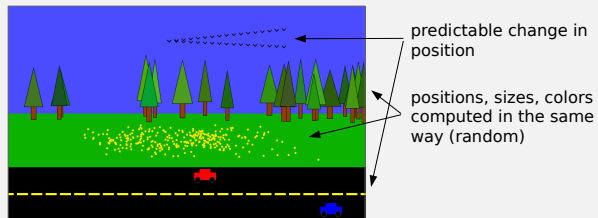## Loops

When do you need a loop?

- you have more than a few copies of something, and
- what changes between copies changes in a predictable way (or is computed in the same way)

predictable change in position

positions, sizes, colors computed in the same way (random)

Loop Questions

- What is repeated? → loop body
- What changes from one repetition to the next?
  → loop variables(s)
- How do things start?
  → initialization of loop variables
- How do things change?
  → update of loop variables
- When do you keep going? → loop condition
  - may be easier to think "when do you stop?" and then figure out the opposite
  - two patterns
    - repeat as long as / until – condition involves one or more loop variables
    - repeat *n* times (counting loop)

Counting Loops – Repeat *n* Times

- a *counting loop* is when the "keep going" condition involves a number of repetitions – repeat *n* times
  - introduce a counter variable to keep track of the number of repetitions completed so far

if the loop variables are all ints

```
for ( int count = 0,
    declare and initialize loop variables ;
    count < number of repetitions ;
    count = count+1, update loop variables ) {
  loop body
}
```

if the loop variables are not all ints

```
{
  declare and initialize loop variables
  for ( int count = 0 ;
      count < number of repetitions ;
      count = count+1, update loop variables ) {
    loop body
  }
}
```

Counting Loops – `int` Loop Variables

```
for ( int count = 0,
    declare and initialize loop variables ;
    count < number of repetitions ;
    count = count+1, update loop variables ) {
  loop body
}
```

if the loop variables are all ints

stack of four circles

```
// do we need a loop?  (more than a few copies?  do the different things
//  change in a predictable way or are they computed in the same way?)
//   -> yes
// what is repeated?  -> draw a red circle
// what changes from one repetition to the next?  -> y coordinate
// how do things start?  -> circle touching the bottom of the window
// how do things change?  -> decrease y by the diameter of the circles
// when do you keep going?  -> do four repetitions (counting loop!)
```

```
for ( int count = 0, y = height-20; count < 4; count = count+1, y = y-40 ) {
  fill(255, 0, 0);
  stroke(0);
  ellipse(20, y, 40, 40);
}
```

Counting Loops – non-`int` Loop Variables

```
{
  declare and initialize loop variables
  for ( int count = 0 ;
        count < number of repetitions ;
        count = count+1, update loop variables ) {
    loop body
  }
}
```

if the loop variables
are not all ints

stack of
four circles

```
// do we need a loop?  (more than a few copies?  do the different things
//   change in a predictable way or are they computed in the same way?)
//   -> yes
// what is repeated?  -> draw a red circle
// what changes from one repetition to the next?  -> y coordinate
// how do things start?  -> circle touching the bottom of the window
// how do things change?  -> decrease y by the diameter of the circles
// when do you keep going?  -> do four repetitions (counting loop!)
```

```
{
  float y = height-20;
  for ( int count = 0; count < 4; count = count+1, y = y-40 ) {
    fill(255, 0, 0);
    stroke(0);
    ellipse(20, y, 40, 40);
  }
}
```