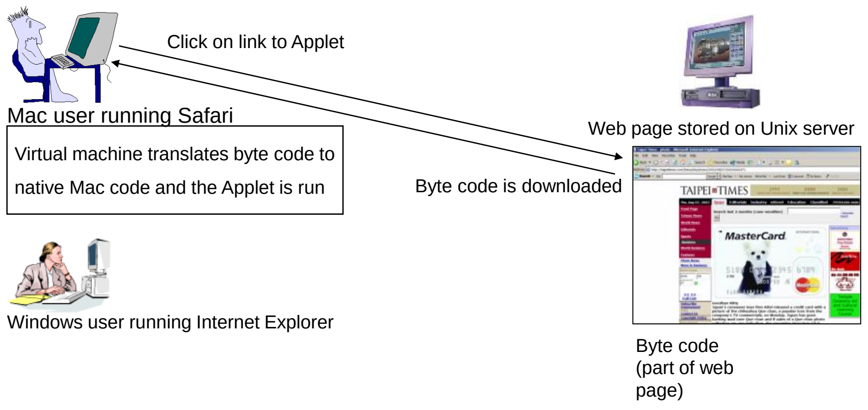
Introduction To Java Programming

You will learn about the process of creating Java programs and constructs for input, output, branching, looping and arrays.

James Tam

Java: Write Once, Run Anywhere

•Consequence of Java's history (coming later): platform-independence

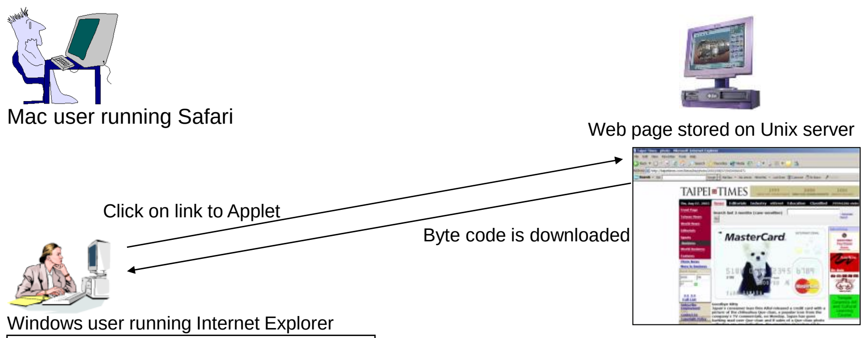

Click on link to Applet
Mac user running Safari
Web page stored on Unix server
Byte code is downloaded
Windows user running Internet Explorer
Byte code (part of web page)

Virtual machine translates byte code to native Mac code and the Applet is run

James Tam

Java: Write Once, Run Anywhere

- Consequence of Java's history (coming later): platform-independent



Virtual machine translates byte code to native Windows code and the Applet is run

James Tam

Java: Write Once, Run Anywhere (2)

- But Java can also create standard (non-web based) programs

Dungeon Master (Java version)
http://homepage.mac.com/aberfield/dmj/

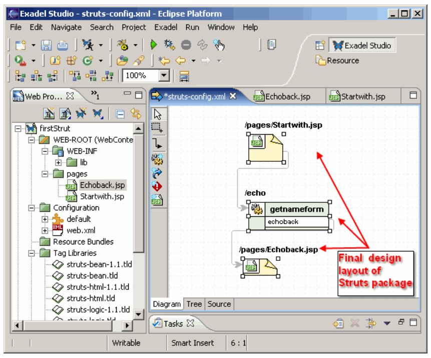
Kung Fu Panda:
screen grab from www.kunfupanda.com

Some examples of mobile Java games: http://www.mobilegamesarena.net

James Tam

Java: Write Once, Run Anywhere (3)

- Java has been used by large and reputable companies to create serious stand-alone applications.
- Example:
  - Eclipse[1]: started as a programming environment created by IBM for developing Java programs. The program Eclipse was itself written in Java.


Exadel Studio - struts-config.xml - Eclipse Platform
/pages/Startwith.jsp
/echo
getnameform
/pages/Echoback.jsp
Final design layout of Struts package

1 For more information: http://www.eclipse.org/downloads/

James Tam

JT's Note: IDE's

- There are many graphical development environments available for Java (e.g., Eclipse).
- Learning one or more these environments prior to embarking on employment would be a valuable experience.
- However it is not recommended that you use them for this course.
  - You may have drastic problems configuring the environment (e.g., if you have to use example starting code).
  - It's easier programming without an IDE and then learning one later than the opposite (not all development teams can/will use them).
  - With the size of the programs you will see in this class it would be a good learning experience to 'work without a net'.
    - Because you have to do it all yourself you will likely learn things better.
- Bottom line: if you have problems with the IDE then you will likely be on your own.

