CS 120 Lecture 16

Java
Loops

(Java: An Eventful Approach, Ch 7 and 13),

6 November 2012

Slides Credit: Bruce, Danyluk and Murtagh

Programs Involving Repetition

- Drawing Grass

- Drawing grids
- Printing marks on a ruler
- Repeatedly rolling dice in craps game

Recognizing a Pattern

```
public void begin() {
        // add the blades of grass
        new Line(0, GRASS_TOP, 0, GROUND_LINE, canvas);
        new Line(4, GRASS_TOP, 4, GROUND_LINE, canvas);
        new Line(8, GRASS_TOP, 8, GROUND_LINE, canvas);
        new Line(12, GRASS_TOP, 12, GROUND_LINE, canvas);
        new Line(16, GRASS_TOP, 16, GROUND_LINE, canvas);
        …
        }
```

Making a Pattern Explicit

```
// add the blades of grass
bladePosition = 0;

new Line(bladePosition, GRASS_TOP, bladePosition, GROUND_LINE,  canvas);
bladePosition = bladePosition + GRASS_SPACING;

new Line(bladePosition, GRASS_TOP, bladePosition, GROUND_LINE, canvas);
bladePosition = bladePosition + GRASS_SPACING;

new Line(bladePosition, GRASS_TOP, bladePosition, GROUND_LINE, canvas);
bladePosition = bladePosition + GRASS_SPACING;
…
```

Eliminating Code Repetition

```
private int bladePosition=0;
public void onMouseClick(Location point) {
        // grow a blade of grass with each mouse click
        if (bladePosition < canvas.getWidth()) {
                new Line(bladePosition, GRASS_TOP,
                        bladePosition, GROUND_LINE,
                        canvas);
                bladePosition = bladePosition + GRASS_SPACING;
        }
}
```

•First approach tedious for programmer

•Second approach tedious for user

The while Loop (Indefinite loop)

- A control construct for specifying repetition
- General Structure:

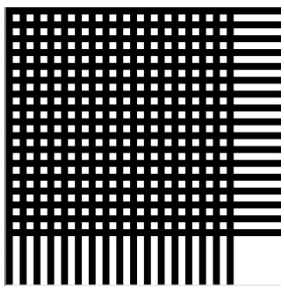
```
while (condition) {
    //Statements to be repeated
}
```

Drawing Grass with while

```
public void begin() {
    // add the blades of grass
    double bladePosition = 0;
    while ( bladePosition < canvas.getWidth() ) {
            new Line(bladePosition,GRASS_TOP,
                    bladePosition,GROUND_LINE,
                    canvas);
            bladePosition = bladePosition +
                            GRASS_SPACING;
    }
}
```

Drawing a Grid

```
while (verticalCorner.getX() < canvas.getWidth() ||
       horizontalCorner.getY() < canvas.getHeight() ) {
    new FilledRect(verticalCorner, 5, canvas.getHeight(), canvas);
    new FilledRect(horizontalCorner, canvas.getWidth(), 5,
                   canvas);
    verticalCorner.translate(10, 0);
    horizontalCorner.translate(0, 10);
}
```



The Counting while loop

- Counting up

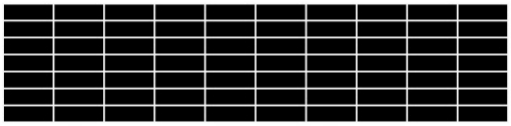
```
int i=initialValue;
while(i<endValue){
    //statements to be repeated
    i++;
}
```

Drawing a Number of Bricks

- Might want to draw exactly 10 bricks

```
private static final int BRICKS_TOTAL=10;
int brickPosition=0;
int brickCount=0;
while ( brickCount < BRICKS_TOTAL ) {
        new FilledRect(brickPosition, BRICK_TOP,
                BRICK_WIDTH, BRICK_HEIGHT,
                canvas);
        brickPosition = brickPosition + BRICK_WIDTH + BRICK_SPACING;
        brickCount++;
}
```

- Suppose we want to draw a brick wall



Use a while loop to draw each row of the wall

```
int level = 0;
while ( level < WALL_HEIGHT) {
        …//draw one row of bricks
        brickY = brickY + BRICK_HEIGHT;
        level ++;
}
```

- Already know how to draw a row of bricks
- Nest 1 while loop inside another

```
while (condition1) {
    //moves to draw a row of bricks
    while (condition2) {
        //draws one row of bricks
    }
}
```

Putting Things Together

```
int level = 0;
double brickY = WALL_Y;
while ( level < WALL_HEIGHT ) {
    brickInLevel = 0;
    brickX = WALL_X;

    //draw one row of bricks
    while ( brickInLevel < WALL_WIDTH ) {
        new FilledRect ( brickX, brickY,
                         BRICK_WIDTH, BRICK_HEIGHT,
                         canvas);
        brickX = brickX + BRICK_WIDTH+1;
        brickInLevel ++;
    }
    brickY = brickY – BRICK_HEIGHT-1;
    level ++;
}
```

