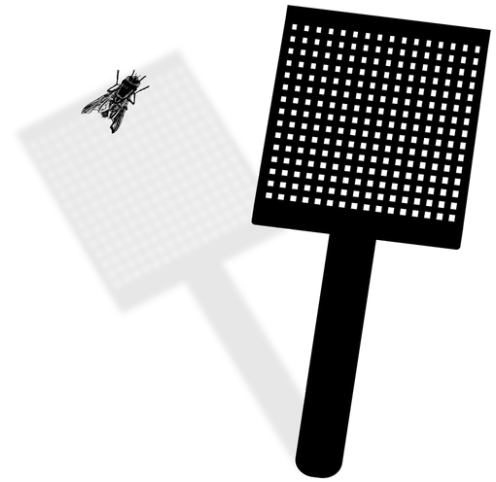
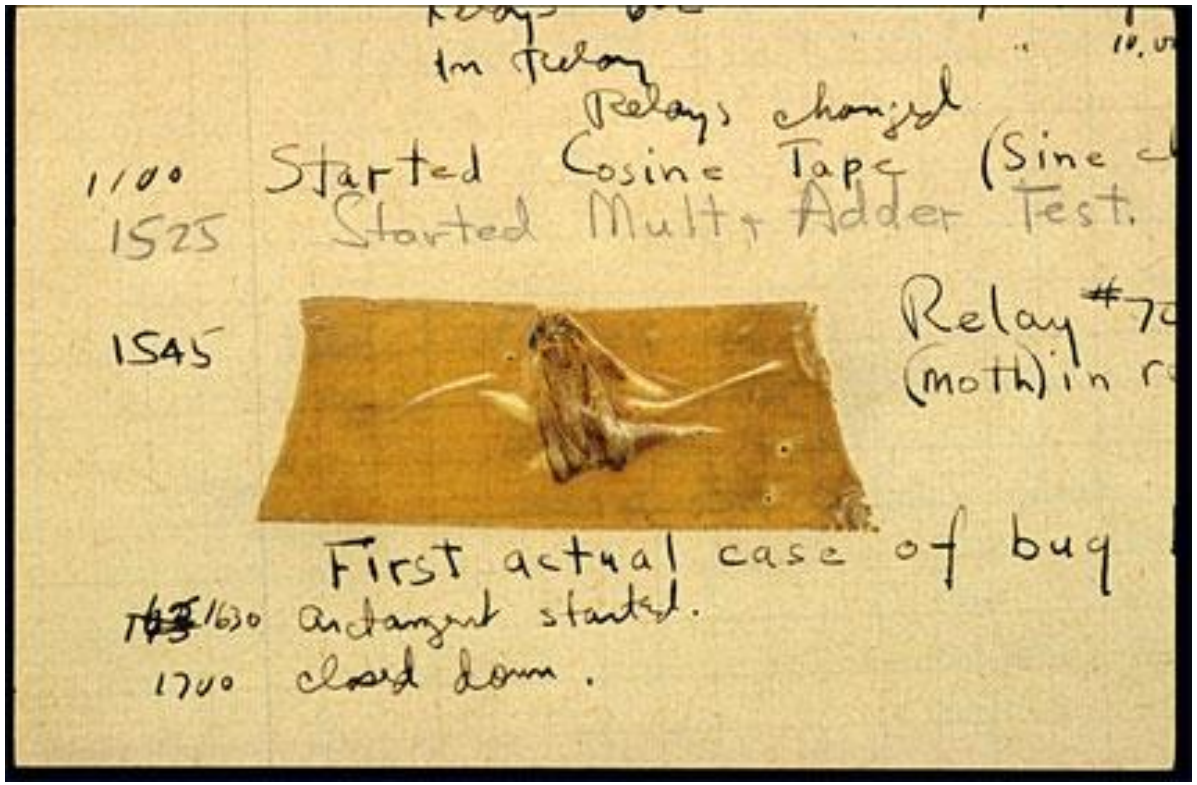


Types of Errors & Debugging

History of “bug”

A page from the Harvard Mark II electromechanical computer's log, featuring a dead moth that was removed from the device



“bug” was used by Isaac Asimov to refer to problems with a robot

a Harvard team of programmers found a moth trapped in the Mark II computer in 1947, leading to problems, bug was taped into logbook

3 types of errors

1) Syntax - easiest to find, caught by compiler
2) Logical - hardest to find
3) Runtime

Syntax Errors

Bad grammar in Java, compiler catches it and prints out error messages.