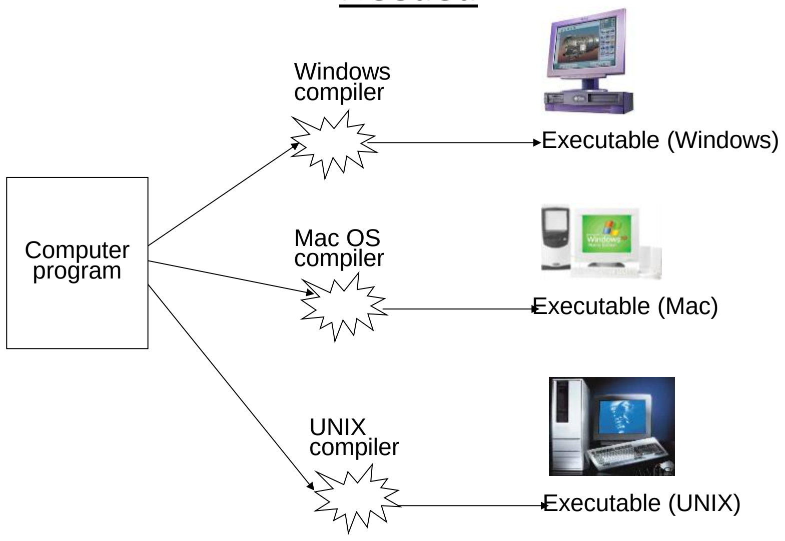
James Tam

Compilation

- Translating from a high level programming language such as Java or C++ to low level machine language (binary).
- Python:
  - One stage translation process from Python to machine.
  - The translated instructions remain in memory.
- Java
  - Two stage process: 1) one time translation occurs Java to a generic binary that is common to many computers and many electronic devices (this creates a file) 2) when the program is run the generic binary is translated to machine language that is specific to the device.

James Tam

Compiled Programs With Different Operating Systems: Multiple Compilers Needed



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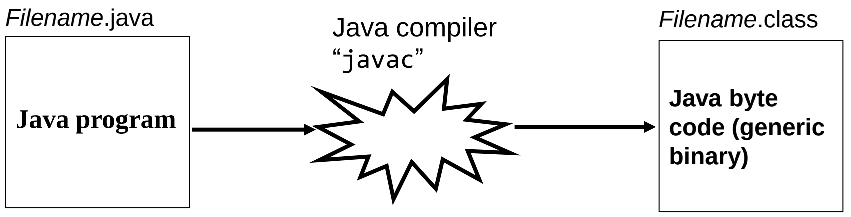
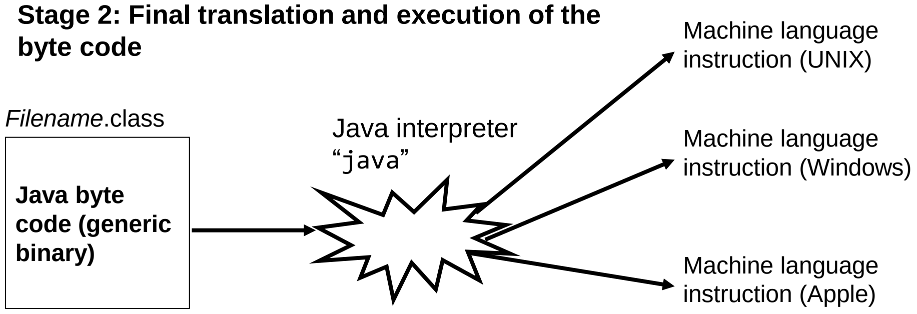
A High Level View Of Translating/Executing Java Programs

Stage 1: Compilation



A High Level View Of Translating/Executing Java Programs (2)

Stage 2: Final translation and execution of the byte code


Filename.class
Java byte code (generic binary)
Java interpreter
"java"
Machine language instruction (UNIX)
Machine language instruction (Windows)
Machine language instruction (Apple)

http://java.sun.com/javase/downloads/index.jsp

Which Java?

- Java 1.6 JDK (Java Development Kit), Standard Edition includes:
  - JDK (Java development kit) – for *developing* Java software (creating Java programs).
  - JRE (Java Runtime environment) –for *running* pre-created Java programs.
    - Java Plug-in – a special version of the JRE designed to run through web browsers.
- For consistency/fairness: Your graded work will be based on the version of Java installed on the CPSC network (don't use versions past 1.6).
  - Only run your program using a remote connection program (e.g., SSH to a CPSC Linux computer) or test your code periodically on the network to make sure it's compatible.
  - It's your responsibility to ensure compatibility.
  - If the program doesn't work on the Lunix computers in the lab then it will only receive partial marks (at most).

