

How Novice Programmers Interact with Programming Environments

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Let's interact with a few programming environments

- Command-line / javac
 - often used with novices
- BlueJ 3 & 4
 - designed for novices
- EJE
 - basic, suitable for novices
- Netbeans
 - “Industry-strength”

A very simple Java program


```
public class PrintNums {  
    public static void main (String[] args){  
        for(int x = 0; x < 10; x++)  
            System.out.println(x);  
    }  
}
```

Output:

0
1
2
3
4
5
6
7
8
9

Let's introduce a syntax error

```
public class PrintNums {  
    public static void main (String[] args){  
        for(int x = 0: x < 10; x++)  
            System.out.println(x);  
    }  
}
```



Regular colon :
instead of semicolon ;

Command-line / javac

javac 1.8.0_131

Command-line / javac (with error)

```
Command Prompt
C:\Users\bbecker\Desktop\Junk>javac PrintNums.java
PrintNums.java:3: error: ';' expected
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: ';' expected
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: illegal start of type
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: illegal start of expression
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: ')' expected
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: illegal start of expression
    for(int x = 0: x < 10; x++)
                   ^

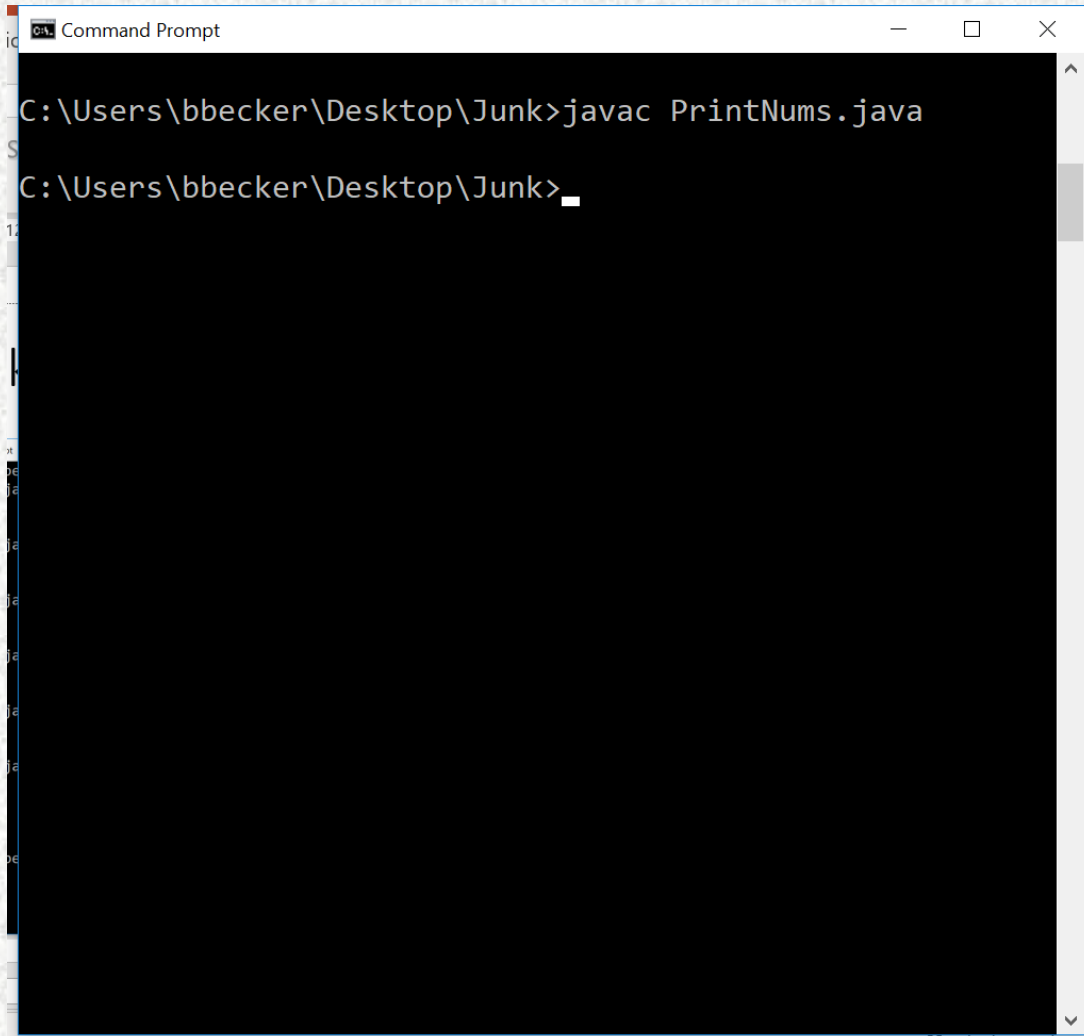
6 errors

C:\Users\bbecker\Desktop\Junk>
```

- Produces six “errors”
 - I’d rather call these *messages*
 - One first* message
 - Five subsequent* messages

* Taxonomy of ‘traditional’ compiler error messages:
Becker, et al. 2018: brettbecker.com/publications/#27

Command-line / javac (error fixed)



```
Command Prompt
C:\Users\bbecker\Desktop\Junk>javac PrintNums.java
C:\Users\bbecker\Desktop\Junk>_
```

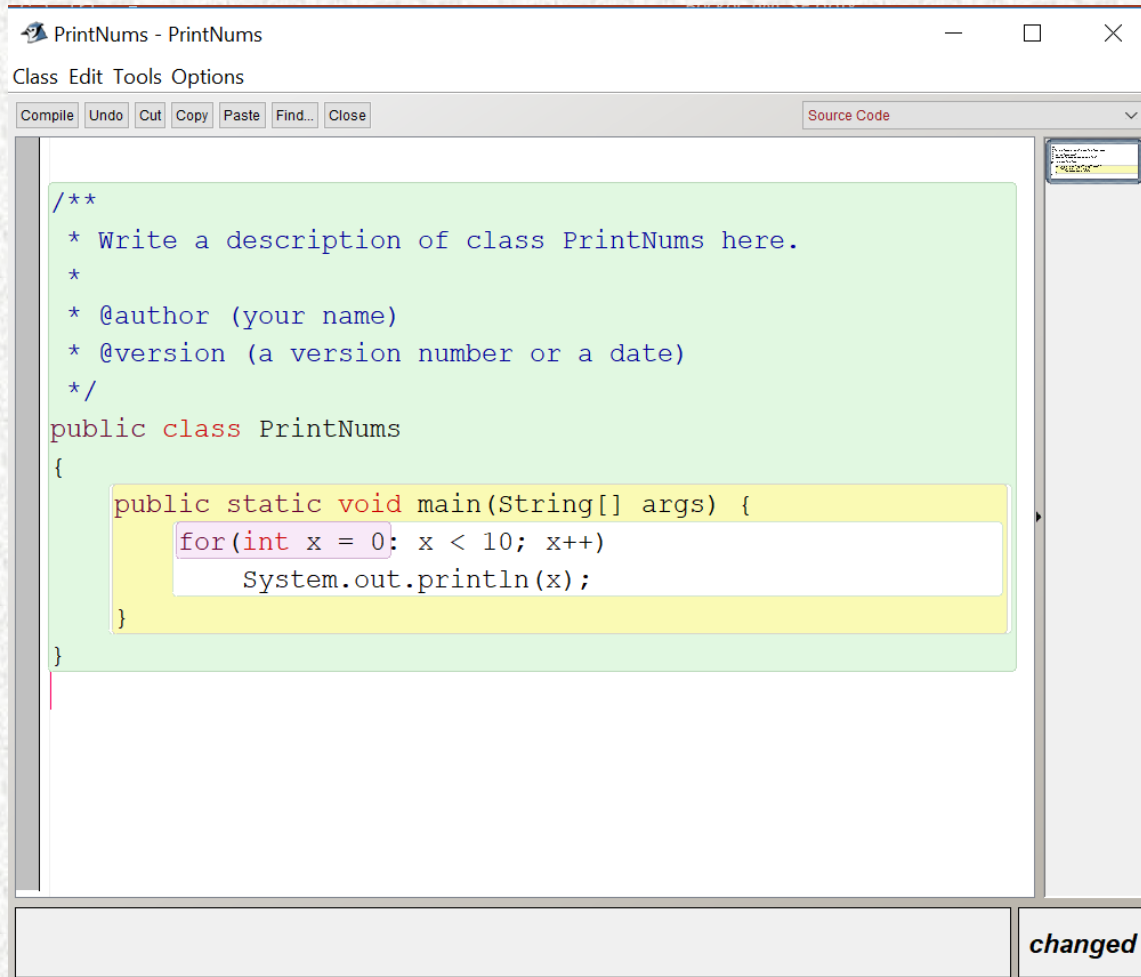
- Produces nothing on success

BlueJ 3

BlueJ 3.1.7

Kölling et al., 2003: www.bluej.org/papers/2003-12-CSEd-bluej.pdf

BlueJ 3 (with error)



```
PrintNums - PrintNums
Class Edit Tools Options
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}
changed
```

