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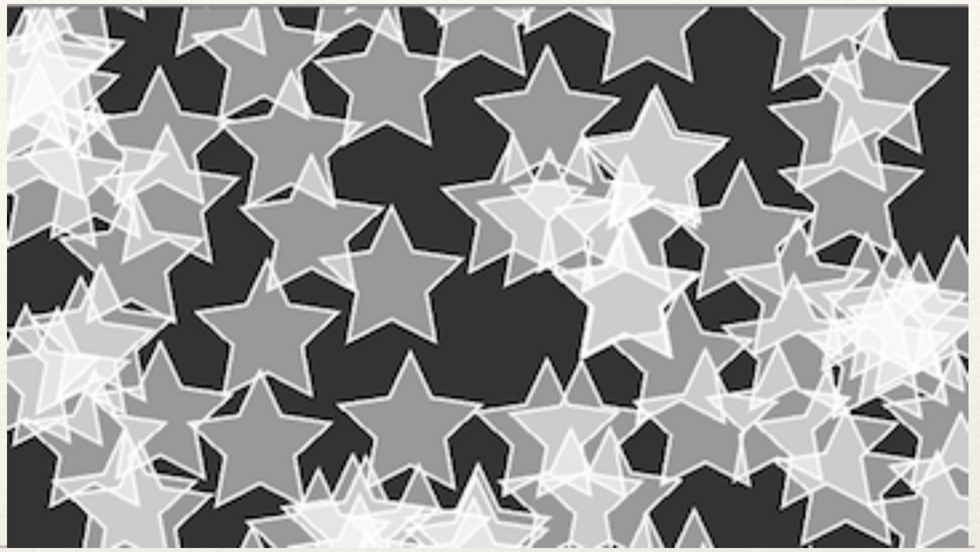
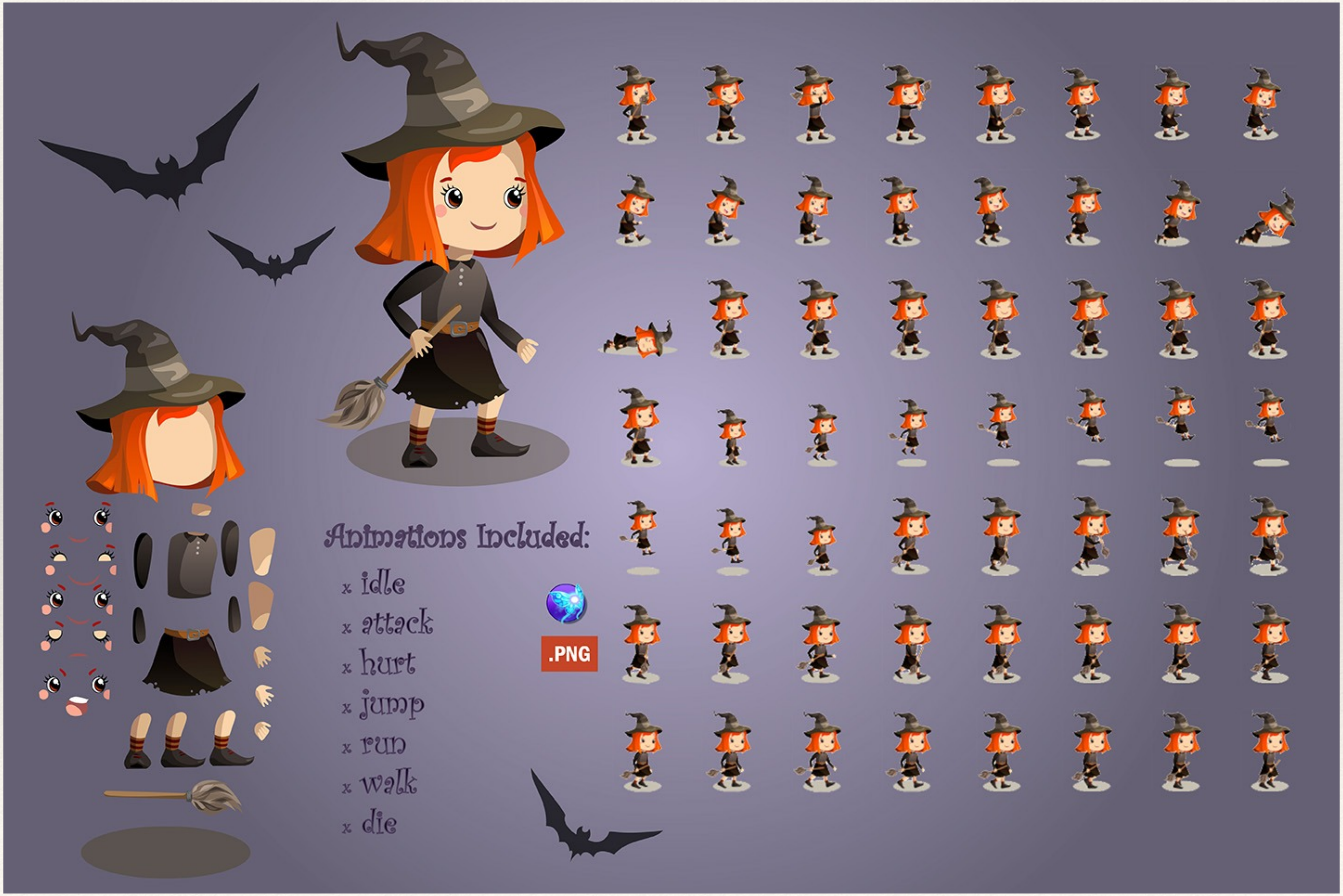