James Tam

Location Of Online Examples For This Section

- Course website:
  - `www.cpsc.ucalgary.ca/~tamj/233/examples/intro`
- UNIX directory:
  - `/home/233/examples/intro`

James Tam

Smallest Compilable And Executable Java Program

The name of the online example is: `Smallest.java` (*Important note: the file name must match the word after the keyword 'class' below*).

```
public class Smallest
{
    public static void main (String[] args)
    {
    }
}
```

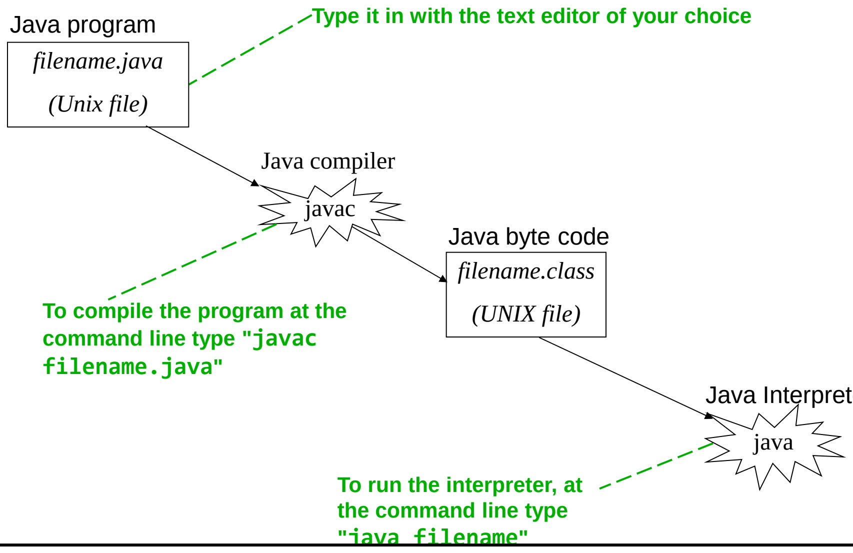
`Smallest.java`

```
public class
Smallest
{

}
```

James Tam

Creating, Compiling And Running Java Programs On The Computer Science Network



Type it in with the text editor of your choice

To compile the program at the command line type "`javac filename.java`"

To run the interpreter, at the command line type "`java filename`"

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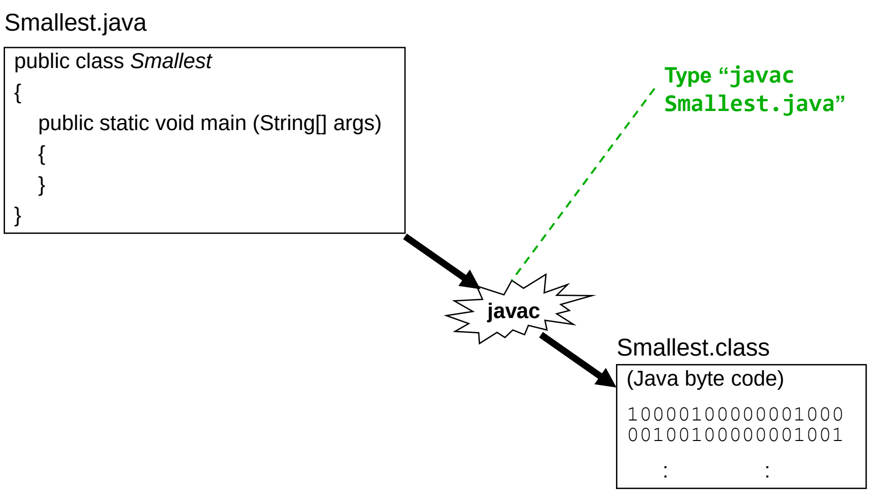
Compiling The `Smallest.java` Program



Smallest.java

```
public class Smallest
{
    public static void main (String[] args)
    {
    }
}
```

Type “`javac Smallest.java`”

Smallest.class

(Java byte code)

```
10000100000001000
00100100000001001
    :          :
```

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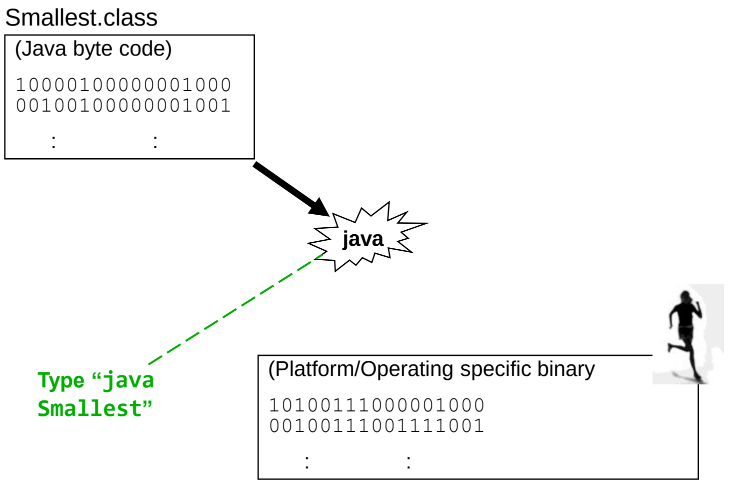
Running The `Smallest.java` Program