- Some red highlighting
- Red cursor at end

BlueJ 3 (with error)

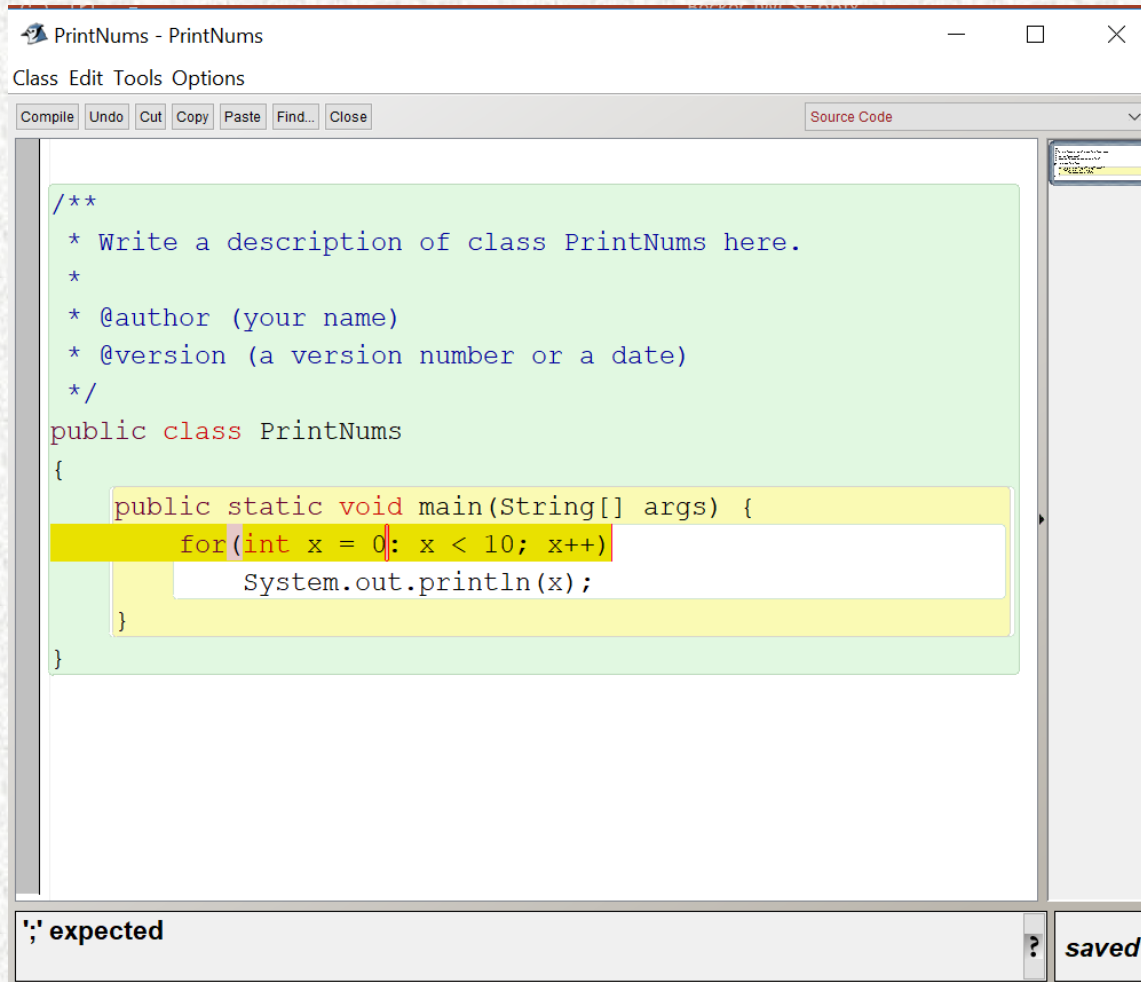
```
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}
```

; expected

saved

- Upon clicking compile:
 - Message appears in output window
 - This is a simplification of the first javac message
 - Highlighting changes
 - Red cursor changes, moves

BlueJ 3 (with error)



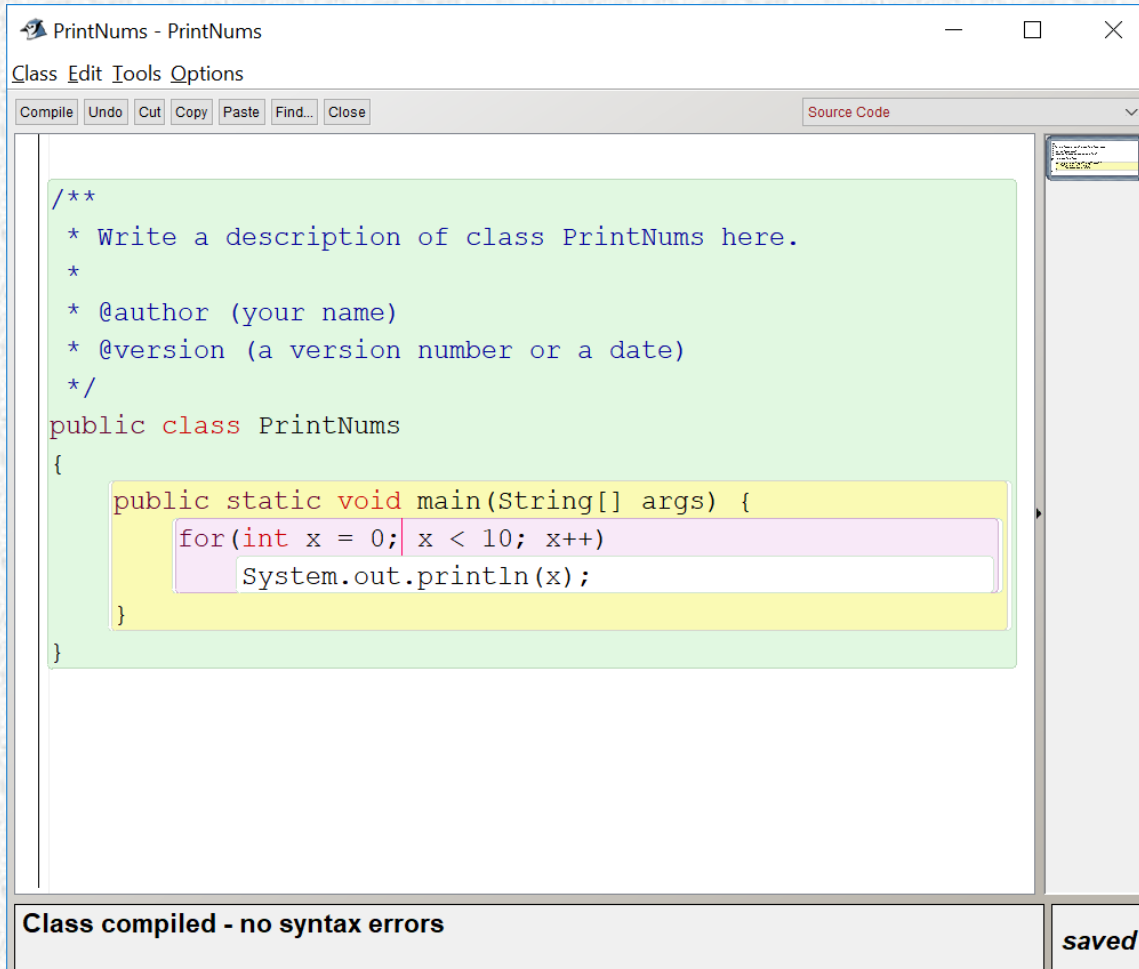
The screenshot shows the BlueJ IDE window titled "PrintNums - PrintNums". The menu bar includes "Class", "Edit", "Tools", and "Options". The toolbar contains "Compile", "Undo", "Cut", "Copy", "Paste", "Find...", and "Close". The "Source Code" tab is active. The code editor displays the following Java code:

```
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}
```

The code is highlighted in green. The "Compile" button is highlighted in yellow. The status bar at the bottom shows a red error icon, the text "; expected", a question mark icon, and the word "saved".