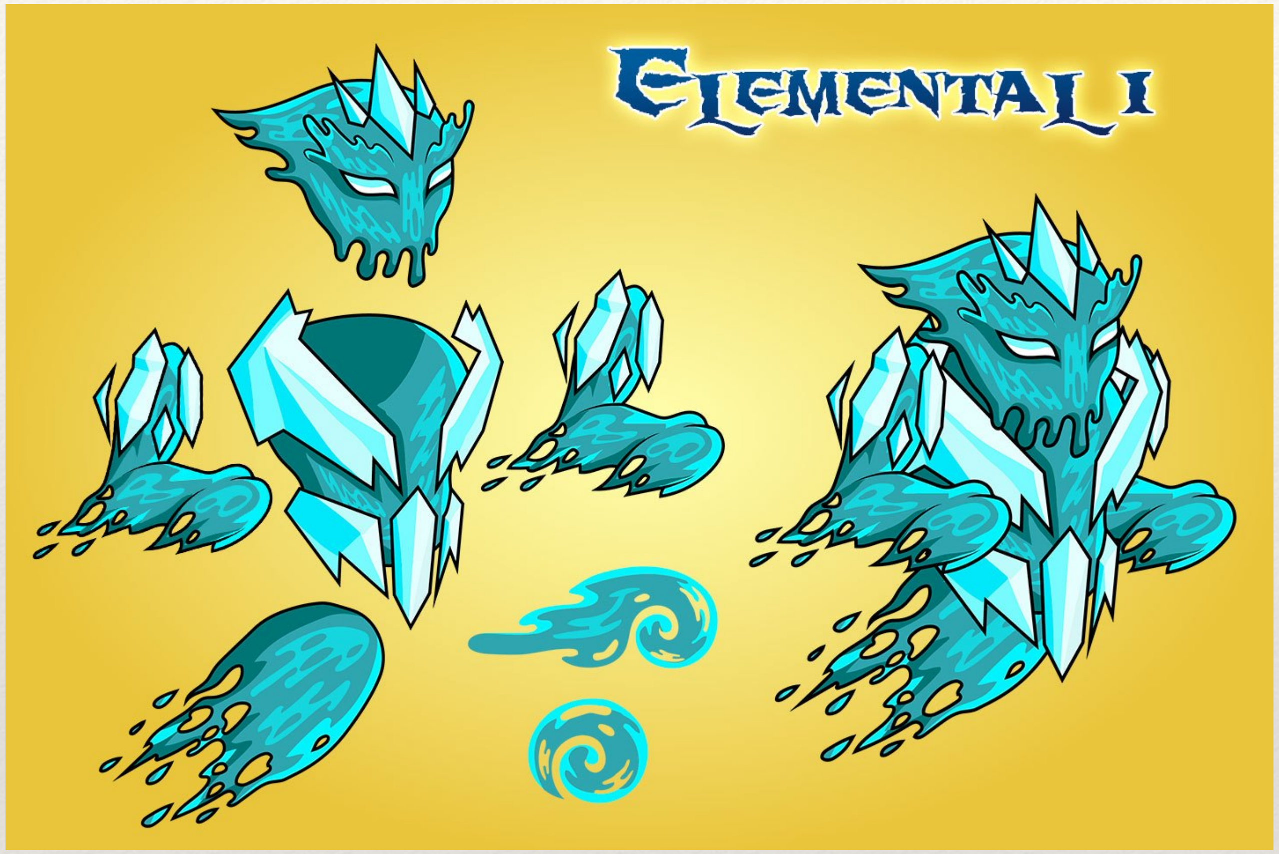
Shapes

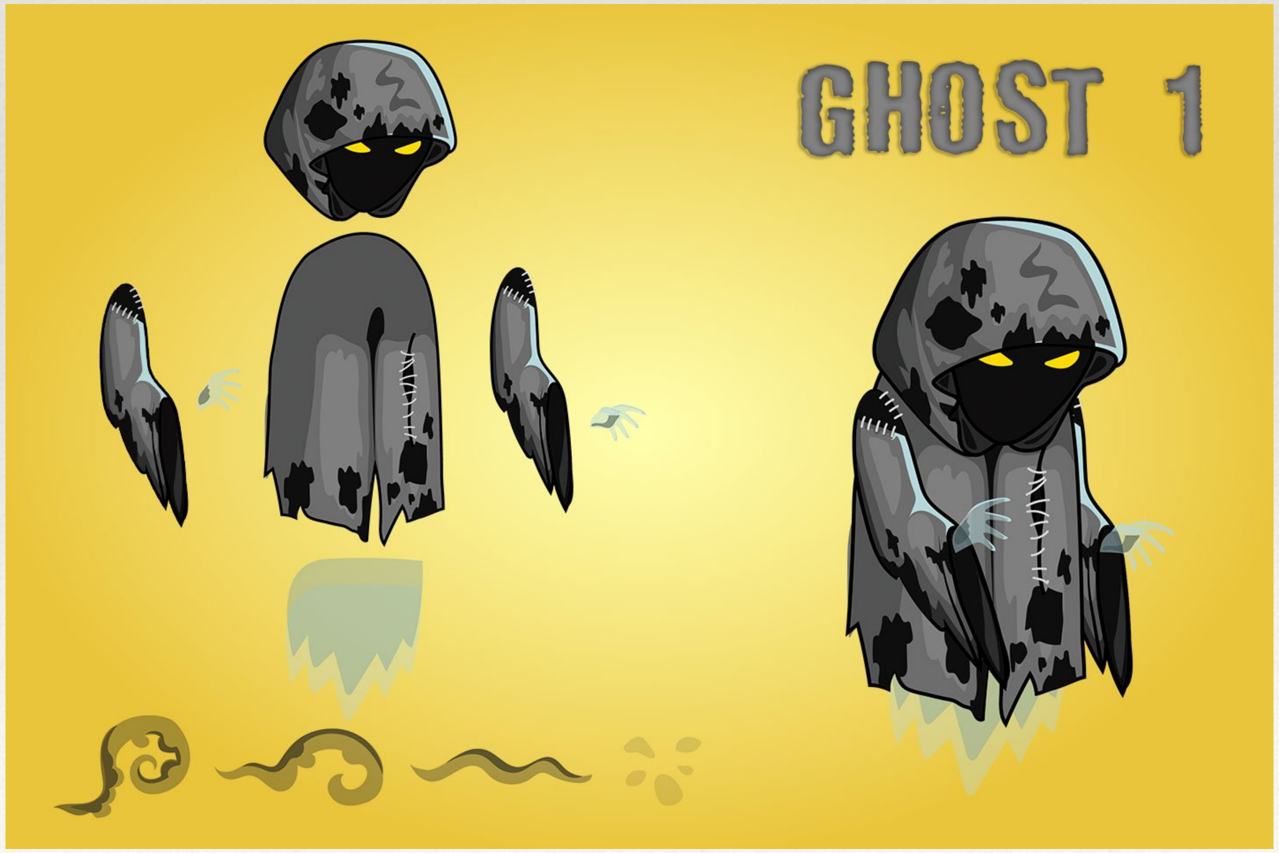
Elements of Graphics
CS324e

Animation Hierarchy Example



How to make the individual pieces?





