1 p5.js ソースコード

本稿では p5.js と呼ばれるプログラミング環境を用いる．p5.js は，Processing に影響を受けて開発されたプログラミング環境である．Processing は MIT メディアラボの Casey Reas と Benjamin Fry によって設計された．電子アートとビジュアルデザインのための言語と統合開発環境から構成される．Processing や p5.js で作られた作品については openprocessing.org で閲覧できる．Java 言語と呼ばれるプログラミング言語を単純化し，グラッフィクに特化したものと思って良い．プログラムをした内容がビジュアルに表現されるため，初心者がプログラミングを学習するのに適していると言われている．最近ではアーティストだけでなくデータサイエンティスト等にも人気があり，巨大なデータの可視化等で活躍している

p5.js は Lauren McCarthy によって開発された JavaScript ライブラリである．JavaScript は，Java 言語と名前は似ているが別のプログラミング言語である．現在 Python と並んで，非常に人気のあるプログラミング言語で，テキストエディタと Web ブラウザだけで試すことができる．つまり，「メモ帳」と「Internet Explorer」だけあれば，自宅のパソコン等でも気軽に学習を進めることができる．講義では「TeraPad」もしくは「Atom」というテキストエディタと，「Google Chrome」を推奨する．本稿の各ソースコードは Processing 環境を対象とした教科書「Processing をはじめよう第 2 版（現題:Getting Started with Processing, Casey Reas, Ben Fry 著」（船田 巧訳）と，英語の書籍 “Getting Started with p5.js”(Lauren McCarthy, Casey Reas & Ben Fry 著) を参考にしている．教科書を自分で読みながら，本稿を元にソースコードを入力し，参考にして欲しい．

■実習に関する注意

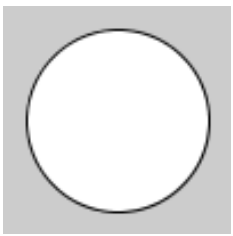
1. 実習に関係ない私語は慎むこと．ただし，実習に関連する相談は推奨する．
2. 自分の頭で考え，自分の手で作業を行い，自分の言葉でノートにメモを取ること．
3. 初出のキーワードは書きだして確認すること．

■ソースコード入力における注意

1. 行の先頭は行番号なので入力しないこと．
2. 括弧の対応 (...), {...}, カンマ , やセミコロン ; を忘れずに入力すること．
3. コードの色分けに注意すること．
4. 大文字と小文字の区別に注意すること．
5. インデント（行頭の空白）に注意して入力すること．
6. 文字間の空白についても統一を心がけること．
7. コンソールに表示される出力やエラーメッセージをよく読むこと．

Listing 1 Ex_02_01.js

```
1: function draw() {
2:   background(204);
3:   ellipse(50, 50, 80, 80);
4: }
```



Listing 2 Ex_02_02.js

```
1: function setup() {
2:   createCanvas(480, 120);
3: }
4: function draw() {
5:   if (mouseIsPressed) {
6:     fill(0);
7:   } else {
8:     fill(255);
9:   }
10:  ellipse(mouseX, mouseY, 80, 80);
11: }
```

Listing 3 Ex_03_01.js

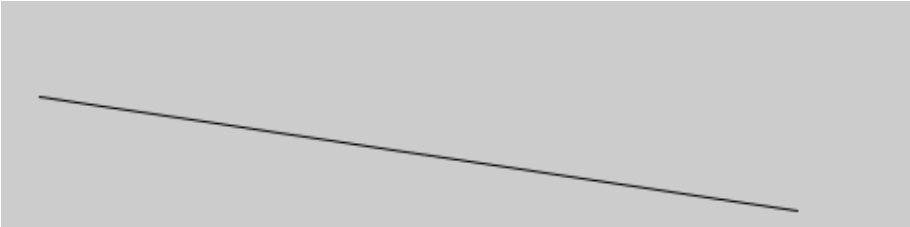
```
1: function setup() {
2:   createCanvas(480, 120); // 教科書では 800x600 です
3: }
4: function draw() {
5:   background(204);
6: }
```


Listing 4 Ex_03_02.js

```
1: function setup() {
2:   createCanvas(480, 120);
3: }
4: function draw() {
5:   background(204);
6:   point(240, 60);
7: }
```

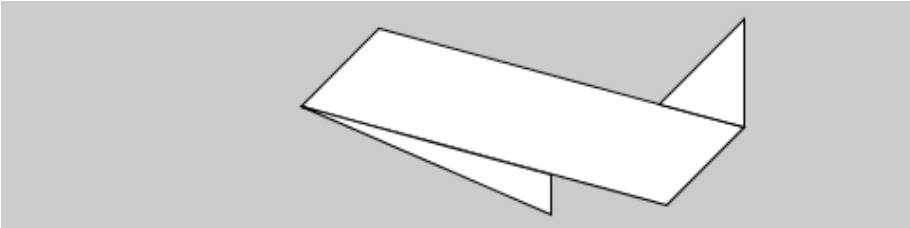
Listing 5 Ex_03_03.js

```
1: function setup() {
2:   createCanvas(480, 120);
3: }
4: function draw() {
5:   background(204);
6:   line(20, 50, 420, 110);
7: }
```



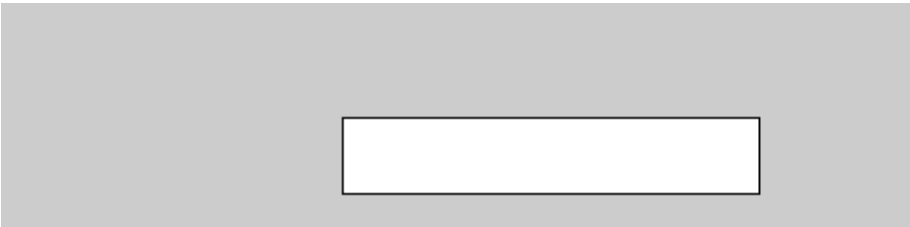
Listing 6 Ex_03_04.js

```
1: function setup() {
2:   createCanvas(480, 120);
3: }
4: function draw() {
5:   background(204);
6:   fill(255);
7:   quad(158, 55, 199, 14, 392, 66, 351, 107);
8:   triangle(347, 54, 392, 9, 392, 66);
9:   triangle(158, 55, 290, 91, 290, 112);
10: }
```



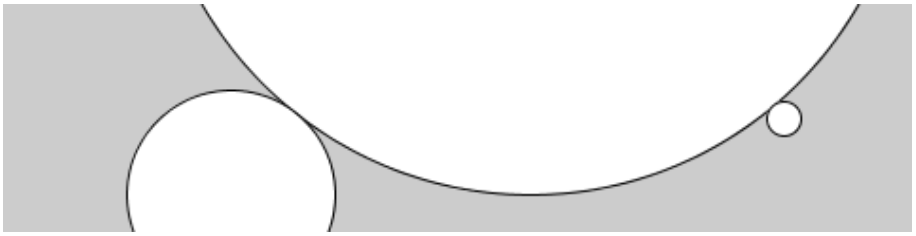
Listing 7 Ex_03_05.js

```
1: function setup() {
2:   createCanvas(480, 120);
3: }
4: function draw() {
5:   background(204);
6:   fill(255);
7:   rect(180, 60, 220, 40);
8: }
```



Listing 8 Ex_03_06.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   fill(255);
 7:   ellipse(278, -100, 400, 400);
 8:   ellipse(120, 100, 110, 110);
 9:   ellipse(412, 60, 18, 18);
10: }
```



Listing 9 Ex_03_07.js

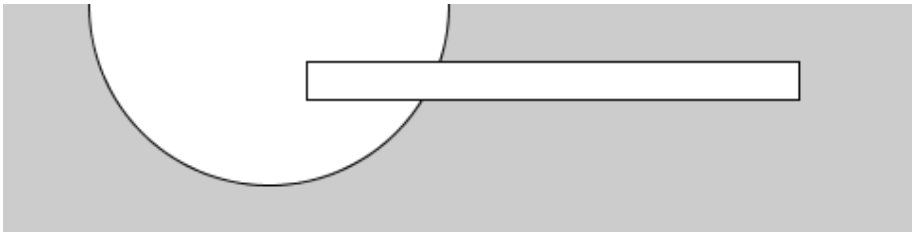
```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   fill(255);
 7:   arc(90, 60, 80, 80, 0, HALF_PI);
 8:   arc(190, 60, 80, 80, 0, PI+HALF_PI);
 9:   arc(290, 60, 80, 80, PI, TWO_PI+HALF_PI);
10:   arc(390, 60, 80, 80, QUARTER_PI, PI+QUARTER_PI);
11: }
```

Listing 10 Ex_03_08.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   fill(255);
 7:   arc(90, 60, 80, 80, 0, radians(90));
 8:   arc(190, 60, 80, 80, 0, radians(270));
 9:   arc(290, 60, 80, 80, radians(180), radians(450));
10:   arc(390, 60, 80, 80, radians(45), radians(225));
11: }
```

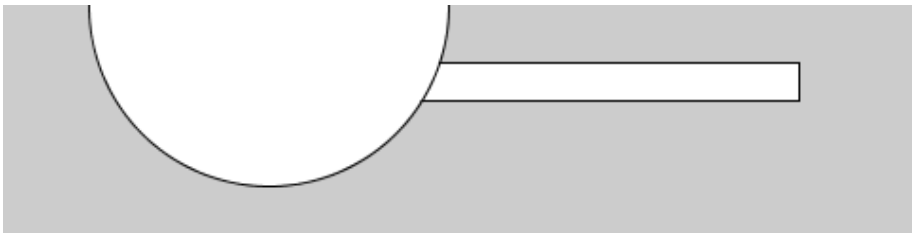
Listing 11 Ex_03_09.js

```
1: function setup() {
2:   createCanvas(480, 120);
3: }
4: function draw() {
5:   background(204);
6:   fill(255);
7:   ellipse(140, 0, 190, 190);
8:   rect(160, 30, 260, 20);
9: }
```



