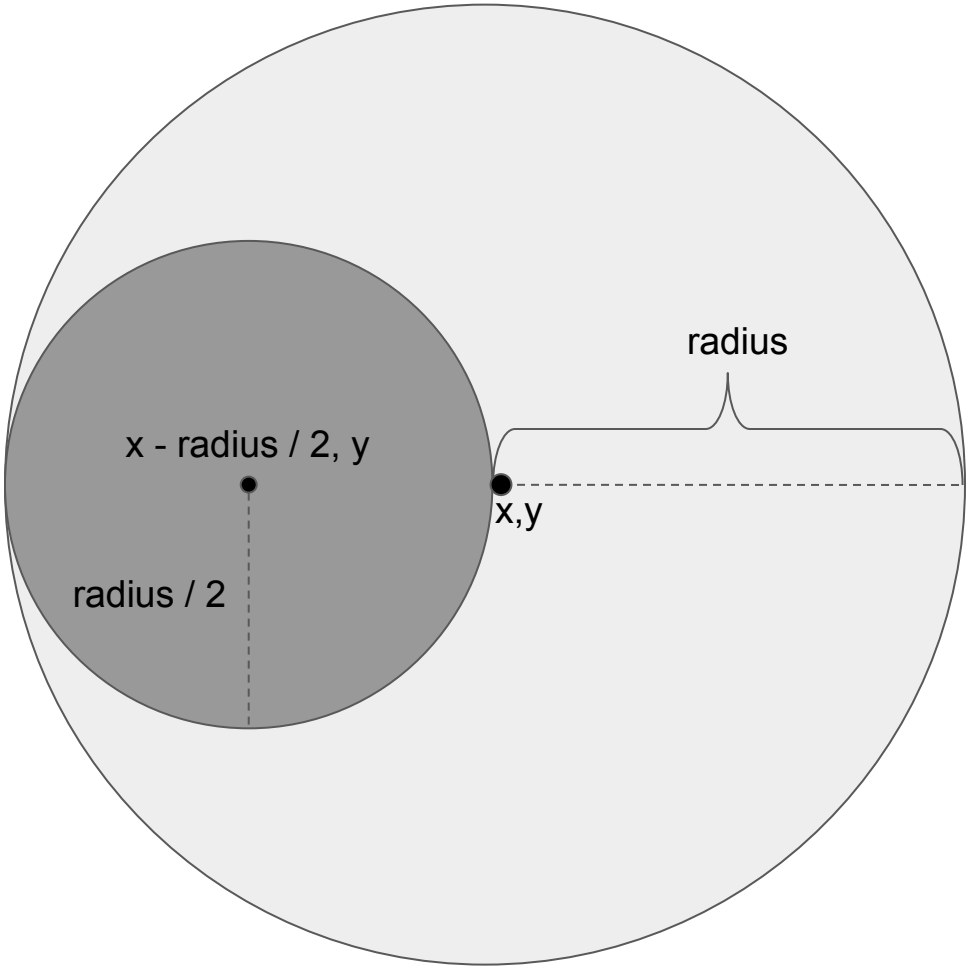
Tracing NestedCircles.java

Put your PDF application into “presentation” or “full-screen” mode to view.

http://www.cs.princeton.edu/courses/archive/fall17/cos126/precepts/NestedCircles.java


radius
x - radius / 2, y
x,y
radius / 2

```
void draw(int n, double x, double y, double radius){
   if (n == 0) return;
   fancyCircle(x, y, radius);
   double halfRadius = radius/2;
   // recursively draw two nested circles order n-1
   draw(n-1, x - halfRadius, y, halfRadius);
   draw(n-1, x + halfRadius, y, halfRadius)
}
public static void main(String[] args) {
  int n = Integer.parseInt(args[0]);
  double x = 0.5, y = 0.5;
  draw(n, x, y, 0.5);
}
```

everything is in relation to the current level n with a center of (x, y)

```
draw(int n, double x, double y, double radius)

    if (n==0) return;

    fancyCircle(x, y, radius);

    double halfRadius = radius/2;

    draw(n-1, x - halfRadius, y, halfRadius);

    draw(n-1, x + halfRadius, y, halfRadius);
```

base case (stop at 0)

DRAW current circle in center

Half the radius

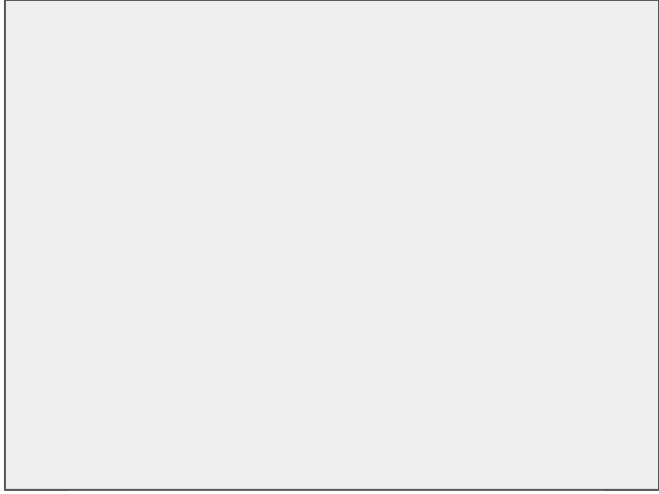
smaller circle to left

smaller circle to right

Let’s trace…..

1

```
draw(2, 1/2, 1/2, 1/2)
   if (n == 0) return;
   fancyCircle(x, y, radius);
   double halfRadius = radius/2;
   draw(n-1, x - halfRadius, y, halfRadius);
   draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

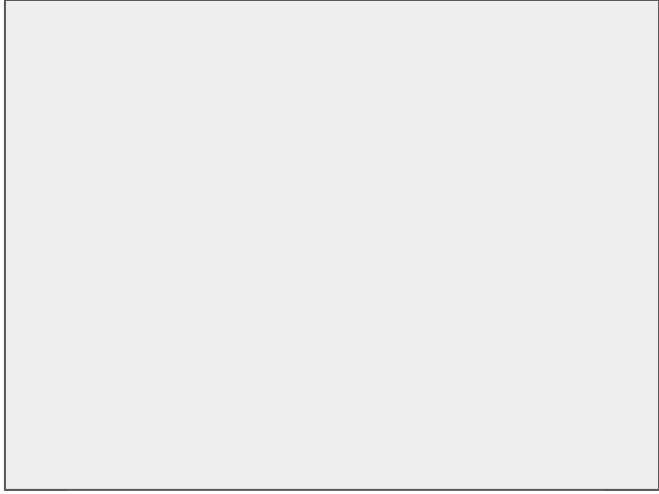
1

draw:
n=2, x= 1/2, y=1/2, radius=1/2

1

```
draw(2, 1/2, 1/2, 1/2)
   if (n == 0) return;
   fancyCircle(x, y, radius);
   double halfRadius = radius/2;
   draw(n-1, x - halfRadius, y, halfRadius);
   draw(n-1, x + halfRadius, y, halfRadius);
```

The green outline indicates the current statement.



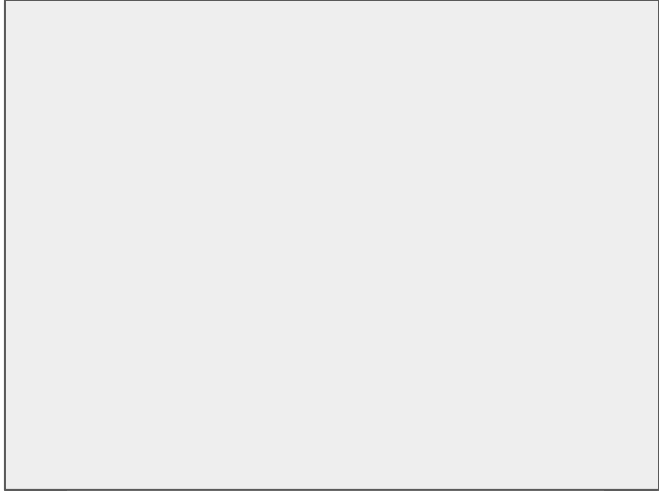
StdDraw

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2

1