Creating Shapes from Vertex Points

1. Use `beginShape()` function start shape
2. Specify points defining the shape with `vertex()`
3. Complete the shape with `endShape()`

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

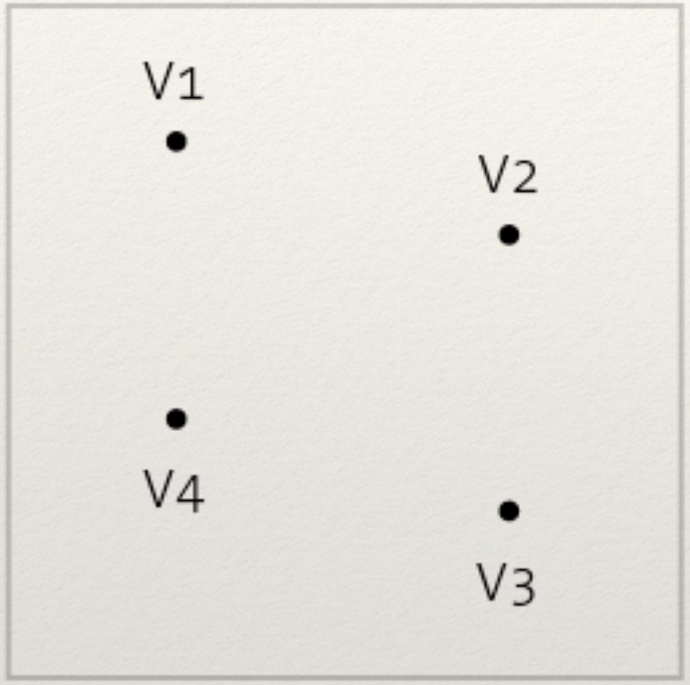