Listing 12 Ex_03_10.js

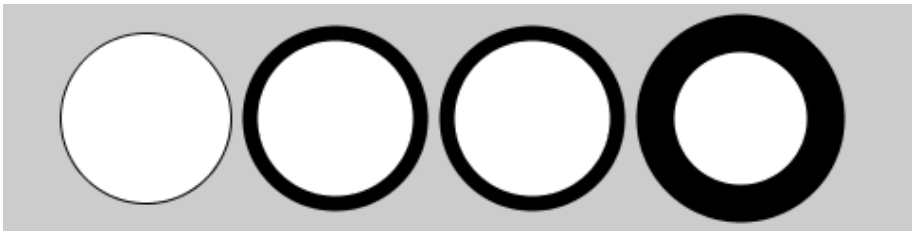
```
1: function setup() {
2:   createCanvas(480, 120);
3: }
4: function draw() {
5:   background(204);
6:   fill(255);
7:   rect(160, 30, 260, 20);
8:   ellipse(140, 0, 190, 190);
9: }
```



Listing 13 Ex_03_11.js

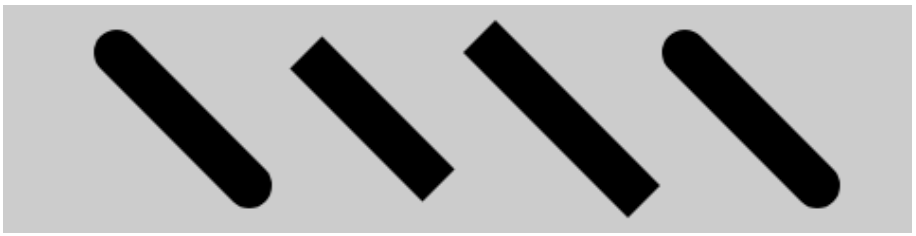
```
1: function setup() {
2:   createCanvas(480, 120);
3:   noLoop();
4: }
5: function draw() {
6:   background(204);
7:   fill(255);
8:   ellipse(75, 60, 90, 90);
9:   strokeWeight(8);
10:  ellipse(175, 60, 90, 90);
```

```
11:   ellipse(279, 60, 90, 90);
12:   strokeWeight(20);
13:   ellipse(389, 60, 90, 90);
14: }
```



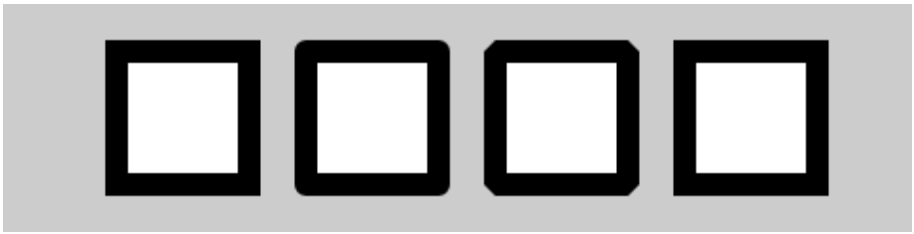
Listing 14 Ex_03_12.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   strokeWeight(24);
 4: }
 5: function draw() {
 6:   background(204);
 7:   line(60, 25, 130, 95);
 8:   strokeCap(SQUARE);
 9:   line(160, 25, 230, 95);
10:   strokeCap(PROJECT);
11:   line(260, 25, 330, 95);
12:   strokeCap(ROUND);
13:   line(360, 25, 430, 95);
14: }
```



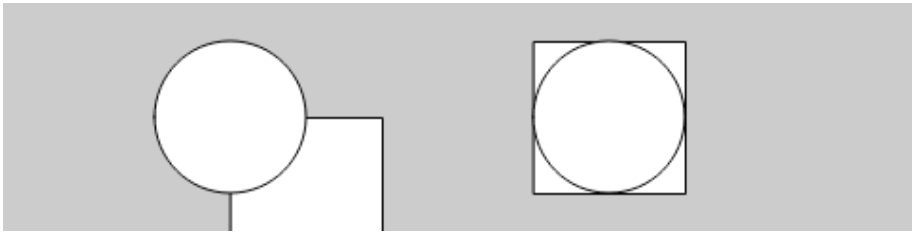
Listing 15 Ex_03_13.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   strokeWeight(12);
 4: }
 5: function draw() {
 6:   background(204);
 7:   rect(60, 25, 70, 70);
 8:   strokeJoin(ROUND);
 9:   rect(160, 25, 70, 70);
10:   strokeJoin(BEVEL);
11:   rect(260, 25, 70, 70);
12:   strokeJoin(MITER);
13:   rect(360, 25, 70, 70);
14: }
```



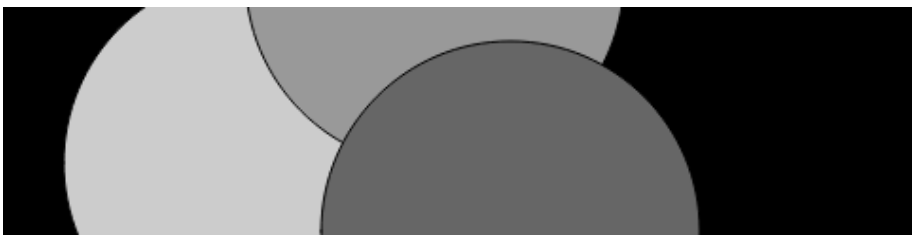
Listing 16 Ex_03_14.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   noLoop();
4: }
5: function draw() {
6:   background(204);
7:   fill(255);
8:   rect(120, 60, 80, 80);
9:   ellipse(120, 60, 80, 80);
10:  ellipseMode(CORNER);
11:  rect(280, 20, 80, 80);
12:  ellipse(280, 20, 80, 80);
13: }
```



Listing 17 Ex_03_15.js

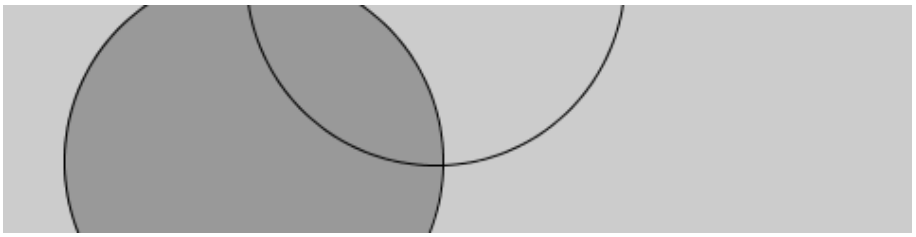
```
1: function setup() {
2:   createCanvas(480, 120);
3:   noLoop();
4: }
5: function draw() {
6:   background(0);
7:   fill(204);
8:   ellipse(132, 82, 200, 200);
9:   fill(153);
10:  ellipse(228, -16, 200, 200);
11:  fill(102);
12:  ellipse(268, 118, 200, 200);
13: }
```



Listing 18 Ex_03_16.js

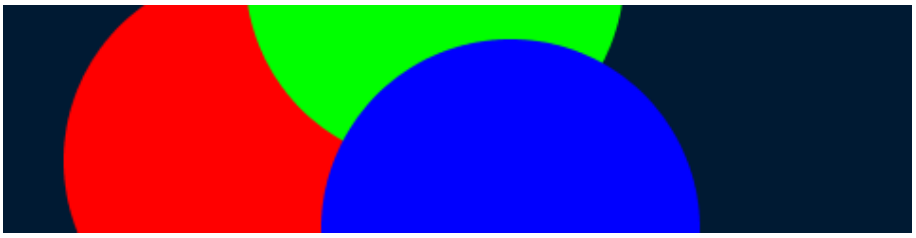
```
1: function setup() {
2:   createCanvas(480, 120);
```

```
 3:   noLoop();
 4: }
 5: function draw() {
 6:   background(204);
 7:   fill(153);                      // Medium gray
 8:   ellipse(132, 82, 200, 200);    // Gray circle
 9:   noFill();                      // Turn off fill
10:   ellipse(228, -16, 200, 200);  // Outline circle
11:   noStroke();                    // Turn off stroke
12:   ellipse(268, 118, 200, 200);  // Doesn't draw!
13: }
```



Listing 19 Ex_03_17.js

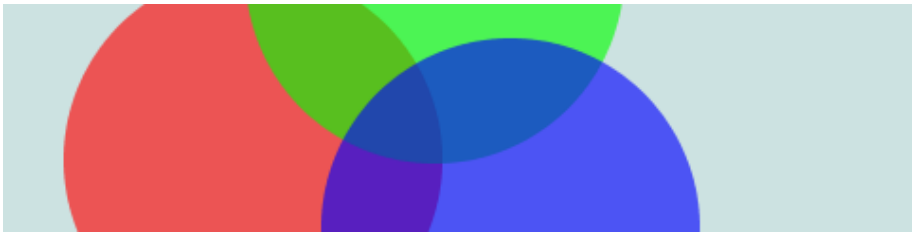
```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   noStroke();
 4: }
 5: function draw() {
 6:   background(0, 26, 51);          // Dark blue color
 7:   fill(255, 0, 0);                // Red color
 8:   ellipse(132, 82, 200, 200);    // Red circle
 9:   fill(0, 255, 0);                // Green color
10:   ellipse(228, -16, 200, 200);  // Green circle
11:   fill(0, 0, 255);                // Blue color
12:   ellipse(268, 118, 200, 200);  // Blue circle
13: }
```



Listing 20 Ex_03_18.js

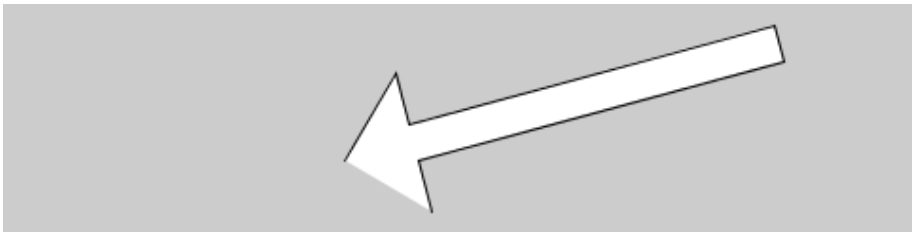
```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   noStroke();
 4: }
 5: function draw() {
 6:   background(204, 226, 225);    // Light blue color
 7:   fill(255, 0, 0, 160);          // Red color
 8:   ellipse(132, 82, 200, 200);   // Red circle
 9:   fill(0, 255, 0, 160);          // Green color
10:   ellipse(228, -16, 200, 200); // Green circle
11:   fill(0, 0, 255, 160);          // Blue color
12:   ellipse(268, 118, 200, 200); // Blue circle
```

