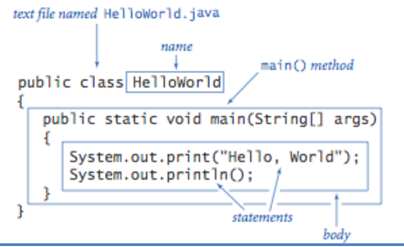
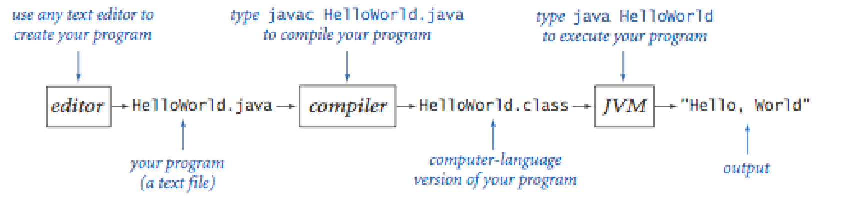
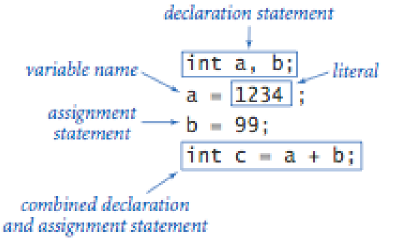


```
public class HelloWorld
{
   public static void main(String[] args)
   {
      System.out.print("Hello, World");
      System.out.println();
   }
}
```


use any text editor to create your program
type javac HelloWorld.java to compile your program
type java HelloWorld to execute your program
editor
HelloWorld.java
compiler
HelloWorld.class
JVM
"Hello, World"
your program (a text file)
computer-language version of your program
output

type	set of values	common operators	sample literal values
int	integers	+ - * / %	99 -12 2147483647
double	floating-point numbers	+ - * /	3.14 -2.5 6.022e23
boolean	boolean values	&& || !	true false
char	characters		'A' '1' '%' '\n'
String	sequences of characters	+	"AB" Hello "2.5"



```
int a, b;
a = 1234;
b = 99;
int c = a + b;
```

values	integers between -2^{31} and $+2^{31}-1$
typical literals	1234 99 -99 0 1000000
operations	add subtract multiply divide remainder
operators	+ - * / %

expression	value	comment
5 + 3	8	
5 - 3	2	
5 * 3	15	
5 / 3	1	no fractional part
5 % 3	2	remainder
1 / 0		run-time error
3 * 5 - 2	13	* has precedence
3 + 5 / 2	5	/ has precedence
3 - 5 - 2	-4	left associative
(3 - 5) - 2	-4	better style
3 - (5 - 2)	0	unambiguous

values	real numbers (specified by IEEE 754 standard)
typical literals	3.14159 6.022e23 -3.0 2.0 1.4142135623730951
operations	add subtract multiply divide
operators	+ - * /

expression	value
3.141 + .03	3.171
3.141 - .03	3.111
6.02e23 / 2.0	3.01e23
5.0 / 3.0	1.6666666666666667
10.0 % 3.141	0.577
1.0 / 0.0	Infinity
Math.sqrt(2.0)	1.4142135623730951
Math.sqrt(-1.0)	NaN

op	meaning	true	false
==	equal	2 == 2	2 == 3
!=	not equal	3 != 2	2 != 2
<	less than	2 < 13	2 < 2
<=	less than or equal	2 <= 2	3 <= 2
>	greater than	13 > 2	2 > 13
>=	greater than or equal	3 >= 2	2 >= 3

values	true or false		
literals	true false		
operations	and	or	not
operators	&&	||	!

a	!a
true	false
false	true

a	b	a && b	a || b
false	false	false	false
false	true	false	true
true	false	false	true
true	true	true	true

non-negative discriminant?	(b*b - 4.0*a*c) >= 0.0
beginning of a century?	(year % 100) == 0
legal month?	(month >= 1) && (month <= 12)

int	Integer.parseInt(String s)	convert s to an int value
double	Double.parseDouble(String s)	convert s to a double value
long	Long.parseLong(String s)	convert s to a long value

```
public class Math
   double abs(double a)                  absolute value of a
   double max(double a, double b)        maximum of a and b
   double min(double a, double b)        minimum of a and b
```

Note 1: abs(), max(), *and* min() *are defined also for* int, long, *and* float.