Vertex Points Example

```
beginShape();

vertex(30, 20);

vertex(85, 20);

vertex(85, 75);

vertex(30, 75);

endShape();

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

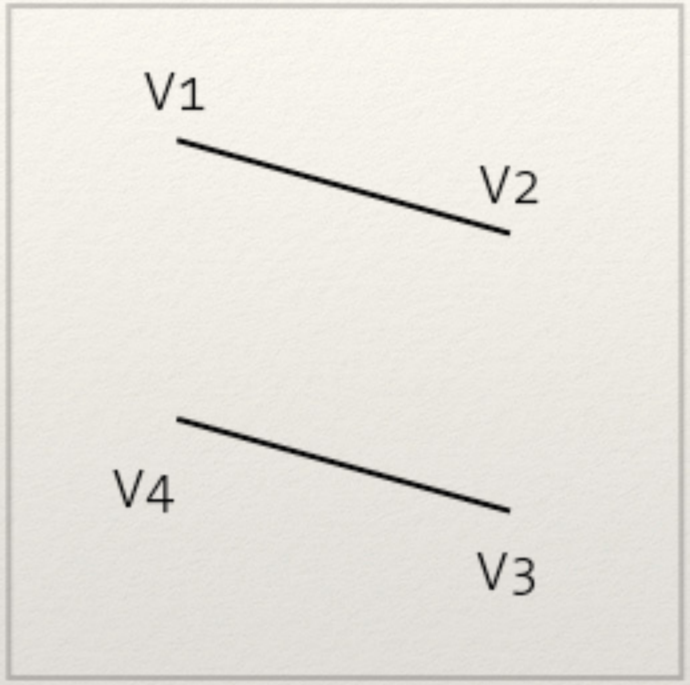
Geometry

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

