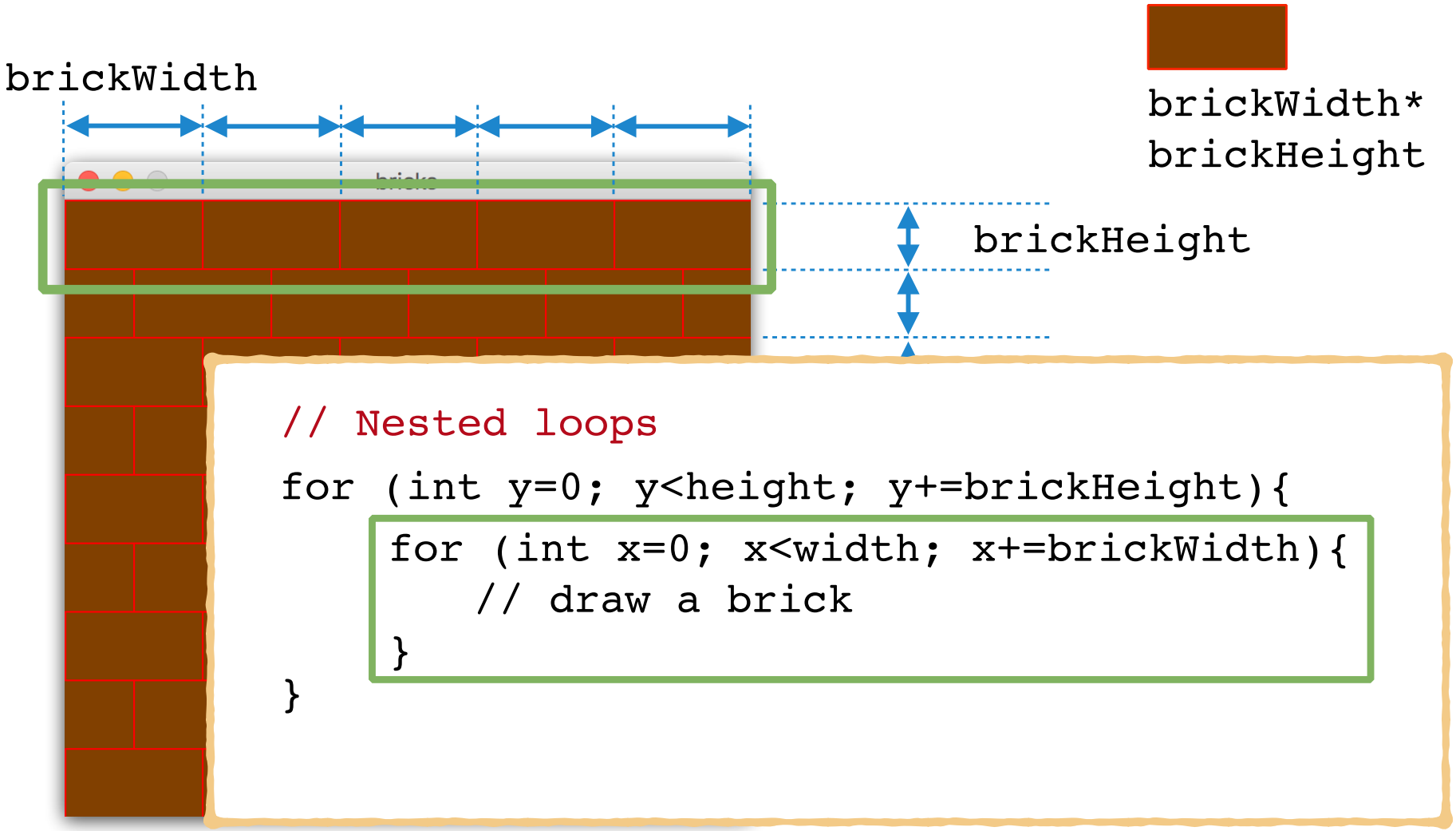
week7

範例程式: https://github.com/jonesfish/programming101

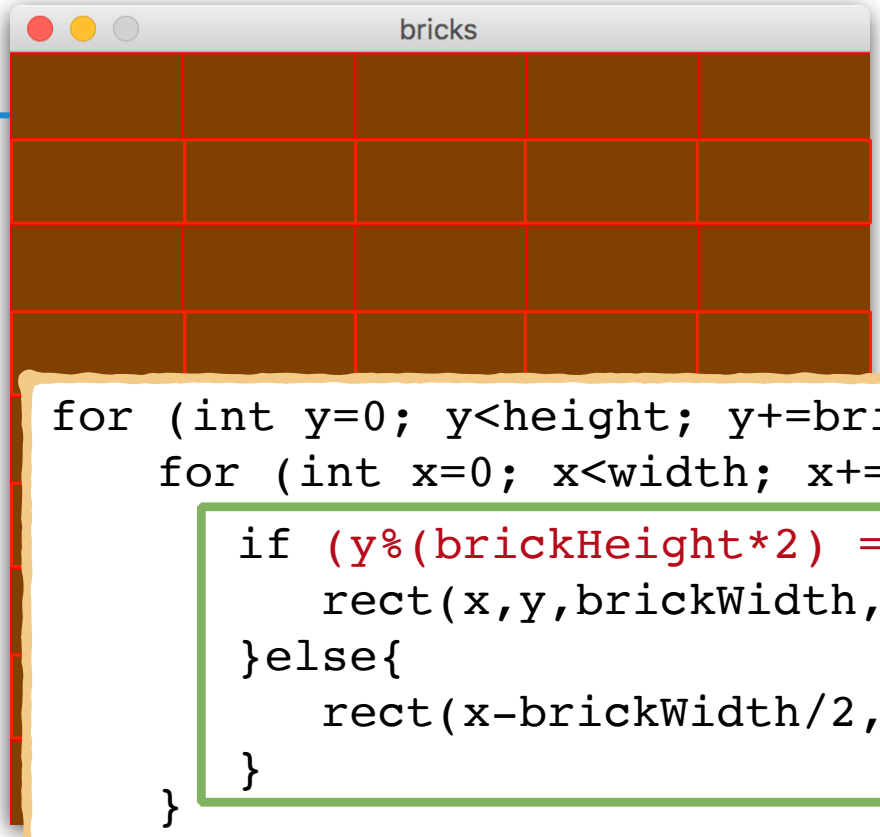
在畫面中填滿磚塊牆




```
// Nested loops
for (int y=0; y<height; y+=brickHeight){