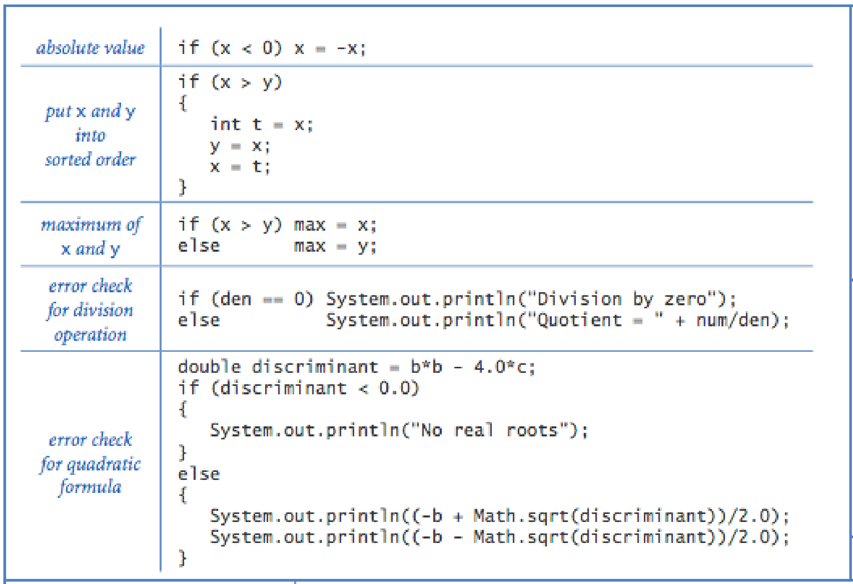
```
   double sin(double theta)              sine function
   double cos(double theta)              cosine function
   double tan(double theta)              tangent function
```

Note 2: Angles are expressed in radians. Use toDegrees() *and* toRadians() *to convert.*
Note 3: Use asin(), acos(), *and* atan() *for inverse functions.*

```
   double exp(double a)                  exponential (e^a)
   double log(double a)                  natural log (log_e a, or ln a)
   double pow(double a, double b)        raise a to the bth power (a^b)

     long round(double a)                round to the nearest integer
   double random()                       random number in [0, 1)
   double sqrt(double a)                 square root of a

   double E                              value of e (constant)
   double PI                             value of π (constant)
```

expression	library	type	value
Integer.parseInt("123")	Integer	int	123
Math.sqrt(5.0*5.0 - 4.0*4.0)	Math	double	3.0
Math.random()	Math	double	random in [0, 1)
Math.round(3.14159)	Math	long	3

expression	expression type	expression value
"1234" + 99	String	"123499"
Integer.parseInt("123")	int	123
(int) 2.71828	int	2
Math.round(2.71828)	long	3
(int) Math.round(2.71828)	int	3
(int) Math.round(3.14159)	int	3
11 * 0.3	double	3.3
(int) 11 * 0.3	double	3.3
11 * (int) 0.3	int	0
(int) (11 * 0.3)	int	3



absolute value

```
if (x < 0) x = -x;
```

put x and y into sorted order

```
if (x > y)
{
   int t = x;
   y = x;
   x = t;
}
```

maximum of x and y

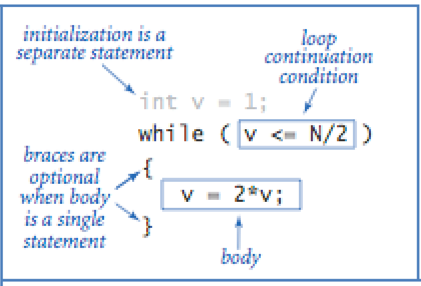
```
if (x > y) max = x;
else       max = y;
```

error check for division operation

```
if (den == 0) System.out.println("Division by zero");
else          System.out.println("Quotient = " + num/den);
```

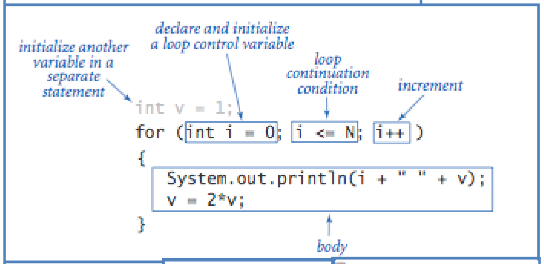
error check for quadratic formula

```
double discriminant = b*b - 4.0*c;
if (discriminant < 0.0)
{
   System.out.println("No real roots");
}
else
{
   System.out.println((-b + Math.sqrt(discriminant))/2.0);
   System.out.println((-b - Math.sqrt(discriminant))/2.0);
}
```



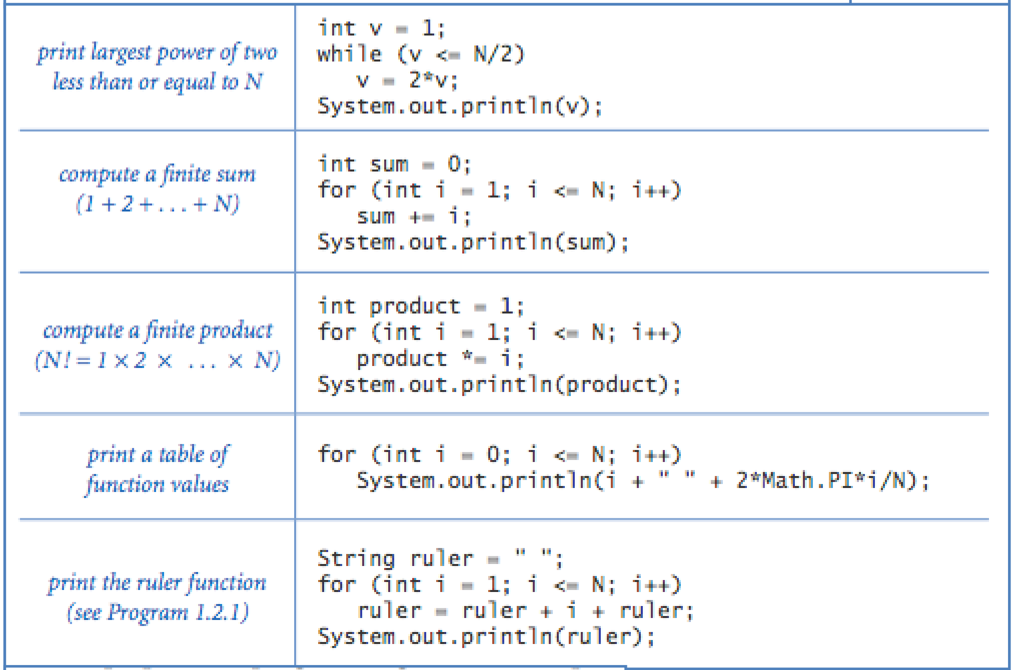
```
int v = 1;
while ( v <= N/2 )
{
   v = 2*v;
}
```