```
draw(2, 1/2, 1/2, 1/2)
   if (n == 0) return;
   fancyCircle(x, y, radius);
   double halfRadius = radius/2;
   draw(n-1, x - halfRadius, y, halfRadius);
   draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

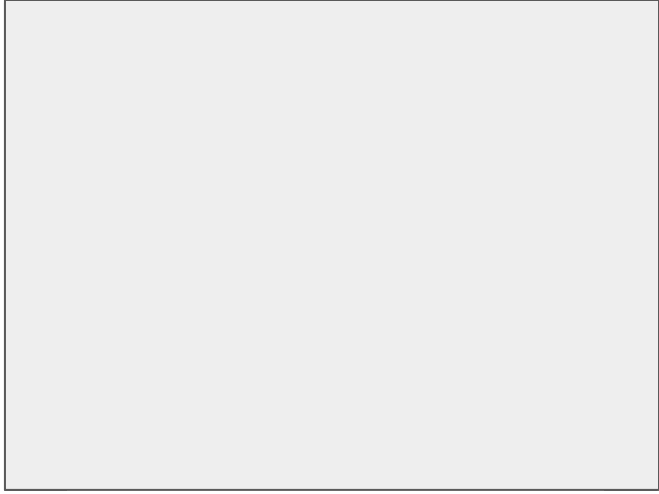
The number indicates the sequence of method calls.

