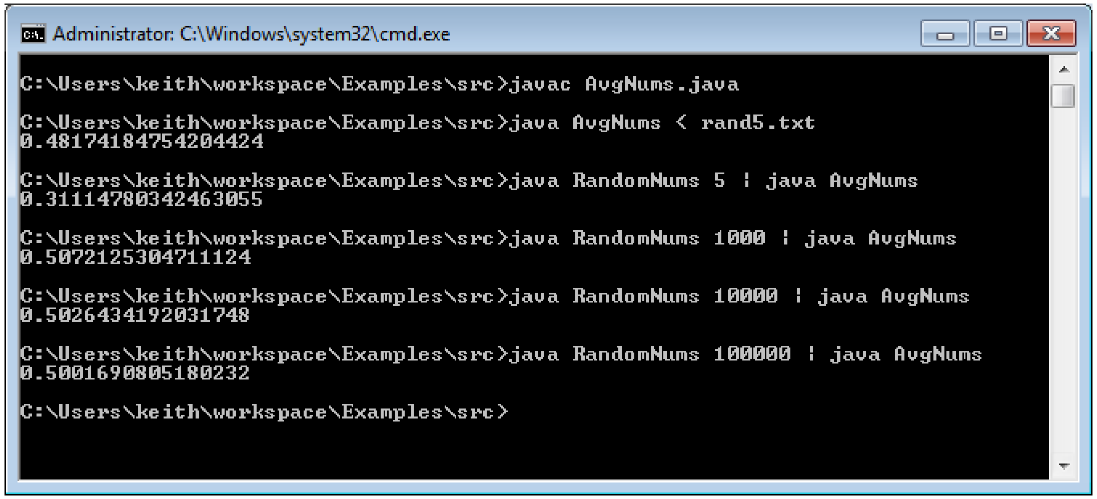
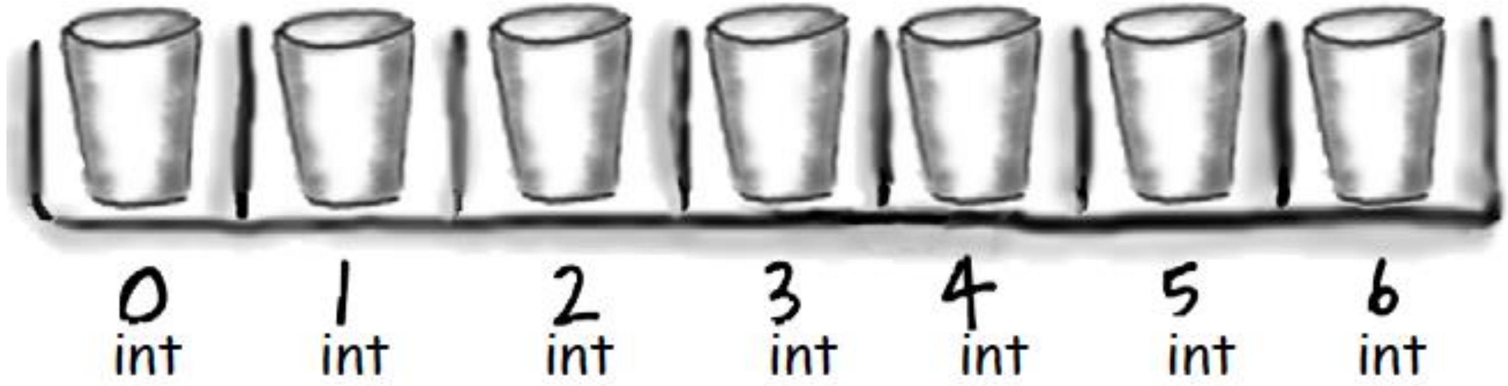
Command line, standard input, and arrays



```
C:\Users\keith\workspace\Examples\src>javac AvgNums.java

C:\Users\keith\workspace\Examples\src>java AvgNums < rand5.txt
0.48174184754204424

C:\Users\keith\workspace\Examples\src>java RandomNums 5 | java AvgNums
0.31114780342463055

C:\Users\keith\workspace\Examples\src>java RandomNums 1000 | java AvgNums
0.5072125304711124

C:\Users\keith\workspace\Examples\src>java RandomNums 10000 | java AvgNums
0.5026434192031748

C:\Users\keith\workspace\Examples\src>java RandomNums 100000 | java AvgNums
0.5001690805180232

C:\Users\keith\workspace\Examples\src>
```

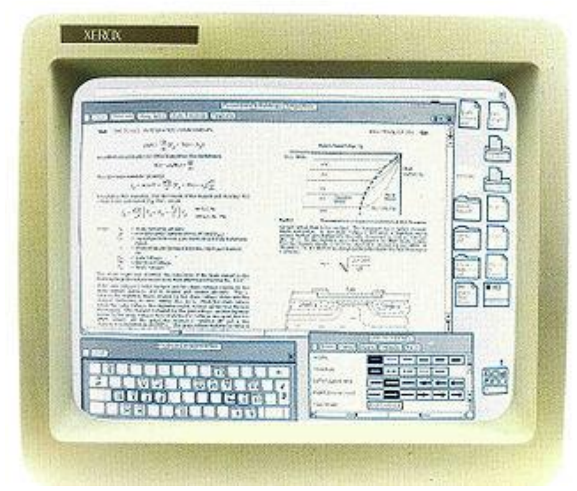


Overview

- Learning to use the command line
- New ways to get input into your programs:
  - Read information from user
  - Read information from a file
  - Read information from another program
- New way to store things
  - Arrays: store multiple things under one name
  - e.g. `args[0], args[1], args[2]`