initialization is a separate statement
loop continuation condition
braces are optional when body is a single statement
body



```
int v = 1;
for (int i = 0; i <= N; i++)
{
   System.out.println(i + " " + v);
   v = 2*v;
}
```

initialize another variable in a separate statement
declare and initialize a loop control variable
loop continuation condition
increment
body



print largest power of two less than or equal to N

```
int v = 1;
while (v <= N/2)
   v = 2*v;
System.out.println(v);
```

compute a finite sum (1 + 2 + . . . + N)

```
int sum = 0;
for (int i = 1; i <= N; i++)
   sum += i;
System.out.println(sum);
```

compute a finite product (N! = 1 × 2 × . . . × N)

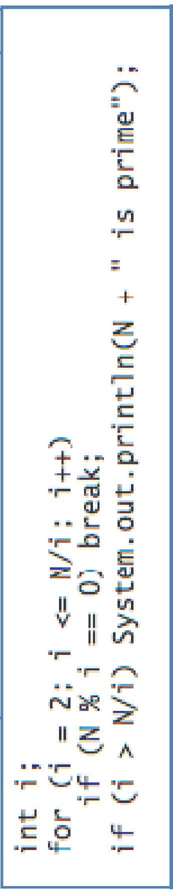
```
int product = 1;
for (int i = 1; i <= N; i++)
   product *= i;
System.out.println(product);
```

print a table of function values

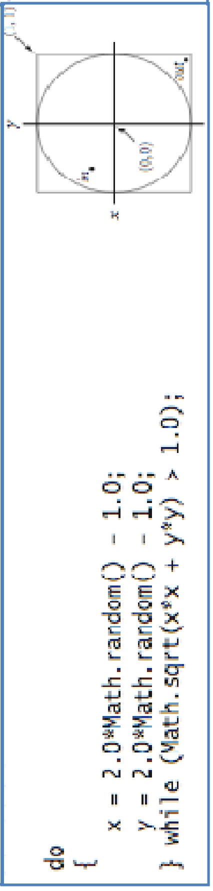
```
for (int i = 0; i <= N; i++)
   System.out.println(i + " " + 2*Math.PI*i/N);
```

print the ruler function (see Program 1.2.1)

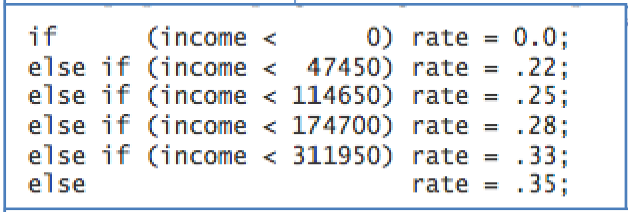
```
String ruler = " ";
for (int i = 1; i <= N; i++)
   ruler = ruler + i + ruler;
System.out.println(ruler);
```



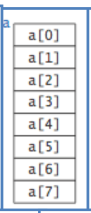
```
int i;
for (i = 2; i <= N/i; i++)
   if (N % i == 0) break;
if (i > N/i) System.out.println(N + " is prime");
```

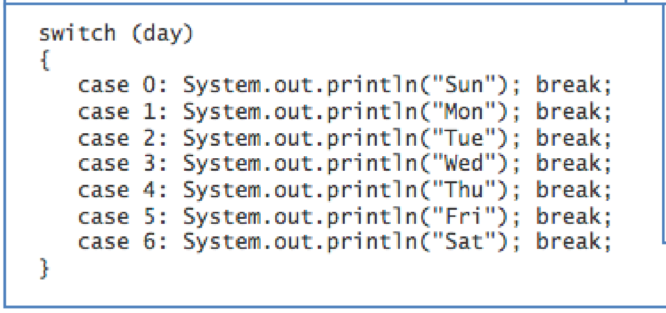


```
do
{
   x = 2.0*Math.random() - 1.0;
   y = 2.0*Math.random() - 1.0;
} while (Math.sqrt(x*x + y*y) > 1.0);
```