- misspelled words
- missing semicolons, words , “, { or (
- using reserved keyword
- using , instead of ;
- missing block (example: no if block when there is an else block)

Examples of compiler error message

source code file name

line number error occurs

explanation of error

```
MyClass.java:5: illegal start of expression
  void g() {
  ^
MyClass.java:8: ';' expected
}
^
MyClass.java:9: '}' expected
^
```

```
/MyClass.java:3: error: 'else' without 'if'
      else
      ^
1 error
```

Logical Errors

Program compiles and runs but does not produce the expected result in all of the possible cases

- must test your program for many inputs
- consider “edge cases” that involve exceptional values or circumstances

Runtime Errors

Program compiles and runs, but crashes during runtime because the program cannot continue executing. Called exceptions

- integer division by zero
- infinite loop (run out of memory)
- wrong type of input (program expected a number instead of a string of characters) but this can also be a syntax error if caught!!
- trying to access a value/character that doesn’t exist in a collection of values or a string

Example of runtime error message

```
Exception in thread "main" java.lang.ArithmeticException: / by zero
    at MyClass.main(MyClass.java:4)
```

Full list of errors and exceptions

https://drive.google.com/file/d/17XHkWue8lyN_M8Ms0IKUQyaVv8plYbs3/view?usp=sharing

Assignment

With your partner:

1) Review the algorithm for making a PB&J sandwich for errors. Spot and fix the errors! For each error in the original algorithm, highlight them to classify as a syntax error, logical error, or runtime error.

2) Add 1 sticky note to answer the question on slides 42 - 46 in the slide presentation from day 1.

Intro to Java: classes

A Java program is contained in a source code file. The header of the class must contain the keywords `class` and the name of the class. By style convention, Java class names start with a capital letter. The class is enclosed in curly braces. Example:

```
public class ClassName {

}
```

Java variables

Java is a **strongly typed**, **statically typed** language. The type of a variable is checked before a program is run (during compilation) to make sure there are no errors that would occur because of type. (Example: you can't subtract strings of characters!)

Once a variable's type is declared, it cannot be changed. This is different than other languages like Python!

Intro to Java: variable types

The first time a variable is used in a program, it must be declared with a type. The type of a variable cannot be changed after the variable is created. The value of the variable may also be assigned in the same line.

```
int num;                        String message = "abcde";
double val = 10.5;              boolean on;
```

Type	Description	Example of values	Memory Size
`byte`	small integer value from -128 to 127	0, 2, -100	8 bits
`short`	integer value	-32768, 11, 32767	16 bits
`int`	integer value, most common integer type	-1010, 0 1, 2	32 bits
`long`	large integer value, use if you know values will be greater than 2,147,483,647 or smaller than -2,147,483,648	-9,000,000,000,000,000,000	64 bits
`float`	smaller decimal value	-1,234,567,890.12345, 0.0, 0.5	32 bits
`double`	larger decimal value, most common decimal type	4,123,456,789,0123.1111111	64 bits
`boolean`	represents two states	true or false	4-8 bits
`char`	holds one symbol	'a', '1', '!', ' ', '.'	16 bit
`String`	not a primitive variable type, holds many characters	"abcd", "1 2 3 4 5", " "	depends on length

Intro to Java: basic syntax and style

- Lines (that are not block headers) must end in a ;
- Whitespace and indents do not matter to compiler but should be used to show organization, improve readability
- variable names start with lowercase letters
- multiword names should use camel case (twoWords or ClassName)
- Strings are enclosed in “ “ and char are enclosed in ‘ ‘

Java: operators

The symbols represent operators that can be used with some types:

- + concatenates strings or adds numberics values
- − subtracts numeric values
- * multiplies numeric values
- / divides integers with int division, divides a floating point with normal division
- % (modulus) calculates the remainder after division
- ! makes the opposite of a boolean value
- = assigns a value to a variable

Intro to Java: print method

The `print` method prints information to the screen, called the console.

`System.out.print(`String message to be printed`)`

Make mistakes

Go to CodeHS sandbox and tinker around in a source code file. Play around to determine what is allowed and what is not! Make some errors!