```
13: }
```



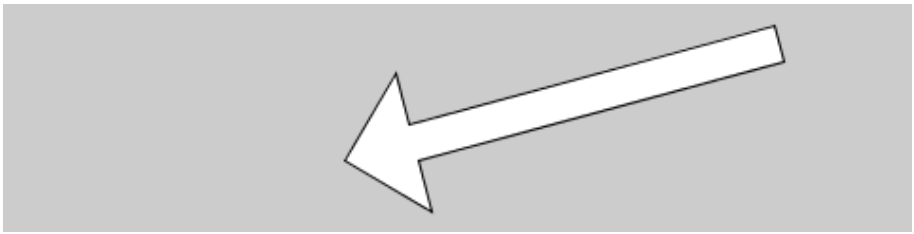
Listing 21 Ex_03_19.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   fill(255);
 7:   beginShape();
 8:   vertex(180, 82);
 9:   vertex(207, 36);
10:   vertex(214, 63);
11:   vertex(407, 11);
12:   vertex(412, 30);
13:   vertex(219, 82);
14:   vertex(226, 109);
15:   endShape();
16: }
```



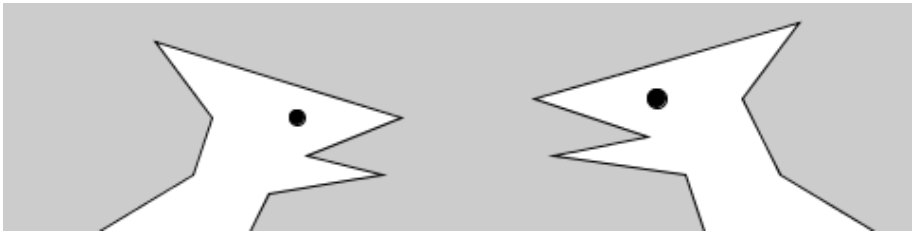
Listing 22 Ex_03_20.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   fill(255);
 7:   beginShape();
 8:   vertex(180, 82);
 9:   vertex(207, 36);
10:   vertex(214, 63);
11:   vertex(407, 11);
12:   vertex(412, 30);
13:   vertex(219, 82);
14:   vertex(226, 109);
15:   endShape(CLOSE);
16: }
```



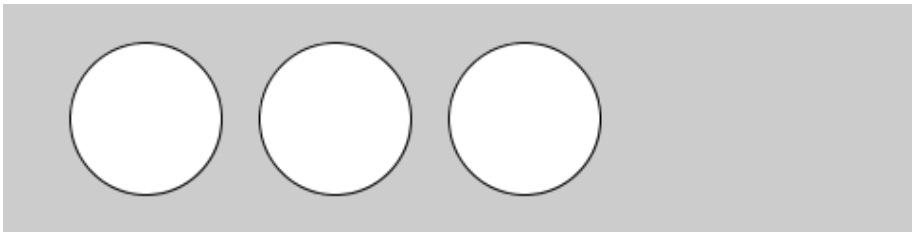
Listing 23 Ex_03_21.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   fill(255);
 7:
 8:   // Left creature
 9:   beginShape();
10:   vertex(50, 120);
11:   vertex(100, 90);
12:   vertex(110, 60);
13:   vertex(80, 20);
14:   vertex(210, 60);
15:   vertex(160, 80);
16:   vertex(200, 90);
17:   vertex(140, 100);
18:   vertex(130, 120);
19:   endShape();
20:   fill(0);
21:   ellipse(155, 60, 8, 8);
22:   // Right creature
23:   fill(255);
24:   beginShape();
25:   vertex(370, 120);
26:   vertex(360, 90);
27:   vertex(290, 80);
28:   vertex(340, 70);
29:   vertex(280, 50);
30:   vertex(420, 10);
31:   vertex(390, 50);
32:   vertex(410, 90);
33:   vertex(460, 120);
34:   endShape();
35:   fill(0);
36:   ellipse(345, 50, 10, 10);
37: }
```



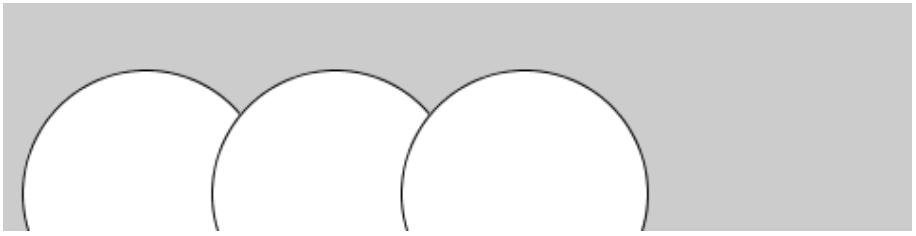
Listing 24 Ex_04_01.js

```
 1: var y = 60;
 2: var d = 80;
 3: function setup() {
 4:   createCanvas(480, 120);
 5: }
 6: function draw() {
 7:   background(204);
 8:   fill(255);
 9:   ellipse(75, y, d, d);   // Left
10:   ellipse(175, y, d, d);  // Middle
11:   ellipse(275, y, d, d);  // Right
12: }
```



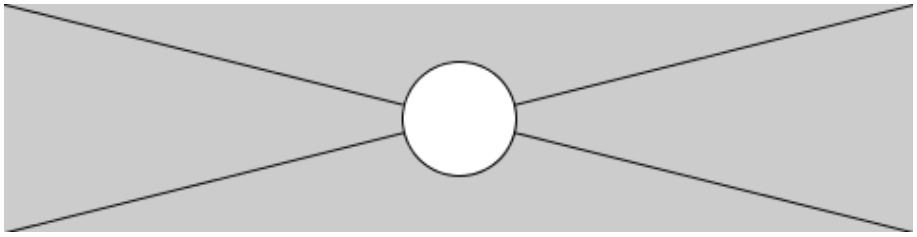
Listing 25 Ex_04_02.js

```
 1: var y = 100;
 2: var d = 130;
 3: function setup() {
 4:   createCanvas(480, 120);
 5: }
 6: function draw() {
 7:   background(204);
 8:   fill(255);
 9:   ellipse(75, y, d, d);   // Left
10:   ellipse(175, y, d, d);  // Middle
11:   ellipse(275, y, d, d);  // Right
12: }
```



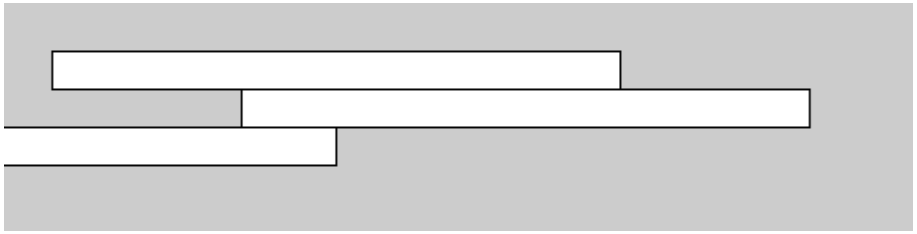
Listing 26 Ex_04_03.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   fill(255);
 7:   line(0, 0, width, height);  // Line from (0,0) to (480, 120)
 8:   line(width, 0, 0, height);  // Line from (480, 0) to (0, 120)
 9:   ellipse(width/2, height/2, 60, 60);
10: }
```



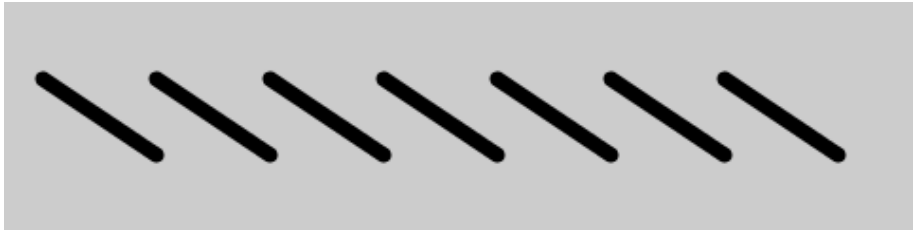
Listing 27 Ex_04_04.js

```
 1: var x = 25;
 2: var h = 20;
 3: var y = 25;
 4: function setup() {
 5:   createCanvas(480, 120);
 6: }
 7: function draw() {
 8:   background(204);
 9:   fill(255);
10:   x = 20;
11:   rect(x, y, 300, h);         // Top
12:   x = x + 100;
13:   rect(x, y + h, 300, h);     // Middle
14:   x = x - 250;
15:   rect(x, y + h*2, 300, h); // Bottom
16: }
```



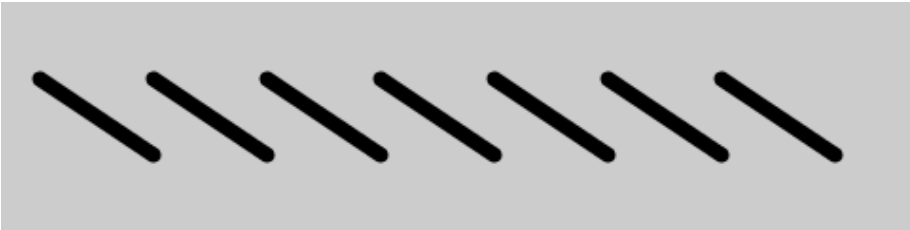
Listing 28 Ex_04_05.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   strokeWeight(8);
 4: }
 5: function draw() {
 6:   background(204);
 7:   line(20, 40, 80, 80);
 8:   line(80, 40, 140, 80);
 9:   line(140, 40, 200, 80);
10:   line(200, 40, 260, 80);
11:   line(260, 40, 320, 80);
12:   line(320, 40, 380, 80);
13:   line(380, 40, 440, 80);
14: }
```