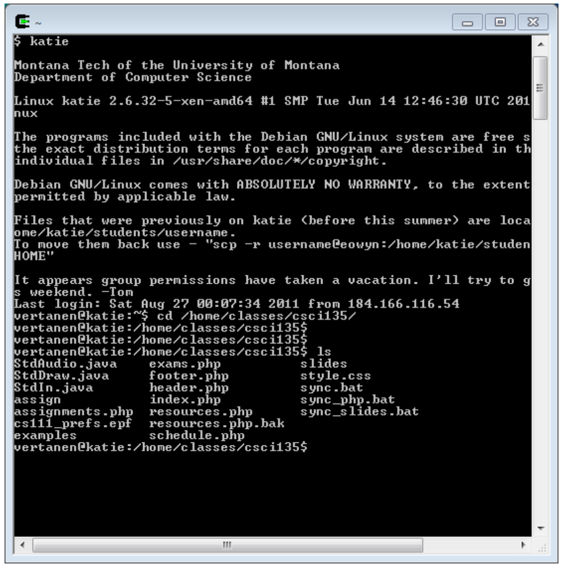
Interfacing with your computer

- GUI (graphical user interfaces)
  - Today: predominant interaction method
  - Windows, buttons, mouse
  - Advantages
    - Easier for novices
    - No commands to remember
    - Rich input and output capabilities

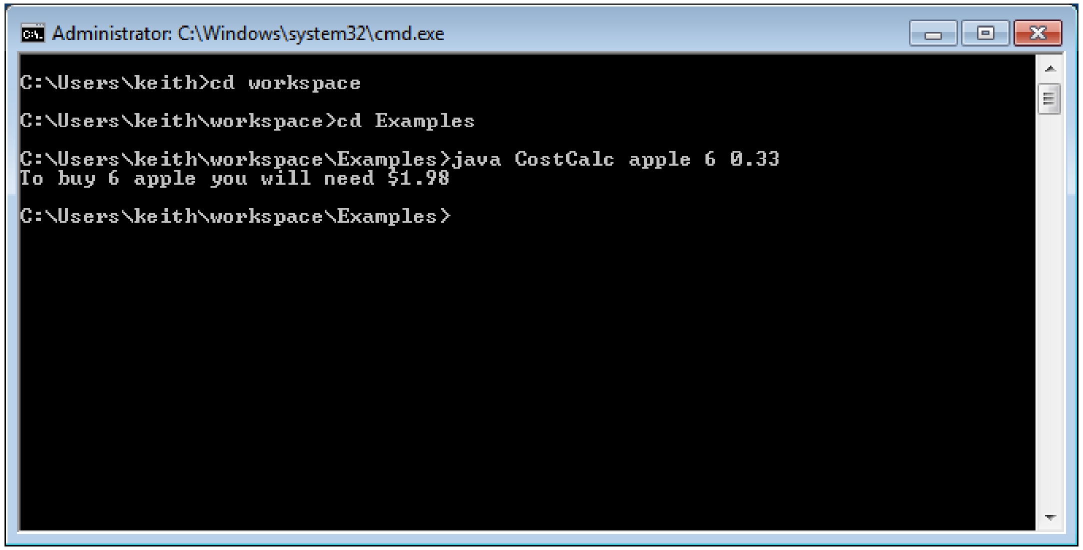


Interfacing with your computer

- Command line interface (CLI)
  - Originally the only option
  - Input by typing commands
  - Advantages:
    - Can be faster for experts than a GUI
    - Easier to automate tasks
    - Easier to hook programs together

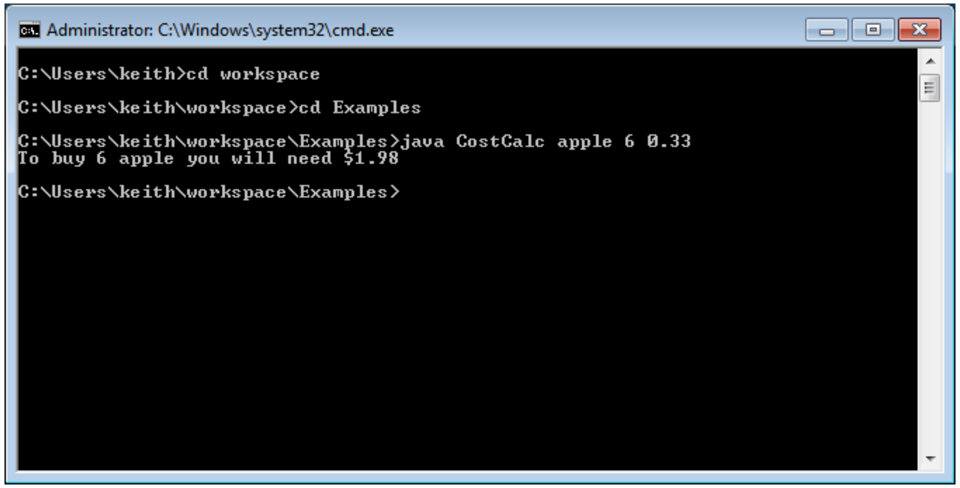


```
$ katie

Montana Tech of the University of Montana
Department of Computer Science

Linux katie 2.6.32-5-xen-amd64 #1 SMP Tue Jun 14 12:46:30 UTC 201
nux

The programs included with the Debian GNU/Linux system are free s
the exact distribution terms for each program are described in th
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

Files that were previously on katie (before this summer) are loca
ome/katie/students/username.
To move them back use - "scp -r username@eowyn:/home/katie/studen
HOME"

It appears group permissions have taken a vacation. I'll try to g
s weekend. -Tom
Last login: Sat Aug 27 00:07:34 2011 from 184.166.116.54
vertanen@katie:~$ cd /home/classes/csci135/
vertanen@katie:/home/classes/csci135$
vertanen@katie:/home/classes/csci135$
vertanen@katie:/home/classes/csci135$ ls
StdAudio.java     exams.php            slides
StdDraw.java      footer.php           style.css
StdIn.java        header.php           sync.bat
assign            index.php            sync_php.bat
assignments.php   resources.php        sync_slides.bat
cs111_prefs.epf   resources.php.bak
examples          schedule.php
vertanen@katie:/home/classes/csci135$
```



```
C:\Users\keith>cd workspace

C:\Users\keith\workspace>cd Examples

C:\Users\keith\workspace\Examples>java CostCalc apple 6 0.33
To buy 6 apple you will need $1.98

C:\Users\keith\workspace\Examples>
```

