, z -> {3})
[6]           y = x
[7]       else            (x -> {1}, y -> {2}, z -> {3})
[8]           y = z       (x -> {1}, y -> {3,8}, z -> {3})
[9]                       (x -> {1}, y -> {1,3,8}, z -> {3})
[10]      if (y == 0)     (x -> {1}, y -> {1,3,6,8}, z -> {3})
[11]          x = z       (x -> {3,11}, y -> {1,3,6,8}, z -> {3})
[12]                      (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
[13]      if (x != y)     (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
[14]          z = 1
[15]                      (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
[16]      print(x)        (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
[17]      print(y)        (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
[18]      print(z)        (x -> {1,3,6,8,11}, y -> {1,3,6,8}, z -> {3})
      }
```

After unioning the mappings of dynamic analysis, I found each parameter's dependencies of each instruction is a subset of corresponding instruction's of `Exercise 1`.

Question 4

The reason for that is static program slicing is over approximation of the run time situation. Dynamic program slicing is under approximation of the run time situation. That's the reason for the different result of Exercise 1 and Exercise 3.

Exercise 4

```
void fun(int a, int b) {
[1]     int x = a       // x == a
[2]     int y = b       // x == a, y == b
[3]     int z = 0       // x == a, y == b, z == 0
[4]                     // x == a, y == b, z == 0
[5]     if (x == 0)     // x == z == 0, y == b
[6]         y = x       // x == z == y == 0
[7]     else            // x == b, z == 0, x == a != 0
[8]         y = z       // y == z == 0, x == a != 0
[9]                     // y == z == 0
[10]    if (y == 0)     // y == z == 0
[11]        x  = z      // x == y == z == 0
[12]                    // x == y == z == 0
[13]    if (x != y)
[14]        z = 1
[15]                    // x == y == z == 0
[16]    print(x)        // x == y == z == 0
[17]    print(x)        // x == y == z == 0
```

```
[18]    print(x)        // x == y == z == 0
}
```

Exercise 5

first if condition: may be executed second if condition: definitely will be executed third if condition: impossible to be executed

```
void fun(int a, int b) {
[1]     int x = a       // x == a
[2]     int y = b       // x == a, y == b
[3]     int z = 0       // x == a, y == b, z == 0
[4]                     // x == a, y == b, z == 0
[5]     if (x == 0)     // x == z == 0, y == b
[6]         y = x       // x == z == y == 0
[7]     else            // x == b, z == 0, x == a != 0
[8]         y = z       // y == z == 0, x == a != 0
[9]                     // y == z == 0
[10]    if (y == 0)     // y == z == 0
[11]        x  = z      // x == y == z == 0
[12]                    // x == y == z == 0
[13]    if (x != y)
[14]        z = 1
[15]                    // x == y == z == 0
[16]    print(x)        // x == y == z == 0
[17]    print(x)        // x == y == z == 0
[18]    print(x)        // x == y == z == 0
}
```