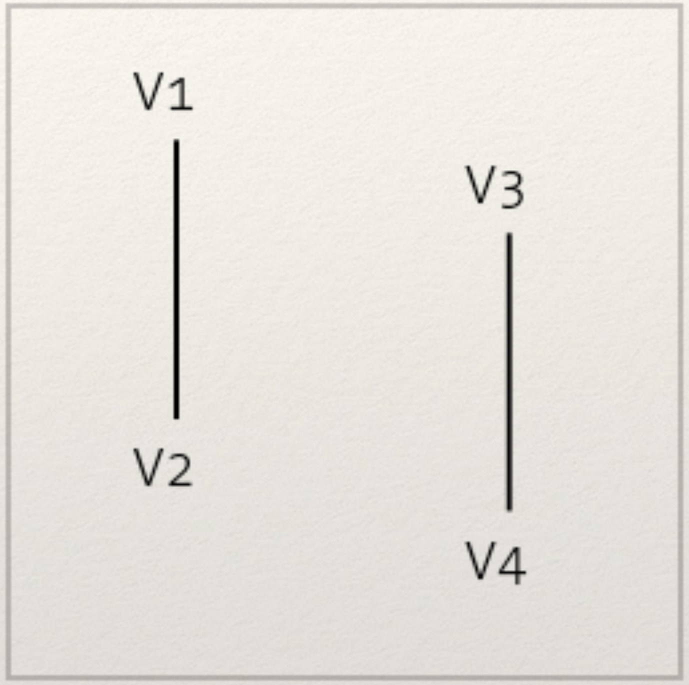
Geometry Examples



POINTS

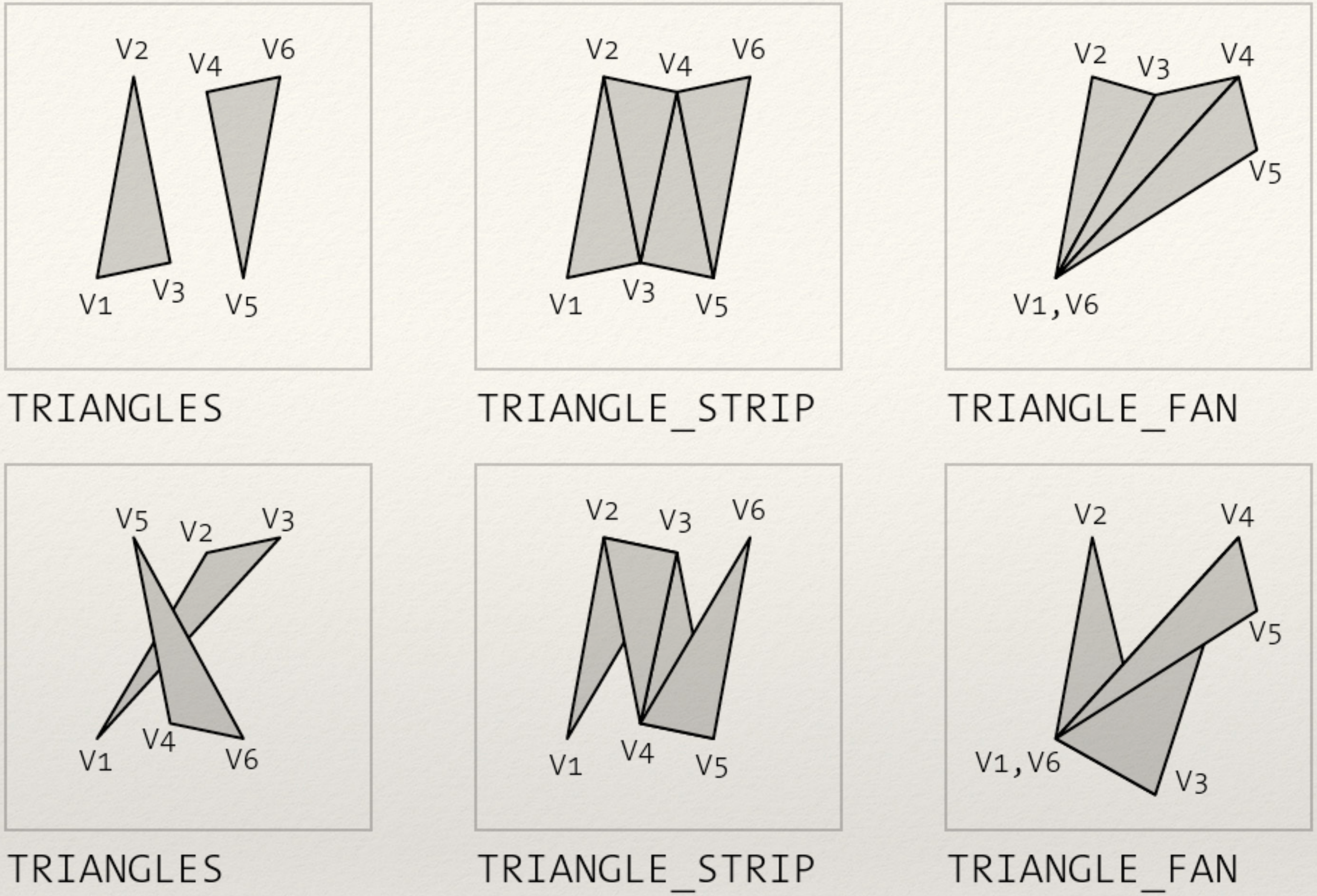


LINES



LINES

- `beginShape(POINTS);`
- `beginShape(LINES);`



TRIANGLES

TRIANGLE_STRIP

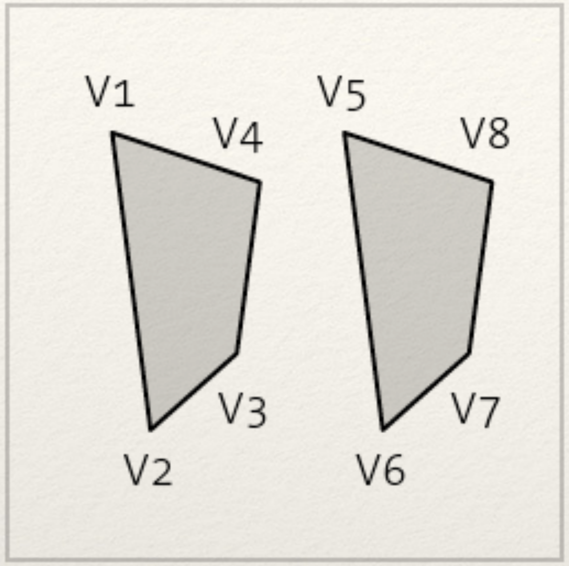
TRIANGLE_FAN

TRIANGLES