Starting a command shell

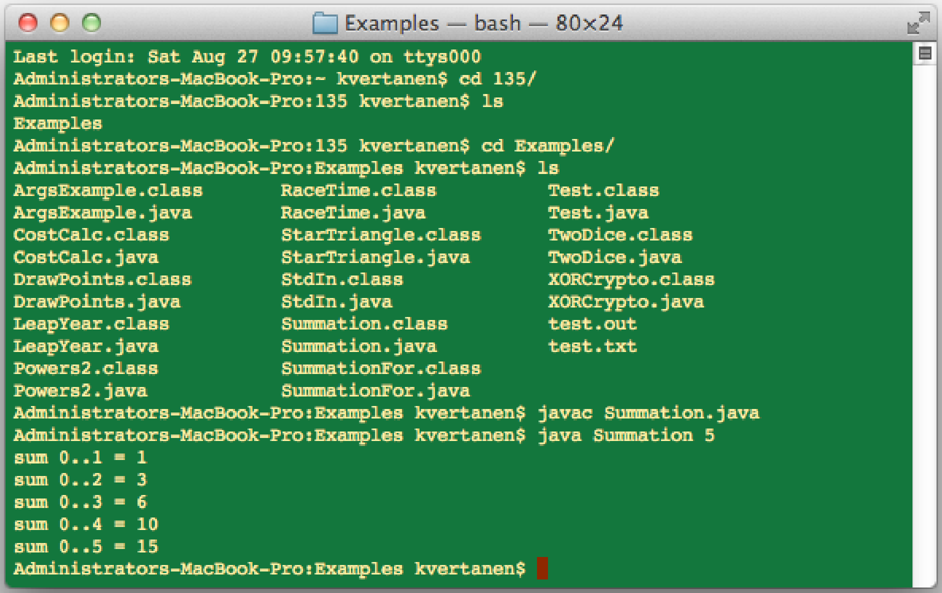


```
C:\Users\keith>cd workspace

C:\Users\keith\workspace>cd Examples

C:\Users\keith\workspace\Examples>java CostCalc apple 6 0.33
To buy 6 apple you will need $1.98

C:\Users\keith\workspace\Examples>
```

Windows 7

Start → type "cmd"

All Programs → Accessories → Command Prompt



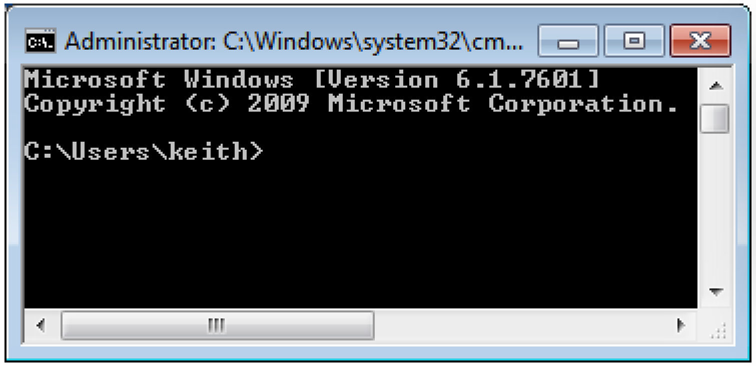
```
Last login: Sat Aug 27 09:57:40 on ttys000
Administrators-MacBook-Pro:~ kvertanen$ cd 135/
Administrators-MacBook-Pro:135 kvertanen$ ls
Examples
Administrators-MacBook-Pro:135 kvertanen$ cd Examples/
Administrators-MacBook-Pro:Examples kvertanen$ ls
ArgsExample.class       RaceTime.class          Test.class
ArgsExample.java        RaceTime.java           Test.java
CostCalc.class          StarTriangle.class      TwoDice.class
CostCalc.java           StarTriangle.java       TwoDice.java
DrawPoints.class        StdIn.class             XORCrypto.class
DrawPoints.java         StdIn.java              XORCrypto.java
LeapYear.class          Summation.class         test.out
LeapYear.java           Summation.java          test.txt
Powers2.class           SummationFor.class
Powers2.java            SummationFor.java
Administrators-MacBook-Pro:Examples kvertanen$ javac Summation.java
Administrators-MacBook-Pro:Examples kvertanen$ java Summation 5
sum 0..1 = 1
sum 0..2 = 3
sum 0..3 = 6
sum 0..4 = 10
sum 0..5 = 15
Administrators-MacBook-Pro:Examples kvertanen$
```