    for (int x=0; x<width; x+=brickWidth){
        // draw a brick
    }
}
```

在畫面中填滿磚塊牆

x-brickWidth/2



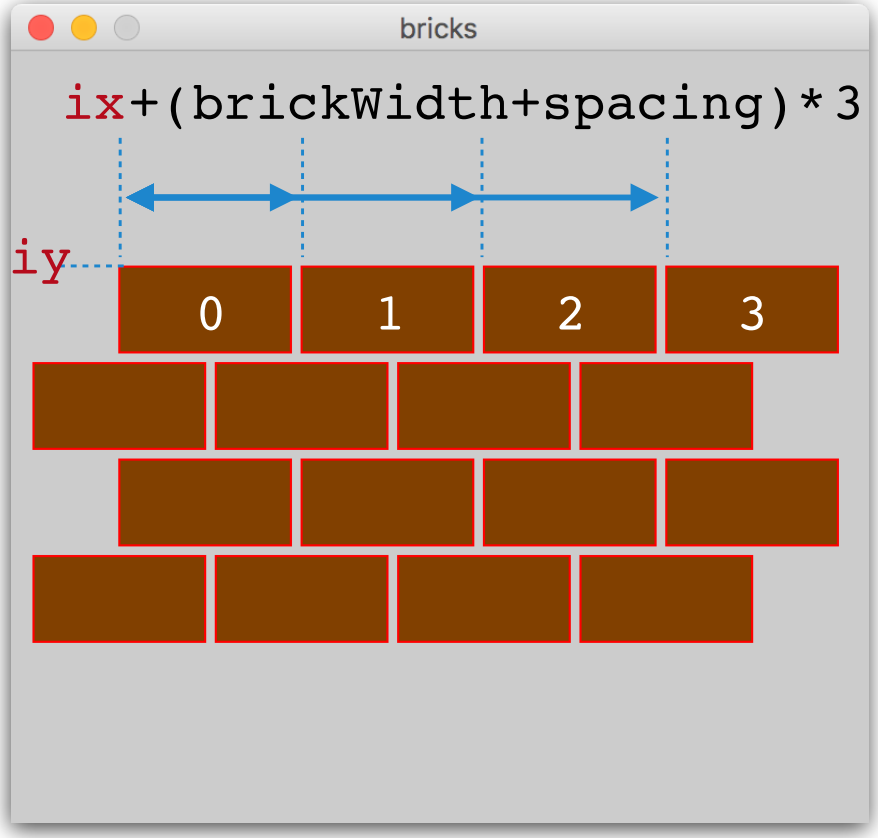
brickHeight*1

(y%(brickHeight*2) != 0)