Smallest.class

(Java byte code)

```
10000100000001000
00100100000001001
    :          :
```

Type “`java Smallest`”

(Platform/Operating specific binary

```
10100111000001000
00100111001111001
    :          :
```

James Tam

Running The Java Compiler At Home

- After installing Java you will need to indicate to the operating system where the java compiler has been installed ('setting the path').
  - This is similar to Python.
- For details of how to set your path variable for your particular operating system try the Sun or Java website.
- Example of how to set the path in Windows:
  - http://java.sun.com/j2se/1.4.2/install-windows.html (see step 5 on the web link)
- Alternatively: create your Java programs in the same location as the Java compiler.

James Tam

Documentation / Comments

Multi-line documentation

```
/*   Start of documentation
*/   End of documentation
```

Documentation for a single line

```
//Everything until the end of the line is a comment
```

James Tam

Review: What Should You Document

- Program (or that portion of the program) author
- What does the program as a while do e.g., tax program.
- What are the specific features of the program e.g., it calculates personal or small business tax.
- What are it's limitations e.g., it only follows Canadian tax laws and cannot be used in the US. In Canada it doesn't calculate taxes for organizations with yearly gross earnings over $1 billion.
- What is the version of the program
  - If you don't use numbers for the different versions of your program then consider using dates (tie versions with program features).

James Tam

Important Note

- Each Java instruction must be followed by a semi-colon!

General format

```
Instruction1;
Instruction2;
Instruction3;
   :       :
```

Examples

```
int num = 0;
System.out.println(num);
  :    :
```

James Tam

Java Output

- **Format:**

```
System.out.print(<string or variable name one> + <string or variable name two>..);
OR
System.out.println(<string or variable name one> + <string or variable name two>..);
```

- **Examples (online program called "`OutputExample1.java`")**

```
public class OutputExample1
{
    public static void main(String [] args)
    {
        int num = 123;   // More on this shortly
        System.out.println("Good-night gracie!");
        System.out.print(num);
        System.out.println("num="+num);
    }
}
```

James Tam

Output : Some Escape Sequences For Formatting

Escape sequence	Description
`\t`	Horizontal tab
`\n`	New line
`\"`	Double quote
`\\`	Backslash

James Tam

Variables

- Unlike Python variables must be declared before they can be used.
- Variable declaration:
  - Creates a variable in memory.
  - Specify the name of the variable as well as the type of information that it will store.
  - E.g. `int num;`
  - Although requiring variables to be explicitly declared appears to be an unnecessary chore it can actually be useful for minimizing insidious logic errors (example to follow shortly).
- Using variables
  - Only after a variable has been declared can it be used (e.g., assignment)
  - E.g., `num = 12;`

James Tam

Using Variables: A Contrast

Python

- Variables do not need to be declared before being used.
- Easy to start programming.
- Easy to make logic errors!

```
incomeTam = 25000
if (winLottery):
    incomeSmith = 1000000
```

Logic error: can be tricky to catch in a real (large and complex) program

Java

- Syntactically variables must always be declared prior to use.
- A little more work to get started.
- Some logic errors may be prevented.

```
int incomeTam = 25000;
if (winLottery)
    incomeSmith = 1000000;
```

Syntax error: compiler points out the source of the problem

James Tam

Declaring Variables: Syntax

- **Format**:
  <type of information> <name of variable>;

- **Example**:
  `char firstInitial;`

- Variables can be initialized (set to a starting value) as they're declared:

```
char firstInitial = 'j';
int age = 30;
```

James Tam

Some Built-In Types Of Variables In Java

Type	Description
byte	8 bit signed integer
short	16 but signed integer
int	32 bit signed integer
long	64 bit signed integer
float	32 bit signed real number (rare)
double	64 bit signed real number (compiler default)
char	16 bit Unicode character (ASCII values and beyond)
boolean	True or false value
String	A sequence of characters between **double quotes** ("")

James Tam

Location Of Variable Declarations

```
public class <name of class>
{
    public static void main (String[] args)
    {
       // Local variable declarations occur here

       << Program statements >>
                :                 :

    }
}
```

James Tam

Style Hint: Initializing Variables

- Always initialize your variables prior to using them!
  - Do this whether it is syntactically required or not.
- Example how not to approach (with some languages it's a logic and not a syntax error):

```
public class OutputExample1
{
   public static void main (String [] args)
   {
       int num;
       System.out.print(num);
    }
}
```

OutputExample1.java:7: error: variable num might not have been initialized
System.out.print(num);
^

James Tam

Formatting Output

- It's somewhat similar to Python.
- The field width and places of precision (float point) can be specified.
- **Format ('System.out.' requirement excluded for brevity)**:

```
printf("%<field width>d", price);       // Integer
printf("%<field width>s", price);       // String
printf("%<field width>.<precision>f", price);   // Floating point
```

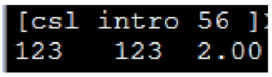
- If field width greater than the size of the data:
  - A positive field width will result in leading spaces (right justify).
  - A negative field width will result in trailing spaces (left justify).