- Clicking compile again does nothing
 - Repeat forever...

BlueJ 3 (error fixed)



```
PrintNums - PrintNums
Class Edit Tools Options
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}
```

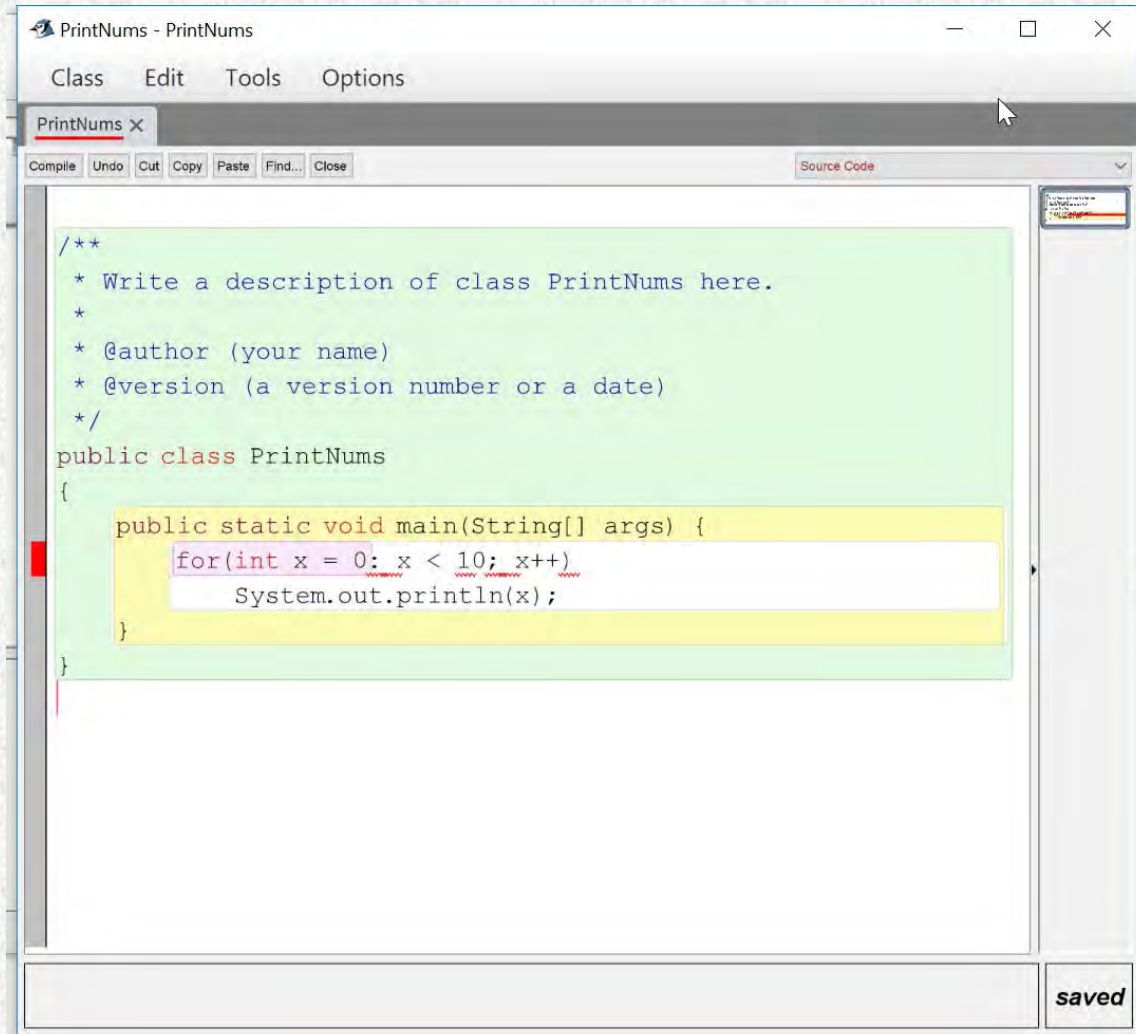
Class compiled - no syntax errors saved

- Upon fixing the error and clicking compile, we get:
 - Success message
 - Highlighting changes
 - Red cursor changes and moves

BlueJ 4

BlueJ 4.0.0 preview 2

BlueJ 4 (with error)

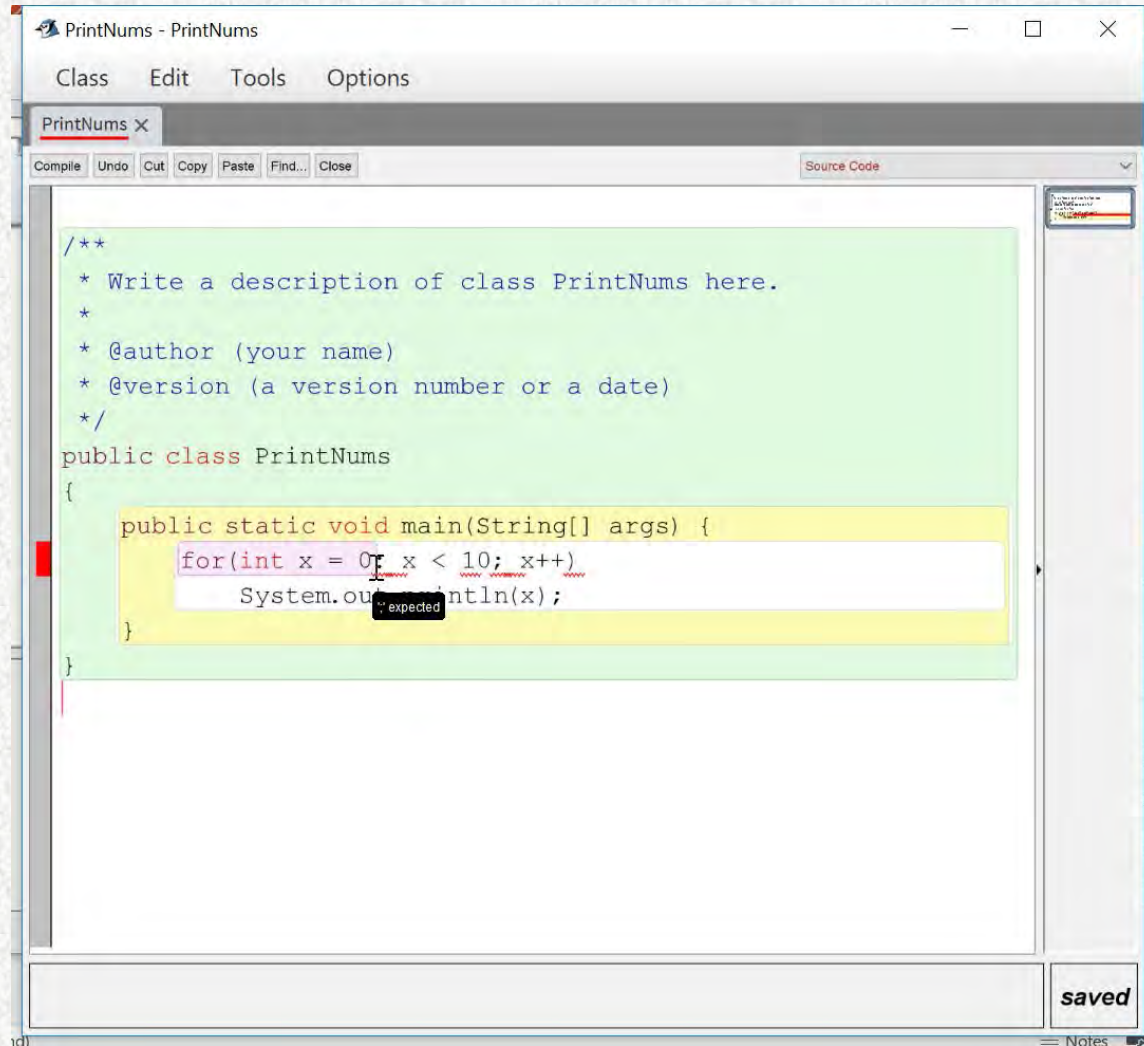


```
PrintNums - PrintNums
Class Edit Tools Options
PrintNums x
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0: x < 10; x++)
            System.out.println(x);
    }
}
```

saved

- Without clicking compile, BlueJ 4 has:
 - Similar highlighting to BlueJ 3
 - A red bar in the left margin
 - Lots of underlining (red squiggles)
 - Similar to BlueJ 3, mysterious red cursor at end

