Objectives: Spotting errors. Awesome computer science with arrays.
MP3 TopSecret due tonight 8pm. Free regrade Mon week 8pm
Midterm 1 is Wed 7pm. Bring your ICARD & a writing implement.
Wed lecture: Review & Graphics.
Lastname A-H:1ASL150 I-P:1MH103 R-Z:1BEV180

```
public class L15_Molecules {

  public static void main(String[] args) {
    int natoms = 100;
    int radius = 20;
    double[][] posn = new double[natoms][2];
    double[][] velocity = new double[natoms][2];
    for (int i = 0; i < natoms; i ++) {
      posn[i][0] = radius + Math.random() * (Zen.getZenWidth() - radius);
      posn[i][1] = radius + Math.random() * (Zen.getZenHeight() - radius);
      velocity[i][0] = 20 * (Math.random() - 0.5);
      velocity[i][1] = 20 * (Math.random() - 0.5);
    }
    while (true) {
      int maxX = Zen.getZenWidth() - radius;
      int maxY = Zen.getZenHeight() - radius;
      for (int i = 0; i < natoms; i++) {
        if (posn[i][0] + velocity[i][0] < radius || posn[i][0] + velocity[i][0] > maxX)
          velocity[i][0] = -velocity[i][0];
        if (posn[i][1] + velocity[i][1] < radius || posn[i][1] + velocity[i][1] > maxY)
          velocity[i][1] = -velocity[i][1];
        posn[i][0] += velocity[i][0];
        posn[i][1] += velocity[i][1];
        Zen.setColor (0, 0, 255);
        Zen.fillOval((int) posn[i][0], (int) posn[i][1], radius, radius);
      }
      Zen.flipBuffer();
      Zen.sleep(10);
    }
  }
} // Spot the error? And what about efficient collision detection?
```

1. Complete the following bucket sort code to sort the data array.

```
int[] data = {5,22,5,18,4,...    13232 more values between 0 & 999
int max = 1000;
int[] histogram = new int[max];
// Phase 1, count the number of occurrences of 0,1,2,3... max-1
for(int i = 0; i < data.length; i ++)
 ?  ________________________________________

// Phase 2, Use histogram to create the sorted output data

int ptr = 0; // we will write values into data[ptr]
for (int value = 0; value < max; value ++)

?


// This sort is fast but what limitations can you see with this algorithm?
```

2. Fix / Complete the following code to initialize and return a square array of size h x h to a checker patter of "O" and "E" (O for 'odd' squares, E for even including [0][0]).

```
public static ___________   makeChecker(int h) {
   ___________ result = new ______________
   int i=0, j =0;
   for(; i < result.length; i ++ ) {
      for( ; j < result.length; j ++) {

         if ((i+j) _________ )
             result______________
         else
             result ______________
      }

}
```

3. How should I test makeChecker? What unit tests should we create?

```
public static void main(String[] args) {
  String quote = "...and then it occurred to me that a computer is a...";
  int n = 1000; // population size
  char[][] data = new char[n][quote.length()];

  for (int generation = 0; generation < 4000; generation ++) {

    char[] fittest = mostFit(data, quote);
    if ((generation % 100) == 0) System.out.println(fittest);

    for (int i = 0; i < n/2; i ++) {
      char[] replace = data[(int) (Math.random() * n)];
      breed(replace, fittest);
    }
  }
}

public static void breed(char[] replace, char[] fittest) {
  for (int j = 0; j < replace.length; j++)
    if (Math.random() < 0.5) replace[j] = fittest[j];
  // Mutate one gene:
  replace[(int) (Math.random() * replace.length)] = (char) (Math.random() * 127);
}
public static char[] mostFit(char[][] data, String quote) {
  int  result = 0, bestFitness = -1;
  for (int i = 0; i < data.length; i++) {
     int fitness = 0;
     for (int j = 0; j < quote.length(); j++)
        if (data[i][j] == quote.charAt(j))  fitness++;
     if (fitness > bestFitness) {
      bestFitness = fitness;
      result= i;
     }
  }
  return data[result];
}
```

What does the following print?

```
for (int a = 5; a > 2; a --) {
   int b = a;
   while (b < 2 * a) { TextIO.put('*'); b ++;}
   TextIO.putln(“”);
}
```

Why does the following cipher attempt fail for long messages? Can you fix it?

```
String mesg = TextIO.getln();
mesg = mesg.toUpperCase();
String result = "";
for (int x = 0; x < mesg.length(); x ++) {
  char c = mesg.charAt(x);
  char encoded = (char)('A' + (c -'A' + x));
  result += encoded;
}
```