James Tam

Formatting Output (2)

- Name of the online example: `FormatttingOutput.java`

```
public class FormattingExample
{
    public static void main(String [] args)
    {
        String str = "123";
        int num = 123;
        double price = 1.999;
        System.out.printf("%-4s", str);
        System.out.printf("%5d", num);
        System.out.printf("%6.2f", price);
    }
}
```



```
[csl intro 56 ]
123    123   2.00
```

James Tam

Java Constants ("Final")

Reminder: constants are like variables in that they have a name and store a certain type of information but unlike variables they CANNOT change. (Unlike Python this is syntactically enforced…hurrah!).

Format:

```
     final <constant type> <CONSTANT NAME> = <value>;
```

Example:

```
     final int SIZE = 100;
```

James Tam

Location Of Constant Declarations

```
public class <name of class>
{
    public static void main (String[] args)
    {
       // Local constant declarations occur here (for now)
       // Local variable declarations

       < Program statements >>
            :               :

    }
}
```

James Tam

Variable Naming Conventions In Java

- Compiler requirements
  - Can't be a keyword nor can the names of the special constants: true, false or null be used
  - Can be any combination of letters, numbers, underscore or dollar sign (first character must be a letter or underscore)

- Common stylistic conventions
  - The name should describe the purpose of the variable
  - Avoid using the dollar sign
  - With single word variable names, all characters are lower case
    - e.g., double grades;
  - Multiple words are separated by capitalizing the first letter of each word except for the first word
    - e.g., String firstName = "James";

James Tam

Java Keywords

abstract	boolean	break	byte	case	catch	char
class	const	continue	default	do	double	else
extends	final	finally	float	for	goto	if
implements	import	instanceof	int	interface	long	native
new	package	private	protected	public	return	short
static	super	switch	synchronized	this	throw	throws
transient	try	void	volatile	while		

James Tam

Common Java Operators / Operator Precedence

Precedence level	Operator	Description
1	expression++ expression--	Post-increment Post-decrement
2	++expression --expression + - ! ~ (type)	Pre-increment Pre-decrement Unary plus Unary minus Logical negation Bitwise complement Cast

James Tam

Common Java Operators / Operator Precedence

Precedence level	Operator	Description
3	* / %	Multiplication Division Remainder/modulus
4	+ -	Addition or String concatenation Subtraction
5	<< >>	Left bitwise shift Right bitwise shift

James Tam

Common Java Operators / Operator Precedence

Precedence level	Operator	Description
6	< <= > >=	Less than Less than, equal to Greater than Greater than, equal to
7	= = !=	Equal to Not equal to
8	&	Bitwise AND
9	^	Bitwise exclusive OR

James Tam

Common Java Operators / Operator Precedence

Precedence level	Operator	Description
10	|	Bitwise OR
11	&&	Logical AND
12	||	Logical OR

James Tam

Common Java Operators / Operator Precedence

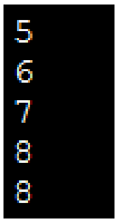
Precedence level	Operator	Description
13	=	Assignment
	+=	Add, assignment
	-=	Subtract, assignment
	*=	Multiply, assignment
	/=	Division, assignment
	%=	Remainder, assignment
	&=	Bitwise AND, assignment
	^=	Bitwise XOR, assignment
	|=	Bitwise OR, assignment
	<<=	Left shift, assignment
	>>=	Right shift, assignment

James Tam

Post/Pre Operators

The name of the online example is: `Order1.java`

```
public class Order1
{
    public static void main (String [] args)
    {
        int num = 5;
        System.out.println(num);
        num++;
        System.out.println(num);
        ++num;
        System.out.println(num);
        System.out.println(++num);
        System.out.println(num++);
    }
}
```



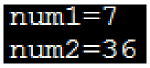
```
5
6
7
8
8
```

James Tam

Post/Pre Operators (2)

The name of the online example is: `Order2.java`

```
public class Order2
{
    public static void main (String [] args)
    {
        int num1;
        int num2;
        num1 = 5;
        num2 = ++num1 * num1++;
        System.out.println("num1=" + num1);
        System.out.println("num2=" + num2);
    }
}
```



```
num1=7
num2=36
```