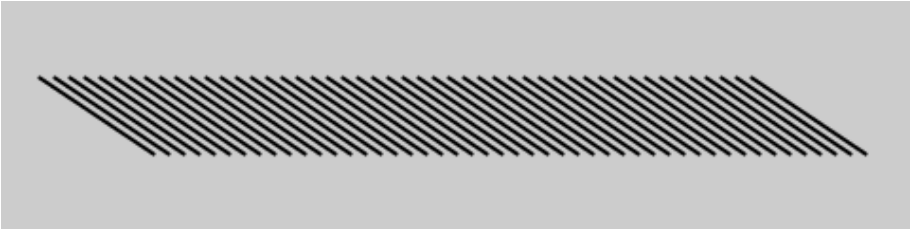
Listing 29 Ex_04_06.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   strokeWeight(8);
 4: }
 5: function draw() {
 6:   background(204);
 7:   for (var i = 20; i < 400; i += 60) {
 8:     line(i, 40, i + 60, 80);
 9:   }
10: }
```



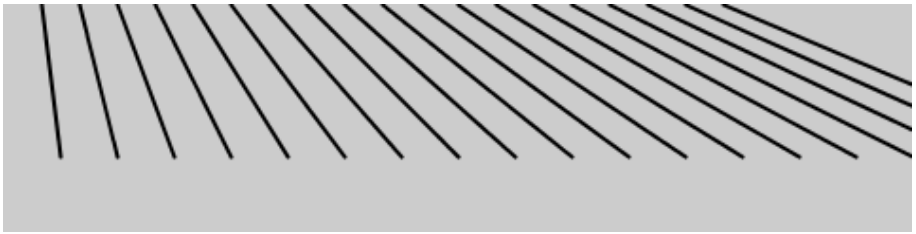
Listing 30 Ex_04_07.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   strokeWeight(2);
 4: }
 5: function draw() {
 6:   background(204);
 7:   for (var i = 20; i < 400; i += 8) {
 8:     line(i, 40, i + 60, 80);
 9:   }
10: }
```



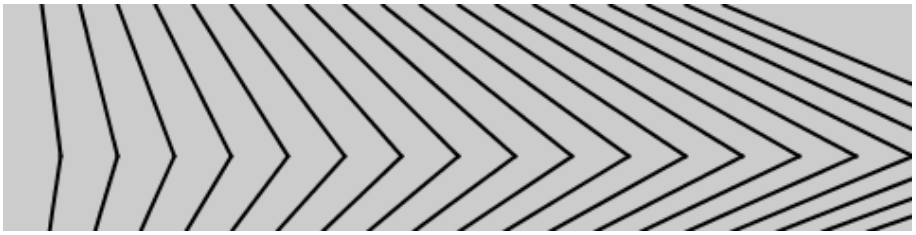
Listing 31 Ex_04_08.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   strokeWeight(2);
 4: }
 5: function draw() {
 6:   background(204);
 7:   for (var i = 20; i < 400; i += 20) {
 8:     line(i, 0, i + i/2, 80);
 9:   }
10: }
```



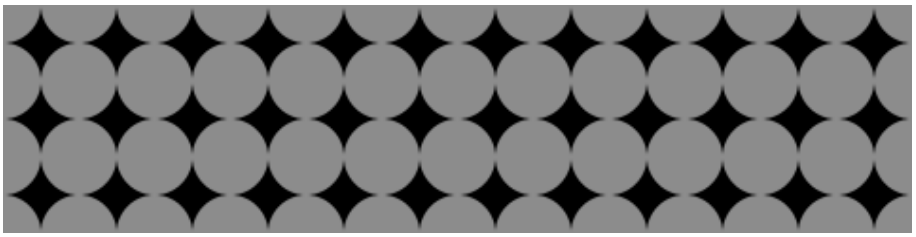
Listing 32 Ex_04_09.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   strokeWeight(2);
4: }
5: function draw() {
6:   background(204);
7:   for (var i = 20; i < 400; i += 20) {
8:     line(i, 0, i + i/2, 80);
9:     line(i + i/2, 80, i*1.2, 120);
10:  }
11: }
```



Listing 33 Ex_04_10.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   noStroke();
4: }
5: function draw() {
6:   background(0);
7:   for (var y = 0; y <= height; y += 40) {
8:     for (var x = 0; x <= width; x += 40) {
9:       fill(255, 140);
10:      ellipse(x, y, 40, 40);
11:    }
12:  }
13: }
```



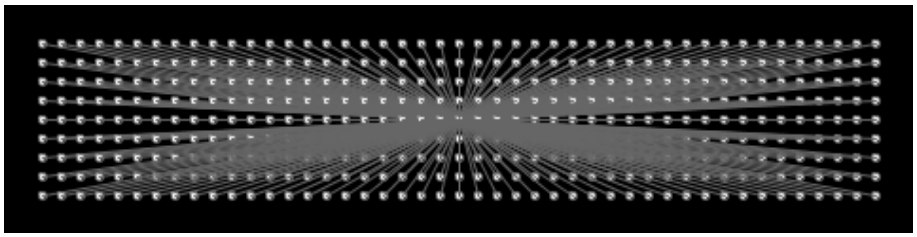
Listing 34 Ex_04_11.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   noStroke();
4: }
```

```
 5: function draw() {
 6:   background(0);
 7:   for (var y = 0; y < height+45; y += 40) {
 8:     fill(255, 140);
 9:     ellipse(0, y, 40, 40);
10:   }
11:   for (var x = 0; x < width+45; x += 40) {
12:     fill(255, 140);
13:     ellipse(x, 0, 40, 40);
14:   }
15: }
```

Listing 35 Ex_04_12.js

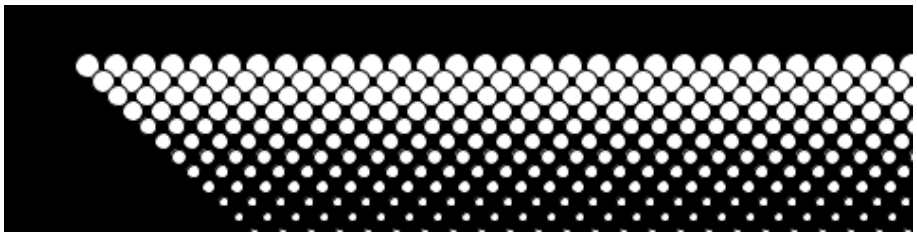
```
 1: function setup() {
 2:   createCanvas(480, 120);
 3:   fill(255);
 4:   stroke(102);
 5: }
 6: function draw() {
 7:   background(0);
 8:   for (var y = 20; y <= height-20; y += 10) {
 9:     for (var x = 20; x <= width-20; x += 10) {
10:       ellipse(x, y, 4, 4);
11:       // Draw a line to the center of the display
12:       line(x, y, 240, 60);
13:     }
14:   }
15: }
```



Listing 36 Ex_04_13.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(0);
 6:   fill(255);
 7:   for (var y = 32; y <= height; y += 8) {
 8:     for (var x = 12; x <= width; x += 15) {
 9:       ellipse(x + y, y, 16 - y/10.0, 16 - y/10.0);
10:     }
```

```
11:   }
12: }
```



Listing 37 Ex_05_01.js

```
1: function draw() {
2:   // Displays the frame count to the Console
3:   print("I'm drawing");
4:   print(frameCount);
5: }
```

Listing 38 Ex_05_02.js

```
1: function setup() {
2:   print("I'm starting");
3: }
4: function draw() {
5:   print("I'm running");
6: }
```

Listing 39 Ex_05_03.js

```
1: var x = 280;
2: var y = -100;
3: var diameter = 380;
4: function setup() {
5:   createCanvas(480, 120);
6:   fill(102);
7: }
8: function draw() {
9:   background(204);
10:  ellipse(x, y, diameter, diameter);
11: }
```

Listing 40 Ex_05_04.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   fill(0, 102);
4:   noStroke();
5: }
```

```
6: function draw() {
7:   ellipse(mouseX, mouseY, 9, 9);
8: }
```

Listing 41 Ex_05_05.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   fill(0, 102);
4:   noStroke();
5: }
6: function draw() {
7:   background(204);
8:   ellipse(mouseX, mouseY, 9, 9);
9: }
```

Listing 42 Ex_05_06.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   strokeWeight(4);
4:   stroke(0, 102);
5: }
6: function draw() {
7:   line(mouseX, mouseY, pmouseX, pmouseY);
8: }
```

Listing 43 Ex_05_07.js

```
1: function setup() {
2:   createCanvas(480, 120);
3:   stroke(0, 102);
4: }
5: function draw() {
6:   var weight = dist(mouseX, mouseY, pmouseX, pmouseY);
7:   strokeWeight(weight);
8:   line(mouseX, mouseY, pmouseX, pmouseY);
9: }
```

Listing 44 Ex_05_08.js

```
1: var x = 0;
2: var easing = 0.01;
3: function setup() {
4:   createCanvas(220, 120);
```

```
 5: }
 6: function draw() {
 7:   var targetX = mouseX;
 8:   x += (targetX - x) * easing;
 9:   ellipse(x, 40, 12, 12);
10:   print(targetX + " : " + x);
11: }
```

Listing 45 Ex_05_09.js

```
 1: var x = 0;
 2: var y = 0;
 3: var px = 0;
 4: var py = 0;
 5: var easing = 0.05;
 6: function setup() {
 7:   createCanvas(480, 120);
 8:   stroke(0, 102);
 9: }
10: function draw() {
11:   var targetX = mouseX;
12:   x += (targetX - x) * easing;
13:   var targetY = mouseY;
14:   y += (targetY - y) * easing;
15:   var weight = dist(x, y, px, py);
16:   strokeWeight(weight);
17:   line(x, y, px, py);
18:   py = y;
19:   px = x;
20: }
```

Listing 46 Ex_05_10.js

```
 1: function setup() {
 2:   createCanvas(240, 120);
 3:   strokeWeight(30);
 4: }
 5: function draw() {
 6:   background(204);
 7:   stroke(102);
 8:   line(40, 0, 70, height);
 9:   if (mouseIsPressed == true) {
10:     stroke(0);
11:   }
12:   line(0, 70, width, 50);
13: }
```

Listing 47 Ex_05_11.js

```
 1: function setup() {
 2:   createCanvas(240, 120);
 3:   strokeWeight(30);
 4: }
 5: function draw() {
 6:   background(204);
 7:   stroke(102);
 8:   line(40, 0, 70, height);
 9:   if (mouseIsPressed) {
10:     stroke(0);
11:   } else {
12:     stroke(255);
13:   }
14:   line(0, 70, width, 50);
15: }
```

Listing 48 Ex_05_12.js

```
 1: function setup() {
 2:   createCanvas(120, 120);
 3:   strokeWeight(30);
 4: }
 5: function draw() {
 6:   background(204);
 7:   stroke(102);
 8:   line(40, 0, 70, height);
 9:   if (mouseIsPressed) {
10:     if (mouseButton == LEFT) {
11:       stroke(255);
12:     } else {
13:       stroke(0);
14:     }
15:     line(0, 70, width, 50);
16:   }
17: }
```