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2

1

```
draw(2, 1/2, 1/2, 1/2)
   if (n == 0) return;
   fancyCircle(x, y, radius);
   double halfRadius = radius/2;
   draw(n-1, x - halfRadius, y, halfRadius);
   draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

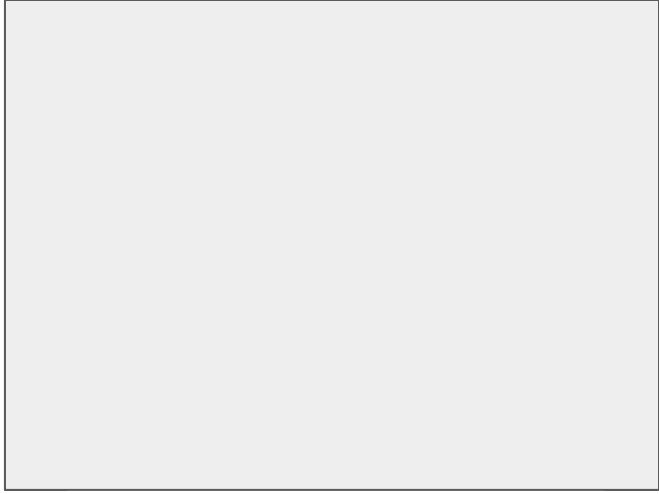
The frame or environment of the method. Similar to what the Java Visualizer displays. Also similar to what is shown in the example in Lecture 6A, Slide 7.

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



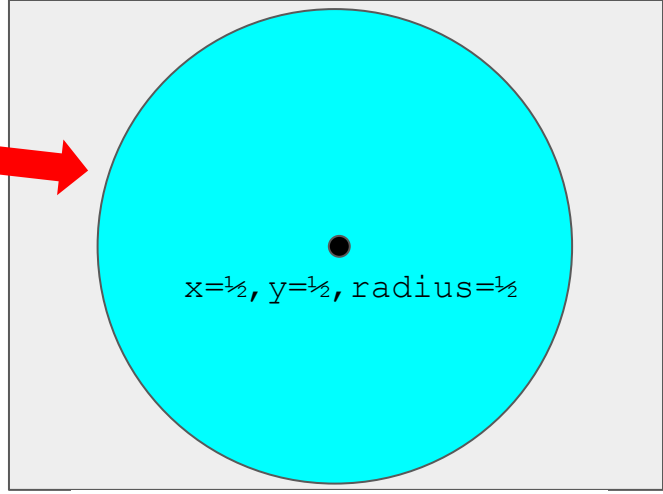
StdDraw

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



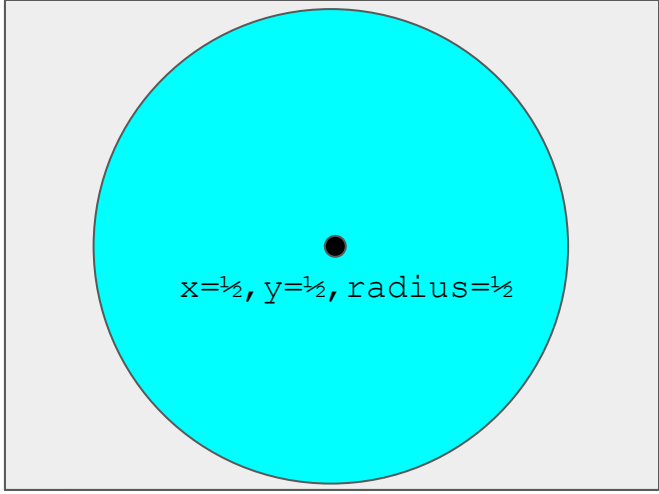
StdDraw

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

1

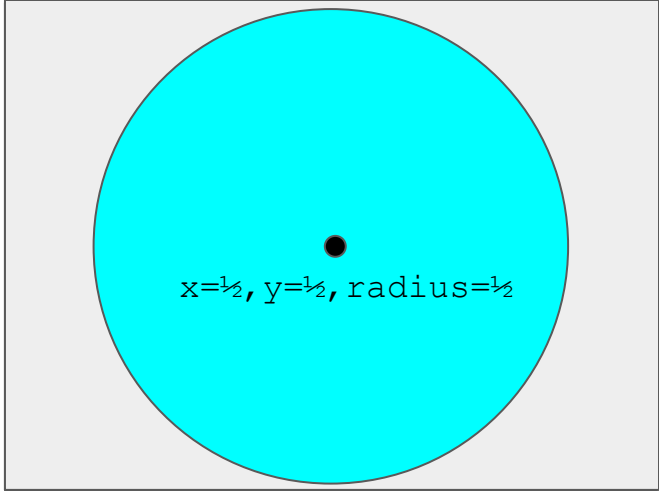
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4

1

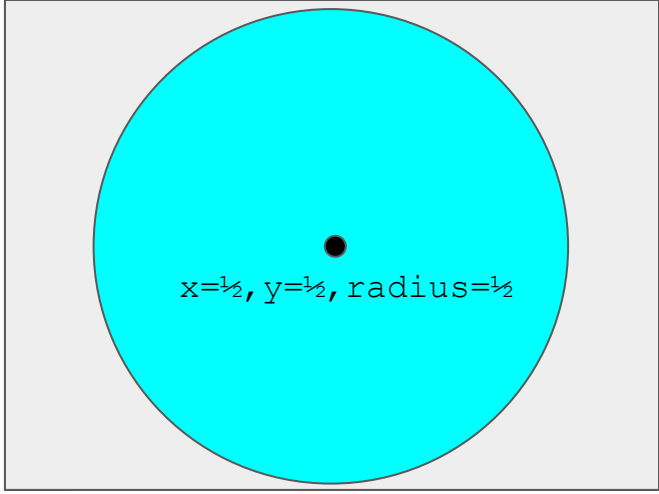
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

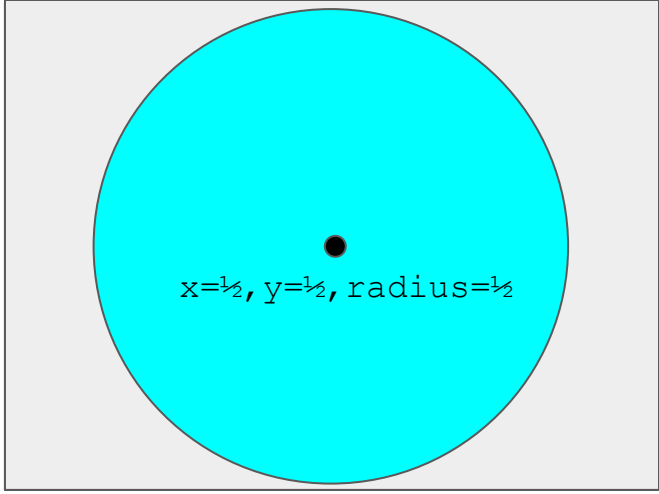
1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

The yellow outline indicates where the method waits after calling another method.



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4

1

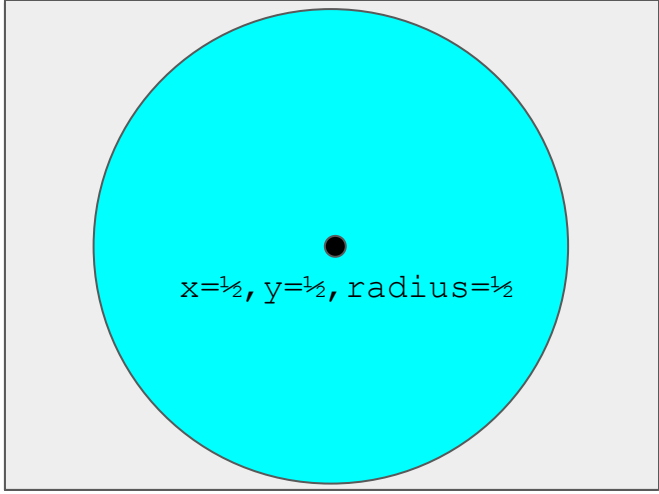
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4

1

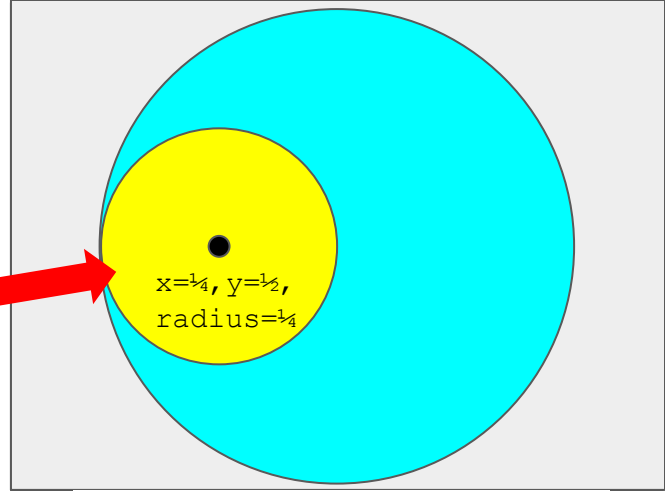
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4

1

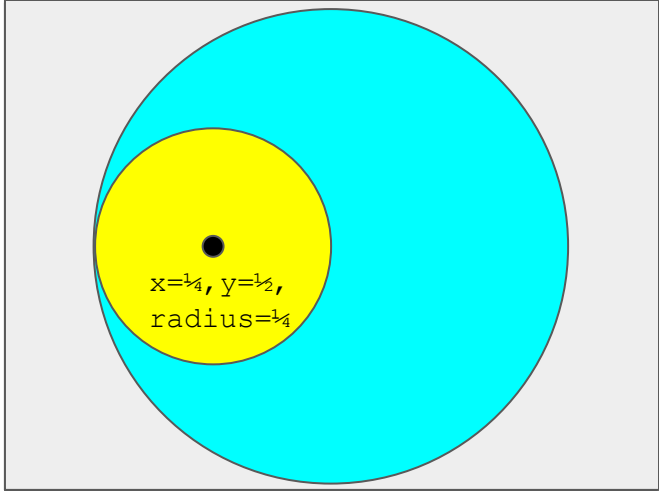
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

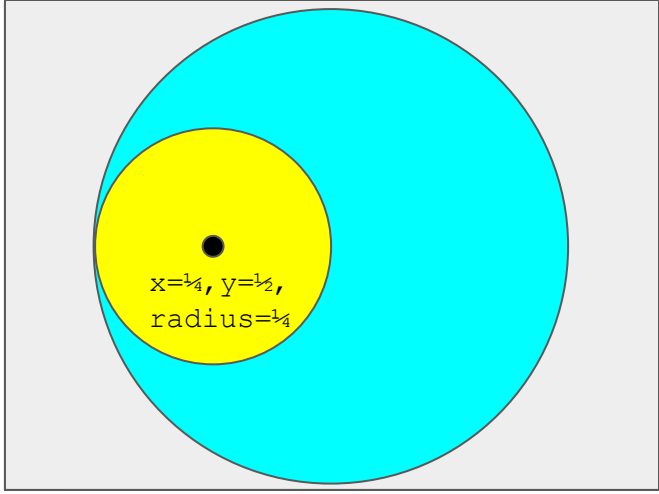
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

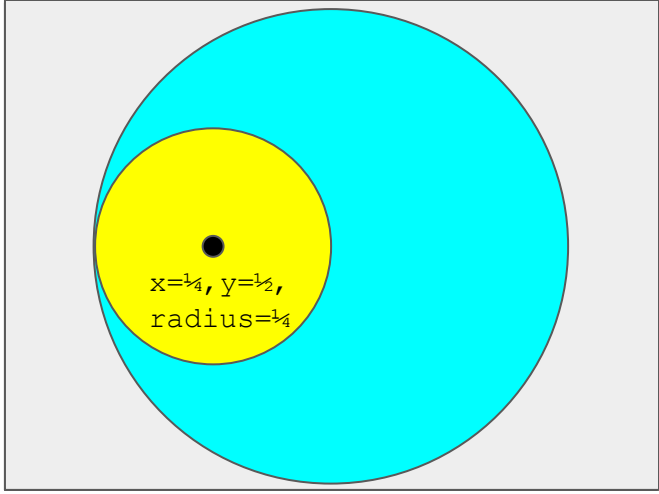
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

3

```
draw(0,1/8,1/2,1/8)
 if (n == 0) return;
  ...
```



StdDraw

3

draw:
n=0, x= 1/8, y=1/2, radius=1/8

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

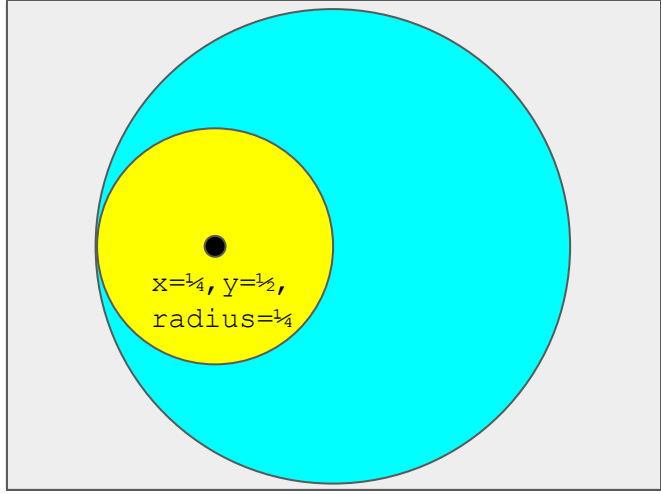
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

3