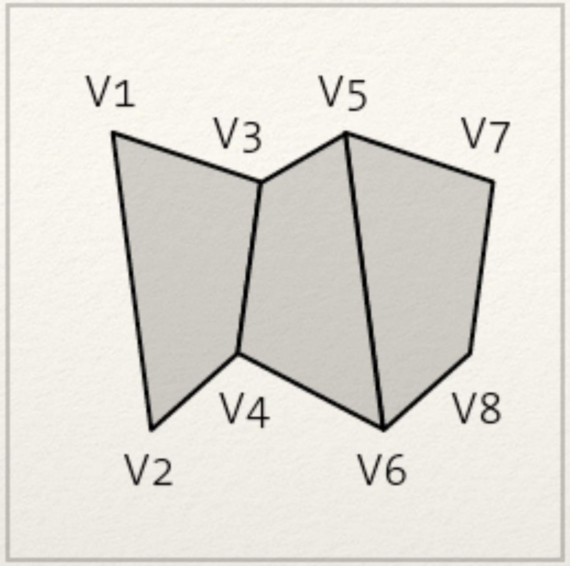
TRIANGLE_STRIP

TRIANGLE_FAN

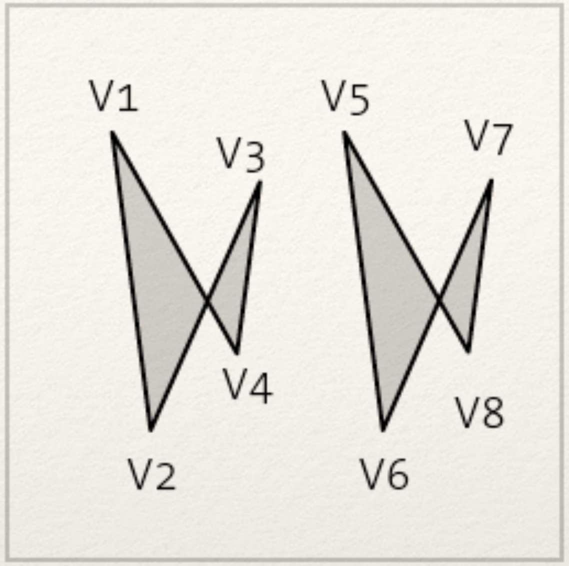
- beginShape(TRIANGLES);
- beginShape(TRIANGLE_STRIP);
- beginShape(TRIANGLE_FAN);



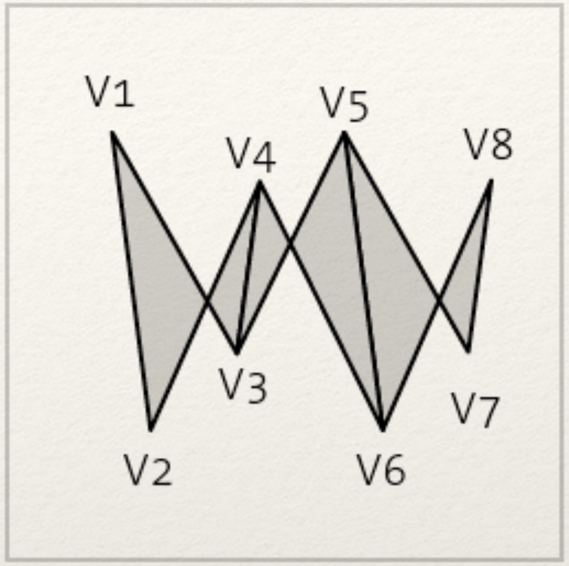
QUADS



QUAD_STRIP



QUADS



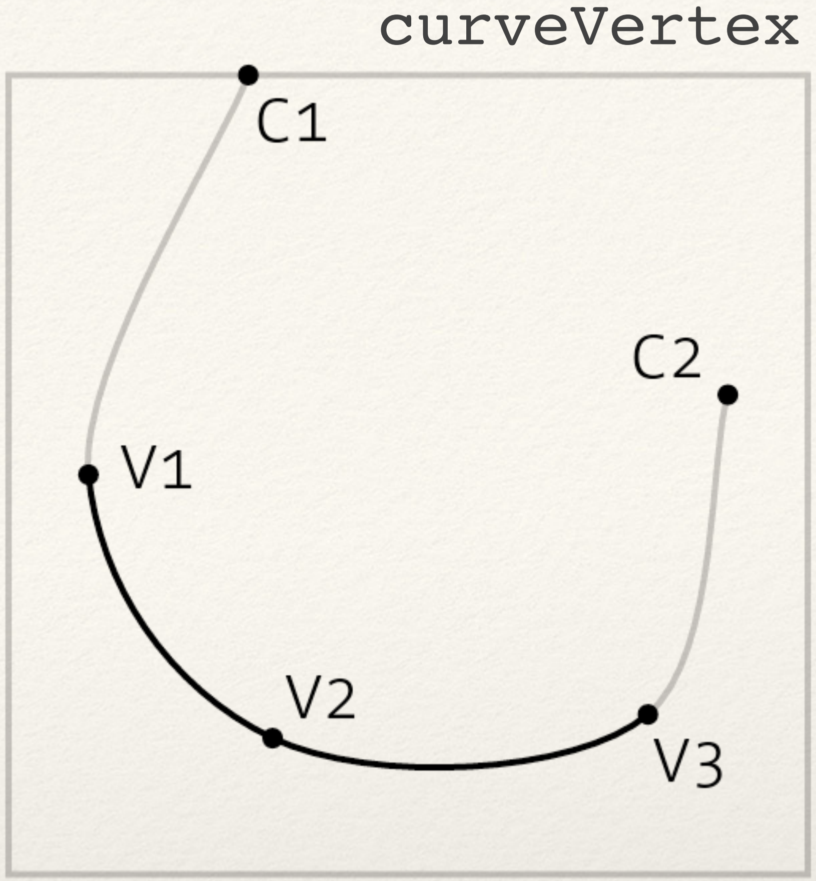