brickHeight*3

```
for (int y=0; y<height; y+=brickHeight){
    for (int x=0; x<width; x+=brickWidth){
        if (y%(brickHeight*2) == 0){
            rect(x,y,brickWidth, brickHeight);
        }else{
            rect(x-brickWidth/2, y, brickWidth, brickHeight);
        }
    }
}
```

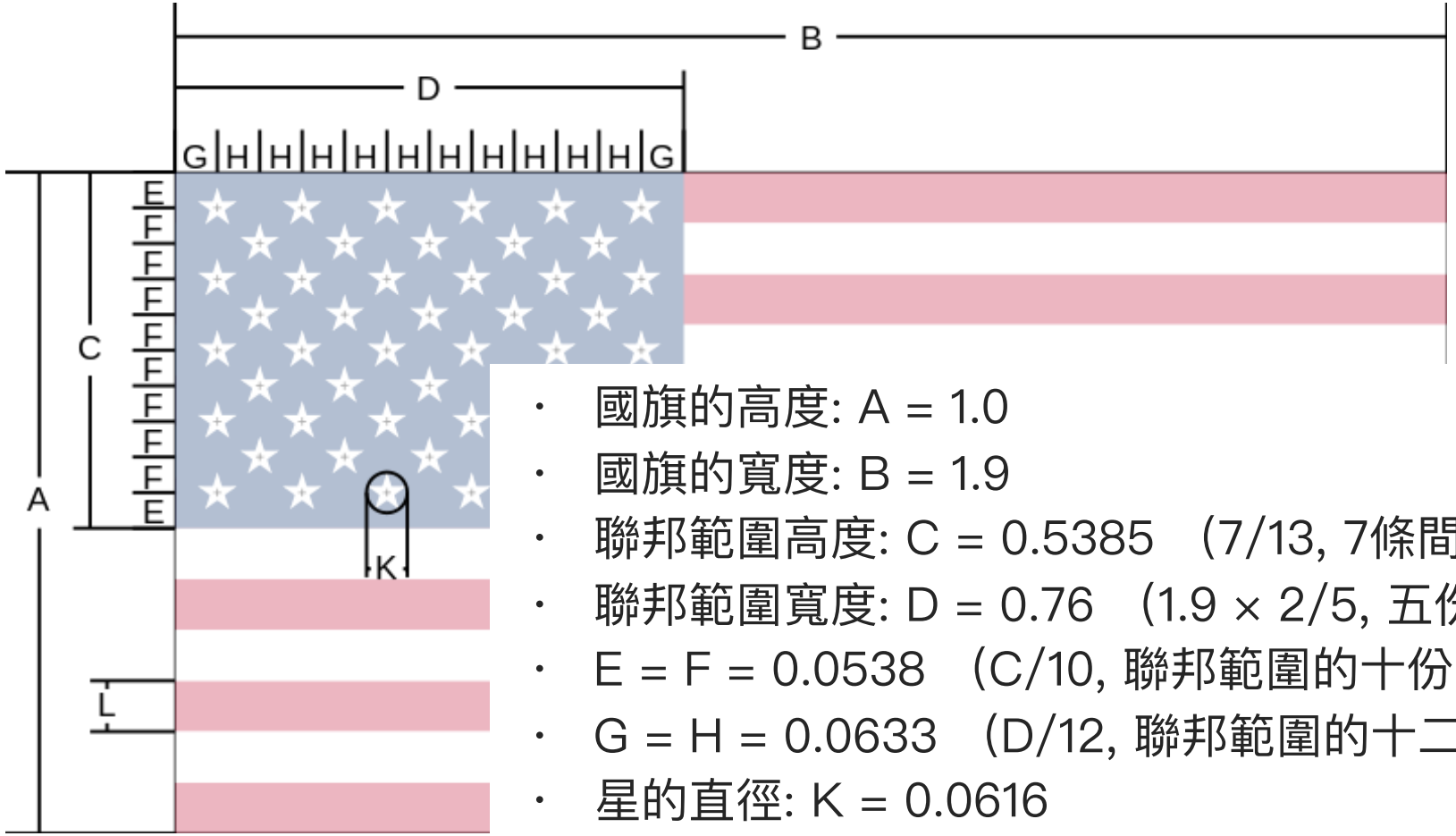
在任意位置填入 4x4 個磚塊




```
for (int row=0; row<4; row++){
  for (int col=0; col<4; col++){

    int x=ix+(brickWidth+spacing)*col;
    int y=iy+(brickHeight+spacing)*row;
    if (row%2 == 0){
      rect(x,y,brickWidth, brickHeight);
    }else{
      rect(x-brickWidth/2,y,brickWidth,
    brickHeight);
    }
  }
}
```