Listing 49 Ex_05_13.js

```
 1: var x;
 2: var offset = 10;
 3: function setup() {
 4:   createCanvas(240, 120);
 5:   x = width/2;
 6: }
 7: function draw() {
 8:   background(204);
 9:   if (mouseX > x) {
10:     x += 0.5;
11:     offset = -10;
```

```
12:   }
13:   if (mouseX < x) {
14:     x -= 0.5;
15:     offset = 10;
16:   }
17:   line(x, 0, x, height);
18:   line(mouseX, mouseY, mouseX + offset, mouseY - 10);
19:   line(mouseX, mouseY, mouseX + offset, mouseY + 10);
20:   line(mouseX, mouseY, mouseX + offset*3, mouseY);
21: }
```

Listing 50 Ex_05_14.js

```
1: var x = 120;
2: var y = 60;
3: var radius = 12;
4: function setup() {
5:   createCanvas(240, 120);
6:   ellipseMode(RADIUS);
7: }
8: function draw() {
9:   background(204);
10:  var d = dist(mouseX, mouseY, x, y);
11:  if (d < radius) {
12:    radius++;
13:    fill(0);
14:  } else {
15:    fill(255);
16:  }
17:  ellipse(x, y, radius, radius);
18: }
```

Listing 51 Ex_05_15.js

```
1: var x = 80;
2: var y = 30;
3: var w = 80;
4: var h = 60;
5: function setup() {
6:   createCanvas(240, 120);
7: }
8: function draw() {
9:   background(204);
10:  if ((mouseX > x) && (mouseX < x+w) &&
11:    (mouseY > y) && (mouseY < y+h)) {
12:    fill(0);
13:  }
14:  else {
15:    fill(255);
16:  }
```

```
17:   rect(x, y, w, h);
18: }
```

Listing 52 Ex_05_16.js

```
 1: function setup() {
 2:   createCanvas(240, 120);
 3:   smooth();
 4: }
 5: function draw() {
 6:   background(204);
 7:   line(20, 20, 220, 100);
 8:   if (keyIsPressed) {
 9:     line(220, 20, 20, 100);
10:   }
11: }
```

Listing 53 Ex_05_17.js

```
 1: function setup() {
 2:   createCanvas(120, 120);
 3:   textSize(64);
 4:   textAlign(CENTER);
 5:   fill(255);
 6: }
 7: function draw() {
 8:   background(0);
 9:   text(key, 60, 80);
10: }
```

Listing 54 Ex_05_18.js

```
 1: function setup() {
 2:   createCanvas(120, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   if (keyIsPressed) {
 7:     if ((key == 'h') || (key == 'H')) {
 8:       line(30, 60, 90, 60);
 9:     }
10:     if ((key == 'n') || (key == 'N')) {
11:       line(30, 20, 90, 100);
12:     }
13:   }
14:   line(30, 20, 30, 100);
15:   line(90, 20, 90, 100);
16: }
```

Listing 55 Ex_05_19.js

```
var x = 215;
function setup() {
  createCanvas(480, 120);
}
function draw() {
  if (keyIsPressed) {
    if (keyCode == LEFT_ARROW) {
      x--;
    }
    else if (keyCode == RIGHT_ARROW) {
      x++;
    }
  }
  rect(x, 45, 50, 50);
}
```

Listing 56 Ex_05_20.js

```
function setup() {
  createCanvas(240, 120);
  strokeWeight(12);
}
function draw() {
  background(204);
  stroke(102);
  line(mouseX, 0, mouseX, height);
  stroke(0);
  var mx = mouseX/2 + 60;
  line(mx, 0, mx, height);
}
```

Listing 57 Ex_05_21.js

```
function setup() {
  createCanvas(240, 120);
  strokeWeight(12);
}
function draw() {
  background(204);
  stroke(102);
  line(mouseX, 0, mouseX, height);
  stroke(0);
  var mx = map(mouseX, 0, width, 60, 180);
  line(mx, 0, mx, height);
}
```

Listing 58 Ex_06_01.js

```
1: function setup() {
2:   createCanvas(120, 120);
3:   background(204);
4: }
5: function draw() {
6:   translate(mouseX, mouseY);
7:   rect(0, 0, 30, 30);
8: }
```

Listing 59 Ex_06_02.js

```
1: function setup() {
2:   createCanvas(120, 120);
3:   background(204);
4: }
5: function draw() {
6:   translate(mouseX, mouseY);
7:   rect(0, 0, 30, 30);
8:   translate(35, 10);
9:   rect(0, 0, 15, 15);
10: }
```

Listing 60 Ex_06_03.js

```
1: function setup() {
2:   createCanvas(120, 120);
3: }
4: function draw() {
5:   rotate(mouseX / 100.0);
6:   rect(0, 0, 160, 20);
7: }
```

Listing 61 Ex_06_04.js

```
1: function setup() {
2:   createCanvas(120, 120);
3: }
4: function draw() {
5:   rotate(mouseX / 100.0);
6:   rect(-80, -10, 160, 20);
7: }
```

Listing 62 Ex_06_05.js

```
 1: var angle = 0.0;
 2: function setup() {
 3:   createCanvas(120, 120);
 4:   background(204);
 5: }
 6: function draw() {
 7:   translate(mouseX, mouseY);
 8:   rotate(angle);
 9:   rect(-15, -15, 30, 30);
10:   angle += 0.1;
11: }
```

Listing 63 Ex_06_06.js

```
 1: var angle = 0.0;
 2: function setup() {
 3:   createCanvas(120, 120);
 4:   background(204);
 5: }
 6: function draw() {
 7:   rotate(angle);
 8:   translate(mouseX, mouseY);
 9:   rect(-15, -15, 30, 30);
10:   angle += 0.1;
11: }
```

Listing 64 Ex_06_07.js

```
 1: var angle = 0.0;
 2: var angleDirection = 1;
 3: var speed = 0.005;
 4: function setup() {
 5:   createCanvas(120, 120);
 6:   //background(204);
 7: }
 8: function draw() {
 9:   background(204);
10:   translate(20, 25);  // Move to start position
11:   rotate(angle);
12:   strokeWeight(12);
13:   line(0, 0, 40, 0);
14:   translate(40, 0);   // Move to next jovar
15:   rotate(angle * 2.0);
16:   strokeWeight(6);
17:   line(0, 0, 30, 0);
18:   translate(30, 0);   // Move the next jovar
19:   rotate(angle * 2.5);
20:   strokeWeight(3);
21:   line(0, 0, 20, 0);
22:
```

```
23:   angle += speed * angleDirection;
24:   if ((angle > QUARTER_PI) || (angle < 0)) {
25:         angleDirection *= -1;
26:   }
27: }
```

Listing 65 Ex_06_08.js

```
1: function setup() {
2:   createCanvas(120, 120);
3: }
4: function draw() {
5:   translate(mouseX, mouseY);
6:   scale(mouseX / 60.0);
7:   rect(-15, -15, 30, 30);
8: }
```

Listing 66 Ex_06_09.js

```
1: function setup() {
2:   createCanvas(120, 120);
3: }
4: function draw() {
5:   translate(mouseX, mouseY);
6:   var scalar = mouseX / 60.0;
7:   scale(scalar);
8:   strokeWeight(1.0 / scalar);
9:   rect(-15, -15, 30, 30);
10: }
```

Listing 67 Ex_06_10.js

```
1: function setup() {
2:   createCanvas(120, 120);
3: }
4: function draw() {
5:   push();
6:   translate(mouseX, mouseY);
7:   rect(0, 0, 30, 30);
8:   pop();
9:   translate(35, 10);
10:  rect(0, 0, 15, 15);
11: }
```

Listing 68 Ex_07_01.js

```
1: var img;
2: function preload() {
3:   img = loadImage("media/lunar.jpg");
4: }
5: function setup() {
6:   createCanvas(480, 480);
7: }
8: function draw() {
9:   image(img, 0, 0);
10: }
```

Listing 69 Ex_07_02.js

```
1: var img1;
2: var img2;
3: function preload() {
4:   img1 = loadImage("media/lunar.jpg");
5:   img2 = loadImage("media/capsule.jpg");
6: }
7: function setup() {
8:   createCanvas(480, 120);
9: }
10: function draw() {
11:   image(img1, -120, 0);
12:   image(img1, 130, 0, 240, 120);
13:   image(img2, 300, 0, 240, 120);
14: }
```

Listing 70 Ex_07_03.js

```
1: var img;
2: function preload() {
3:   img = loadImage("media/lunar.jpg");
4: }
5: function setup() {
6:   createCanvas(480, 120);
7: }
8: function draw() {
9:   background(0);
10:   image(img, 0, 0, mouseX * 2, mouseY * 2);
11: }
```

Listing 71 Ex_07_04.js

```
1: var img;
2: function preload() {
3:   img = loadImage("media/clouds.gif");
```

```
 4: }
 5: function setup() {
 6:   createCanvas(480, 120);
 7: }
 8: function draw() {
 9:   background(255);
10:   image(img, 0, 0);
11:   image(img, 0, mouseY * -1);
12: }
```

Listing 72 Ex_07_05.js

```
 1: var img;
 2: function preload() {
 3:   img = loadImage("media/clouds.png");
 4: }
 5: function setup() {
 6:   createCanvas(480, 120);
 7: }
 8: function draw() {
 9:   background(204);
10:   image(img, 0, 0);
11:   image(img, 0, mouseY * -1);
12: }
```

Listing 73 Ex_07_06.js

```
 1: function preload() {
 2:   font = loadFont("media/SourceCodePro-Regular.ttf");
 3: }
 4: function setup() {
 5:   createCanvas(480, 120);
 6:   textFont(font);
 7: }
 8: function draw() {
 9:   background(102);
10:   fill(255);
11:   textSize(32);
12:   text("That's one small step for man...", 25, 60);
13:   textSize(16);
14:   text("That's one small step for man...", 27, 90);
15: }
```

Listing 74 Ex_07_07.js

```
 1: function preload() {
 2:   font=loadFont("media/SourceCodePro-Regular.ttf");
 3: }
```

```
 4: function setup() {
 5:   createCanvas(480, 120);
 6:   textFont(font);
 7: }
 8: function draw() {
 9:   background(102);
10:   fill(255);
11:   textSize(22);
12:   text("That's one small step for man...", 26, 24, 240, 100);
13: }
```