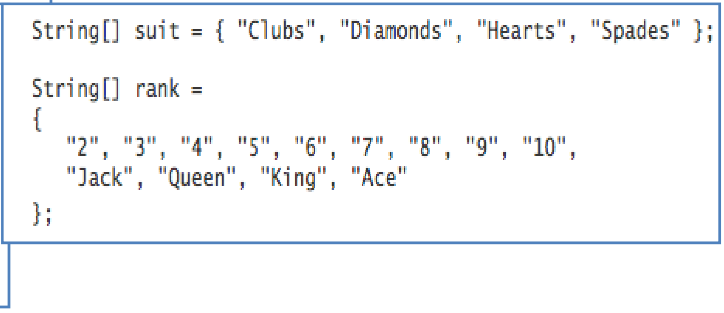


```
if      (income <      0) rate = 0.0;
else if (income <  47450) rate = .22;
else if (income < 114650) rate = .25;
else if (income < 174700) rate = .28;
else if (income < 311950) rate = .33;
else                      rate = .35;
```





```
switch (day)
{
   case 0: System.out.println("Sun"); break;
   case 1: System.out.println("Mon"); break;
   case 2: System.out.println("Tue"); break;
   case 3: System.out.println("Wed"); break;
   case 4: System.out.println("Thu"); break;
   case 5: System.out.println("Fri"); break;
   case 6: System.out.println("Sat"); break;
}
```



```
String[] suit = { "Clubs", "Diamonds", "Hearts", "Spades" };

String[] rank =
{
   "2", "3", "4", "5", "6", "7", "8", "9", "10",
   "Jack", "Queen", "King", "Ace"
};
```

create an array with random values

```
double[] a = new double[N];
for (int i = 0; i < N; i++)
   a[i] = Math.random();
```

print the array values, one per line

```
for (int i = 0; i < N; i++)
   System.out.println(a[i]);
```

find the maximum of the array values

```
double max = Double.NEGATIVE_INFINITY;
for (int i = 0; i < N; i++)
   if (a[i] > max) max = a[i];
```

compute the average of the array values

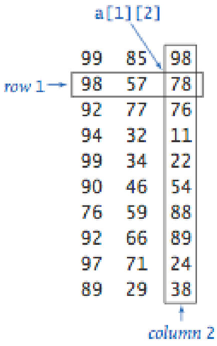
```
double sum = 0.0;
for (int i = 0; i < N; i++)
   sum += a[i];
double average = sum / N;
```

copy to another array

```
double[] b = new double[N];
for (int i = 0; i < N; i++)
   b[i] = a[i];
```

reverse the elements within an array

```
for (int i = 0; i < N/2; i++)
{
   double temp = b[i];
   b[i] = b[N-1-i];
   b[N-i-1] = temp;
}
```



```
99  85  98
98  57  78
92  77  76
94  32  11
99  34  22
90  46  54
76  59  88
92  66  89
97  71  24
89  29  38
```

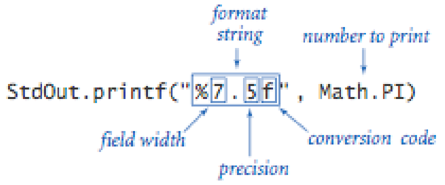
```
int[][] a =
{
   { 99, 85, 98,  0 },
   { 98, 57, 78,  0 },
   { 92, 77, 76,  0 },
   { 94, 32, 11,  0 },
   { 99, 34, 22,  0 },
   { 90, 46, 54,  0 },
   { 76, 59, 88,  0 },
   { 92, 66, 89,  0 },
   { 97, 71, 24,  0 },
   { 89, 29, 38,  0 },
   {  0,  0,  0,  0 }
};
```

```
for (int i = 0; i < a.length; i++)
{
   for (int j = 0; j < a[i].length; j++)
      System.out.print(a[i][j] + " ");
   System.out.println();
}
```

```
public class StdOut
```

`void print(String s)`	*print* `s`
`void println(String s)`	*print* `s`*, followed by newline*
`void println()`	*print a new line*
`void printf(String f, ... )`	*formatted print*

API for our library of static methods for standard output



Anatomy of a formatted print statement

type	*code*	*typical literal*	*sample format strings*	*converted string values for output*

`int`	`d`	`512`	`"%14d"`
			`"%-14d"`
				`"           512"`
				`"512           "`

`double`	`f`
	`e`
		`1595.1680010754388`	`"%14.2f"`
			`"%.7f"`
			`"%14.4e"`
				`"       1595.17"`
				`"1595.1680011"`
				`"    1.5952e+03"`

`String`	`s`	`"Hello, World"`	`"%14s"`
			`"%-14s"`
			`"%-14.5s"`
				`"  Hello, World"`
				`"Hello, World  "`
				`"Hello         "`

```
public class StdIn
```

`boolean isEmpty()`	`true` *if no more values,* `false` *otherwise*
`int readInt()`	*read a value of type* `int`
`double readDouble()`	*read a value of type* `double`
`long readLong()`	*read a value of type long*
`boolean readBoolean()`	*read a value of type* `boolean`
`char readChar()`	*read a value of type* `char`
`String readString()`	*read a value of type* `String`
`String readLine()`	*read the rest of the line*
`String readAll()`	*read the rest of the text*

