Putting it All Together
Friday Four Square!
Outside Gates, 4:15PM
Artistry Submissions
An Interesting Listen

RadioLab: “Talking to Machines”
http://www.radiolab.org/2011/may/31/
Snowfall Revisited
A Simple Collision Detector

(x, y)

(x + 2r, y + 2r)

(x + r, y + 2r)
A Simple Collision Detector
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A Simple Collision Detector
Combining Animation and Events
The Chaos Game

• Pick any three points.

• Starting at any of the points:
  • Choose one of the three points randomly.
  • Move halfway from your current location to the chosen point.
  • Draw a dot at your current location.
  • Repeat.
Sierpinski Triangle
A Minor Change
What Just Happened?
double x = 0;
double y = 0;

while (true) {
    moveRandomly(x, y);
    plotPixel(x, y);
}
Pass by Value

GPoint d = getRandomPoint();

x = (x + d.getX()) / 2.0;

y = (y + d.getY()) / 2.0;
Pass by Value

GPoint d = getRandomPoint();

\[
x = \frac{x + d.getX()}{2.0};
\]

\[
y = \frac{y + d.getY()}{2.0};
\]
double x = 0;
double y = 0;

while (true) {
    moveRandomly(x, y);
    plotPixel(x, y);
}

0 0
0 0
Pass by Reference

GPoint pt = new GPoint(0, 0);

while (true) {
    moveRandomly(pt);
    plotPixel(pt);
}
Pass by Reference

```java
GPoint d = chooseRandomPoint();

pt.setLocation((pt.getX() + d.getX()) / 2.0, (pt.getY() + d.getY()) / 2.0);
```
GPoint d = chooseRandomPoint();

pt.setLocation((pt.getX() + d.getX()) / 2.0, (pt.getY() + d.getY()) / 2.0);
GPoint pt = new GPoint(0, 0);

while (true) {
    moveRandomly(pt);
    plotPixel(pt);
}

(137, 42)
Parameter Passing

- Primitive types (int, double, boolean, etc.) are passed by value.
  - Changes made to them do not reflect in the caller.

- Objects (GRect, GOval, GPoint, etc.) are passed by reference.
  - Changes made to the referenced objects do reflect in the caller.
One More Change...
Pass by Reference, Take II

GPoint pt = new GPoint(0, 0);

while (true) {
    moveRandomly(pt);
    plotPixel(pt);
}

(0, 0)
Pass by Reference, Take II

GPoint d = chooseRandomPoint();
GPoint result =
    new GPoint((pt.getX() + d.getX()) / 2.0,
                (pt.getY() + d.getY()) / 2.0);

pt = result;
Pass by Reference, Take II

GPoint d = chooseRandomPoint();
GPoint result =
    new GPoint((pt.getX() + d.getX()) / 2.0,
               (pt.getY() + d.getY()) / 2.0);

pt = result;

result

pt

(137, 42)

(0, 0)
Pass by Reference, Take II

GPoint d = chooseRandomPoint();
GPoint result =
    new GPoint((pt.getX() + d.getX()) / 2.0,
              (pt.getY() + d.getY()) / 2.0);

pt = result;
Pass by Reference, Take II

GPoint pt = new GPoint(0, 0);

while (true) {
    moveRandomly(pt);
    plotPixel(pt);
}
Parameter Passing

- Primitive types (\texttt{int}, \texttt{double}, \texttt{boolean}, etc.) are passed by \texttt{value}.
  - Changes made to them do not reflect in the caller.

- Objects (\texttt{GRect}, \texttt{GOval}, \texttt{GPoint}, etc.) are passed by \texttt{reference}.
  - Changes made to the referenced objects do reflect in the caller.
  - You cannot change \texttt{which object} is being referenced, though.
One Final Approach...
Returning Objects

GPoint pt = new GPoint(0, 0);

while (true) {
    pt = moveRandomly(pt);
    plotPixel(pt);
}

(pt) (0, 0)
Returning Objects

GPoint d = chooseRandomPoint();
GPoint result =
    new GPoint((pt.getX() + d.getX()) / 2.0,
                (pt.getY() + d.getY()) / 2.0);

return result;
Returning Objects

GPoint d = chooseRandomPoint();
GPoint result =
    new GPoint((pt.getX() + d.getX()) / 2.0,
                (pt.getY() + d.getY()) / 2.0);

return result;
Returning Objects

```java
GPoint pt = new GPoint(0, 0);

while (true) {
    pt = moveRandomly(pt);
    plotPixel(pt);
}
```