Listing 75 Ex_07_08.js

```
 1: var quote = "That's one small step for man..."
 2: function preload() {
 3:   font=loadFont("media/SourceCodePro-Regular.ttf");
 4: }
 5: function setup() {
 6:   createCanvas(480, 120);
 7:   textFont(font);
 8: }
 9: function draw() {
10:   background(102);
11:   fill(255);
12:   textSize(22);
13:   text(quote, 26, 24, 240, 100);
14: }
```

Listing 76 Ex_07_09.js

```
 1: var img;
 2: function preload() {
 3:   img = loadImage("media/network.svg");
 4: }
 5: function setup() {
 6:   createCanvas(480, 120);
 7: }
 8: function draw() {
 9:   background(0);
10:   image(img, 30, 10);
11:   image(img, 180, 10, 280, 280);
12: }
```

Listing 77 Ex_07_10.js

```
 1: var img;
 2: function preload() {
 3:   img = loadImage("media/network.svg");
```

```
 4: }
 5: function setup() {
 6:   createCanvas(480, 120);
 7:   imageMode(CENTER);
 8: }
 9: function draw() {
10:   background(0);
11:   var diameter = map(mouseX, 0, width, 10, 800);
12:   image(img, 120, 60, diameter, diameter);
13: }
```

Listing 78 Ex_08_01.js

```
1: function draw() {
2:   var fr = frameRate();
3:   print(fr);
4: }
```

Listing 79 Ex_08_02.js

```
 1: function setup() {
 2:   frameRate(30); // Thirty frames each second
 3:   //frameRate(12); // Twelve frames each second
 4:   //frameRate(2); // Two frames each second
 5:   //frameRate(0.5); // One frame every two seconds
 6: }
 7: function draw() {
 8:   var fr = frameRate();
 9:   print(fr);
10: }
```

Listing 80 Ex_08_03.js

```
 1: var radius = 40;
 2: var x = -radius;
 3: var speed = 0.5;
 4: function setup() {
 5:   createCanvas(240, 120);
 6:   ellipseMode(RADIUS);
 7: }
 8: function draw() {
 9:   background(0);
10:   x += speed;  // Increase the value of x
11:   arc(x, 60, radius, radius, 0.52, 5.76);
12: }
```

Listing 81 Ex_08_04.js

```
var radius = 40;
var x = -radius;
var speed = 0.5;
function setup() {
  createCanvas(240, 120);
  ellipseMode(RADIUS);
}
function draw() {
  background(0);
  x += speed;  // Increase the value of x
  if (x > width+radius) {  // If the shape is off screen
    x = -radius;  // move to the left edge
  }
  arc(x, 60, radius, radius, 0.52, 5.76);
}
```

Listing 82 Ex_08_05.js

```
var radius = 40;
var x = 110;
var speed = 0.5;
var direction = 1;
function setup() {
  createCanvas(240, 120);
  ellipseMode(RADIUS);
}
function draw() {
  background(0);
  x += speed * direction;
  if ((x > width-radius) || (x < radius)) {
    direction = -direction; // Flip direction
  }
  if (direction == 1) {
    arc(x, 60, radius, radius, 0.52, 5.76); // Face right
  } else {
    arc(x, 60, radius, radius, 3.67, 8.9); // Face left
  }
}
```

Listing 83 Ex_08_06.js

```
var startX = 20;   // Initial x-coordinate
var stopX = 160;   // Final x-coordinate
var startY = 30;   // Initial y-coordinate
var stopY = 80;    // Final y-coordinate
var x = startX;    // Current x-coordinate
var y = startY;    // Current y-coordinate
var step = 0.005;  // Size of each step (0.0 to 1.0)
var pct = 0.0;     // Percentage traveled (0.0 to 1.0)
```

```
 9: function setup() {
10:   createCanvas(240, 120);
11: }
12: function draw() {
13:   background(0);
14:   if (pct < 1.0) {
15:     x = startX + ((stopX-startX) * pct);
16:     y = startY + ((stopY-startY) * pct);
17:     pct += step;
18:   }
19:   ellipse(x, y, 20, 20);
20: }
```

Listing 84 Ex_08_07.js

```
1: function draw() {
2:   var r = random(0, mouseX);
3:   print(r);
4: }
```

Listing 85 Ex_08_08.js

```
 1: function setup() {
 2:   createCanvas(240, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   for (var x = 20; x < width; x += 20) {
 7:     var mx = mouseX / 10;
 8:     var offsetA = random(-mx, mx);
 9:     var offsetB = random(-mx, mx);
10:     line(x + offsetA, 20, x - offsetB, 100);
11:   }
12: }
```

Listing 86 Ex_08_09.js

```
 1: var speed = 2.5;
 2: var diameter = 20;
 3: var x;
 4: var y;
 5: function setup() {
 6:   createCanvas(240, 120);
 7:   x = width/2;
 8:   y = height/2;
 9:   background(204);
10: }
11: function draw() {
```

```
12:   x += random(-speed, speed);
13:   y += random(-speed, speed);
14:   ellipse(x, y, diameter, diameter);
15: }
```

Listing 87 Ex_08_10.js

```
1: function draw() {
2:   var timer = millis();
3:   print(timer);
4: }
```

Listing 88 Ex_08_11.js

```
1: var time1 = 2000;
2: var time2 = 4000;
3: var x = 0;
4: function setup() {
5:   createCanvas(480, 120);
6: }
7: function draw() {
8:   var currentTime = millis();
9:   background(204);
10:  if (currentTime > time2) {
11:    x -= 0.5;
12:  } else if (currentTime > time1) {
13:    x += 2;
14:  }
15:  ellipse(x, 60, 90, 90);
16: }
```

Listing 89 Ex_08_12.js

```
1: var angle = 0.0;
2: function draw() {
3:   var sinval = sin(angle);
4:   print(sinval);
5:   var gray = map(sinval, -1, 1, 0, 255);
6:   background(gray);
7:   angle += 0.1;
8: }
```

Listing 90 Ex_08_13.js

```
1: var angle = 0.0;
```

```
 2: var offset = 60;
 3: var scalar = 40;
 4: var speed = 0.05;
 5: function setup() {
 6:   createCanvas(240, 120);
 7: }
 8: function draw() {
 9:   background(0);
10:   var y1 = offset + sin(angle) * scalar;
11:   var y2 = offset + sin(angle + 0.4) * scalar;
12:   var y3 = offset + sin(angle + 0.8) * scalar;
13:   ellipse( 80, y1, 40, 40);
14:   ellipse(120, y2, 40, 40);
15:   ellipse(160, y3, 40, 40);
16:   angle += speed;
17: }
```

Listing 91 Ex_08_14.js

```
 1: var angle = 0.0;
 2: var offset = 60;
 3: var scalar = 30;
 4: var speed = 0.05;
 5: function setup() {
 6:   createCanvas(120, 120);
 7:   background(204);
 8: }
 9: function draw() {
10:   var x = offset + cos(angle) * scalar;
11:   var y = offset + sin(angle) * scalar;
12:   ellipse( x, y, 40, 40);
13:   angle += speed;
14: }
```

Listing 92 Ex_08_15.js

```
 1: var angle = 0.0;
 2: var offset = 60;
 3: var scalar = 2;
 4: var speed = 0.05;
 5: function setup() {
 6:   createCanvas(120, 120);
 7:   fill(0);
 8:   background(204);
 9: }
10: function draw() {
11:   var x = offset + cos(angle) * scalar;
12:   var y = offset + sin(angle) * scalar;
13:   ellipse( x, y, 2, 2);
14:   angle += speed;
```

```
15:   scalar += speed;
16: }
```

Listing 93 Ex_09_01.js

```
 1: function setup() {
 2:   print("Ready to roll!");
 3:   rollDice(20);
 4:   rollDice(20);
 5:   rollDice(6);
 6:   print("Finished.");
 7: }
 8: function rollDice(numSides) {
 9:   var d = 1 + int(random(numSides));
10:   print("Rolling... " + d);
11: }
```

Listing 94 Ex_09_02.js

```
 1: function setup() {
 2:   print("Ready to roll!");
 3:   var d1 = 1 + int(random(20));
 4:   print("Rolling... " + d1);
 5:   var d2 = 1 + int(random(20));
 6:   print("Rolling... " + d2);
 7:   var d3 = 1 + int(random(6));
 8:   print("Rolling... " + d3);
 9:   print("Finished.");
10: }
```

Listing 95 Ex_09_03.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   translate(110, 110);
 7:   stroke(0);
 8:   strokeWeight(70);
 9:   line(0, -35, 0, -65); // Body
10:   noStroke();
11:   fill(255);
12:   ellipse(-17.5, -65, 35, 35);  // Left eye dome
13:   ellipse(17.5, -65, 35, 35);   // Right eye dome
14:   arc(0, -65, 70, 70, 0, PI);   // Chin
15:   fill(0);
16:   ellipse(-14, -65, 8, 8);  // Left eye
```

```
17:   ellipse(14, -65, 8, 8);   // Right eye
18:   quad(0, -58, 4, -51, 0, -44, -4, -51); // Beak
19: }
```

Listing 96 Ex_09_04.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:
 7:   // Left owl
 8:   translate(110, 110);
 9:   stroke(0);
10:   strokeWeight(70);
11:   line(0, -35, 0, -65); // Body
12:   noStroke();
13:   fill(255);
14:   ellipse(-17.5, -65, 35, 35);  // Left eye dome
15:   ellipse(17.5, -65, 35, 35);   // Right eye dome
16:   arc(0, -65, 70, 70, 0, PI);   // Chin
17:   fill(0);
18:   ellipse(-14, -65, 8, 8);  // Left eye
19:   ellipse(14, -65, 8, 8);   // Right eye
20:   quad(0, -58, 4, -51, 0, -44, -4, -51); // Beak
21:
22:   // Right owl
23:   translate(70, 0);
24:   stroke(0);
25:   strokeWeight(70);
26:   line(0, -35, 0, -65); // Body
27:   noStroke();
28:   fill(255);
29:   ellipse(-17.5, -65, 35, 35);  // Left eye dome
30:   ellipse(17.5, -65, 35, 35);   // Right eye dome
31:   arc(0, -65, 70, 70, 0, PI);   // Chin
32:   fill(0);
33:   ellipse(-14, -65, 8, 8);  // Left eye
34:   ellipse(14, -65, 8, 8);   // Right eye
35:   quad(0, -58, 4, -51, 0, -44, -4, -51); // Beak
36: }
```