```
draw(0,1/8,1/2,1/8)
 if (n == 0) return;
  ...
```



StdDraw

3

draw:
n=0, x= 1/8, y=1/2, radius=1/8

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

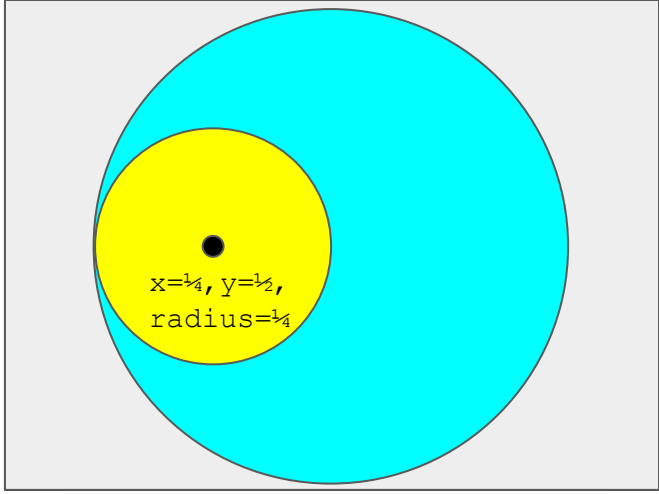
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

3

```
draw(0,1/8,1/2,1/8)
 if (n == 0) return;
   ...
```



StdDraw

3

draw:
n=0, x= 1/8, y=1/2, radius=1/8

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

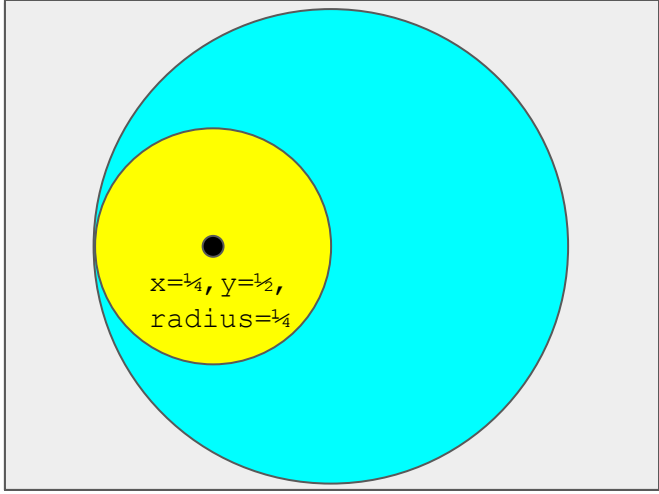
2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

3

```
draw(0,1/8,1/2,1/8)
 if (n == 0) return;
   ...
```

✓



StdDraw

3

draw:
n=0, x= 1/8, y=1/2, radius=1/8

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

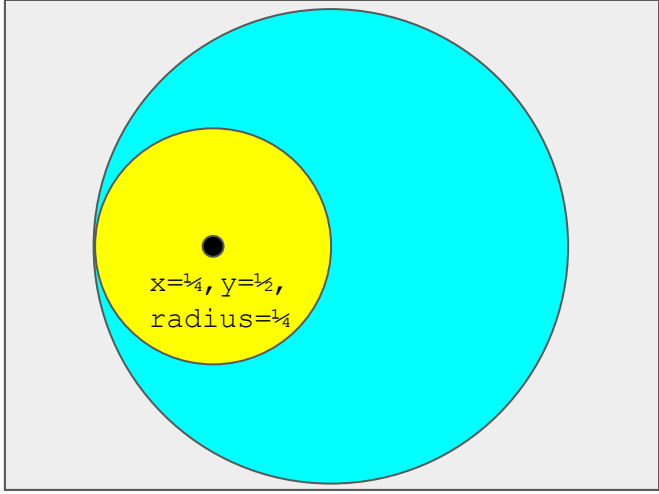
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

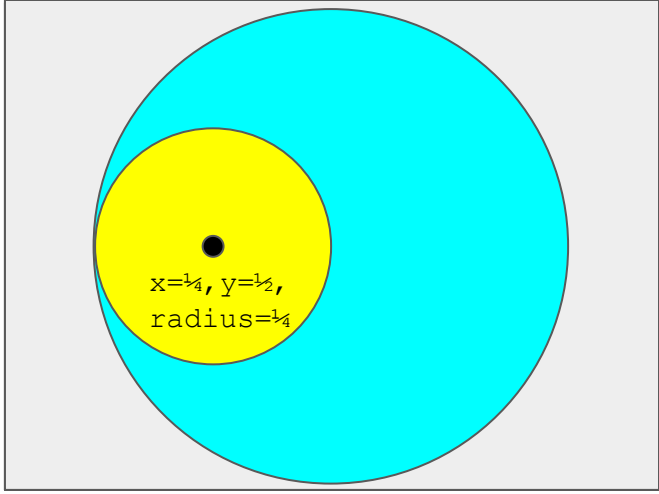
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

4

```
draw(0,3/8,1/2,1/8)
  if (n == 0) return;
  ...
```



StdDraw

4

draw:
n=0, x= 3/8, y=1/2, radius=1/4

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

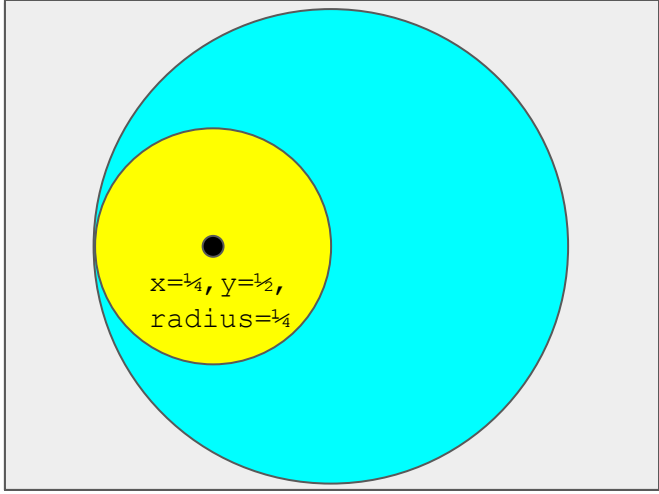
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

4

```
draw(0,3/8,1/2,1/8)
  if (n == 0) return;
  ...
```



StdDraw

4

draw:
n=0, x= 3/8, y=1/2, radius=1/4

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

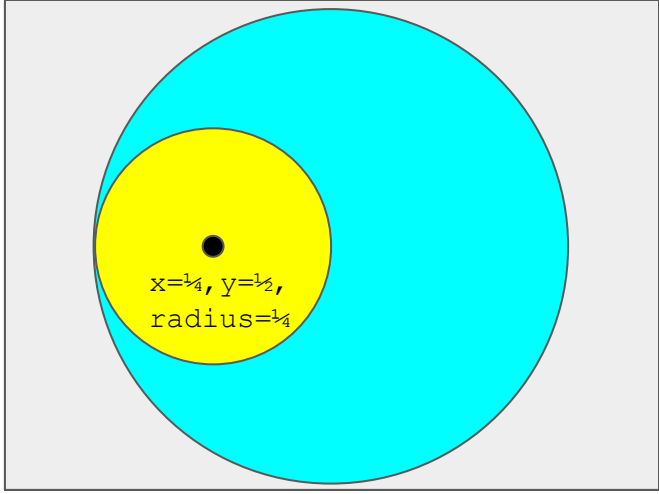
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

4