Mac

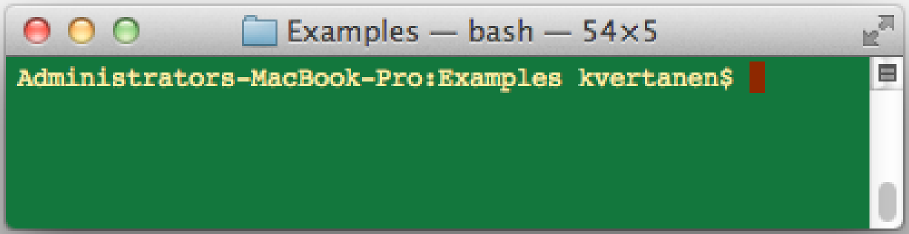
Spotlight → type "terminal"

Go → Applications → Utilities → Terminal

Getting around the command line



```
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.

C:\Users\keith>
```



```
Administrators-MacBook-Pro:Examples kvertanen$
```

Action	Windows	Mac OS / Unix
Move into a folder	`cd myfolder`	`cd myfolder`
Move into parent folder	`cd ..`	`cd ..`
Move into a folder, absolute folder	`cd \Users\keith`	`cd /Users/keith`
List files in current folder	`dir`	`ls`
Compile program in current folder	`javac Prog.java`	`javac Prog.java`
Run a compiled program	`java Prog`	`java Prog`
See what is in a text file	`type Prog.java`	`more Prog.java`
Auto-complete filenames	`<tab key>`	`<tab key>`
Last command	`<up arrow>`	`<up arrow>`

Input via command line

- Input via args[] array
  - Tedious to enter lots of input
  - Impossible to have interactive user input
  - e.g. What we need for a number hunting game

```
% java NumberHunt
Guess a number between 1-100? 50
Ice cold.
Guess a number between 1-100? 20
Getting warmer.
Guess a number between 1-100? 10
Hot.
Guess a number between 1-100? 5
Getting warmer.
Guess a number between 1-100? 15
Hot.
Guess a number between 1-100? 12
You nailed it!
It took you 6 guesses.
```

Standard input class

- Allows input from user or from a file
- Download `StdIn.java`
  - Place in same directory as your program
  - Refresh Eclipse project to make it show up

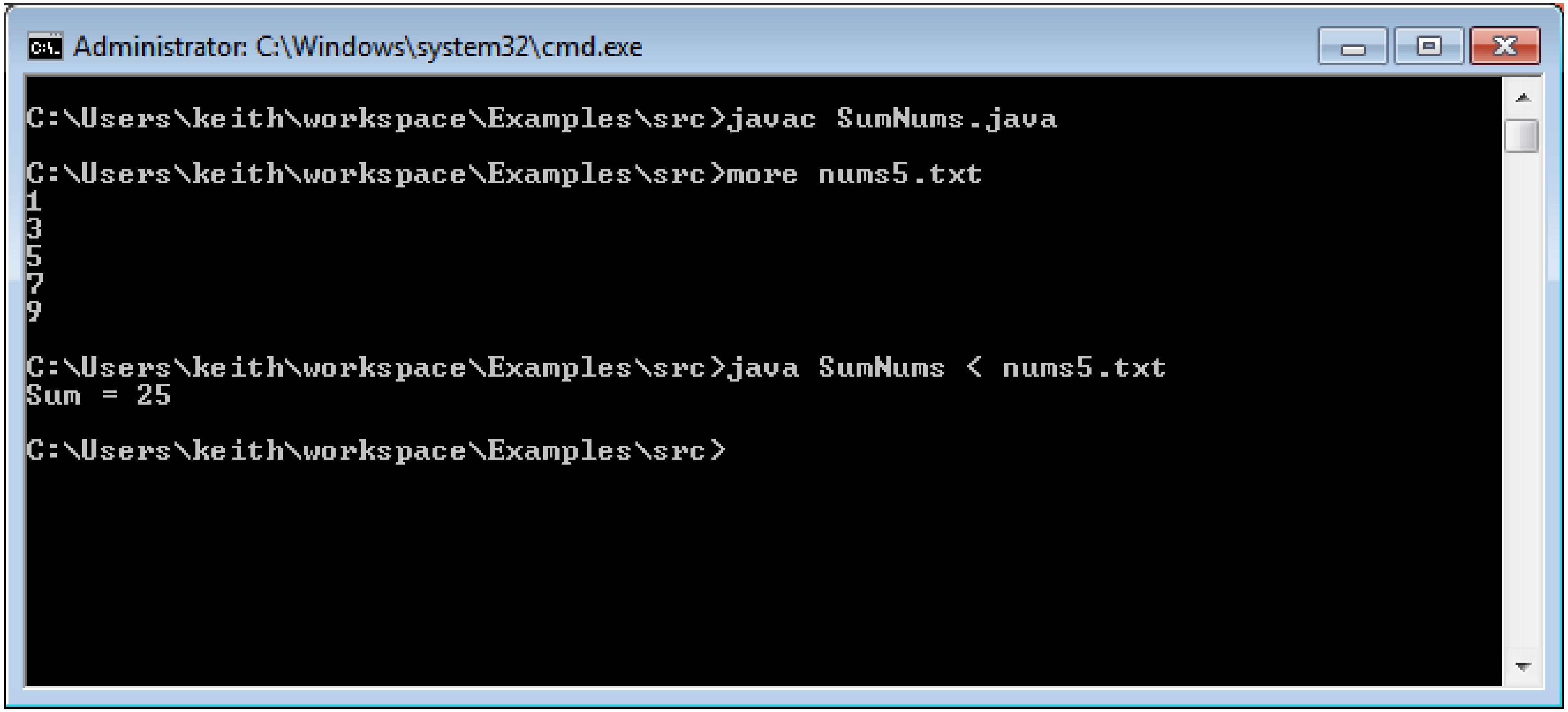
```java
public class AddTwo
{
   public static void main(String [] args)
   {
      System.out.print("Enter first integer: ");
      int num1 = StdIn.readInt();

      System.out.print("Enter second integer: ");
      int num2 = StdIn.readInt();

      int sum = num1 + num2;
      System.out.println("Sum = " + sum);
   }
}
```