Listing 97 Ex_09_05.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
```

```
 6:   owl(110, 110);
 7:   owl(180, 110);
 8: }
 9: function owl(x, y) {
10:   push();
11:   translate(x, y);
12:   stroke(0);
13:   strokeWeight(70);
14:   line(0, -35, 0, -65); // Body
15:   noStroke();
16:   fill(255);
17:   ellipse(-17.5, -65, 35, 35); // Left eye dome
18:   ellipse(17.5, -65, 35, 35);  // Right eye dome
19:   arc(0, -65, 70, 70, 0, PI);  // Chin
20:   fill(0);
21:   ellipse(-14, -65, 8, 8); // Left eye
22:   ellipse(14, -65, 8, 8);  // Right eye
23:   quad(0, -58, 4, -51, 0, -44, -4, -51); // Beak
24:   pop();
25: }
```

Listing 98 Ex_09_06.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   for (var x = 35; x < width + 70; x += 70) {
 7:     owl(x, 110);
 8:   }
 9: }
10: function owl(x, y) {
11:   push();
12:   translate(x, y);
13:   stroke(0);
14:   strokeWeight(70);
15:   line(0, -35, 0, -65);  // Body
16:   noStroke();
17:   fill(255);
18:   ellipse(-17.5, -65, 35, 35);  // Left eye dome
19:   ellipse(17.5, -65, 35, 35);   // Right eye dome
20:   arc(0, -65, 70, 70, 0, PI);   // Chin
21:   fill(0);
22:   ellipse(-14, -65, 8, 8); // Left eye
23:   ellipse(14, -65, 8, 8);  // Right eye
24:   quad(0, -58, 4, -51, 0, -44, -4, -51); // Beak
25:   pop();
26: }
```

Listing 99 Ex_09_07.js

```
 1: function setup() {
 2:   createCanvas(480, 120);
 3: }
 4: function draw() {
 5:   background(204);
 6:   randomSeed(0);
 7:   for (var i = 35; i < width + 40; i += 40) {
 8:     var gray = int(random(0, 102));
 9:     var scalar = random(0.25, 1.0);
10:     owl(i, 110, gray, scalar);
11:   }
12: }
13: function owl(x, y, g, s) {
14:   push();
15:   translate(x, y);
16:   scale(s);  // Set the size
17:   stroke(g); // Set the gray value
18:   strokeWeight(70);
19:   line(0, -35, 0, -65); // Body
20:   noStroke();
21:   fill(255-g);
22:   ellipse(-17.5, -65, 35, 35); // Left eye dome
23:   ellipse(17.5, -65, 35, 35);  // Right eye dome
24:   arc(0, -65, 70, 70, 0, PI);  // Chin
25:   fill(g);
26:   ellipse(-14, -65, 8, 8);  // Left eye
27:   ellipse(14, -65, 8, 8);   // Right eye
28:   quad(0, -58, 4, -51, 0, -44, -4, -51); // Beak
29:   pop();
30: }
```

Listing 100 Ex_09_08.js

```
1: function setup() {
2:   var yourWeight = 132;
3:   var marsWeight = calculateMars(yourWeight);
4:   print(marsWeight);
5: }
6: function calculateMars(w) {
7:   var newWeight = w * 0.38;
8:   return newWeight;
9: }
```

Listing 101 Ex_10_01.js

```
1: var bug; // Declare object
2: function setup() {
3:   createCanvas(480, 120);
4:   background(204);
```

```
 5:   fill(255);
 6:   // Create object and pass in parameters
 7:   bug = new Jitter();
 8: }
 9: function draw() {
10:   bug.move();
11:   bug.display();
12: }
13: function Jitter() {
14:   this.x = random(width);
15:   this.y = random(height);
16:   this.diameter = random(10, 30);
17:   this.speed = 2.5;
18:
19:   this.move = function() {
20:     this.x += random(-this.speed, this.speed);
21:     this.y += random(-this.speed, this.speed);
22:   }
23:
24:   this.display = function() {
25:     ellipse(this.x, this.y, this.diameter, this.diameter);
26:   }
27: }
```

Listing 102 Ex_10_02.js

```
 1: var jit;
 2: var bug;
 3: function setup() {
 4:   createCanvas(480, 120);
 5:   background(204);
 6:   fill(255);
 7:   jit = new Jitter();
 8:   bug = new Jitter();
 9: }
10: function draw() {
11:   jit.move();
12:   jit.display();
13:   bug.move();
14:   bug.display();
15: }
16: function Jitter() {
17:   this.x = random(width);
18:   this.y = random(height);
19:   this.diameter = random(10, 30);
20:   this.speed = 2.5;
21:   this.move = function() {
22:     this.x += random(-this.speed, this.speed);
23:     this.y += random(-this.speed, this.speed);
24:   }
25:   this.display = function() {
26:     ellipse(this.x, this.y, this.diameter, this.diameter);
27:   }
```

```
28: }
```

Listing 103 Ex_11_01.js

```
1: var x1 = -20;
2: var x2 = 20;
3: function setup() {
4:   createCanvas(240, 120);
5:   noStroke();
6: }
7: function draw() {
8:   background(0);
9:   fill(255);
10:  x1 += 0.5;
11:  x2 += 0.5;
12:  arc(x1, 30, 40, 40, 0.52, 5.76);
13:  arc(x2, 90, 40, 40, 0.52, 5.76);
14: }
```

Listing 104 Ex_11_02.js

```
1: var x1 = -10;
2: var x2 = 10;
3: var x3 = 35;
4: var x4 = 18;
5: var x5 = 30;
6: function setup() {
7:   createCanvas(240, 120);
8:   noStroke();
9: }
10: function draw() {
11:  background(0);
12:  fill(255);
13:  x1 += 0.5;
14:  x2 += 0.5;
15:  x3 += 0.5;
16:  x4 += 0.5;
17:  x5 += 0.5;
18:  arc(x1, 20, 20, 20, 0.52, 5.76);
19:  arc(x2, 40, 20, 20, 0.52, 5.76);
20:  arc(x3, 60, 20, 20, 0.52, 5.76);
21:  arc(x4, 80, 20, 20, 0.52, 5.76);
22:  arc(x5, 100, 20, 20, 0.52, 5.76);
23: }
```

Listing 105 Ex_11_03.js

```
1: var x = [];
```

```
 2: x.length = 3000;
 3: function setup() {
 4:   createCanvas(240, 120);
 5:   noStroke();
 6:   fill(255, 200);
 7:   for (var i = 0; i < x.length; i++) {
 8:     x[i] = random(-1000, 200);
 9:   }
10: }
11: function draw() {
12:   background(0);
13:   for (var i = 0; i < x.length; i++) {
14:     x[i] += 0.5;
15:     var y = i * 0.4;
16:     arc(x[i], y, 12, 12, 0.52, 5.76);
17:   }
18: }
```

Listing 106 Ex_11_04.js

```
 1: var x = [];  // Declare the array
 2: function setup() {
 3:   createCanvas(200, 200);
 4:   x[0] = 12;      // Assign the first value
 5:   x[1] = 2;       // Assign the second value
 6: }
 7: function draw() {
 8:   textSize(32);
 9:   text("x[0]="+x[0], 10, 32);
10:   text("x[1]="+x[1], 10, 64);
11: }
```

Listing 107 Ex_11_05.js

```
 1: var x = [12, 2];  // Declare and assign
 2: function setup() {
 3:   createCanvas(200, 200);
 4: }
 5: function draw() {
 6:   textSize(32);
 7:   text("x[0]="+x[0], 10, 32);
 8:   text("x[1]="+x[1], 10, 64);
 9: }
```

Listing 108 Ex_11_06.js

```
 1: var x = [12, 24, 36];
 2: function setup() {
```

```
 3:   createCanvas(240, 120);
 4:   noStroke();
 5: }
 6: function draw() {
 7:   background(204);
 8:   textSize(x[0]);
 9:   text(x[0]+"point", 10, 30);
10:   textSize(x[1]);
11:   text(x[1]+"point", 10, 60);
12:   textSize(x[2]);
13:   text(x[2]+"point", 10, 100);
14: }
```

Listing 109 Ex_11_07.js

```
 1: var x = [-20, 20];
 2: function setup() {
 3:   createCanvas(240, 120);
 4:   noStroke();
 5: }
 6: function draw() {
 7:   background(0);
 8:   x[0] += 0.5;  // Increase the first element
 9:   x[1] += 0.5;  // Increase the second element
10:   arc(x[0], 30, 40, 40, 0.52, 5.76);
11:   arc(x[1], 90, 40, 40, 0.52, 5.76);
12: }
```

Listing 110 Ex_11_08.js

```
 1: var gray = [];
 2: function setup() {
 3:   createCanvas(240, 120);
 4:   for (var i = 0; i < width; i++) {
 5:     gray[i] = random(0, 255);
 6:   }
 7: }
 8: function draw() {
 9:   background(204);
10:   for (var i = 0; i < gray.length; i++) {
11:     stroke(gray[i]);
12:     line(i, 0, i, height);
13:   }
14: }
```

Listing 111 Ex_11_09.js

```
 1: var num = 60;
```

```
 2: var x = [];
 3: var y = [];
 4: function setup() {
 5:   createCanvas(240, 120);
 6:   noStroke();
 7:   for (var i = 0; i < num; i++) {
 8:     x[i] = 0;
 9:     y[i] = 0;
10:   }
11: }
12: function draw() {
13:   background(0);
14:   // Copy array values from back to front
15:   for (var i = x.length-1; i > 0; i--) {
16:     x[i] = x[i-1];
17:     y[i] = y[i-1];
18:   }
19:   x[0] = mouseX; // Set the first element
20:   y[0] = mouseY; // Set the first element
21:   for (var i = 0; i < x.length; i++) {
22:     fill(i * 4);
23:     ellipse(x[i], y[i], 40, 40);
24:   }
25: }
```

