"To excel in Java, or any computer language, you want to build skill in both the "large" and "small". By "large" I mean the sweeping, strategic issues of algorithms, data structures, ... what we think of basically as a degree in Computer Science. You also need skill in the "small" -- 10 or 20 line methods built of loops, logic, strings, lists etc. to solve each piece of the larger problem. Working with students in my office hours, I see what an advantage it is for students who are practiced and quick with their method code. Skill with the method code allows you to concentrate on the larger parts of the problem. Or put another way, someone who struggles with the loops, logic, etc. does not have time for the larger issues."

- Nick Parlante
Stanford University, Google
What We Will Do Today

- What are computer languages?
- Writing Java Programs
  - text editor and command line
  - Eclipse
- First programming concepts
  - output with printIn statements
  - syntax and errors
- identifiers, keywords, and comments
- Strings
Computers and Computer Languages

- Computers are everywhere
  - how many computers do you own?

- Computers are useful because they run programs
  - program is simply a set of instructions to complete some task
  - how many different programs do you use in a day?
Definitions

- **program**: A set of instructions that are to be carried out by a computer.

- **program execution**: The act of carrying out the instructions contained in a program.
  - this is done by feeding the instructions to the CPU

- **programming language**: A systematic set of rules used to describe computations, generally in a format that is readable and editable by humans.
  - in this class we use Java
High Level Languages

- Computers are fast
  - Intel® Core™ i7-8086K Processor on the order of 2 billion transistors (a switch that is on or off)
  - performs tens of billions of operations per second

- Computers are simple
  - They can only carry out a very limited set of instructions
    - on the order of 100 or so depending on the computer's processor
    - machine language instructions, aka instruction set architecture (ISA)
    - Add, Branch, Jump, Get Data, Get Instruction, Store, (CS429)
Machine Code

- John von Neumann - co-author of paper in 1946 with Arthur W. Burks and Hermann H. Goldstine, 
  - "Preliminary Discussion of the Logical Design of an Electronic Computing Instrument"

- One of the key points
  - program commands and data stored as sequences of bits in the computer's memory

- A program:
  
  111000111000000000
  010101101110000000
  011010000100000000
  000010000000010000
  000101101100010000
  000100100110000100
  011010000100000000
  000011100000001100

  6
Say What?

- Programming with Strings of bits (1s or 0s) is not the easiest thing to do.
- Assembly language
  - mnemonics for machine language instructions

```
.ORIG x3001
LD   R1, x3100
AND  R3, R3 #0
LD   R4, R1
BRn  x3008
ADD  R3, R3, R4
ADD  R1, R1, #1
LD   R4, R1
BRnzp x3003
```
High Level Languages

- Assembly language, still not so easy, and lots of commands to accomplish things
- High Level Computer Languages provide the ability to accomplish a lot with fewer commands than machine or assembly language in a way that is hopefully easier to understand

```c
int sum = 0;
int count = 0;
while (list[count] != -1) {
    sum += list[count];
    count = count + 1;
}
```
Binary Numbers - Base 2

- Base 10, 10 digits
  \[5127_{10} = 5 \times 1000 + 1 \times 100 + 2 \times 10 + 7 \times 1\]
  \[5127_{10} = 5 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 7 \times 10^0\]

- Base 2, 2 digits
  \[110101_2 = 1 \times 32 + 1 \times 16 + 0 \times 8 + 1 \times 4 + 0 \times 2 + 1 \times 1\]
  \[110101_2 = 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^2 + 1 \times 2^0\]
  \[110101_2 = 53_{10}\]
Java

- There are thousands of high level computer languages. Java, C++, C, Basic, Fortran, Cobol, Lisp, Perl, Prolog, Eiffel, Python
- The capabilities of the languages vary widely, but they all need a way to do
  - declarative statements
  - conditional statements
  - iterative or repetitive statements
- A compiler is a program that converts commands in high level languages to machine language instructions
public class Hello {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}

This would be in a text file named Hello.java
DEMO of writing and running a program via notepad and
the command line
Running a program

1. Write it.
   - code or source code: The set of instructions in a program.

2. Compile it.
   - compile: Translate a program from one language to another.
   - byte code: The Java compiler converts your code into a format named byte code that runs on many computer types.