Standard input class

- Reading from a file via redirection
  - Need to do from command line
    - Can't redirect file (easily) inside Eclipse
- Goal: Sum all integers in a file
  - Keep reading numbers until End Of File (EOF)
    - EOF can be sent by hitting ctrl-z or ctrl-d in Eclipse

```
public class SumNums
{
   public static void main(String [] args)
   {
      int sum = 0;
      while (!StdIn.isEmpty())
      {
         sum += StdIn.readInt();
      }
      System.out.println("Sum = " + sum);
   }
}
```

Reading from a file



Administrator: C:\Windows\system32\cmd.exe

```
C:\Users\keith\workspace\Examples\src>javac SumNums.java

C:\Users\keith\workspace\Examples\src>more nums5.txt
1
3
5
7
9

C:\Users\keith\workspace\Examples\src>java SumNums < nums5.txt
Sum = 25

C:\Users\keith\workspace\Examples\src>
```

StdIn.java

```
public class StdIn

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

```
this is an example text file
1.23 3.45
10 20
the
end
```

Combining programs

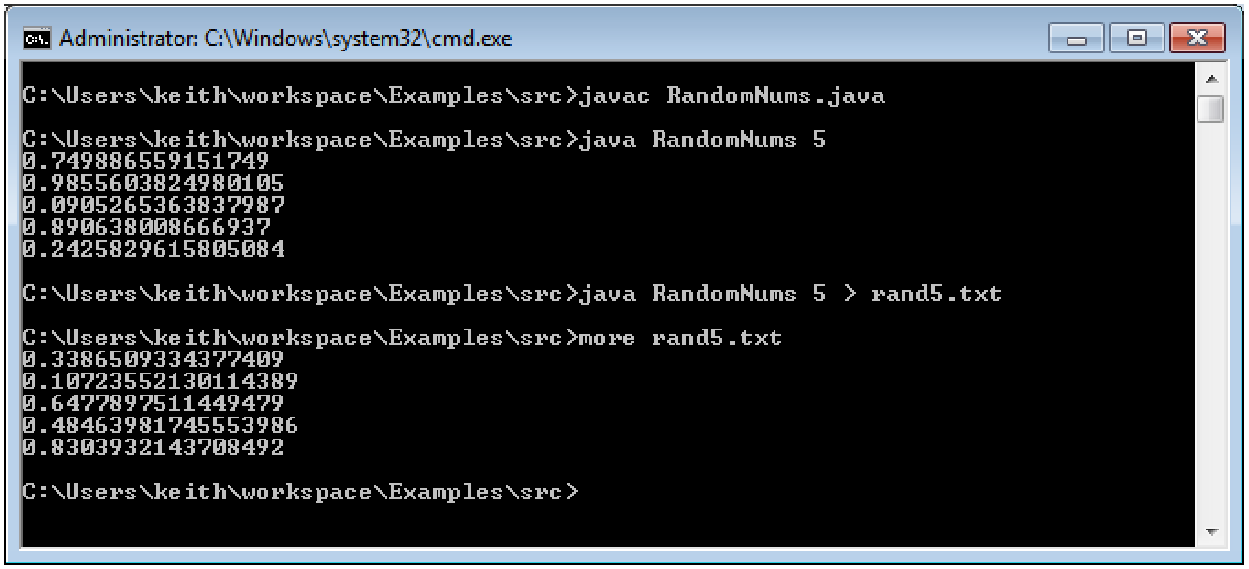
- Output can also be redirected
  - To a file (for later review) via redirection
  - Directly to another program via piping
- Example:
  - First program generates random numbers
  - Second program averages the numbers

Combining programs