```
draw(0,3/8,1/2,1/8)
  if (n == 0) return;
    ...
```



StdDraw

4

draw:
n=0, x= 3/8, y=1/2, radius=1/4

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

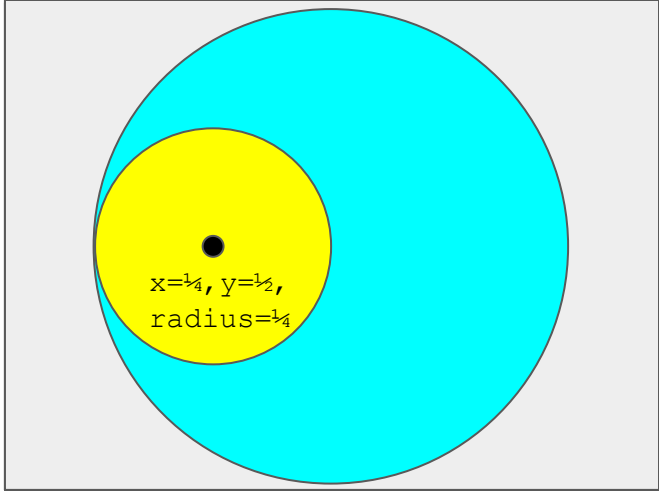
2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

4

```
draw(0,3/8,1/2,1/8)
  if (n == 0) return;
    ...
```

✓



StdDraw

4

draw:
n=0, x= 3/8, y=1/2, radius=1/4

2

draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

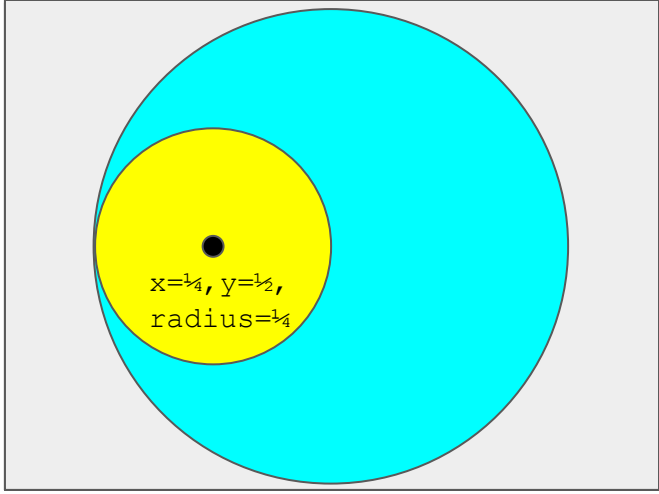
1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

2

```
draw(1, 1/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

✓



StdDraw

2

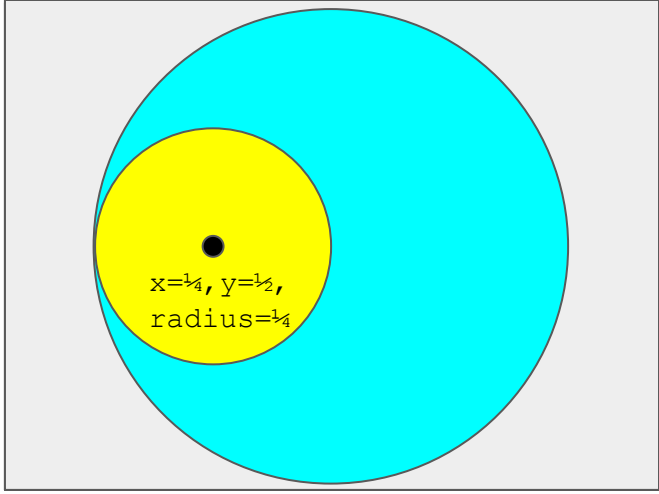
draw:
n=1, x= 1/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

1

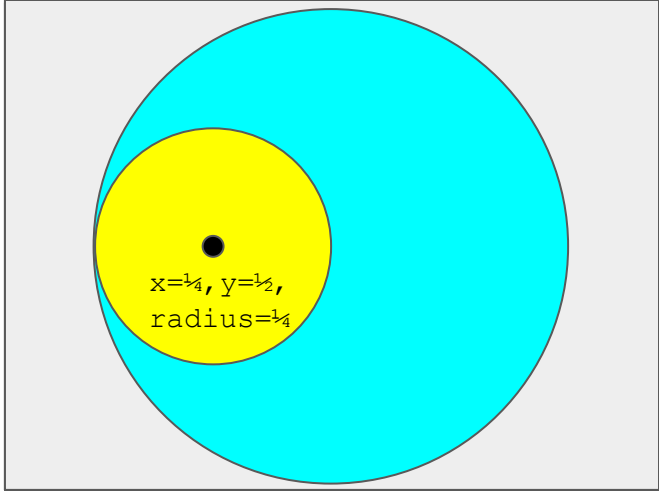
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,

1

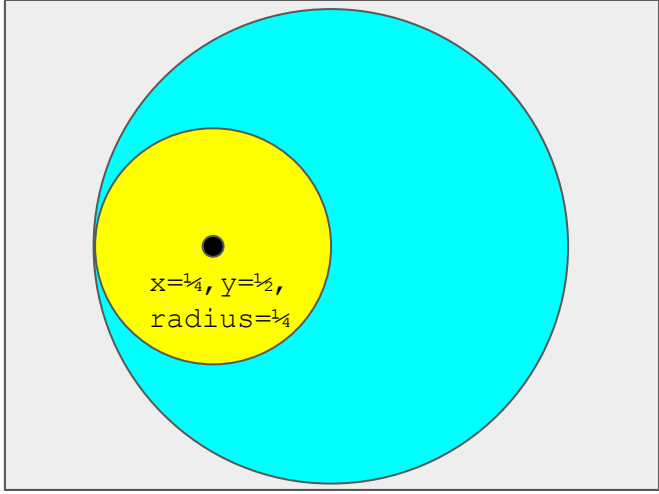
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4

1

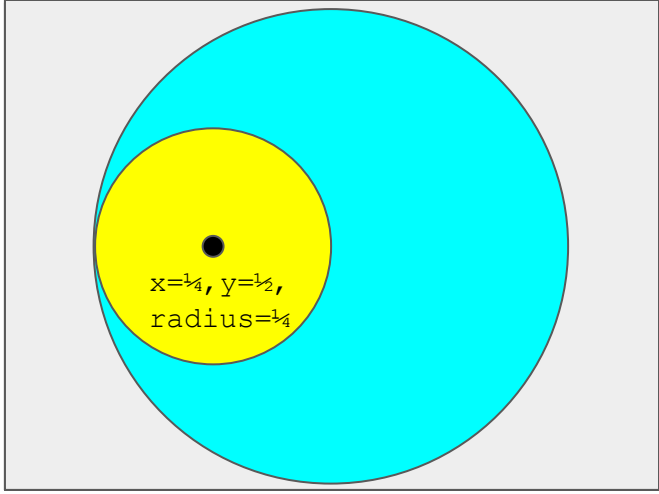
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4

1

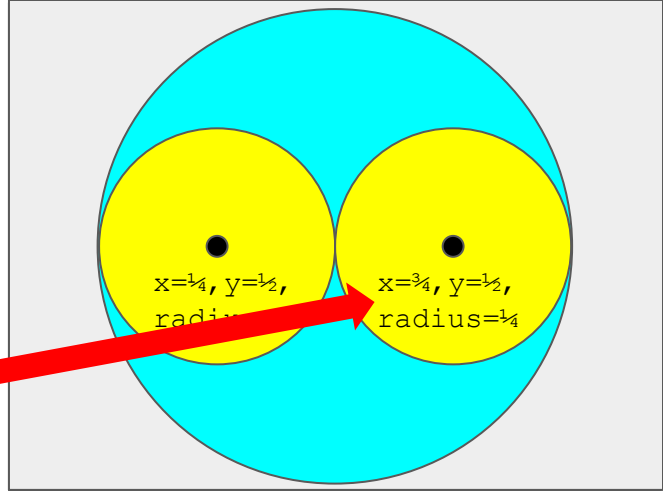
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5 draw:
n=1, x= 3/4, y=1/2, radius=1/4