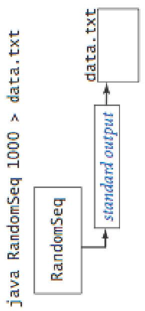
API for our library of static methods for standard input

```
public class StdDraw
   void line(double x0, double y0, double x1, double y1)
   void point(double x, double y)
   void text(double x, double y, String s)
   void circle(double x, double y, double r)
   void filledCircle(double x, double y, double r)
   void square(double x, double y, double r)
   void filledSquare(double x, double y, double r)
   void polygon(double[] x, double[] y)
   void filledPolygon(double[] x, double[] y)
```

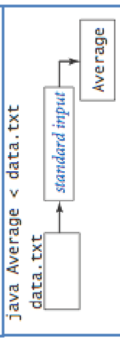
`void setXscale(double x0, double x1)`	*reset x range to* (x_0, x_1)
`void setYscale(double y0, double y1)`	*reset y range to* (y_0, y_1)
`void setPenRadius(double r)`	*set pen radius to* `r`
`void setPenColor(Color c)`	*set pen color to* `c`
`void setFont(Font f)`	*set text font to* `f`
`void setCanvasSize(int w, int h)`	*set canvas to* `w`*-by-*`h` *window*
`void clear(Color c)`	*clear the canvas; color it* `c`
`void show(int dt)`	*show all; pause* `dt` *milliseconds*
`void save(String filename)`	*save to a* `.jpg` *or* `.png` *file*

Note: Methods with the same names but no arguments reset to default values.

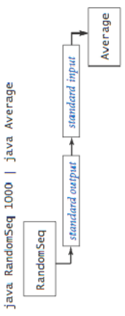
API for our library of static methods for standard drawing



Redirecting standard output to a file



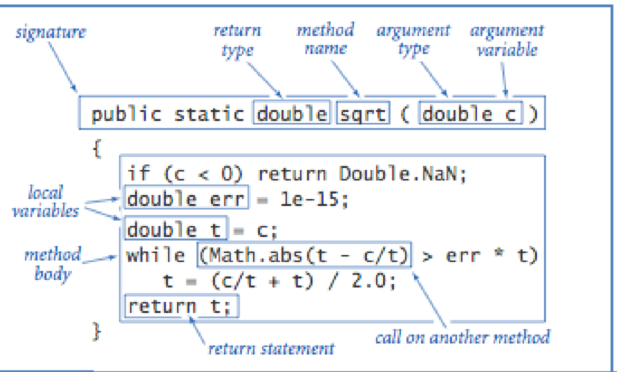
Redirecting from a file to standard input



Piping the output of one program to the input of another

	`public class StdAudio`	
`void`	`play(String file)`	*play the given .wav file*
`void`	`play(double[] a)`	*play the given sound wave*
`void`	`play(double x)`	*play sample for 1/44100 second*
`void`	`save(String file, double[] a)`	*save to a .wav file*
`double[]`	`read(String file)`	*read from a .wav file*

API for our library of static methods for standard audio



```
public static double sqrt ( double c )
{
   if (c < 0) return Double.NaN;
   double err = 1e-15;
   double t = c;
   while (Math.abs(t - c/t) > err * t)
      t = (c/t + t) / 2.0;
   return t;
}
```

absolute value of an `int` *value*

```
public static int abs(int x)
{
   if (x < 0) return -x;
   else       return  x;
}
```

absolute value of a `double` *value*

```
public static double abs(double x)
{
   if (x < 0.0) return -x;
   else         return  x;
}
```

primality test

```
public static boolean isPrime(int N)
{
   if (N < 2) return false;
   for (int i = 2; i <= N/i; i++)
      if (N % i == 0) return false;
   return true;
}
```

hypotenuse of a right triangle

```
public static double hypotenuse(double a, double b)
{  return Math.sqrt(a*a + b*b);  }
```

Harmonic number

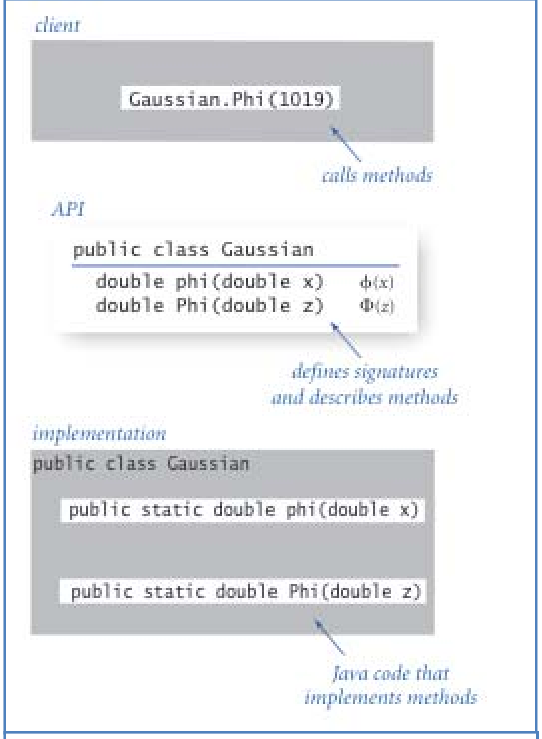
```
public static double H(int N)
{
   double sum = 0.0;
   for (int i = 1; i <= N; i++)
      sum += 1.0 / i;
   return sum;
}
```