US Flag



- 國旗的高度: A = 1.0
- 國旗的寬度: B = 1.9
- 聯邦範圍高度: C = 0.5385 （7/13, 7條間紋的高度）
- 聯邦範圍寬度: D = 0.76 （1.9 × 2/5, 五份二的國旗寬度）
- E = F = 0.0538 （C/10, 聯邦範圍的十份之一高度）
- G = H = 0.0633 （D/12, 聯邦範圍的十二份之一寬度）
- 星的直徑: K = 0.0616
- 條紋的高度: L = 0.0769 （1/13）

變數的有效範圍 (Variable Scope)

- Scope is the set of variables you have access to.
- global vs local
- Scope helps to prevent name collisions

```
// global variables
int score = 10;
int level = 5;

void draw() {
  // local variable
  int num = 100;

  for (int i=0; i<3; i++){
    int j = 15;
  }
}
```

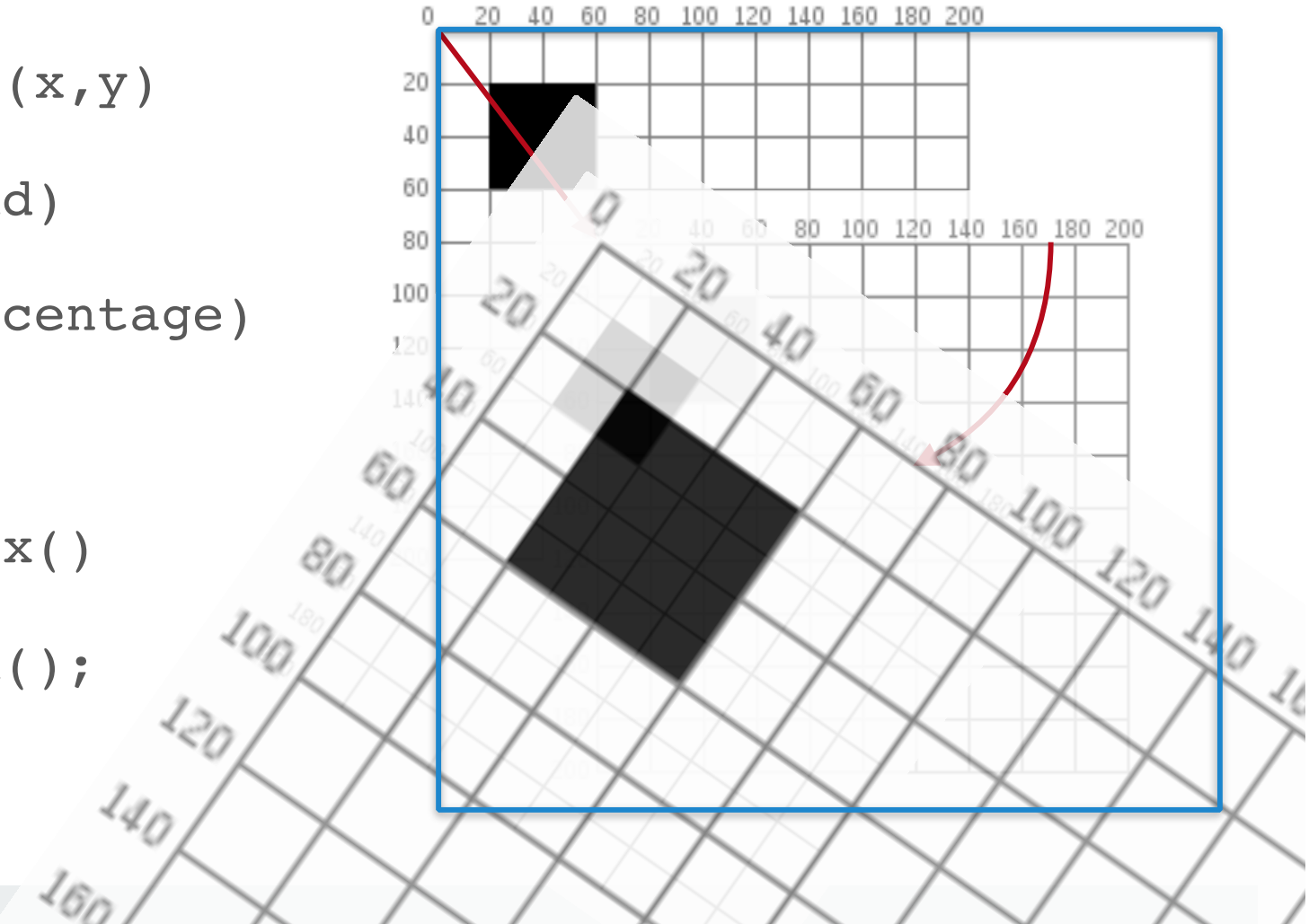
Global scope

Local scope

2D Transformations

- `translate(x,y)`
- `rotate(rad)`
- `scale(percentage)`

- `pushMatrix()`
- `popMatrix();`



The advantage of transformation

```
triangle(x + 15, y, x, y + 15, x + 30, y + 15);
rect(x, y + 15, 30, 30);
rect(x + 12, y + 30, 10, 15);