James Tam

Unary Operator/Order/Associativity

The name of the online example: `Unary_Order3.java`

```
public class Unary_Order3.java
{
    public static void main (String [] args)
    {
        int num = 5;
        System.out.println(num);
        num = num * -num;
        System.out.println(num);
    }
}
```

James Tam

Casting: Converting Between Types

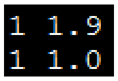
- Casting: the ability to convert between types.
  - Of course the conversion between types must be logical otherwise an error will result.
- In Java unlike Python the conversion isn't just limited to a limited number of functions.
  - Consequently Python doesn't have true 'casting' ability.
- **Format**:

```
<Variable name> = (type to convert to) <Variable name>;
```

Casting: Structure And Examples

The name of the online example: Casting.java

```
public class Casting {
    public static void main(String [] args) {
        int num1;
        double num2;
        String str1;
        num2 = 1.9;
        str1 = "123";
        num1 = (int) num2;   // Cast needed to explicitly convert
        System.out.println(num1 + " " + num2);
        num2 = num1;  // Cast not needed: going from less to more
        System.out.println(num1 + " " + num2);
    }
}
```



```
1 1.9
1 1.0
```

Accessing Pre-Created Java Libraries

- It's accomplished by placing an '`import`' of the appropriate library at the top of your program.
- **Syntax:**

```
import <Full library name>;
```

- **Example:**

```
import java.util.Scanner;
```

James Tam

Getting Text Input

- You can use the pre-written methods (functions) in the `Scanner` class.
- **General structure**:

```
import java.util.Scanner;


main (String [] args)
{
    Scanner <name of scanner> = new Scanner (System.in);
    <variable> = <name of scanner>.<method> ();
}
```

James Tam

Getting Text Input (2)

The name of the online example: `MyInput.java`

```
import java.util.Scanner;

public class MyInput
{
    public static void main (String [] args)
    {
        String name;
        int age;
        Scanner in = new Scanner (System.in);
        System.out.print ("Enter your age: ");
        age = in.nextInt ();
        in.nextLine ();
        System.out.print ("Enter your name: ");
        name = in.nextLine ();
        System.out.println ("Age: " +age +"\t Name:" + name);
    }
}
```

James Tam

Useful Methods Of Class Scanner[1]

- `nextInt()`
- `nextLong()`
- `nextFloat()`
- `nextDouble()`
- `nextLine()`

1 Online documentation: http://java.sun.com/javase/6/docs/api/

James Tam

Reading A Single Character

- Text menu driven programs may require this capability.
- Example:

```
GAME OPTIONS
(a)dd a new player
(l)oad a saved game
(s)ave game
(q)uit game
```

- There's different ways of handling this problem but one approach is to extract the first character from the string.
- Partial example:

```
String s = "boo";
System.out.println(s.charAt(0));
```

James Tam

Reading A Single Character

- Name of the (more complete example): `MyInputChar.java`

```
import java.util.Scanner;
public class MyInputChar
{
    public static void main (String [] args)
    {
        final int FIRST = 0;
        String selection;
        Scanner in = new Scanner (System.in);
        System.out.println("GAME OPTIONS");
        System.out.println("(a)dd a new player");
        System.out.println("(l)oad a saved game");
        System.out.println("(s)ave game");
        System.out.println("(q)uit game");
        System.out.print("Enter your selection: ");
```

James Tam

Reading A Single Character (2)

```
        selection = in.nextLine ();
        System.out.println ("Selection: " +
           selection.charAt(FIRST));
    }
}
```

James Tam

Decision Making In Java

- Java decision making constructs
  - `if`
  - `if, else`
  - `if, else-if`
  - `switch`

James Tam

Decision Making: Logical Operators

Logical Operation	Python	Java
AND	`and`	`&&`
OR	`or`	`||`
NOT	`not`	`!`

James Tam

Decision Making: `If`

Format:

```
if(Boolean Expression)
    Body
```

Example:

```
if(x != y)
    System.out.println("X and Y are not equal");

 if ((x > 0) && (y > 0))
 {
    System.out.println("X and Y are positive");
 }
```

- Indenting the body of the branch is an important stylistic requirement of Java but unlike Python it is not enforced by the syntax of the language.
- What distinguishes the body is either:
  1. A semi colon (single statement branch)
  2. Braces (a body that consists of single or multiple statements)

James Tam

Decision Making: `If, Else`

Format:

```
if(Boolean expression)
    Body of if
else
    Body of else
```

Example:

```
if (x < 0)
    System.out.println("X is negative");
else
    System.out.println("X is non-negative");
```

James Tam

`If, Else-If` (Java)
`If, Elif` (Python)

Format:

```
if (Boolean expression)
   Body of if
else if (Boolean expression)
  Body of first else-if
    :      :     :
else if (Boolean expression)
  Body of last else-if
else
  Body of else
```

James Tam

If, Else-If (2)

