Derivation of the Answers to Example 2 on Page 1 of:

https://euclid.cs.qc.cuny.edu/316/FinalExamExercises.pdf

Call/Pass by Value

Call/Pass by Value-Result

Call/Pass by Value-Result (Algol W)

Call/Pass by Reference

Call/Pass by Name

Call/Pass by Value

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                      static:
 static void test (int x, int y)
                                               1
                                         a[0]
  a[1] = 6;
                                         a[1]
  e = 2;
                                         a[2] 2
  x += 3;
  V - - ;
  System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                      static:
 static void test (int x, int y)
                                         a[0]
  a[1] = 6;
                                         a[1]
                                         a[2]
  e = 2;
  x += 3;
                                        test:
  V - - ;
  System.out.print(x + " " + y + " ");
    Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                     static:
 static void test (int x, int y)
                                        a[0]
  a[1] = 6;
                                        a[1] 1 6
                                        a[2] 2
  e = 2;
  x += 3;
                                       test:
  V--;
  System.out.print(x + " " + y + " ");
                                              0
    Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                      static:
 static void test (int x, int y)
                                         a[0] 0
  a[1] = 6;
                                         a[1] 1 6
                                         a[2] 2
  e = 2;
  x += 3;
                                        test:
  V - - ;
  System.out.print(x + " " + y + " ");
                                               0
    Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                      static:
 static void test (int x, int y)
                                        a[0] 0
  a[1] = 6;
                                        a[1] 1 6
                                        a[2] 2
  e = 2;
  x += 3;
                                       test:
  V - - ;
  System.out.print(x + " " + y + " ");
                                               0
    Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                     static:
 static void test (int x, int y)
                                        a[0] 0
  a[1] = 6;
                                        a[1] 1 6
                                        a[2] 2
  e = 2;
  x += 3;
                                       test:
  V--;
  System.out.print(x + " " + y + " "); x = 1 + 4
    Output:
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                     static:
static void test (int x, int y)
                                        a[0] 0
  a[1] = 6;
                                        a[1] 1 6
                                        a[2] 2
  e = 2;
  x += 3;
                                       test:
  y--;
  System.out.print(x + " " + y + " ");
    Output:
             x y a[0] a[1] a[2] e
              4 -1
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                     static:
static void test (int x, int y)
                                        a[0] 0
  a[1] = 6;
                                        a[1] 1 6
  e = 2;
                                        a[2] 2
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
            x y a[0] a[1] a[2] e
    Output:
              4 -1
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                    static:
static void test (int x, int y)
                                      a[0] 0
  a[1] = 6;
                                      a[1] 1 6
                                      a[2] 2
  e = 2;
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
    Output:
            x y a[0] a[1] a[2]
             4 -1 0 6
```

Call/Pass by Value-Result

```
class FinalExam {
 static int e = 1;
 static int a[] = {0,1,2};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                                    1
                                              a[0] 0
  a[1] = 6;
                                              a[1] 1
  e = 2;
                                              a[2] 2
  x += 3;
  V - - ;
  System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
   System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                             static:
 static void test (int x, int y)
                                                       1
                                               \rightarrowa[0] 0
                                               \rightarrowa[1] 1
   a[1] = 6;
  e = 2;
   x += 3;
                                               test:
   V--;
   System.out.print(x + " " + y + " ");
     Output:
```

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```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
   System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                             static:
 static void test (int x, int y)
                                               \rightarrowa[0] 0
                                               \Rightarrowa[1] 1 6
   a[1] = 6;
                                                a[2] 2
   e = 2;
   x += 3;
                                               test:
   V - - ;
   System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
   System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                            static:
 static void test (int x, int y)
                                             →a[0] 0
                                             \rightarrowa[1] 1 6
   a[1] = 6;
                                               a[2] 2
   e = 2;
   x += 3;
                                              test:
  V - - ;
   System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
   System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                            static:
 static void test (int x, int y)
                                             →a[0] 0
                                             \rightarrowa[1] 1 6
   a[1] = 6;
                                               a[2] 2
   e = 2;
   x += 3;
                                              test:
  V - - ;
   System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
   System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                            static:
 static void test (int x, int y)
                                             →a[0] 0
                                             \rightarrowa[1] 1 6
  a[1] = 6;
  e = 2;
                                              a[2] 2
  x += 3;
                                             test:
  V--;
   System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = \{0,1,2\};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                            →a[0] 0
                                            \rightarrowa[1] 1 6
  a[1] = 6;
  e = 2;
                                              a[2] 2
  x += 3;
                                             test:
  y--;
   System.out.print(x + " " + y + " ");
     Output:
             x y a[0] a[1] a[2] e
              4 -1
```

```
class FinalExam {
 static int e = 1:
 static int a[] = \{0,1,2\};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
 static void test (int x, int y)
  a[1] = 6;
  e = 2;
  x += 3;
  y--;
   System.out.print(x + " " + y + " ");
             x y a[0] a[1] a[2] e
    Output:
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                         static:
static void test (int x, int y)
                                           a[0] 0 -1
                                           a[1] 1 6 4
  a[1] = 6;
  e = 2;
                                           a[2] 2
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
    Output: x y a[0] a[1] a[2]
             4 -1 -1 4
```