```

vs

```
pushMatrix();
translate(x, y);
triangle(15, 0, 0, 15, 30, 15);
rect(0, 15, 30, 30);
rect(12, 30, 10, 15);
popMatrix();
```

The advantage of translation

```
for (int i = 10; i < 350; i = i + 50){
  pushMatrix();
  translate(i, 100);
  // draw a house
  triangle(15, 0, 0, 15, 30, 15);
  rect(0, 15, 30, 30);
  rect(12, 30, 10, 15);

  popMatrix();
}
```

sevenHouse.pde

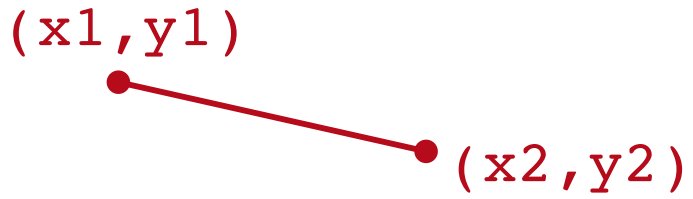
常用數學函式

- 絕對值 `abs(n)`
- 無條件進入 `ceil(n)`
- 無條件捨去 `floor(n)`
- 四捨五入 `round(n)`
- n的平方 `sq(n)`, n的e次方 `pow(n,e)`
- n的平方根 `sqrt(n)`

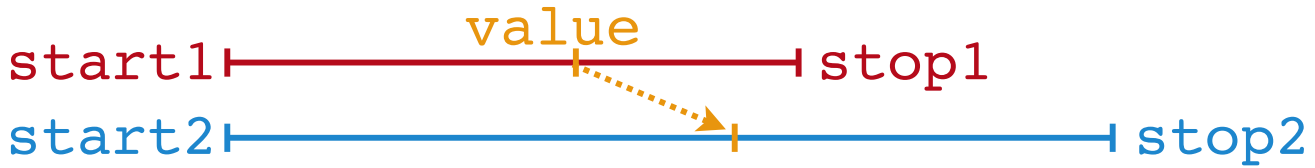
http://processing.org/reference/

常用數學函式

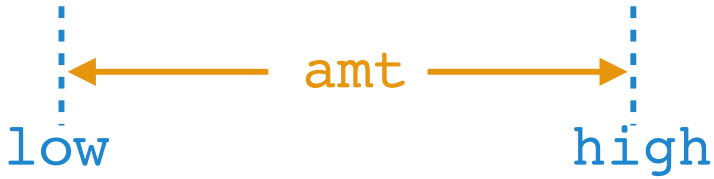
- 求兩點間的距離
  `dist(x1, y1, x2, y2)`



- 對應數值在某個區間
  `map(value, start1, stop1, start2, stop2)`



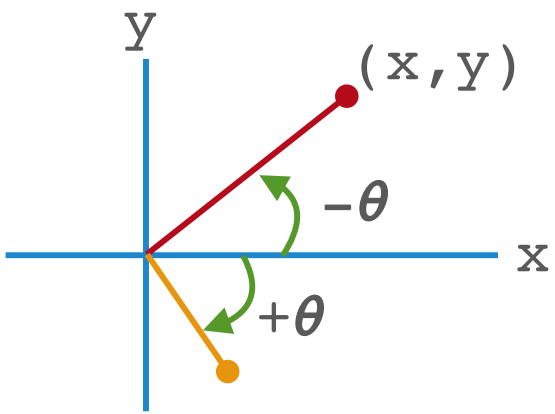
- 限制數值在某個區間
  `constrain(amt, low, high)`