uniform random integer in [0, N)

```
public static int uniform(int N)
{  return (int) (Math.random() * N);  }
```

draw a triangle

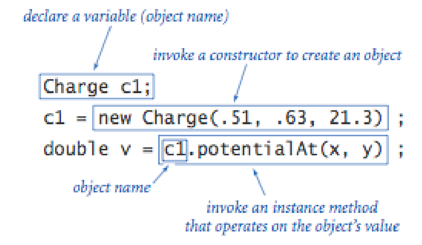
```
public static void drawTriangle(double x0, double y0,
                                double x1, double y1,
                                double x2, double y2 )
{
   StdDraw.line(x0, y0, x1, y1);
   StdDraw.line(x1, y1, x2, y2);
   StdDraw.line(x2, y2, x0, y0);
}
```



client
Gaussian.Phi(1019)
calls methods
API
public class Gaussian
double phi(double x) ϕ(x)
double Phi(double z) Φ(z)
defines signatures and describes methods
implementation
public class Gaussian
public static double phi(double x)
public static double Phi(double z)
Java code that implements methods

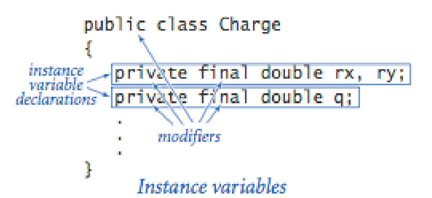
	`public class StdRandom`	
`int`	`uniform(int N)`	*integer between* `0` *and* `N-1`
`double`	`uniform(double lo, double hi)`	*real between* `lo` *and* `hi`
`boolean`	`bernoulli(double p)`	`true` *with probability* `p`
`double`	`gaussian()`	*normal, mean* `0`*, standard deviation* `1`
`double`	`gaussian(double m, double s)`	*normal, mean* `m`*, standard deviation* `s`
`int`	`discrete(double[] a)`	`i` *with probability* `a[i]`
`void`	`shuffle(double[] a)`	*randomly shuffle the array* `a[]`

	`public class StdStats`	
`double`	`max(double[] a)`	*largest value*
`double`	`min(double[] a)`	*smallest value*
`double`	`mean(double[] a)`	*average*
`double`	`var(double[] a)`	*sample variance*
`double`	`stddev(double[] a)`	*sample standard deviation*
`double`	`median(double[] a)`	*median*
`void`	`plotPoints(double[] a)`	*plot points at* `(i, a[i])`
`void`	`plotLines(double[] a)`	*plot lines connecting points at* `(i, a[i])`
`void`	`plotBars(double[] a)`	*plot bars to points at* `(i, a[i])`



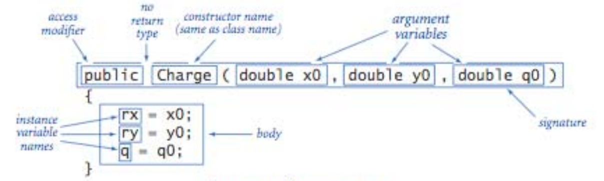
```
Charge c1;
c1 = new Charge(.51, .63, 21.3) ;
double v = c1.potentialAt(x, y) ;
```

declare a variable (object name)
invoke a constructor to create an object
object name
invoke an instance method that operates on the object's value



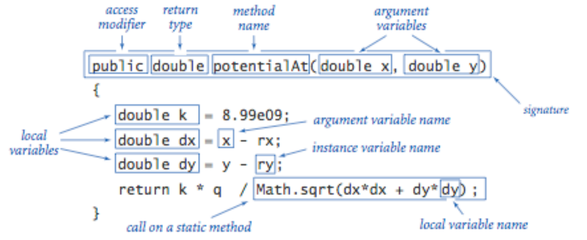
```
public class Charge
{
   private final double rx, ry;
   private final double q;
   .
   .
   .
}
```

Instance variables



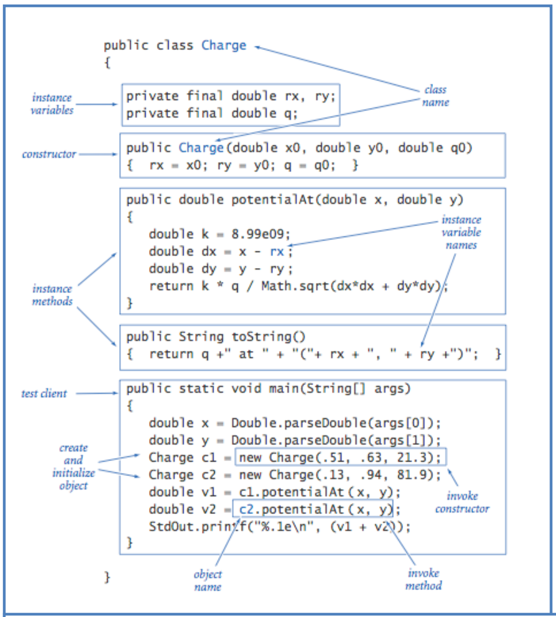
```
public Charge ( double x0 , double y0 , double q0 )
{
   rx = x0;
   ry = y0;
   q = q0;
}
```