3. Run (execute) it.
   - output: The messages printed to the user by a program.
public class Hello {
    public static void main(String[] args) {
        System.out.println("Hello, world!");
        System.out.println();
        System.out.println("This program produces");
        System.out.println("four lines of output");
    }
}

- Its output:
  Hello, world!
  This program produces
  four lines of output

- **console**: Text box into which the program's output is printed.
Every executable Java program consists of a class, that contains a method named `main`, that contains the `statements` (commands) to be executed.
System.out.println

- A statement that prints a line of output on the console.
  - pronounced "print-linn"

- Two ways to use System.out.println:
  - System.out.println("<text>");
    Prints the given message as output.
  - System.out.println();
    Prints a blank line of output.
Syntax

- **syntax**: The set of legal structures and commands that can be used in a particular language.
  - Every basic Java statement ends with a semicolon ;
  - The contents of a class or method occur between { and }

- **syntax error (compiler error)**: A problem in the structure of a program that causes the compiler to fail.
  - Missing semicolon
  - Too many or too few { } braces, braces not matching
  - Class and file names do not match
  - ...
Syntax error example

```java
public class Hello {
    pooblic static void main(String[] args) {
        System.owt.println("Hello, world!")
    }
}

Compiler output:

Hello.java:2: <identifier> expected
    pooblic static void main(String[] args) {
        ^
Hello.java:3: ';' expected
    }
    ^
2 errors

- The compiler shows the line number where it found the error.
- The error messages sometimes can be tough to understand:
  - Why can’t the computer just say “You misspelled ‘public’”?
An Important Realization

- Computers are stupid.

- Computers can’t read minds.

- Computers *seldom* make mistakes.

- If the computer is not doing what we want, it’s because *WE* made a mistake.
More on syntax errors

- Java is case-sensitive
  - Hello and hello are not the same

```java
1 Public class Hello {
2   public static void main(String[] args) {
3     System.out.println("Hello, world!");
4   }
5 }
```

compiler output:
```
Hello.java:1: class, interface, or enum expected
Public class Hello {
    ^
1 error
```
Names

- You must give your program a name.

```java
public class SubstitutionCipherDecoder {

- Naming convention: capitalize each word (e.g. MyClassName)

- Your program's file must match exactly (SubstitutionCipherDecoder.java)
  - includes capitalization (remember, Java is "case-sensitive")
```
Identifiers

- **identifier**: A name given to an item in your program.
  - must start with a letter, underscore, or $ $
  - subsequent characters can be any of those or digits 0 through 9

  - **legal**:
    - _myName
    - TheCure
    - ANSWER_IS_42
    - $bling$

  - **illegal**:
    - me+u
    - 49ers
    - side-swipe
    - Ph.D's
Keywords

- **keyword**: An identifier that you cannot use because it already has a reserved (special) meaning in Java.

  - abstract    default    if    implements    private    this
  - boolean    do        implements    protected    throw
  - break       double     import
  - public
  - byte        else       instanceof    return
  - private     transient
  - case        extends    int
  - static
  - class       float      long
  - strictfp
  - char        finally    native
  - void
  - const       for        new
  - synchronized

  Because Java is case-sensitive, you could technically use `Class` or `cLaSs` as identifiers, but this is very confusing and thus **strongly discouraged**.
Which of the following is not a syntactically correct Java identifier for the name of a program?

A. static
B. Void
C. FirstProgram
D. _My_program
E. More than one of A - D is not a syntactically correct Java identifier.
Strings

- **string**: A sequence of text characters.
  - Starts and ends with a " (quotation mark character).
    - The quotes do not appear in the output.
  - Examples:
    - "hello"
    - "This is a string. It's very long!"

- **Restrictions**:
  - May not span multiple lines.
    - "This is not a legal String."
  - May not contain a " character.
    - "This is not a "legal" String either."

- This begs the question…
Escape sequences

- **escape sequence**: A special sequence of characters used to represent certain special characters in a string.

  - `\t` tab character
  - `\n` new line character
  - `"` quotation mark character
  - `\` backslash character

- Example:
  ```java
  System.out.println("\\hello\\nhow\\tare ""you""?\\\\");
  ```

- Output:
  ```text
  \hello
  how are "you"?
  ```
How many visible characters does the following println statement produce when run?

```java
System.out.println("\t\nn\n\\\n\t\"\tt");
```

A. 0  
B. 1  
C. 2  
D. 3  
E. 4
Practice Program 1

What sequence of println statements will generate the following output?

This program prints the first lines of the song "slots".

"She lives in a trailer"
"On the outskirts 'a Reno"
"She plays quarter slots in the local's casino."
What sequence of println statements will generate the following output?

A "quoted" String is 'much' better if you learn the rules of "escape sequences."

Also, "" represents an empty String. Don't forget to use \" instead of "! "' is not the same as "
What is the output of the following `println` statements?

```java
System.out.println("\ta\tb\tc");
System.out.println("\\\n");
System.out.println("'");
System.out.println("\\\\\\n");
System.out.println("C:\\nin\\nthe downward spiral");
```
Answer to Practice Program 3

Output of each println statement:

```
  a  b  c
 '\'
 "   "
 C:
i the downward spiral
```
Practice Program 4

- Write a `println` statement to produce this output:

```
/ \ // \ \ /// \ /// \ 
```
Answer to Practice Program 4

println statement to produce the line of output:

```java
System.out.println("/ \ \ // \ \ \ /// \ \ \ /// \ \ \ \ ///");
```