Call/Pass by Value-Result (Algol W)

```
class FinalExam {
 static int e = 1;
 static int a[] = \{0,1,2\};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                                     1
                                              a[0] 0
  a[1] = 6;
                                              a[1] 1
  e = 2;
                                              a[2] 2
  x += 3;
  V - - ;
  System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = \{0,1,2\};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                                    1
                                              a[0] 0
  a[1] = 6;
                                              a[1] 1
  e = 2;
                                              a[2] 2
  x += 3:
                                             test:
  V - - ;
  System.out.print(x + " " + y + " "); a[e] x 1
                                          a[e-1] y 0
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = \{0,1,2\};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
 static void test (int x, int y)
                                                   1
                                             a[0] 0
  a[1] = 6;
                                             a[1] 1 6
  e = 2;
                                             a[2] 2
  x += 3;
                                            test:
  V--;
  System.out.print(x + " " + y + " "); a[e] x 1
                                         a[e-1] y 0
    Output:
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
static void test (int x, int y)
                                               e 1 2
                                             a[0] 0
  a[1] = 6;
                                             a[1] 1 6
  e = 2;
                                             a[2] 2
  x += 3;
                                            test:
  V--;
  System.out.print(x + " " + y + " "); a[e] x 1
                                         a[e-1] y 0
    Output:
```

```
class FinalExam {
static int e = 1:
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public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
static void test (int x, int y)
                                               e 1 2
                                             a[0] 0
  a[1] = 6;
                                             a[1] 1 6
  e = 2;
                                             a[2] 2
  x += 3;
                                            test:
  V - - ;
  System.out.print(x + " " + y + " "); a[e] x 1 4
                                         a[e-1] y 0
    Output:
```

```
class FinalExam {
static int e = 1:
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                                          static:
static void test (int x, int y)
                                               e 1 2
                                             a[0] 0
  a[1] = 6;
                                             a[1] 1 6
  e = 2;
                                             a[2] 2
  x += 3;
                                           test:
  V--;
  System.out.print(x + " " + y + " "); a[e] x 1 4
                                         a[e-1] y 0 -1
    Output:
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                         static:
static void test (int x, int y)
                                              e 1 2
                                            a[0] 0
  a[1] = 6;
                                            a[1] 1 6
  e = 2;
                                            a[2] 2
  x += 3;
                                           test:
  y--;
  System.out.print(x + " " + y + " "); a[e] x 1 4
                                        a[e-1] y 0 -1
    Output:
            x y a[0] a[1] a[2] e
             4 -1
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
static void test (int x, int y)
                                             a[0] 0
  a[1] = 6;
                                             a[1] 1 6 -1
                                             a[2] 2
  e = 2;
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
                                          a[e]
                                         a[e-1]
            x y a[0] a[1] a[2] e
    Output:
```

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                        static:
static void test (int x, int y)
                                             e 1 2
                                           a[0] 0
                                           a[1] 1 6 -1
  a[1] = 6;
                                           a[2] 2 4
  e = 2;
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
    Output: x y a[0] a[1] a[2]
             4 -1 0 -1
```

Call/Pass by Reference

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                                    1
                                              a[0] 0
  a[1] = 6;
                                              a[1] 1
  e = 2;
                                              a[2] 2
  x += 3;
  V - - ;
  System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
  a[1] = 6;
  e = 2;
  x += 3;
  System.out.print(x + " " + y + " ");
```

Output:

PASS BY REFERENCE

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
  a[1] = 6;
  e = 2;
  x += 3;
  System.out.print(x + " " + y + " ");
     Output:
```

PASS BY REFERENCE

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
  a[1] = 6;
  e = 2;
  x += 3;
  System.out.print(x + " " + y + " ");
```

Output:

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
  a[1] = 6;
  e = 2;
  x += 3;
  System.out.print(x + " " + y + " ");
```

Output:

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
  a[1] = 6;
  e = 2;
  x += 3;
  V--;
  System.out.print(x + " " + y + " ");
```

Output:

PASS BY REFERENCE

```
class FinalExam {
static int e = 1:
static int a[] = {0,1,2};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
static void test (int x, int y)
  a[1] = 6;
  e = 2;
  x += 3;
  y--;
  System.out.print(x +
             x y a[0] a[1] a[2] e
    Output:
```

PASS BY REFERENCE

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
static void test (int x, int y)
                                             a[0] 0 -1
  a[1] = 6;
                                             a[1] 1 6 9
  e = 2;
                                             a[2] 2
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
    Output: x y a[0] a[1] a[2] e
              9 -1
```

PASS BY REFERENCE

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                         static:
static void test (int x, int y)
                                            a[0] 0 -1
  a[1] = 6;
                                            a[1] 1 6 9
                                            a[2] 2
  e = 2;
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
    Output:
            x y a[0] a[1] a[2]
             9 -1 -1 9
```

Call/Pass by Name

```
class FinalExam {
 static int e = 1:
 static int a[] = {0,1,2};
 public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                                    1
                                              a[0] 0
  a[1] = 6;
                                              a[1] 1
  e = 2;
                                              a[2] 2
  x += 3;
  V - - ;
  System.out.print(x + " " + y + " ");
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = \{0,1,2\};
 public static void main(String args[])
   test(a[e], a[e-1]);
   System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                                    1
                                              a[0] 0
  a[1] = 6;
                                              a[1] 1
  e = 2;
                                              a[2] 2
  x += 3;
                                             test:
  V - - ;
   System.out.print(x + " " + y + " "); a[e] x
                                          a[e-1] y
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = \{0,1,2\};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                           static:
 static void test (int x, int y)
                                                    1
                                              a[0] 0
  a[1] = 6;
                                              a[1] 1 6
  e = 2;
                                              a[2] 2
  x += 3;
                                             test:
  V - - ;
  System.out.print(x + " " + y + " "); a[e] x
                                          a[e-1] y
     Output:
```

```
class FinalExam {
 static int e = 1:
 static int a[] = \{0,1,2\};
 public static void main(String args[])
   test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                          static:
 static void test (int x, int y)
                                                e 1 2
                                             a[0] 0
  a[1] = 6;
                                             a[1] 1 6
  e = 2;
                                             a[2] 2
  x += 3;
                                            test:
  V--;
  System.out.print(x + " " + y + " "); a[e] x
                                         a[e-1] y
    Output:
```

```
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                                          static:
static void test (int x, int y)
                                                e 1 2
                                             a[0] 0
                                             a[1] 1 6
  a[1] = 6;
  e = 2;
                                             a[2] 2 5
  x += 3;
                                            test:
  V--;
  System.out.print(x + " " + y + " "); a[e] x
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    Output:
```

PASS BY NAME

```
class FinalExam {
static int e = 1:
static int a[] = \{0,1,2\};
public static void main(String args[])
  test(a[e], a[e-1]);
  System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
                                         static:
static void test (int x, int y)
                                            a[0] 0
                                            a[1] 1 6 5
  a[1] = 6;
                                            a[2] 2 5
  e = 2;
  x += 3;
                                           test:
  y--;
  System.out.print(x + " " + y + " ");
                                       a[e] x
                                        a[e-1] y
    Output:
            x y a[0] a[1] a[2] e
```

PASS BY NAME

```
class FinalExam {
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                                            a[0] 0
                                            a[1] 1 6 5
  a[1] = 6;
                                            a[2] 2 5
  e = 2;
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
    Output: x y a[0] a[1] a[2] e
```

PASS BY NAME

```
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                                            a[0] 0
                                            a[1] 1 6 5
  a[1] = 6;
                                            a[2] 2 5
  e = 2;
  x += 3;
  y--;
  System.out.print(x + " " + y + " ");
    Output: x y a[0] a[1] a[2]
```