Listing 112 Ex_11_10.js

```
 1: var bugs = [];
 2: function setup() {
 3:   createCanvas(240, 120);
 4:   background(204);
 5:   for (var i = 0; i < 33; i++) {
 6:     var x = random(width);
 7:     var y = random(height);
 8:     var r = i + 2;
 9:     bugs[i] = new JitterBug(x, y, r);
10:   }
11: }
12: function draw() {
13:   for (var i = 0; i < bugs.length; i++) {
14:     bugs[i].move();
15:     bugs[i].display();
16:   }
17: }
18: function JitterBug(tempX, tempY, tempDiameter) {
19:   this.x = tempX;
20:   this.y = tempY;
21:   this.diameter = tempDiameter;
22:   this.speed = 2.5;
23:   this.move = function() {
24:     this.x += random(-this.speed, this.speed);
25:     this.y += random(-this.speed, this.speed);
26:   };
```

```
27:   this.display = function() {
28:     ellipse(this.x, this.y, this.diameter, this.diameter);
29:   };
30: }
```

Listing 113 Ex_11_11.js

```
1: var numFrames = 12; // The number of frames
2: var images = []; // Make the array
3: var currentFrame = 0;
4: function preload() {
5:   for (var i = 0; i < numFrames; i++) {
6:     var imageName = "media/frame-" + nf(i, 4) + ".png";
7:     images[i] = loadImage(imageName); // Load each image
8:   }
9: }
10: function setup() {
11:   createCanvas(240, 120);
12:   frameRate(24);
13: }
14: function draw() {
15:   image(images[currentFrame], 0, 0);
16:   currentFrame++; // Next frame
17:   if (currentFrame == images.length) {
18:     currentFrame = 0;  // Return to first frame
19:   }
20: }
```

Listing 114 Ex_12_01.js

```
1: var stats;
2: function preload() {
3:   stats = loadTable("media/ichiro.csv");
4: }
5: function setup() {
6:   for (var i = 0; i < stats.getRowCount(); i++) {
7:     var year = stats.get(i, 0);
8:     var homeRuns = stats.get(i, 1);
9:     var rbi = stats.get(i, 2);
10:     var average = stats.get(i, 3);
11:     print(year, homeRuns, rbi, average);
12:   }
13: }
```

Listing 115 Ex_12_02.js

```
1: var stats;
2: var homeRuns = [];
```

```
 3: function preload() {
 4:   stats = loadTable("media/ichiro.csv");
 5: }
 6: function setup() {
 7:   createCanvas(480, 120);
 8:   var rowCount = stats.getRowCount();
 9:   homeRuns = [];
10:   for (var i = 0; i < rowCount; i++) {
11:     homeRuns[i] = stats.getNum(i, 1);
12:   }
13: }
14: function draw(){
15:   background(204);
16:   // Draw background grid for data
17:   stroke(153);
18:   line(20, 100, 20, 20);
19:   line(20, 100, 460, 100);
20:   for (var i=0; i< homeRuns.length; i++) {
21:     var x = map(i, 0, homeRuns.length-1, 20, 460);
22:     line(x, 20, x, 100);
23:   }
24:   // Drw lines based on home run data
25:   noFill();
26:   stroke(0);
27:   beginShape();
28:   for (var i=0; i<homeRuns.length; i++) {
29:     var x = map(i, 0, homeRuns.length-1, 20, 460);
30:     var y = map(homeRuns[i], 0, 20, 100, 20);
31:     vertex(x, y);
32:   }
33:   endShape();
34: }
```

Listing 116 Ex_12_03.js

```
 1: var cities;
 2: function preload() {
 3:   cities = loadTable("media/cities.csv", "header");
 4: }
 5: function setup() {
 6:   createCanvas(480, 240);
 7:   fill(255, 150);
 8:   noStroke();
 9: }
10: function draw() {
11:   background(0);
12:   var xoffset = map(mouseX, 0, width, -width*3, -width);
13:   translate(xoffset, -600);
14:   scale(10);
15:   for (var i=0; i< cities.getRowCount(); i++) {
16:     var latitude = cities.getNum(i, "lat");
17:     var longitude = cities.getNum(i, "lng");
18:     setXY(latitude, longitude);
```

```
19:   }
20: }
21: function setXY(lat, lng) {
22:   var x = map(lng, -180, 180, 0, width);
23:   var y = map(lat, 90, -90, 0, height);
24:   ellipse(x, y, 0.25, 0.25);
25: }
```

Listing 117 Ex_12_04.js

```
1: var film;
2: function preload() {
3:   film = loadJSON("media/film.json");
4: }
5: function setup() {
6:   var title = film.title;
7:   var dir = film.director;
8:   var year = film.year;
9:   var rating = film.rating;
10:  print(title + " by " + dir + ", " + year + ". Rating: " + rating);
11: }
```

Listing 118 Ex_12_05.js

```
1: var films = [];
2: var filmData;
3: function preload() {
4:   filmData = loadJSON("media/films.json");
5: }
6: function setup() {
7:   createCanvas(480, 120);
8:   for (var i = 0; i < filmData.length; i++) {
9:     var o = filmData[i];
10:    films[i] = new Film(o);
11:  }
12:  noStroke();
13: }
14: function draw() {
15:  background(0);
16:  for (var i = 0; i < films.length; i++) {
17:    var x = i*32 + 32;
18:    films[i].display(x, 105);
19:  }
20: }
21: function Film(f) {
22:  this.title = f.title;
23:  this.director = f.director;
24:  this.year = f.year;
25:  this.rating = f.rating;
26:
```

```
27:   this.display = function (x, y) {
28:     var ratingGray = map(this.rating, 6.5, 8.1, 102, 255);
29:     push();
30:     translate(x, y);
31:     rotate(-QUARTER_PI);
32:     fill(ratingGray);
33:     text(this.title, 0, 0);
34:     pop();
35:   }
36: }
```

Listing 119 Ex_12_06.js

```
1: var weatherData;
2: function preload() {
3:   weatherData = loadJSON("cincinnati.json");
4: }
5: function setup() {
6:   var temp = getTemp(weatherData);
7:   print(temp);
8: }
9: function getTemp(data) {
10:   var list = data.list;
11:   var item = list[0];
12:   var main = item.main;
13:   var temp = main.temp;
14:   return temp;
15: }
```

Listing 120 Ex_12_07.js

```
1: var weatherData;
2: function preload() {
3:   weatherData = loadJSON("cincinnati.json");
4: }
5: function setup() {
6:   var temp = getTemp(weatherData);
7:   print(temp);
8: }
9: function getTemp(data) {
10:   return data.list[0].main.temp;
11: }
```

Listing 121 pong.js

```
1: //
2: // Simple Pong by Gabriel Lovato
3: // http://www.openprocessing.org/sketch/47481
```

```
 4: // modified by Tatsuyoshi Hamada
 5: //
 6: var gameStart = false;
 7:
 8: var x = 150;
 9: var y = 150;
10: var leftColor = 128;
11: var rightColor = 128;
12: var speedX = 3;
13: var speedY = 3;
14: var diam;
15: var rectSize = 150;
16: var diamHit;
17:
18: function setup() {
19:   createCanvas(500, 500);
20:   noStroke();
21:   smooth();
22:   ellipseMode(CENTER);
23: }
24:
25: function draw() {
26:   background(204);
27:   fill(128, 128, 128);
28:   diam = 20;
29:   ellipse(x, y, diam, diam);
30:
31:   fill(leftColor);
32:   rect(0, 0, 20, height);
33:   fill(rightColor);
34:   rect(width-30, mouseY-rectSize/2, 10, rectSize);
35:
36:
37:   if (gameStart) {
38:
39:     x = x + speedX;
40:     y = y + speedY;
41:
42:     // if ball hits movable bar, invert X direction and apply effects
43:       if ( x > width-30 && x < width -20 &&
44:            y > mouseY-rectSize/2 && y < mouseY+rectSize/2 ) {
45:       speedX = speedX * -1;
46:       x = x + speedX;
47:       rightColor = 0;
48:       fill(random(0, 128),random(0, 128),random(0, 128));
49:       diamHit = random(75, 150);
50:       ellipse(x, y, diamHit, diamHit);
51:       rectSize = rectSize - 10;
52:       rectSize = constrain(rectSize, 10, 150);
53:     }
54:
55:     // if ball hits wall, change direction of X
56:     else if (x < 25) {
57:       speedX = speedX * -1.1;
58:       x = x + speedX;
```

```
59:       leftColor = 0;
60:     }
61:
62:     else {
63:       leftColor = 128;
64:       rightColor = 128;
65:     }
66:     // resets things if you lose
67:     if (x > width) {
68:       gameStart = false;
69:       x = 150;
70:       y = 150;
71:       speedX = random(3, 5);
72:       speedY = random(3, 5);
73:       rectSize = 150;
74:     }
75:
76:
77:     // if ball hits up or down, change direction of Y
78:     if ( y > height || y < 0 ) {
79:       speedY = speedY * -1;
80:       y = y + speedY;
81:     }
82:   }
83: }
84: function mousePressed() {
85:   gameStart = !gameStart;
86: }
```

Listing 122 webgl.js

```
1: var pitch = 0.01
2: function setup(){
3:   createCanvas(710, 400, WEBGL);
4: }
5: function draw(){
6:   background(250);
7:   translate(-250 * 2.5, 0, 0);
8:   normalMaterial();
9:   push();
10:  rotateZ(frameCount * pitch);
11:  rotateX(frameCount * pitch);
12:  rotateY(frameCount * pitch);
13:  plane(80);
14:  pop();
15:  translate(250, 0, 0);
16:  push();
17:  rotateZ(frameCount * pitch);
18:  rotateX(frameCount * pitch);
19:  rotateY(frameCount * pitch);
20:  box(80, 80, 80);
21:  pop();
22:  translate(250, 0, 0);
```

```
23:     push();
24:     rotateZ(frameCount * pitch);
25:     rotateX(frameCount * pitch);
26:     rotateY(frameCount * pitch);
27:     cylinder(80, 80);
28:     pop();
29:     translate(250, 0, 0);
30:     push();
31:     rotateZ(frameCount * pitch);
32:     rotateX(frameCount * pitch);
33:     rotateY(frameCount * pitch);
34:     cone(80, 80);
35:     pop();
36:     translate(250, 0, 0);
37:     push();
38:     rotateZ(frameCount * pitch);
39:     rotateX(frameCount * pitch);
40:     rotateY(frameCount * pitch);
41:     torus(80, 20);
42:     pop();
43:     translate(250, 0, 0);
44:     push();
45:     rotateZ(frameCount * pitch);
46:     rotateX(frameCount * pitch);
47:     rotateY(frameCount * pitch);
48:     sphere(80);
49:     pop();
50: }
```