Example:

```
if (gpa == 4)
{
    System.out.println("A");
}
else if (gpa == 3)
{
    System.out.println("B");
}
else if (gpa == 2)
{
    System.out.println("C");
}
```

James Tam

If, Else-If (2)

```
 else if (gpa == 1)
 {
    System.out.println("D");
 }
 else if (gpa == 0)
 {
    System.out.println(“F");
 }
 else
 {
    System.out.println("Invalid gpa");
 }
```

James Tam

Alternative To Multiple Else-If's: Switch

Format (character-based switch):

```
switch (character variable name)
{
    case '<character value>':
         Body
         break;

    case '<character value>':
         Body
         break;
        :
   default:
        Body
}
```

Important! The break is mandatory to separate Boolean expressions (must be used in all but the last).

The break transfers execution out of the switch construct, otherwise cases will 'fall-through'

1 The type of variable in the brackets can be a byte, char, short, int or long

James Tam

Alternative To Multiple Else-If's: Switch (2)

Format (integer based switch):

```
switch (integer variable name)
{
    case <integer value>:
         Body
         break;

    case <integer value>:
         Body
         break;
        :
   default:
        Body
}
```

1 The type of variable in the brackets can be a byte, char, short, int or long

James Tam

The ‘Break’ Statement

- ‘Break’s is mandatory if cases are to be separated.
- Example:

```
int gpa = 3;
char letter = ' ';
switch (gpa) {
    case 4:
      letter = 'a';
    case 3:
      letter = 'b';
    case 2:
      letter = 'c';
    case 1:
      letter = 'd';
    case 0:
      letter = 'f';
    // Student receives an 'f'!
}
```

As mentioned without a break the switch will execute the first true case and all other cases will ‘fall through’

James Tam

Switch: When To Use/When Not To Use

- Benefit (when to use):
  - It may produce simpler code than using an if, else-if (e.g., if there are multiple compound conditions)
  - Contrast

```
// Using if
If ((menu == ‘a’) ||
    (menu == ‘A’) ||
    (menu == ‘N’) ||
    (menu == ‘n’))
    System.out.println(“New
player added”);
else if ((menu == ‘q’) ||
         (menu == ‘Q’))
```

```
switch(menu)
{
  case ‘a’:
  case ‘A’:
  case ‘N’:
  case ‘n’:
    System.out.println(“New player \
       added”);
    break;

  case ‘Q’:
  case ‘q’:
```

James Tam

Switch: When To Use/When Not To Use (2)

- Name of the online example: `SwitchExample.java` (When to use)

```
import java.util.Scanner;

public class SwitchExample
{
    public static void main (String [] args)
    {
        final int FIRST = 0;
        String line;
        char letter;
        int gpa;
        Scanner in = new Scanner (System.in);
        System.out.print("Enter letter grade: ");
```

James Tam

Switch: When To Use/When Not To Use (3)

```
        line = in.nextLine ();
        letter = line.charAt(FIRST);
        switch (letter)
        {
           case 'A':
           case 'a':
              gpa = 4;
              break;

           case 'B':
           case 'b':
              gpa = 3;
              break;

           case 'C':
           case 'c':
              gpa = 2;
              break;
```

James Tam

Switch: When To Use/When Not To Use (4)

```
          case 'D':
          case 'd':
             gpa = 1;
             break;

          case 'F':
          case 'f':
             gpa = 0;
             break;

          default:
             gpa = -1;

       }  // End of switch (determining GPA)
       System.out.println("Letter grade: " + letter);
       System.out.println("Grade point: " + gpa);
    }
}
```

James Tam

Switch: When To Use/When Not To Use (5)

- When a switch can't be used:
  - For data types other than characters or integers (Java 1.6 and earlier)
  - Boolean expressions that aren't mutually exclusive:
    - As shown a switch can sometimes replace an '`if`, `else-if`' construct
    - A switch usually cannot replace a series of '`if`' branches).
  - Example when not to use a switch:

```
if (x > 0)
    System.out.print("X coordinate right of the origin");
if (y  > 0)
    System.out.print("Y coordinate above the origin");
```

  - Example of when not to use a switch (Java 1.6):

```
String name = in.readLine()
switch (name)
{

}
```

James Tam

Loops

Python loops

- Pre-test loops: `for`, `while`

Java Pre-test loops

- `For`
- `While`

Java Post-test loop

- `Do-while`

James Tam

While Loops

Format:

```
While (Boolean expression)
{
    Body
}
```

Example:

```
int i = 1;
while (i <= 10)
{
   System.out.println(i);
    i = i + 1;
}
```

```
i = 0
while (i < 10):
    print(i)
    i = i + 1
```

James Tam

For Loops

Format:

```
for (initialization; Boolean expression; update control)
{
    Body
}
```