QUAD_STRIP

- beginShape(QUADS);
- beginShape(QUAD_STRIP);

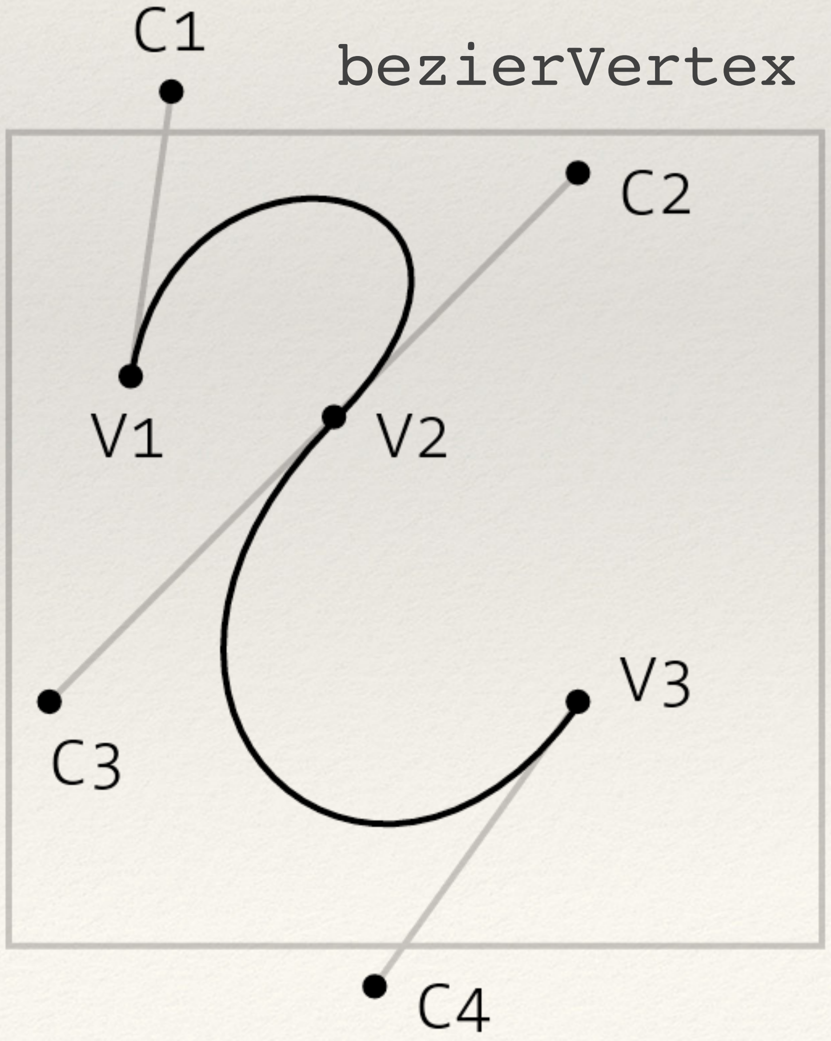
Curves

- `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

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

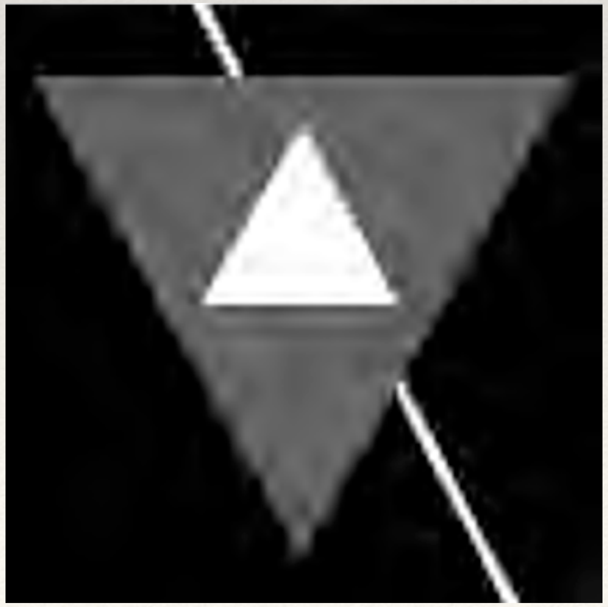