```java
public class RandomNums
{
   public static void main(String [] args)
   {
      int num = Integer.parseInt(args[0]);
      for (int i = 0; i < num; i++)
         System.out.println(Math.random());
   }
}
```

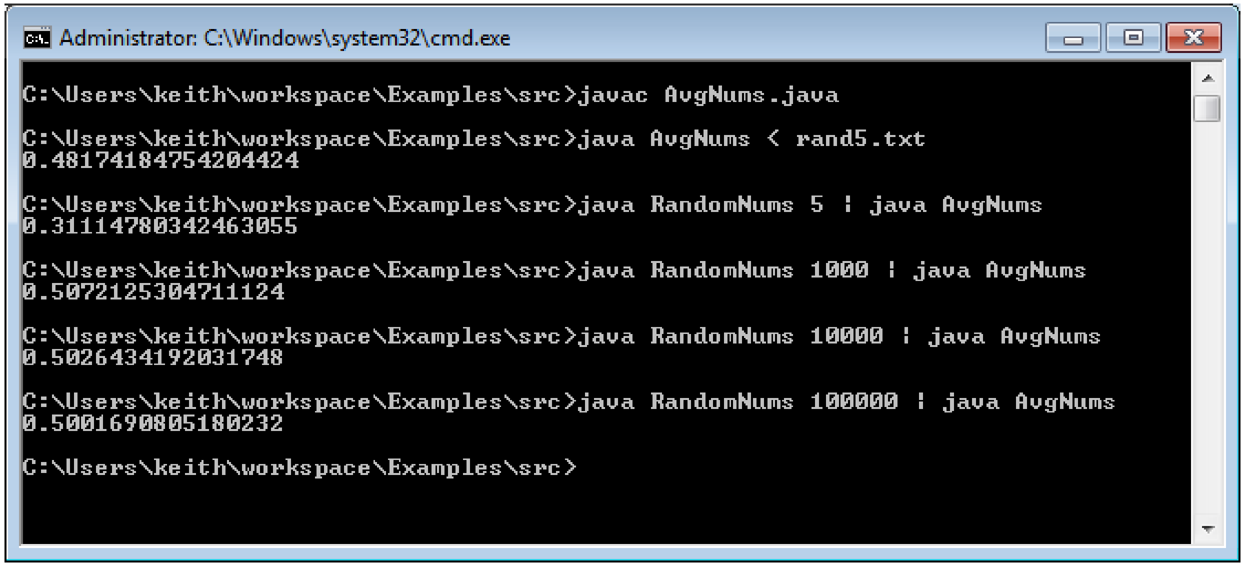
```java
public class AvgNums
{
   public static void main(String [] args)
   {
      double sum   = 0.0;
      long   count = 0;
      while (!StdIn.isEmpty())
      {
         sum += StdIn.readDouble();
         count++;
      }
      System.out.println(sum / count);
   }
}
```

Averaging random numbers



```
C:\Users\keith\workspace\Examples\src>javac RandomNums.java

C:\Users\keith\workspace\Examples\src>java RandomNums 5
0.749886559151749
0.9855603824980105
0.0905265363837987
0.890638008666937
0.2425829615805084

C:\Users\keith\workspace\Examples\src>java RandomNums 5 > rand5.txt

C:\Users\keith\workspace\Examples\src>more rand5.txt
0.3386509334377409
0.10723552130114389
0.6477897511449479
0.48463981745553986
0.8303932143708492

C:\Users\keith\workspace\Examples\src>
```

Redirecting program **output to a file** using **>** followed by the output filename.



```
C:\Users\keith\workspace\Examples\src>javac AvgNums.java

C:\Users\keith\workspace\Examples\src>java AvgNums < rand5.txt
0.48174184754204424

C:\Users\keith\workspace\Examples\src>java RandomNums 5 | java AvgNums
0.31114780342463055

C:\Users\keith\workspace\Examples\src>java RandomNums 1000 | java AvgNums
0.5072125304711124

C:\Users\keith\workspace\Examples\src>java RandomNums 10000 | java AvgNums
0.5026434192031748

C:\Users\keith\workspace\Examples\src>java RandomNums 100000 | java AvgNums
0.5001690805180232

C:\Users\keith\workspace\Examples\src>
```

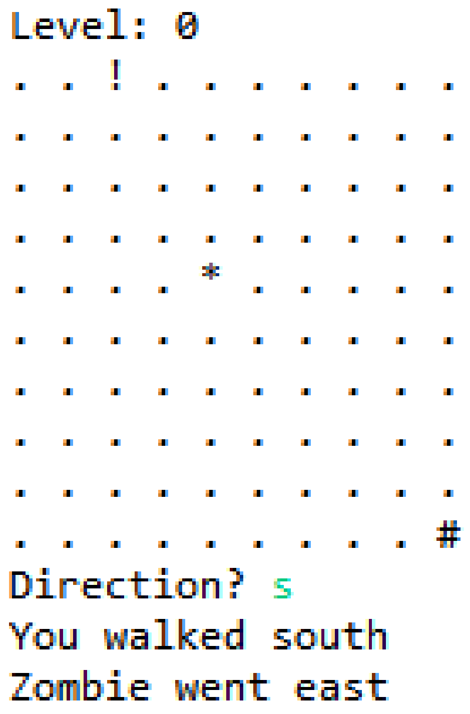
Reading input from file using **<** followed by the filename.

Directly **piping output from one program to another** using pipe **|**

Enter the zombies…

http://www.flickr.com/photos/purplemattfish/4075367455/

Zombie Apocalypse



```
Level: 0
. . ! . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . * . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . #
Direction? s
You walked south
Zombie went east
```

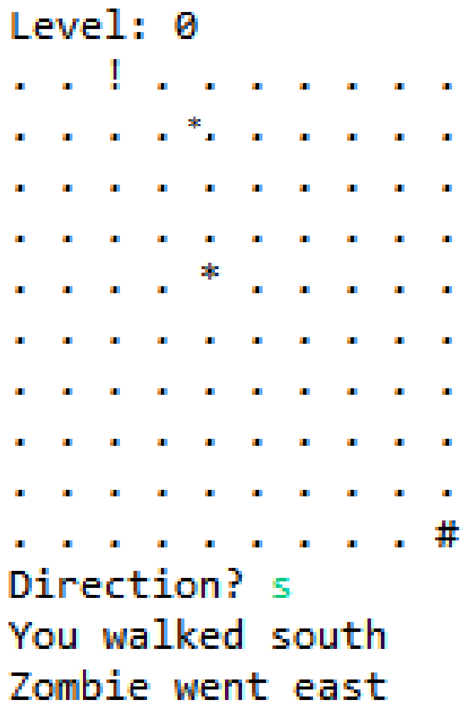
How do I keep track of location of the person and the zombie?