BlueJ 4 (with error)



```
PrintNums - PrintNums
Class Edit Tools Options
PrintNums x
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}
```

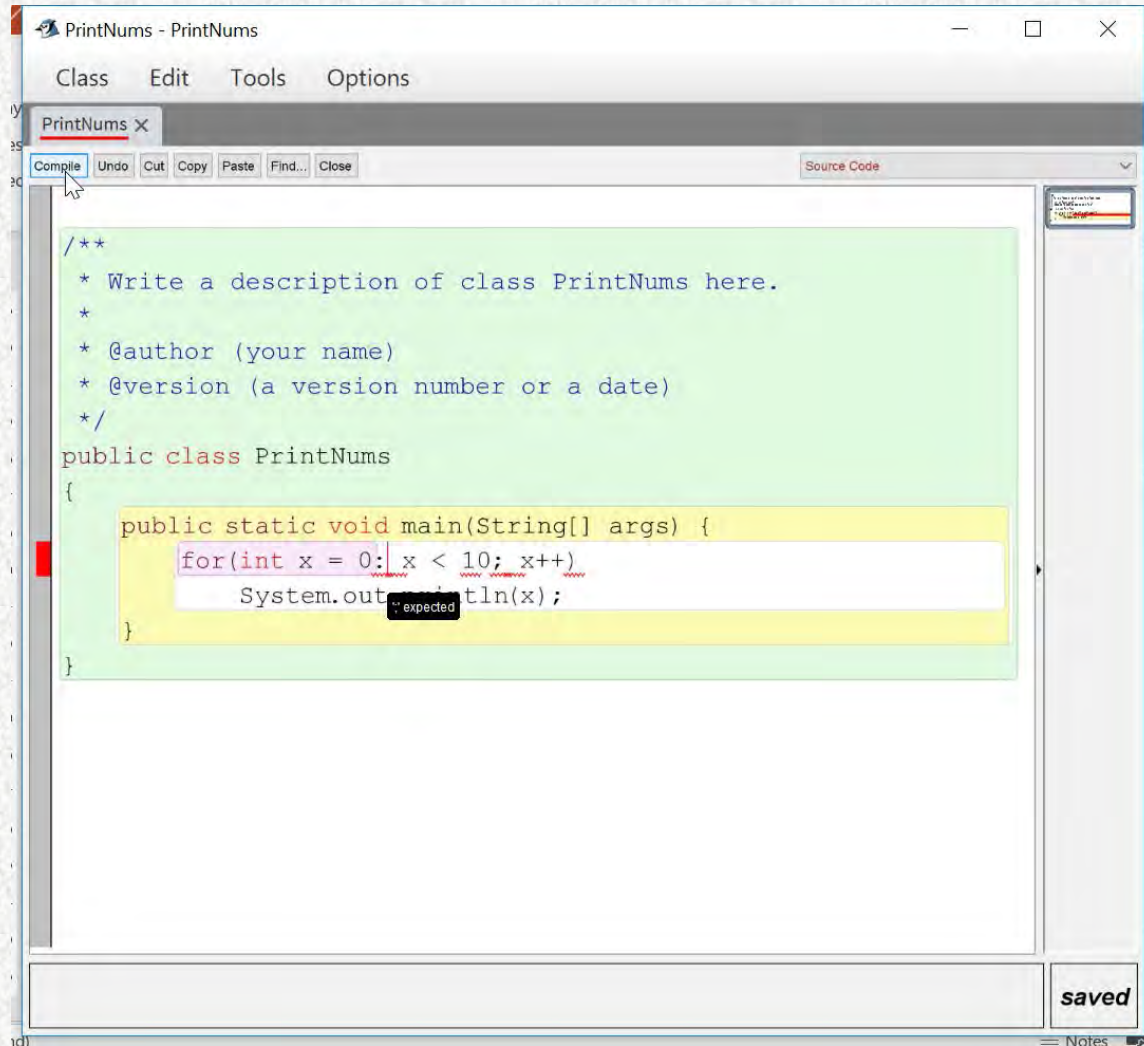
unexpected

saved

Notes

- Clicking compile generates no messages in the output window
- Generates pop-up with abbreviated message that matches first javac message

BlueJ 4 (with error)



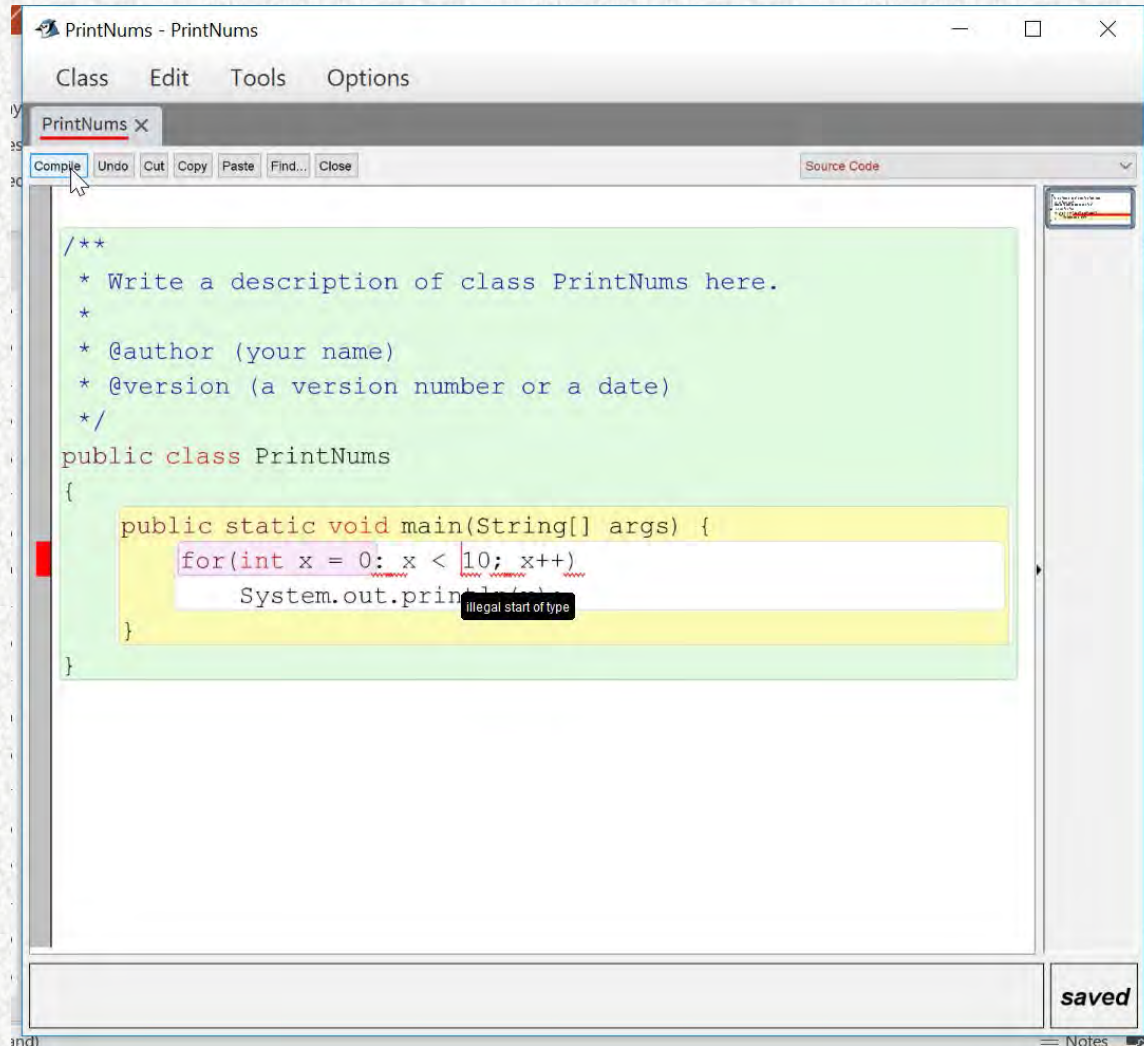
```
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}
```

