Shapes

Elements of Graphics
CS324e
Creating Vertex Points

1. Use `beginShape()` function call
2. Specify a series of points with `vertex()`
3. Complete the shape with `endShape()`

- `fill()`, `stroke()`, `noFill()`, `noStroke()` and `strokeWeight()` control the shape attributes
- `endShape(CLOSE)` closes the shape
Vertex Points Example

```
beginShape();
vertex(30, 20);
vertex(85, 20);
vertex(85, 75);
vertex(30, 75);
vertex(30, 75);
endShape();

//endShape(CLOSE) would add line connecting back to the first vertex
```
Geometry

- `beginShape()` accepts different parameters to define drawing of vertex data
  - POINTS
  - LINES
  - TRIANGLES
  - TRIANGLE_STRIP
  - TRIANGLE_FAN
  - QUADS
  - QUAD_STRIP
Geometry Examples

❖ beginShape(POINTS);
❖ beginShape(LINES);
❖ beginShape(LINES);
- `beginShape( TRIANGLES );`
- `beginShape( TRIANGLE_STRIP );`
- `beginShape( TRIANGLE_FAN );`
- `beginShape(QUADS);`
- `beginShape(QUAD_STRIP);`
Instapoll Question: Drawing Shapes

- We want to ensure this shape always draws quads, even if we add vertices. What line should we modify?
  - Line 6
  - Line 7
  - Line 8
  - Line 9
  - Line 10
  - Line 11

```cpp
void setup() {
  size(500, 500);
}

void draw() {
  beginShape();
  vertex(200, 200);
  vertex(350, 250);
  vertex(450, 450);
  vertex(400, 500);
  endShape(CLOSE);
}
```
Curves

- `beginShape()` and `endShape()` can create curves if `beginShape()` has no parameter:
  - `curveVertex()`
  - `bezierVertex()`
- `curveVertex()` defined by first control point, intermediate vertices, and second control point
- `bezierVertex()` defined by initial anchor point then two control points with an anchor point


```plaintext
beginShape();
curveVertex(C1);
curveVertex(V1);
curveVertex(V2);
curveVertex(V3);
curveVertex(C2);
endShape();

beginShape();
vertex(V1);
bezierVertex(C1, C2, V2);
bezierVertex(C3, C4, V3);
endShape();
```
Contours

- Contours cut holes into Shapes
- `beginContour() / endContour()` called within `beginShape() / endShape()` code block
- `beginContour()` does not take parameters

Shape placed over Shape

Contour removing from Shape
Defining Shapes with Vertices

- A hard task
- Even harder defining 3D shapes
- What if we don’t want to define curves by hand?
- What if we want to import shapes from vector programs like Illustrator or 3D modeling programs like Maya?
PShape

- Class for storing Shapes
- Loads and displays SVGs and OBJs
  - SVG is open standard for storing 2D vector graphics
  - OBJ is standard for storing 3D vector geometry
- `loadShape("filename")` to load into PShape
- `shape(PShape, x, y);` or `shape(PShape, x, y, width, height);` to display it
Load and Display SVGs

PShape vector;

void setup() {
    vector = loadShape("vector.svg");
}

void draw() {
    shape(vector, 0, 0);
}
Load and Display OBJs

PShape object;
void setup() {
    object = loadShape("object.obj");
}
void draw() {
    shape(object, 0, 0);
}

We’ll come back to 3D geometry soon, but let’s focus on 2D examples for now...
Creating PShapes

- Same process of creating a Shape but we place the Shape into a PShape object!

```java
PShape aShape = createShape();
aShape.beginShape();
//Set fill and stroke information here
aShape.vertex(10, 0);
aShape.vertex(100, 30);
aShape.endShape();
```
Modifying PShapes

- PShapes are optimized for fast drawing by storing them as pre-existing geometry.
- Use specialized drawing attributes to change the shape after the object is created:
  - `getVertex()`, `setVertex()` to access and modify specific points.
  - `setFill(color c)` and `setStroke(color c)` must take `color` data type as parameter.
PShape Groups

- Multiple PShapes can be grouped together to create more complex shapes

```java
PShape person = createShape(GROUP);
PShape head = createShape(ELLIPSE, 25, 25, 50, 50);
PShape body = createShape(RECT, 0, 50, 50, 100);

person.addChild(head);
person.addChild(body);
shape(person);
```
Hands-on: Using PShapes

Today’s activities:

1. Create a free-hand Shape using vertex points
2. Create Shape using the TRIANGLE_STRIP parameter
3. Create a Shape using curveVertex
4. Place your free-hand Shape into a PShape
5. Create a group of PShapes that includes at least one ellipse and one rectangle