```java
int personX = 0;
int personY = 0;

int zombieX = 0;
int zombieY = 0;
```

How do I detect when the person gets eaten?

```java
if ((personX == zombieX) && (personY == zombieY))
{
   System.out.println("Zombie got your braaaains!");
   gameOver = true;
}
```

Extreme Zombie Apocalypse

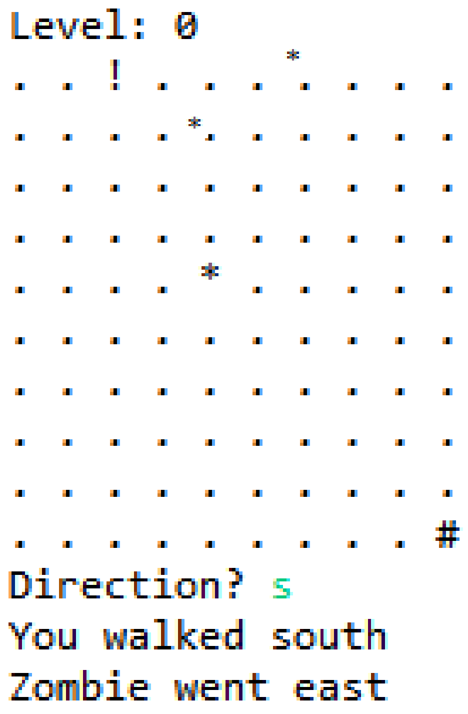


```
Level: 0
. . ! . . . . . . .
. . . .*. . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . * . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . #
Direction? s
You walked south
Zombie went east
```

What if we need to keep track of two zombies?

```java
int personX = 0;
int personY = 0;

int zombieX1 = 0;
int zombieY1 = 0;

int zombieX2 = 0;
int zombieY2 = 0;

...

if (((personX == zombieX1) && (personY == zombieY1)) ||
    ((personX == zombieX2) && (personY == zombieY2)))
{
   System.out.println("Zombie got your braaaains!");
   gameOver = true;
}
```

Super Extreme Zombie Apocalypse

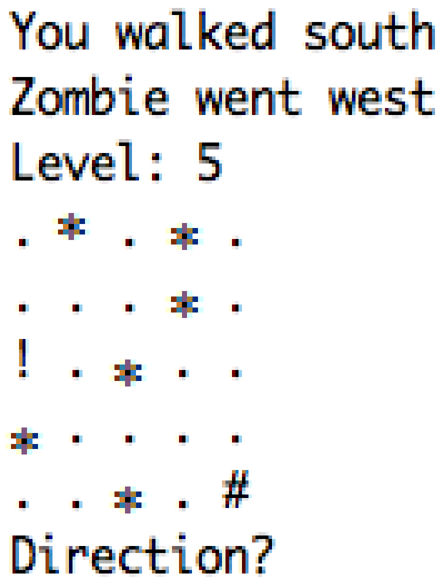


```
Level: 0
. . ! . . . * . . .
. . . . * . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . * . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . #
Direction? s
You walked south
Zombie went east
```

What if we need to keep track of three zombies?

```java
int personX = 0;
int personY = 0;

int zombieX1 = 0;
int zombieY1 = 0;

int zombieX2 = 0;
int zombieY2 = 0;

int zombieX3 = 0;
int zombieY3 = 0;

...

if (((personX == zombieX1) && (personY == zombieY1)) ||
    ((personX == zombieX2) && (personY == zombieY2)) ||
    ((personX == zombieX3) && (personY == zombieY3)))
{
   System.out.println("Zombie got your braaaains!");
   gameOver = true;
}
```

Zombie Apocalypse: The Rising



```
You walked south
Zombie went west
Level: 5
. * . * .
. . . * .
! . * . .
* . . . .
. . * . #
Direction?
```

What if we want to add one zombie every time the player advances a level?

No good way to do this with simple variables!

Arrays to the rescue!

- We've already seen arrays:

```
public static void main(String [] args)
```

```
% java CostCalc bananas 12 0.21
To buy 12 bananas you will need $2.52
```

identifier	meaning	value	type
`args[0]`	1st thing on command line after Java class name	`"bananas"`	`String`
`args[1]`	2nd thing on command line	`"12"`	`String`
`args[2]`	3rd thing on command line after Java class	`"0.21"`	`String`
`args.length`	# of things on command line	3	`int`

Arrays: creating many things

- Arrays: create many variables of same type
- Goal: Ten variables of same type
  - e.g. To hold the values 0-9

```
int a0, a1, a2, a3, a4, a5, a6, a7, a8, a9;
a0 = 0;
a1 = 1;
a2 = 2;
a3 = 3;
a4 = 4;
a5 = 5;
a6 = 6;
a7 = 7;
a8 = 8;
a9 = 9;
```

Arrays: creating many things

- Arrays: create many variables of same type
- Goal: Ten variables of same type
  - e.g. To hold the values 0-9