unexpected

saved

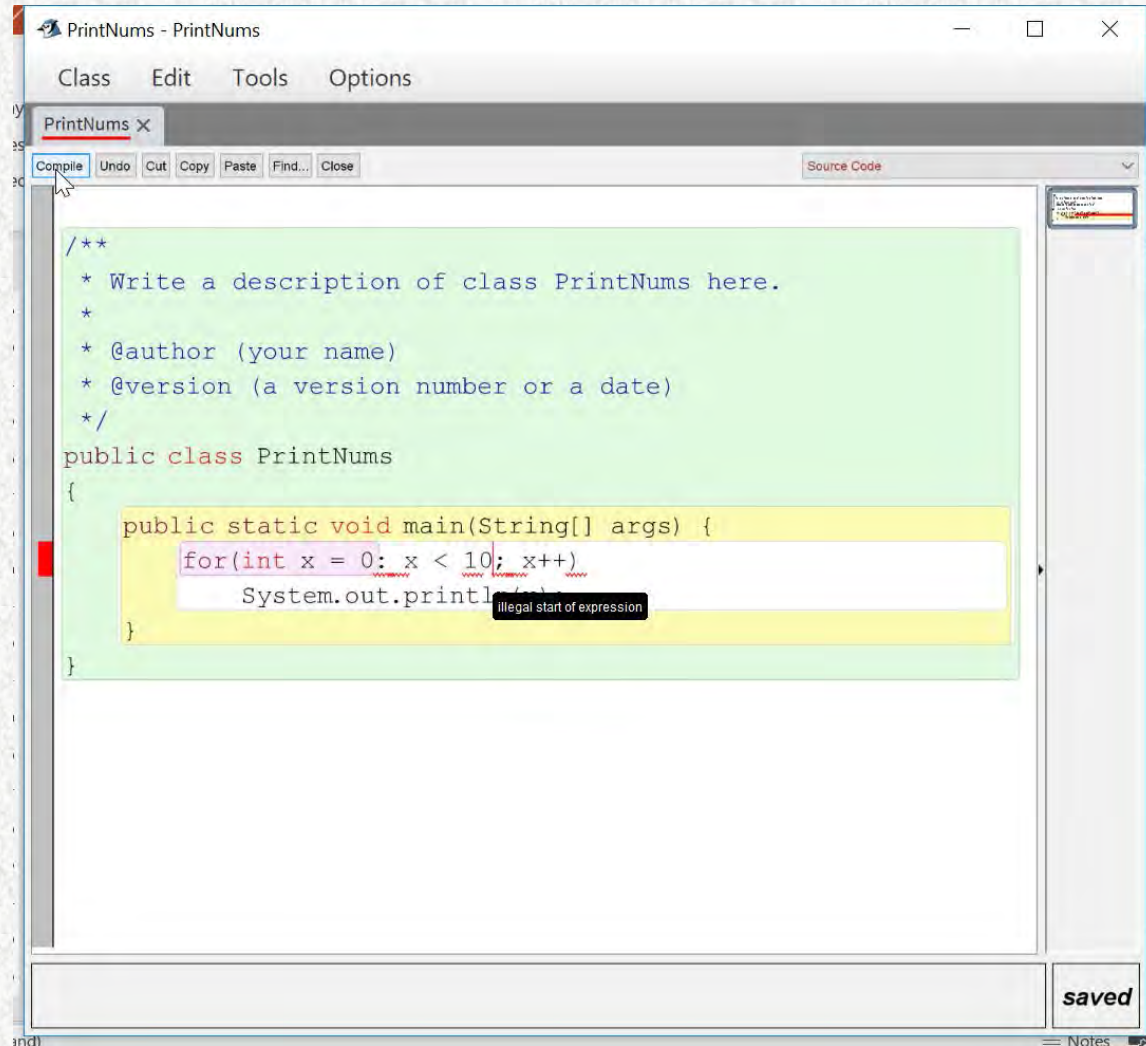
- Clicking compile again generates no messages in the output window
- Generates new pop-up with abbreviated message that matches second javac message

BlueJ 4 (with error)



- Clicking compile again generates no messages in the output window
- Generates new pop-up with abbreviated message that matches third javac message

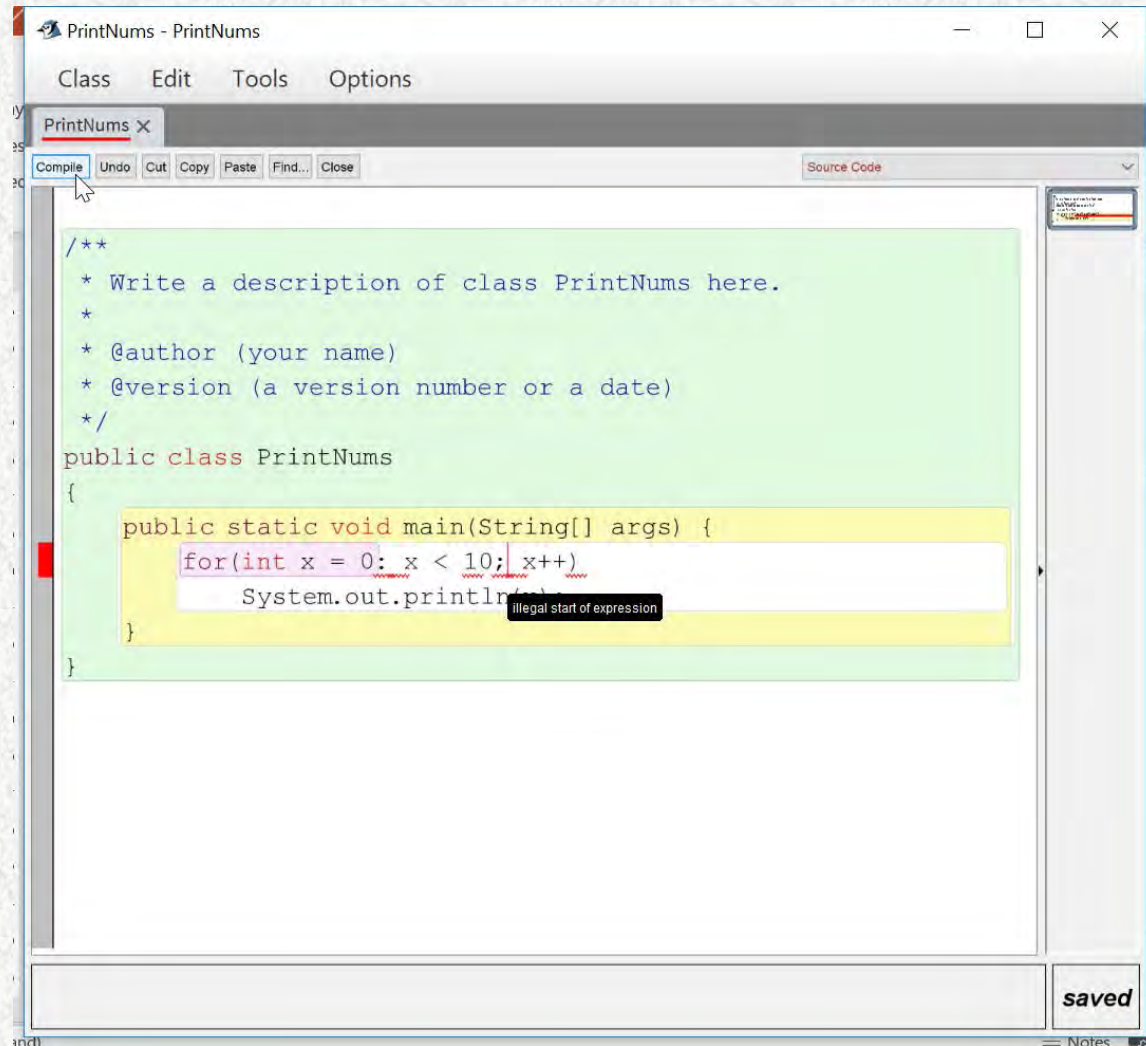
BlueJ 4 (with error)



```
PrintNums - PrintNums
Class Edit Tools Options
PrintNums X
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0: x < 10; x++)
            System.out.println(x);
    }
}
illegal start of expression
saved
Notes
```