```
beginShape();
vertex(V1);
bezierVertex(C1, C2, V2);
bezierVertex(C3, C4, V3);
endShape();
```

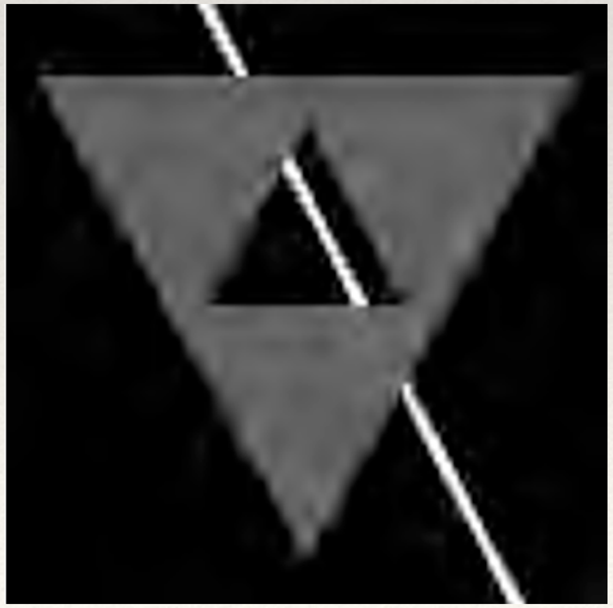


Contours

- Contours cut holes into Shapes
- `beginContour()`/`endContour()` called within `beginShape()`/`endShape()` code block
- `beginContour()` does not take parameters
- Must draw contour in **opposite winding direction** of shape!



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!

```
PShape aShape = createShape();

aShape.beginShape();

//Set fill and stroke information here

aShape.vertex(10, 0);

aShape.vertex(100, 30);

aShape.endShape();
```

PShape Groups

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

```
  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