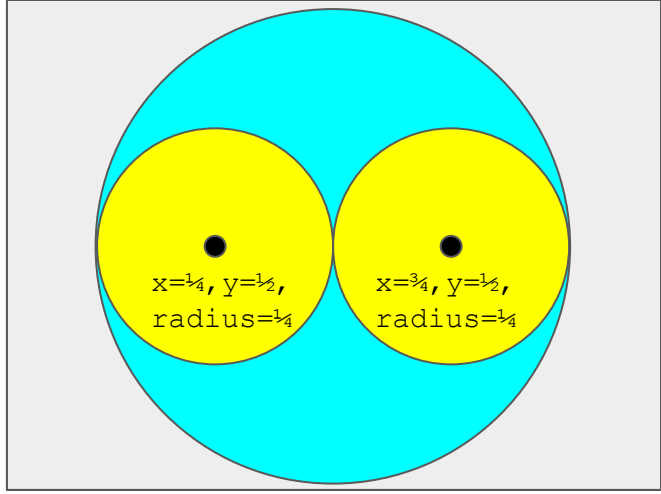
1 draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

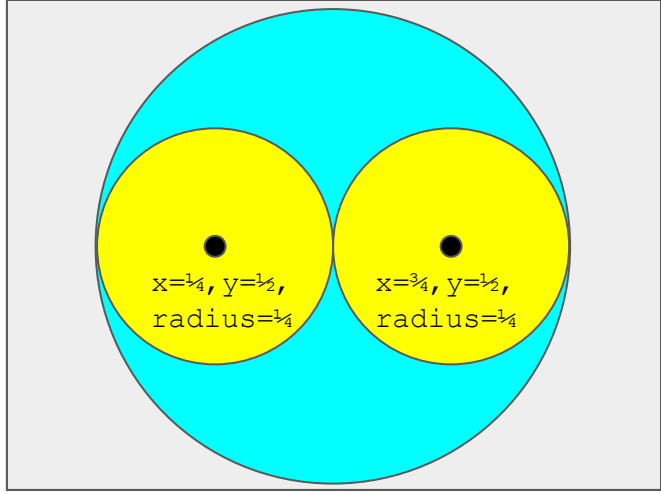
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

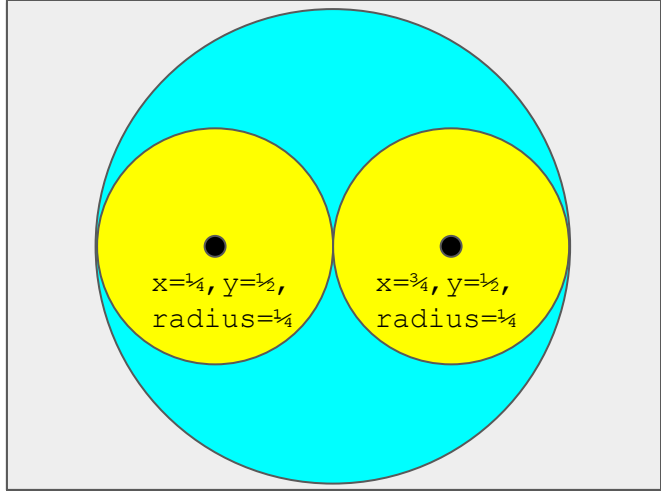
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

6

```
draw(0,5/8,1/2,1/8)
 if (n == 0) return;
  ...
```



StdDraw

6

draw:
n=0, x= 5/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

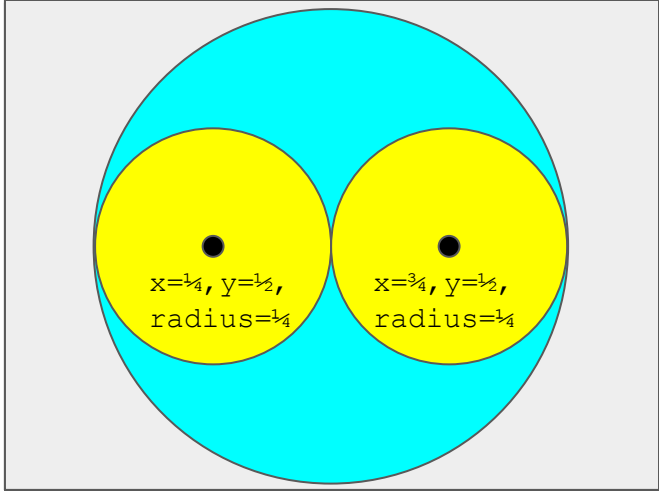
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

6

```
draw(0,5/8,1/2,1/8)
  if (n == 0) return;
   ...
```



StdDraw

6

draw:
n=0, x= 5/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4, halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2, halfRadius = 1/4

1

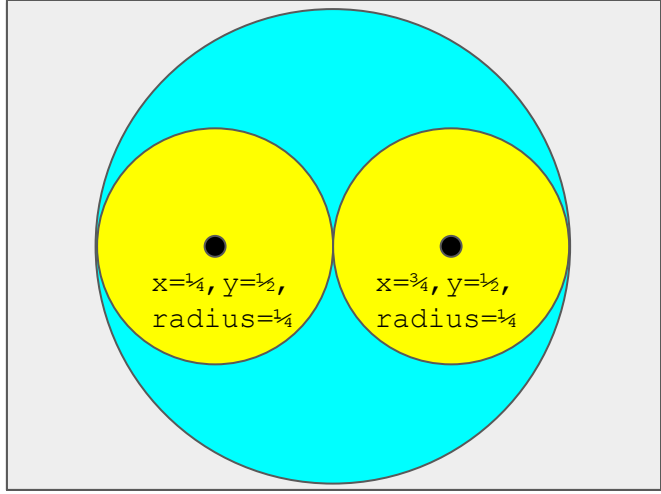
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

6

```
draw(0,5/8,1/2,1/8)
  if (n == 0) return;
    ...
```



StdDraw

6

draw:
n=0, x= 5/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

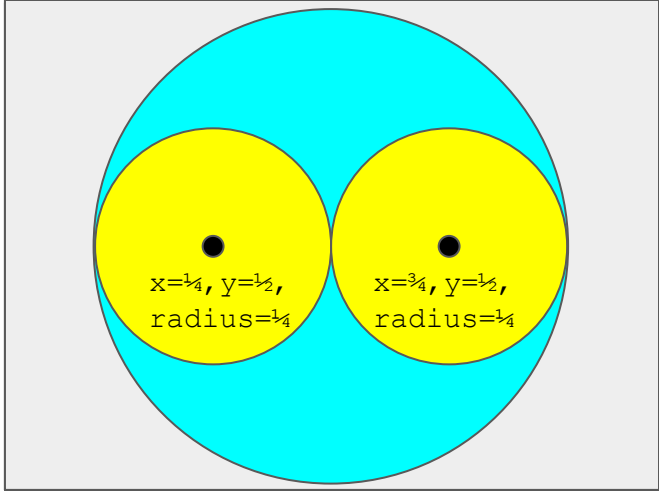
5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