- Clicking compile again generates no messages in the output window
- Generates new pop-up with abbreviated message that matches fourth javac message

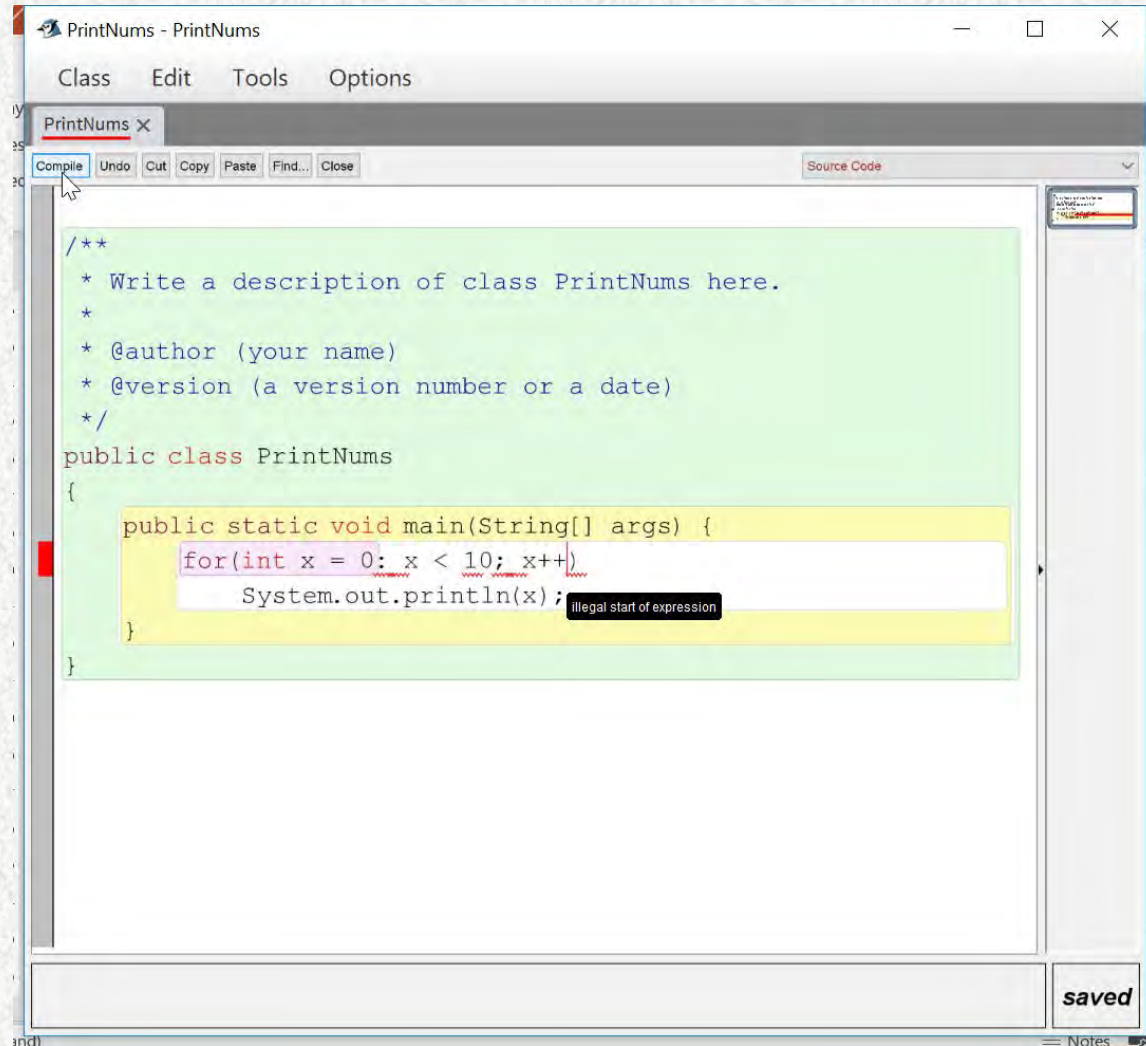
BlueJ 4 (with error)



```
PrintNums - PrintNums
Class Edit Tools Options
PrintNums x
Compile Undo Cut Copy Paste Find... Close
Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0: x < 10; x++)
            System.out.println(;
    }
}
saved
Notes
```

- Clicking compile again generates no messages in the output window
- Generates new pop-up with abbreviated message that matches fifth javac message

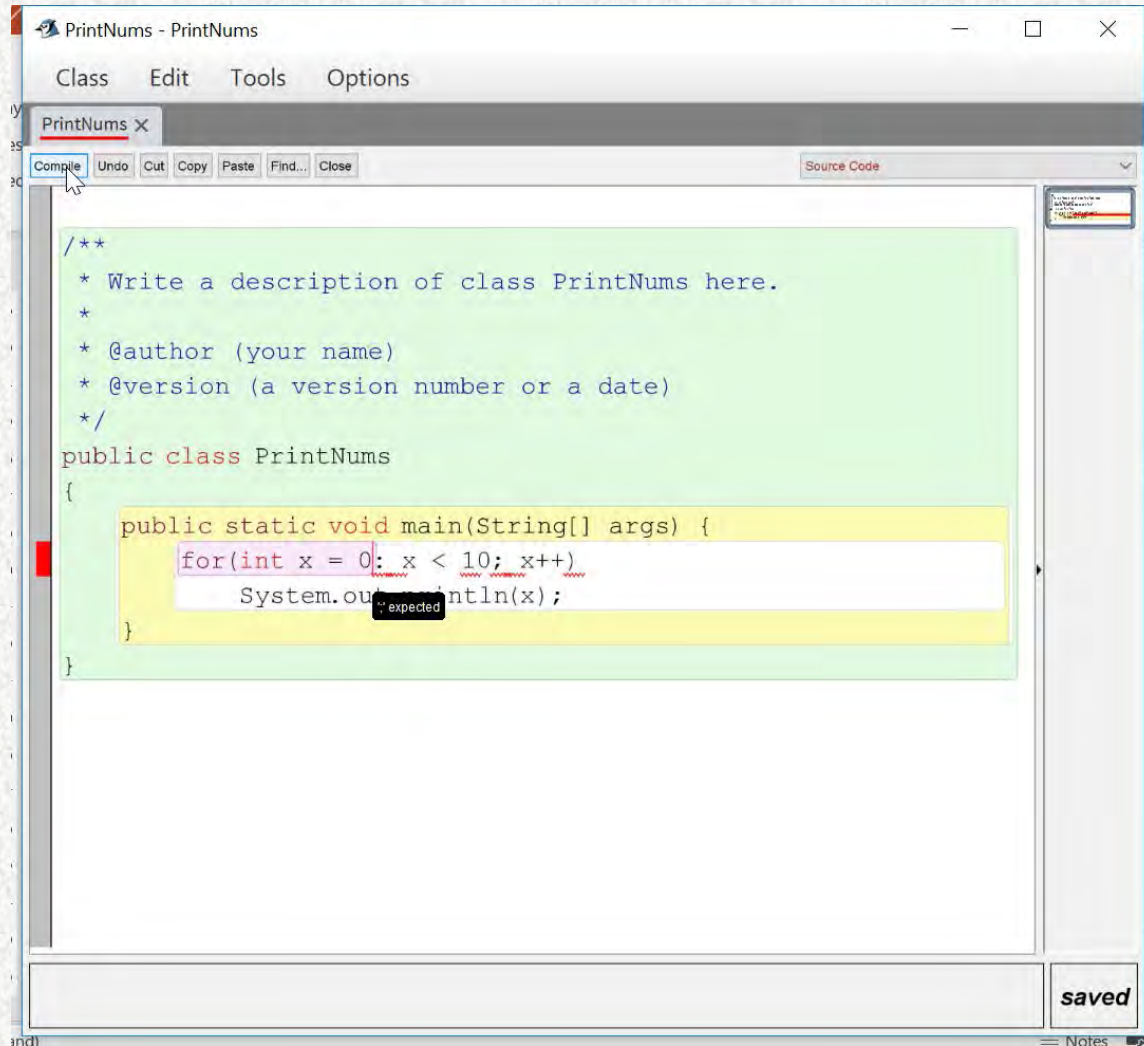
BlueJ 4 (with error)



```
PrintNums - PrintNums
Class Edit Tools Options
PrintNums x
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0: x < 10; x++)
            System.out.println(x);
    }
}
illegal start of expression
saved
Notes
```