Example

```
for (i = 1; i <= 10; i++)
{
    System.out.println(i);
}

for i in range (1, 11, 1):
  print(i)
```

James Tam

For Loops: Java Vs. Python

- Unlike Python with most languages for loops are generally used as counting (e.g., up down).
- Iterating through other series (such as lines in a file) is not possible.
- Python example not possible in other languages

```
inputFile = open(“input.txt”,”r”)
for line in inputFile:
    print(line)
```

- In Java however the loop control can be updated by most any mathematical expression (even randomly assigned).

```
for (i = 1; i <= 100; i = i * 5)
```

James Tam

For Loops: Java Vs. Python (2)

- Also note in Java that the stopping boundary is explicit.

```
for (i = 1; i <= 10; i++)
-Vs.
for i in range (1, 11, 1):
```

James Tam

Post-Test Loop: Do-While

- Recall Pre-test loops generally execute zero or more times.
- Example:

```
i = 100
while (i < 10) {
   // Body never executes
}
```

- Post-test loops evaluate the Boolean expression after the body of the loop has executed.
- This means that post test loops will execute one or more times.
- General structure:

```
i = Start value
do
     Body
} while(condition)
```

James Tam

Do-While Loops

Format:

```
do {
    Body
}
while (Boolean expression);
```

Example:

```
int i = 1;
do {
    System.out.println(i);
    i++;
}
while (i <= 10);
```

James Tam

When To Use Post-Test (Do-While) Loops

- Useful when you need to guarantee execution occurring at least once.
- Example: the loop body encloses the whole program

```
do
{
    // Play game
} while (Player doesn’t quit)
```

James Tam

Common Mistake: Branches/Loops

- Forgetting braces and that single statement bodies are specified by the first semi-colon.
- (Partial) examples:

```
while (i < 10)
    System.out.println(i);     } Body
    i = i + 1;

while (i < 10);
{
    System.out.println(i);     } Body
    i = i + 1;
}
```

James Tam

Many Pre-Created Classes Have Been Created

- Rule of thumb of real life: Before writing new program code to implement the features of your program you should check to see if a class has already been written with the features that you need.
- Note: for some assignments you may have to implement all features yourself rather than use pre-written code.
  - You may receive little or no credit otherwise.
- The Java API is Sun Microsystems's collection of pre-built Java classes:
  - http://java.sun.com/javase/6/docs/api/

James Tam

Example: Generating Random Numbers (Probabilities)

- Name of the (more complete example): `DiceExample.java`

```
public class DiceExample
{
    public static void main(String [] args)
    {
        final int SIDES = 6;
        Random generator = new Random();
        int result = -1;
        result = generator.nextInt(SIDES) + 1;
        System.out.println("1d6: " + result);

        result = generator.nextInt(SIDES) + 1;
        result = result + generator.nextInt(SIDES) + 1;
        result = result + generator.nextInt(SIDES) + 1;
        System.out.println("3d6: " + result);
    }
}
```

James Tam

Arrays

- They are similar to Python lists.
  - Specified with square brackets
  - Indexed from 0 to (number elements-1)
- Some differences:
  - All elements must be of the same type e.g., array of integers cannot mix and match with floats
  - Python has methods associated with lists although an array in Java has a '`length`' attribute associated with it.
  - Arrays cannot be dynamically resized (new array must be created).

James Tam

Creating An Array

- **Format**:
  - *<type>* []$_1$ *<name>* = new *<type>* [*<Number of elements>*];

- **Example (common approach)**:

```
final int MAX = 100;
int [] grades = new int [MAX];
```

- **Example (Fixed size array declared and initialized – rarely used approach)**:

```
int [] array = {1,2,3};
```

1 Each dimension must be specified by a set of square brackets e.g., two dimensional array requires two sets of brackets

James Tam

Arrays: Complete Example

- Name of the (more complete example): `GradesExample.java`

```
public class GradesExample
{
    public static void main(String [] args)
    {
        final int MAX = 10;
        int [] grades = new int [MAX];
        int i = 0;
        Random generator = new Random();
```

James Tam

Arrays: Complete Example (2)

```
        for (i = 0; i < MAX; i++)
        {
            grades[i] = generator.nextInt(101);
        }

        for (i = 0; i < grades.length; i++)
        {
            System.out.println("Element #" + i + " grade " +
              grades[i]);
        }
    }
}
```

James Tam

After This Section You Should Now Know

- The basic structure required for creating a simple Java program as well as how to compile and run programs
- How to document a Java program
- How to perform text based input and output in Java
- The declaration of constants and variables
- Formatting output with the field width, precision and escape codes
- Converting between types using the casting operator
- What are the common Java operators and how they work
- The structure and syntax of decision making and looping constructs

James Tam

After This Section You Should Now Know (2)

- How to generate random numbers
- How to create and work with Java arrays

James Tam