Anatomy of a constructor

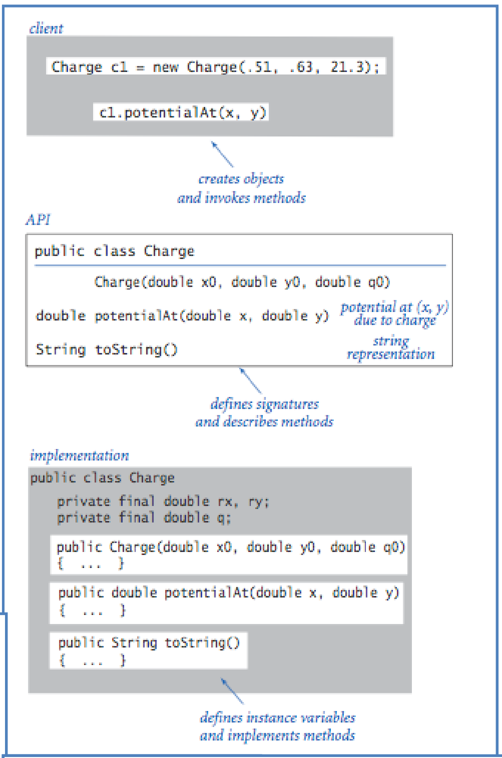


```
public double potentialAt(double x, double y)
{
   double k = 8.99e09;
   double dx = x - rx;
   double dy = y - ry;
   return k * q  / Math.sqrt(dx*dx + dy*dy) ;
}
```

Anatomy of an instance method



```
public class Charge
{
   private final double rx, ry;
   private final double q;

   public Charge(double x0, double y0, double q0)
   {  rx = x0; ry = y0; q = q0;  }

   public double potentialAt(double x, double y)
   {
      double k = 8.99e09;
      double dx = x - rx;
      double dy = y - ry;
      return k * q / Math.sqrt(dx*dx + dy*dy);
   }

   public String toString()
   {  return q +" at " + "("+ rx + ", " + ry +")";  }

   public static void main(String[] args)
   {
      double x = Double.parseDouble(args[0]);
      double y = Double.parseDouble(args[1]);
      Charge c1 = new Charge(.51, .63, 21.3);
      Charge c2 = new Charge(.13, .94, 81.9);
      double v1 = c1.potentialAt(x, y);
      double v2 = c2.potentialAt(x, y);
      StdOut.printf("%.1e\n", (v1 + v2));
   }
}
```

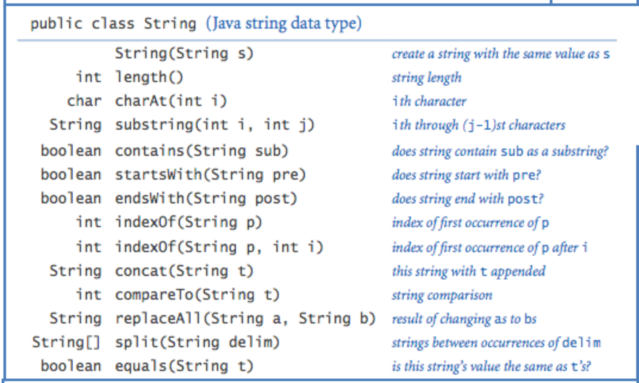


client
creates objects and invokes methods
API
defines signatures and describes methods
implementation
defines instance variables and implements methods

```
Charge c1 = new Charge(.51, .63, 21.3);

   c1.potentialAt(x, y)
```

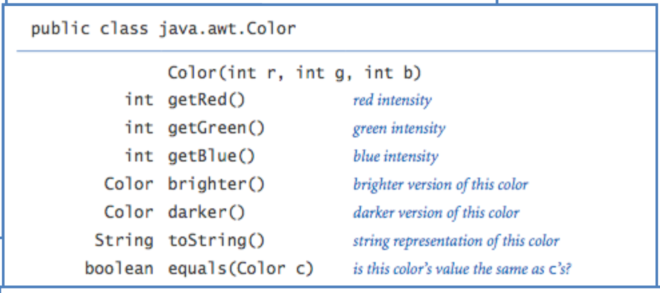
public class Charge	
Charge(double x0, double y0, double q0)	
double potentialAt(double x, double y)	potential at (x, y) due to charge
String toString()	string representation

```
public class Charge
   private final double rx, ry;
   private final double q;

   public Charge(double x0, double y0, double q0)
   {  ...  }

   public double potentialAt(double x, double y)
   {  ...  }

   public String toString()
   {  ...  }
```