- Clicking compile again generates no messages in the output window
- Generates new pop-up with abbreviated message that matches sixth javac message

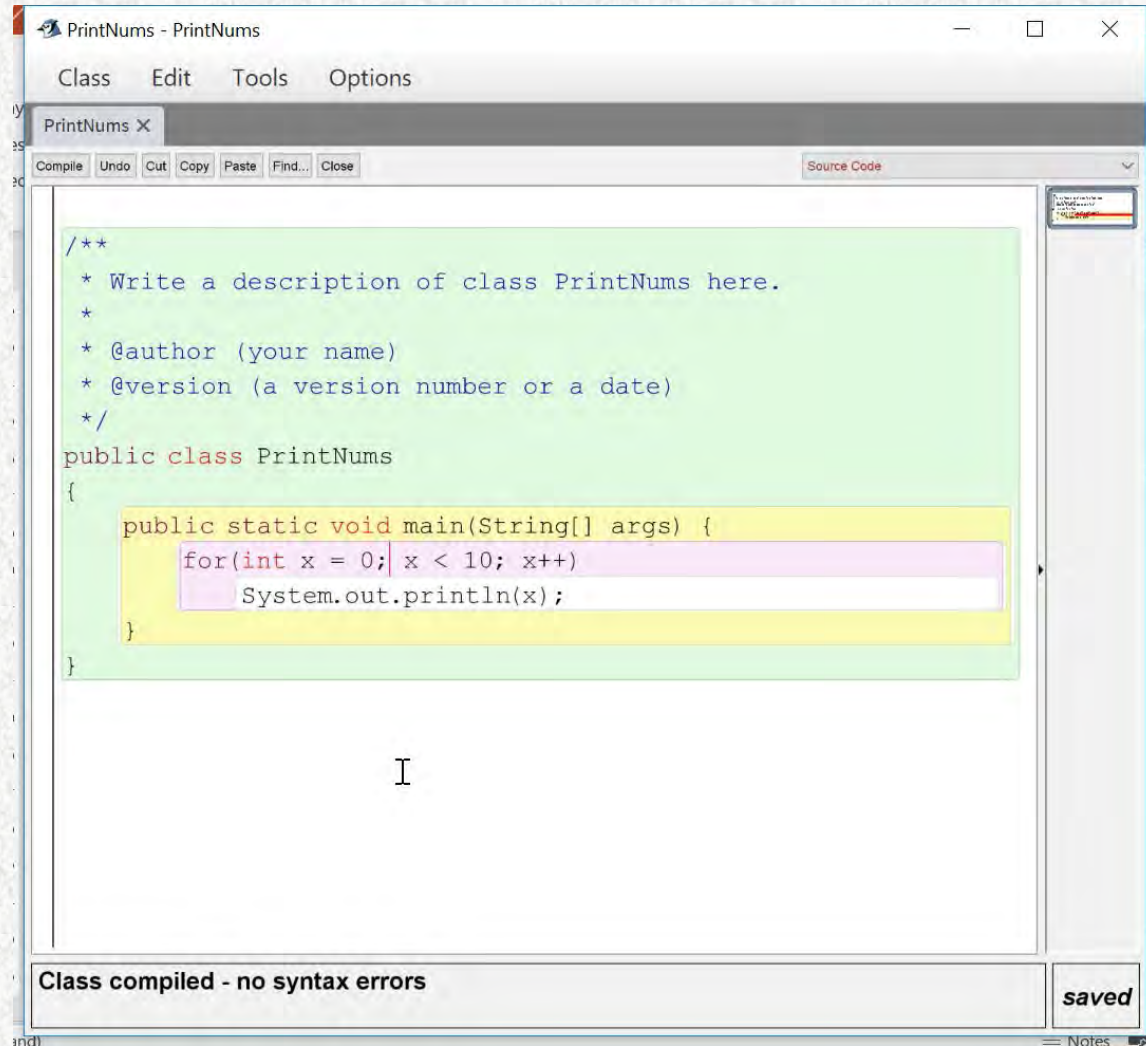
BlueJ 4 (with error)



```
PrintNums - PrintNums
Class Edit Tools Options
PrintNums X
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}
unexpected
saved
Notes
```

- Clicking compile again generates no messages in output window
- Generates new pop-up with abbreviated message that matches **first** javac message (**again**)
- Errors are being cycled in round-robin fashion

BlueJ 4 (error fixed)



```
PrintNums - PrintNums
Class Edit Tools Options
PrintNums X
Compile Undo Cut Copy Paste Find... Close Source Code
/**
 * Write a description of class PrintNums here.
 *
 * @author (your name)
 * @version (a version number or a date)
 */
public class PrintNums
{
    public static void main(String[] args) {
        for(int x = 0; x < 10; x++)
            System.out.println(x);
    }
}

I

Class compiled - no syntax errors
saved
```

- Upon fixing the error, we receive:
 - Success message in output window
 - Highlighting changes
 - Red bar in margin disappears
 - Pop-up disappears
 - Red cursor moves but remains

EJE (Everyone's Java Editor)