mouseCircle.pde

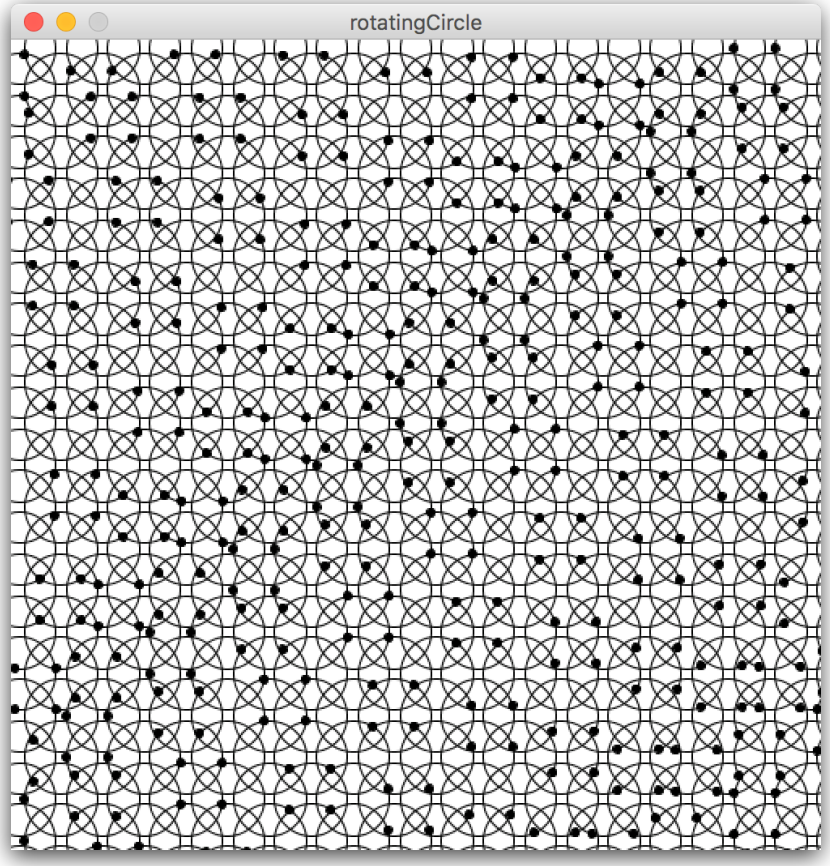
常用數學函式

- 轉換角度至徑度 `radians(deg)`
- 轉換徑度至角度 `degrees(rad)`
- 三角函數 `sin(a), cos(a)  // a: angle in radians`
- 計算原點至(x,y)座標之夾角 `atan2(y, x) // θ: PI~ -PI`

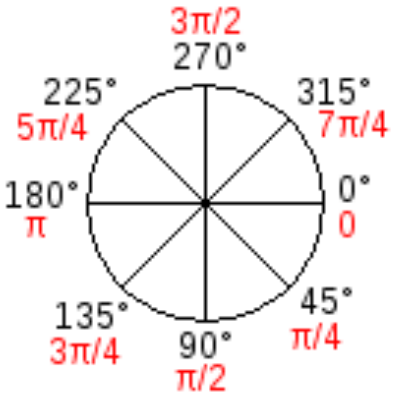


angles.pde

Rotation



rotatingCircle.pde



$$x(t) = A\ cos(\ \boldsymbol{\omega}\ t + \varphi)$$

$$y(t) = A\ sin\ (\boldsymbol{\omega}\ t + \varphi)$$

總結

- Nested loops
  - 利用算式把對應的 col, row轉換成 x, y位置
- Scope
  - global variables: 全區都需用到的變數在程式碼最開頭宣告
  - local variables: 只在某區塊才用到的變數
- 2D Transformations
- Math functions