6

```
draw(0,5/8,1/2,1/8)
  if (n == 0) return;
    ...
```

✓



StdDraw

6

draw:
n=0, x= 5/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

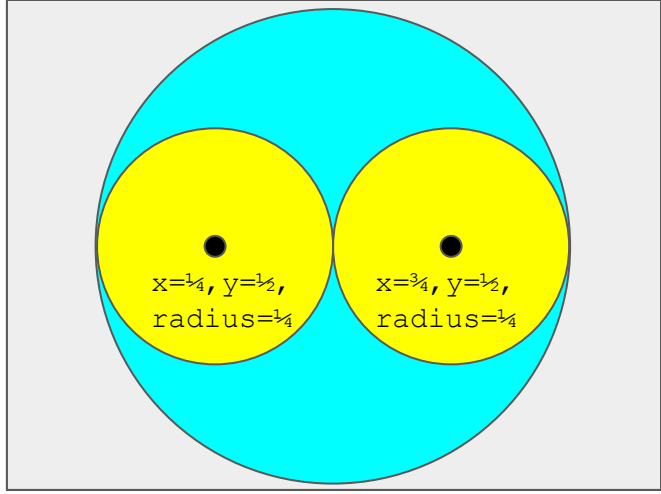
draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

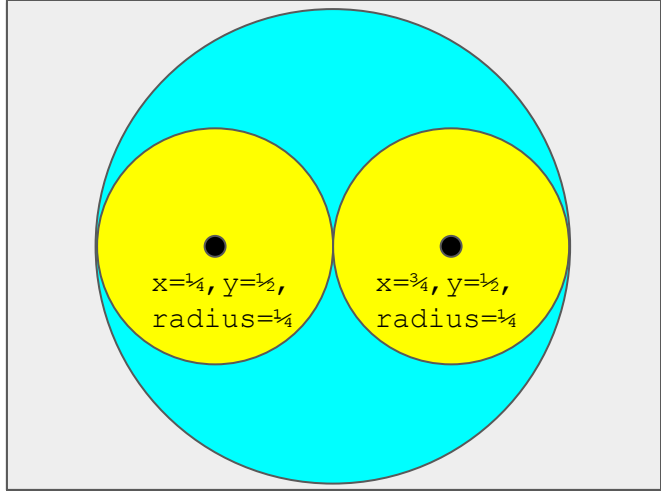
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

7

```
draw(0,7/8,1/2,1/8)
 if (n == 0) return;
  ...
```



StdDraw

7

draw:
n=0, x= 7/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4, halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2, halfRadius = 1/4

1

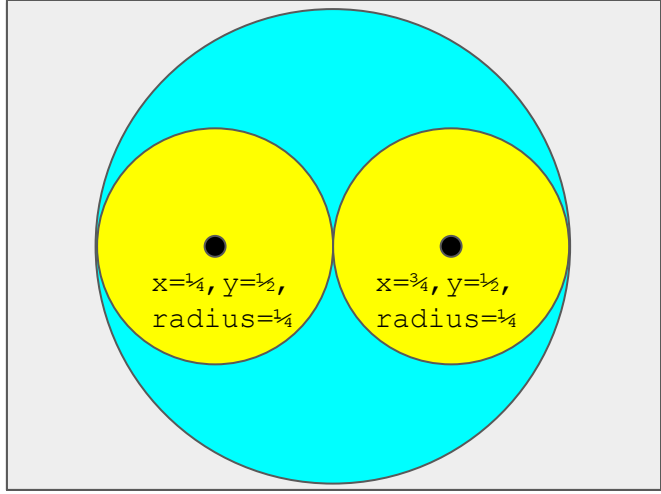
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

7

```
draw(0,5/8,1/2,1/8)
  if (n == 0) return;
   ...
```



StdDraw

7

draw:
n=0, x= 7/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

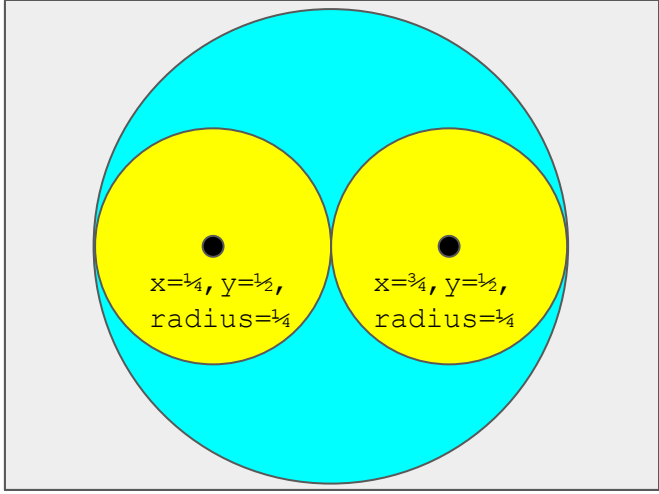
```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

7

```
draw(0,5/8,1/2,1/8)
  if (n == 0) return;
    ...
```



StdDraw

7

draw:
n=0, x= 7/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

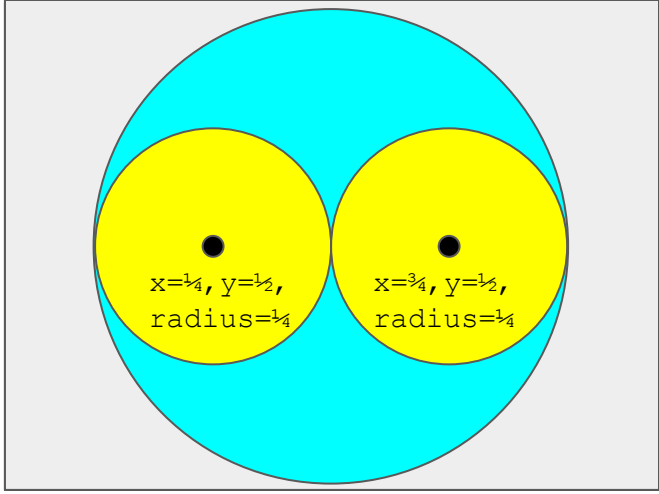
5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

7

```
draw(0,5/8,1/2,1/8)
  if (n == 0) return;
  ...
```

✓



StdDraw

7

draw:
n=0, x= 7/8, y=1/2, radius=1/8

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4, halfRadius = 1/8

1

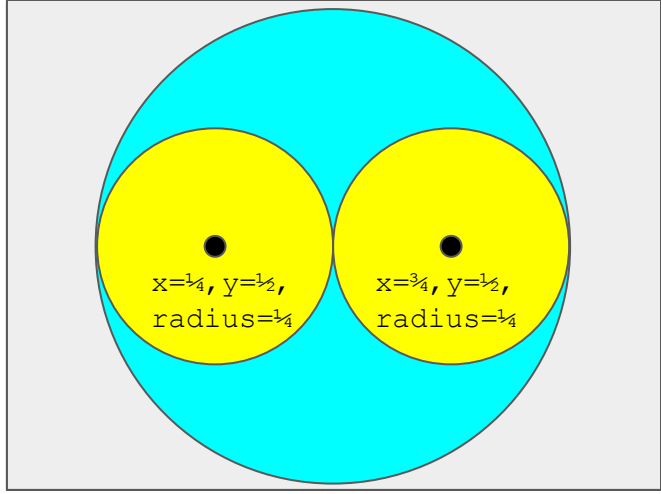
draw:
n=2, x= 1/2, y=1/2, radius=1/2, halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

5

draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

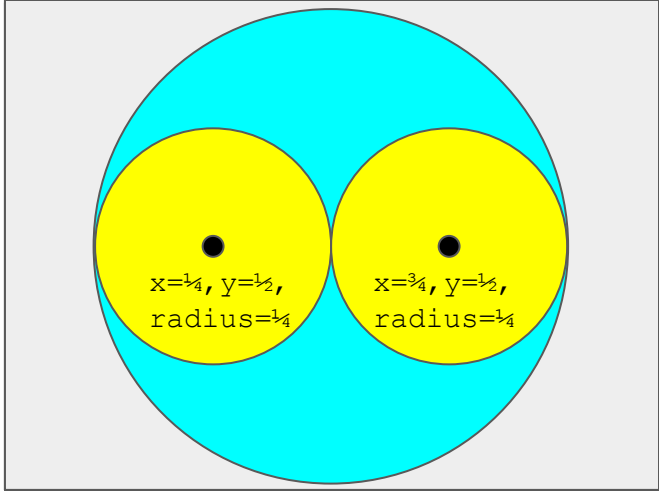
1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

5