```
int [] a = new int[10];
a[0] = 0;
a[1] = 1;
a[2] = 2;
a[3] = 3;
a[4] = 4;
a[5] = 5;
a[6] = 6;
a[7] = 7;
a[8] = 8;
a[9] = 9;
```

new keyword is used
whenever we create an array

Arrays: accessing elements

- Arrays: we can use a variable as the index!
  - Makes code shorter, cleaner, less buggy

```
int N = 10;                         // size of array
int [] a;                           // declare array
a = new int[N];                     // create array

for (int i = 0; i < a.length; i++)  // initialize array elements
   a[i] = i;                        // to be 0 - 9
```

1st element of array is a[0]. We count from zero in computer science!

Arrays: easy to extend

- Arrays: can hold lots and lots of data
  - Same code, but now holds 100,000 integers:

```
int N = 100000;                      // size of array
int [] a;                            // declare array
a = new int[N];                      // create array

for (int i = 0; i < a.length; i++)  // initialize array elements
   a[i] = i;                         // to be 0 - 9
```

Arrays: loading data from file

```
4
fee
fi
fo
fum
```

"There are going to be 4 words to read in"

4words.txt

- Read words into array
- Print out words in reverse order

```
% java Backwards < 4words.txt
fum fo fi fee
```

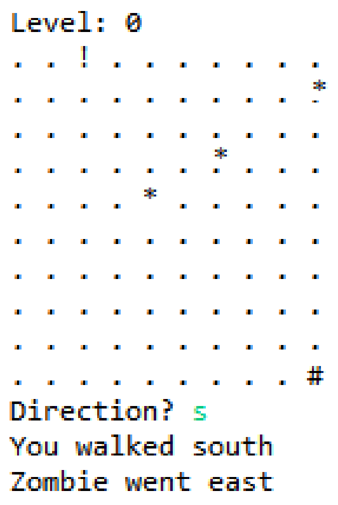
Arrays: loading data from file

```
4
fee
fi
fo
fum
```

```
% java PrintBackward < 4words.txt
fum fo fi fee
```

```java
public class Backwards
{
   public static void main(String [] args)
   {
      int num = StdIn.readInt();
      String [] words = new String[num];

      for (int i = 0; i < num; i++)
         words[i] = StdIn.readString();

      for (int i = num - 1; i >= 0; i--)
         System.out.print(words[i] + " ");
      System.out.println();
   }
}
```

Super Extreme Zombie Apocalypse

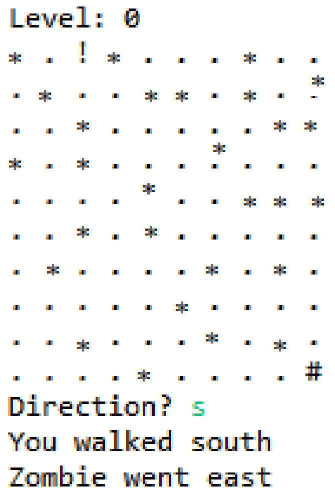


```
Level: 0
. . ! . . . . . . .
. . . . . . . . . *
. . . . . . . . . .
. . . . . . * . . .
. . . . * . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . #
Direction? s
You walked south
Zombie went east
```

What if we need to keep track of three zombies?

```java
int personX = 0;
int personY = 0;
final int NUM_ZOMBIES = 3;  // constant defining # of zombies

int [] zombieX = new int[NUM_ZOMBIES]; // declare & create x-pos array
int [] zombieY = new int[NUM_ZOMBIES]; // declare & create y-pos array

// Set random initial location for each zombie (they can overlap)
for (int i = 0; i < NUM_ZOMBIES; i++)
{
   zombieX[i] = (int) (Math.random() * 10); // set i-th zombie's x-pos
   zombieY[i] = (int) (Math.random() * 10); // set i-th zombie's y-pos
}

...

int i = 0;
while ((i < zombieX.length) && (!gameOver))
{
   if ((personX == zombieX[i]) &&
       (personY == zombieY[i]))
   {
       System.out.println("Zombie got your braaaains!");
       gameOver = true;
   }
   i++;
}
```

Super Mega Extreme Zombie Apocalypse



```
Level: 0
* . ! * . . . * . .
. * . . * * . * . *
. . * . . . . . * *
* . * . . . * . . .
. . . . * . . * * *
. . * . * . . . . .
. * . . . . * . * .
. . . . . * . . . .
. . * . . . * . * .
. . . . * . . . . #
Direction? s
You walked south
Zombie went east
```

What if we need to keep track of thirty zombies?

```java
int personX = 0;
int personY = 0;
final int NUM_ZOMBIES = 30;  // constant defining # of zombies

int [] zombieX = new int[NUM_ZOMBIES]; // declare & create x-pos array
int [] zombieY = new int[NUM_ZOMBIES]; // declare & create y-pos array

// Set random initial location for each zombie (they can overlap)
for (int i = 0; i < NUM_ZOMBIES; i++)
{
   zombieX[i] = (int) (Math.random() * 10); // set i-th zombie's x-pos
   zombieY[i] = (int) (Math.random() * 10); // set i-th zombie's y-pos
}

...

int i = 0;
while ((i < zombieX.length) && (!gameOver))
{
   if ((personX == zombieX[i]) &&
       (personY == zombieY[i]))
   {
       System.out.println("Zombie got your braaaains!");
       gameOver = true;
   }
   i++;
}
```

Summary

- Command line
  - Redirect output to a file
  - Redirect input from a file
  - Pipe output between programs
- Standard input
  - Easy way to read from user or file
- Arrays
  - Allow easy storage of similar data
  - Crucial for developing more advanced programs