Making Code Simple and Clear

•Avoid empty if-parts

No

```
if ( box.contains(point)) {
    //do nothing
} else {
    counter ++;
}
```

Yes

```
If ( !box.contains (point) ) {
    counter++;
}
```

•Use Boolean expressions in assignments

```
if ( box.contains (point) ) {
    boxGrabbed = true;
} else {
    boxGrabbed = false;
}
```

```
boxGrabbed =
        box.contains.(point);
```

•Don't use true or false in conditionals

```
if ( boxGrabbed == true ) {
    …
}
```

```
if (boxGrabbed) {
    …
}
```

Simplifying Code with DeMorgan's Laws

- DeMorgan's Laws

  ! (A && B) = !A || !B

  ! (A || B) = !A && !B

Applying DeMorgan's Laws

- Simplify: !(x < 0 || x >= 100)

  using !(A || B) = !A && !B

  !(x < 0) && !(x >= 100)

  (x >= 0) && (x < 100)

Curly Braces

Curly braces bracketing multiple lines of code are necessary

```
if ( targetContains(pt) ) {
   target.hide();
   score++;
}
```

```
if ( targetContains (pt) )
   target.hide();
   score++;
```

In the second version, score is updated despite the conditional

Curly Braces

A single line of code runs the same with and without curly braces

```
if ( temperature >= 100 ) {
        display.setText("Water is in a gaseous phase");
}
```

is the same as

```
if ( temperature >= 100 )
        display.setText("Water is in a gaseous phase");
```

Curly Braces

Which interpretation is correct?

```
if ( temperature >= 80 )
        if (raining)
                display.setText("Bring an Umbrella");
        else
                display.setText("T-shirt Weather");
```

```
if ( temperature >= 80 )
        if (raining)
                display.setText("Bring an Umbrella");
else    // WRONG!! This else matches the nearest if
        display.setText("Bring a coat!");
```

This is called the "Dangling else" problem.
http://en.wikipedia.org/wiki/Dangling_else

Recognizing Patterns

- Counting: continually updating a value by a fixed amount
- Counting raindrops

```
int dropCount = 0;  //Raindrop counter
while (dropCount < MAX) {
   new Raindrop(…);
   dropCount++;
}
```

Counting Bricks

```
while ( count < TOTAL ) {
    new Brick(…);
    count++;
}
```

The Counting while Loop

```
int i = initialValue;          // initialize
while (i < stopVal) {          // test
    ...                        // do stuff
    i++;                       // increment
}
```

"Counter-Controlled Loop Pattern"

The for loop (Definite Loop)

- Especially useful for counting
- Ex:

```
for ( int i=initialVal;        //initialize
      i<stopVal;               //test
      i++;) {                  //increment
         …                     //do stuff
}
```

Counting Raindrops with for Loop

```
for (int dropCount = 0;
     dropCount <MAX;
     dropCount++) {
    new Raindrop (…);
}
```

More General Start and End Points

- Loops can take whatever starting point, end point, and increment

  Ex:

```
for (int i=23; i <= 1728; i=i+591;){
   //do stuff
}
```

- But one should avoid using a double for any of the three values

Counting Backwards with for Loop

Ex: Printing a countdown

```
for (int count = 10; count >= 1; count--) {
    System.out.println(count);
}
```

Update Values

- Can increment loop index by any value
- Ex: Drawing grass blades

```
for (int pos = 0;
      pos < WIDTH;
      pos = pos + GAP) {
      new Line (pos, TOP, pos, GROUND, canvas);
 }
```

General Syntax of for Loop

- for (initialization; condition; update) {
  //Do something
  }

Initialization: gen'ly creates a counting variable
Condition: a boolean expression to stop the loop
Updating: updates the variable created

Nested Loops

- Any loop body can contain another loop

```
Ex: for ( … ) {
        while (…) {
            while (…) {
                for(…) {
                }
            }
        }
    }
```

The do while Loop

- Syntax:

```
do {
    <code to repeat>
} while (<condition>)
```

(see Craps Example online)

do while Loop vs while Loop

- do while
  - Condition checked at the end
  - Loop body executed at least once
- while
  - Condition checked at the beginning
  - Loop body may never execute

Avoiding Loop Errors

- Easier to find errors if you know where to look
- Common loop errors include:
  - Off by 1 in counting loops
  - Infinite loops

Off by one errors

Suppose we want to run a for loop 5 times:

for(int i=0;i<=5; i++){ }	for(int i=0;i<5;i++) { }

The left hand version will run it 6 times, not 5.

Infinite Loops

Ex:

```
while ( count< TOTAL ) {
   new Brick (…);
}
```

Since value of count is not updated, the condition in while will stay true forever.

Student To Do's

- HW07
  - Exercise 5.8.2 (DNA Generator)
  - Exercise 5.8.3 (Morse Code)
  - Due **Monday** 11/12 by 11:59pm

- Read *Java: An Eventful Approach*
  - Ch. 7 and 13 (Today)

37