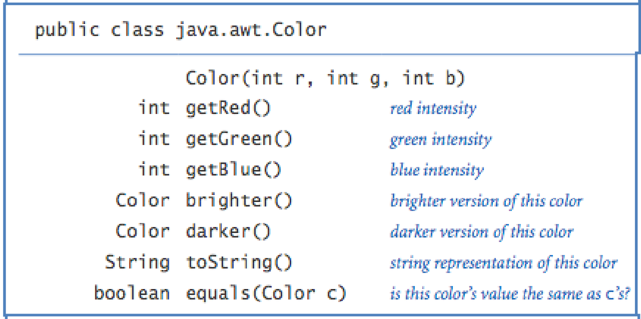
public class String (Java string data type)

	String(String s)	create a string with the same value as s
int	length()	string length
char	charAt(int i)	ith character
String	substring(int i, int j)	ith through (j-1)st characters
boolean	contains(String sub)	does string contain sub as a substring?
boolean	startsWith(String pre)	does string start with pre?
boolean	endsWith(String post)	does string end with post?
int	indexOf(String p)	index of first occurrence of p
int	indexOf(String p, int i)	index of first occurrence of p after i
String	concat(String t)	this string with t appended
int	compareTo(String t)	string comparison
String	replaceAll(String a, String b)	result of changing as to bs
String[]	split(String delim)	strings between occurrences of delim
boolean	equals(String t)	is this string's value the same as t's?



public class java.awt.Color

	Color(int r, int g, int b)	
int	getRed()	red intensity
int	getGreen()	green intensity
int	getBlue()	blue intensity
Color	brighter()	brighter version of this color
Color	darker()	darker version of this color
String	toString()	string representation of this color
boolean	equals(Color c)	is this color's value the same as c's?



public class java.awt.Color

	Color(int r, int g, int b)	
int	getRed()	red intensity
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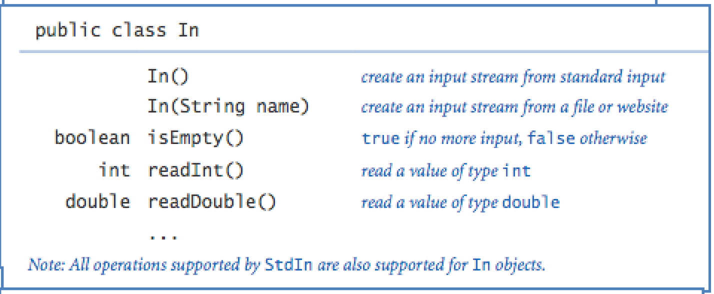
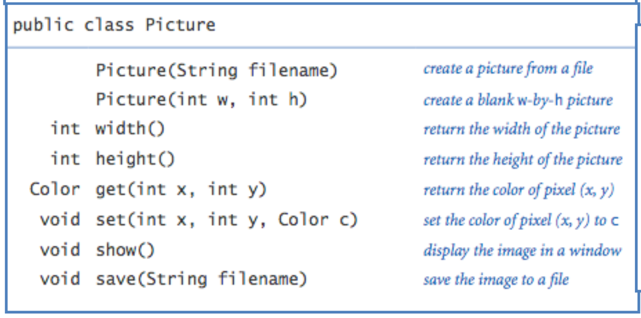
Color	brighter()	brighter version of this color
Color	darker()	darker version of this color
String	toString()	string representation of this color
boolean	equals(Color c)	is this color's value the same as c's?



public class In

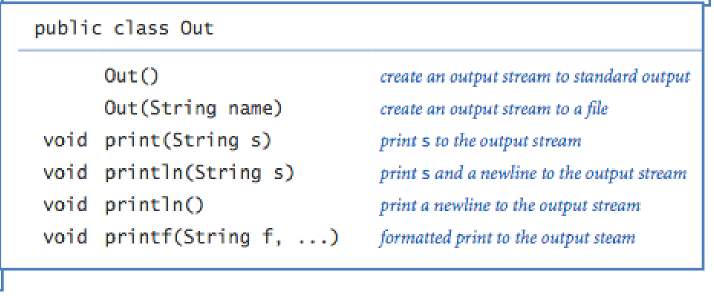
	In()	create an input stream from standard input
	In(String name)	create an input stream from a file or website
boolean	isEmpty()	true if no more input, false otherwise
int	readInt()	read a value of type int
double	readDouble()	read a value of type double
	...	

Note: All operations supported by StdIn are also supported for In objects.



public class Picture

	Picture(String filename)	create a picture from a file
	Picture(int w, int h)	create a blank w-by-h picture
int	width()	return the width of the picture
int	height()	return the height of the picture
Color	get(int x, int y)	return the color of pixel (x, y)
void	set(int x, int y, Color c)	set the color of pixel (x, y) to c
void	show()	display the image in a window
void	save(String filename)	save the image to a file



public class Out

	Out()	create an output stream to standard output
	Out(String name)	create an output stream to a file
void	print(String s)	print s to the output stream
void	println(String s)	print s and a newline to the output stream
void	println()	print a newline to the output stream
void	printf(String f, ...)	formatted print to the output steam

Resumen Java de http://introcs.cs.princeton.edu/java/11cheatsheet/