```
draw(1, 3/4, 1/2, 1/4)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```

✓



StdDraw

5

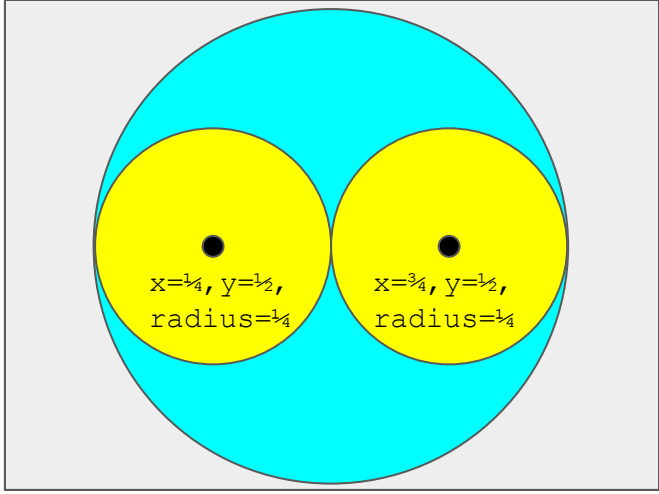
draw:
n=1, x= 3/4, y=1/2, radius=1/4,
halfRadius = 1/8

1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

```
draw(2, 1/2, 1/2, 1/2)
  if (n == 0) return;
  fancyCircle(x, y, radius);
  double halfRadius = radius/2;
  draw(n-1, x - halfRadius, y, halfRadius);
  draw(n-1, x + halfRadius, y, halfRadius);
```



StdDraw

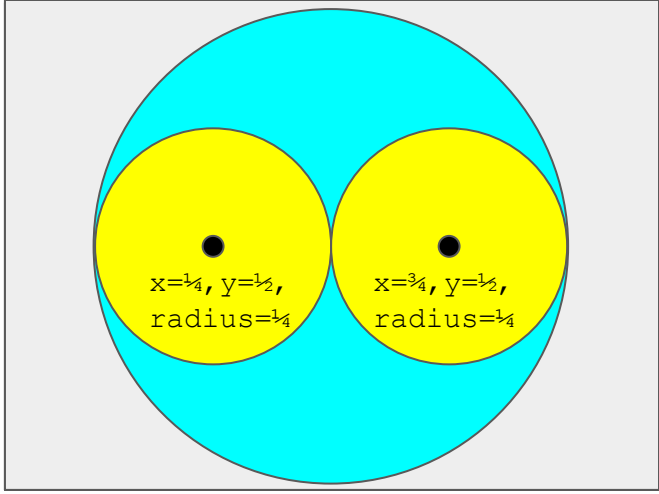
1

draw:
n=2, x= 1/2, y=1/2, radius=1/2,
halfRadius = 1/4

1

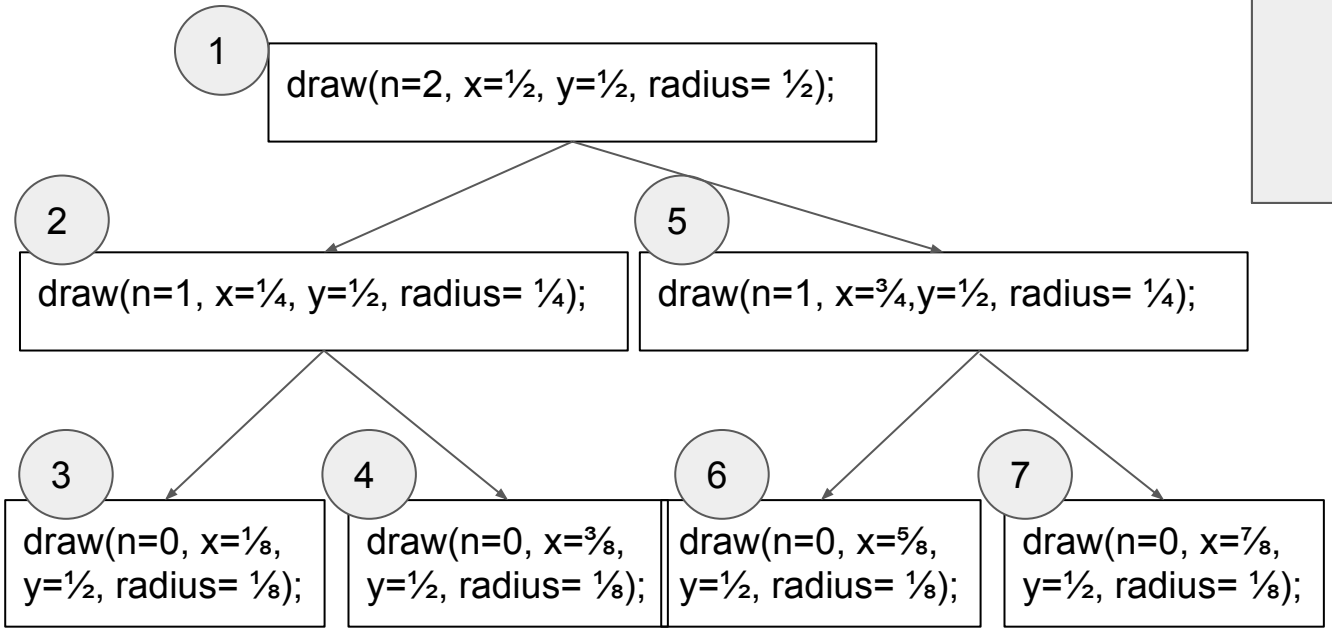
```
draw(2, 1/2, 1/2, 1/2)
   if (n == 0) return;
   fancyCircle(x, y, radius);
   double halfRadius = radius/2;
   draw(n-1, x - halfRadius, y, halfRadius);
   draw(n-1, x + halfRadius, y, halfRadius);
```

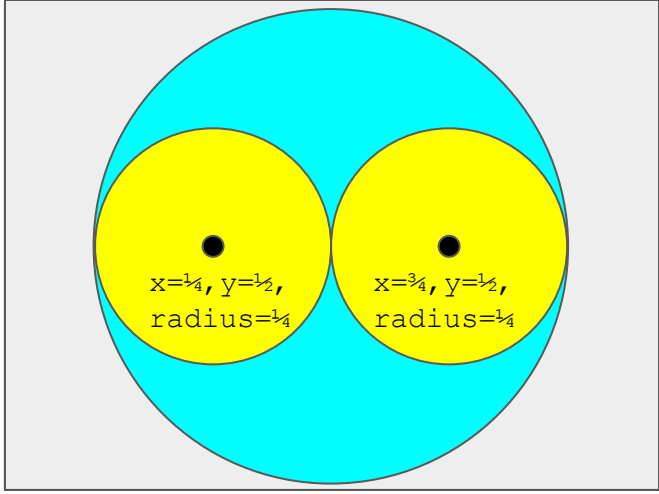
✓



StdDraw

Complete Call Tree for the draw() Method





StdDraw

Acknowledgements:

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- Victoria Pan 2021 assisted with improving the graphics.