EJE 3.5

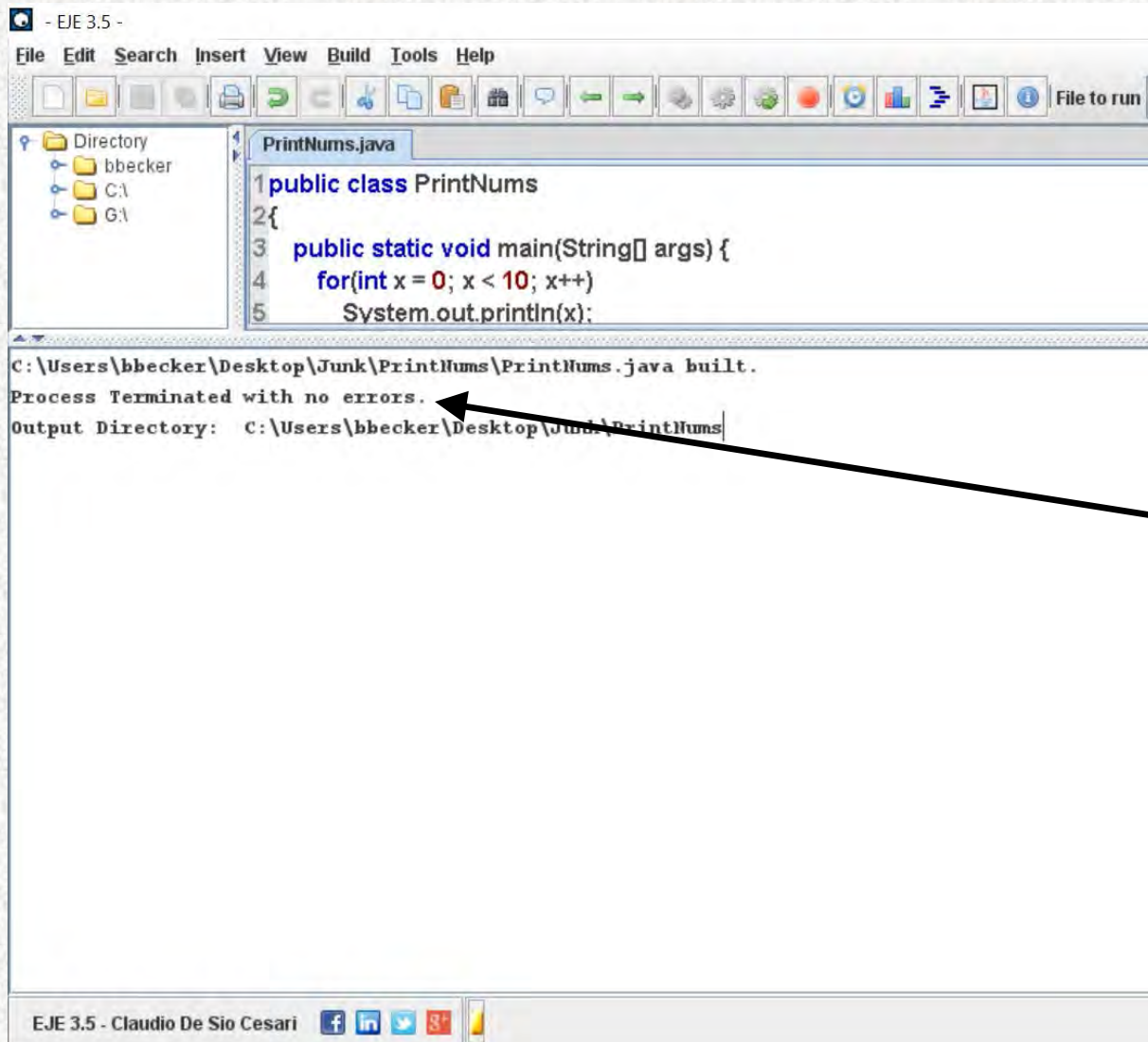
<http://sourceforge.net/projects/eje/>

EJE (with error)

```
- EJE 3.5 -
File Edit Search Insert View Build Tools Help
Directory
  bbecker
  C:\
  G:\
PrintNums.java
1 public class PrintNums
2 {
3 public static void main(String[] args) {
4 for(int x = 0: x < 10; x++)
5 System.out.println(x);
C:\Users\bbecker\Desktop\Junk\PrintNums\PrintNums.java:4: error: ';' expected
for(int x = 0: x < 10; x++)
C:\Users\bbecker\Desktop\Junk\PrintNums\PrintNums.java:4: error: ';' expected
for(int x = 0: x < 10; x++)
C:\Users\bbecker\Desktop\Junk\PrintNums\PrintNums.java:4: error: illegal start of type
for(int x = 0: x < 10; x++)
C:\Users\bbecker\Desktop\Junk\PrintNums\PrintNums.java:4: error: illegal start of expression
for(int x = 0: x < 10; x++)
C:\Users\bbecker\Desktop\Junk\PrintNums\PrintNums.java:4: error: ')' expected
for(int x = 0: x < 10; x++)
C:\Users\bbecker\Desktop\Junk\PrintNums\PrintNums.java:4: error: illegal start of expression
for(int x = 0: x < 10; x++)
6 errors
Process Terminated ... there were problems.
EJE 3.5 - Claudio De Sio Cesari
```

- Upon clicking compile, EJE output is almost identical to javac
- No change in edit window

EJE (error fixed)



The screenshot shows the Eclipse IDE interface. The top menu bar includes File, Edit, Search, Insert, View, Build, Tools, and Help. Below the menu is a toolbar with various icons. The left sidebar shows a directory tree with folders for bbecker, C:\, and G:\. The main editor window displays the code for PrintNums.java:

```
1 public class PrintNums
2 {
3     public static void main(String[] args) {
4         for(int x = 0; x < 10; x++)
5             System.out.println(x);
6     }
7 }
```

Below the editor is the Output window, which contains the following text:

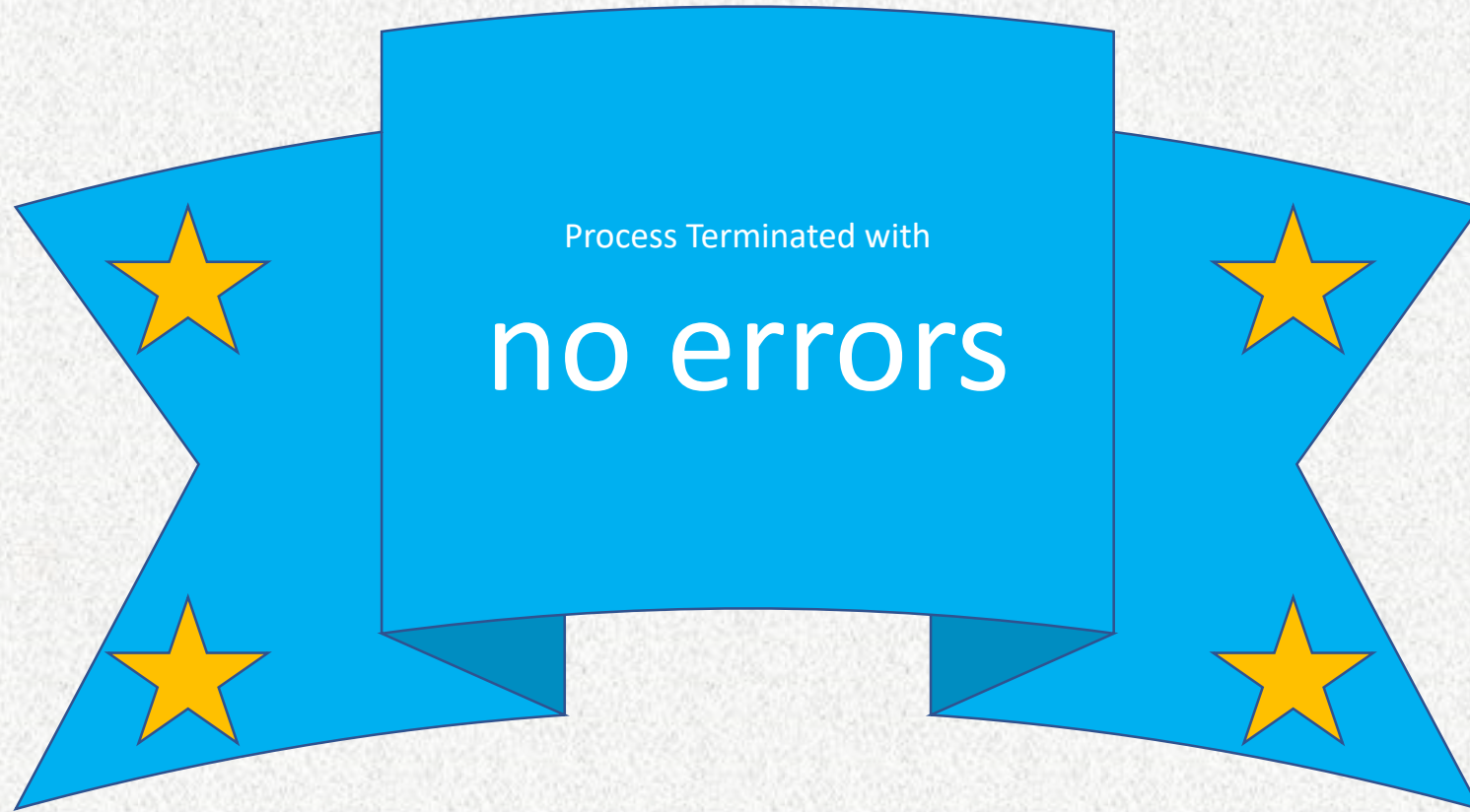
```
C:\Users\bbecker\Desktop\Junk\PrintNums\PrintNums.java built.
Process Terminated with no errors.
Output Directory: C:\Users\bbecker\Desktop\Junk\PrintNums
```

An arrow points from the text "Process Terminated with no errors." to the bullet point "Somewhat oddly it uses 'Terminated' in a success message" in the adjacent list.

EJE 3.5 - Claudio De Sio Cesari

- Upon fixing error and clicking compile we get a message in the output window
 - Unlike javac
 - Same javac version though
- Somewhat oddly it uses “Terminated” in a success message

This might not be what a novice pictures when
seeing this message



This might be what a novice pictures when seeing
this message

X

X

Process **Terminated**

with no errors

X

X

Netbeans

Netbeans 8.1

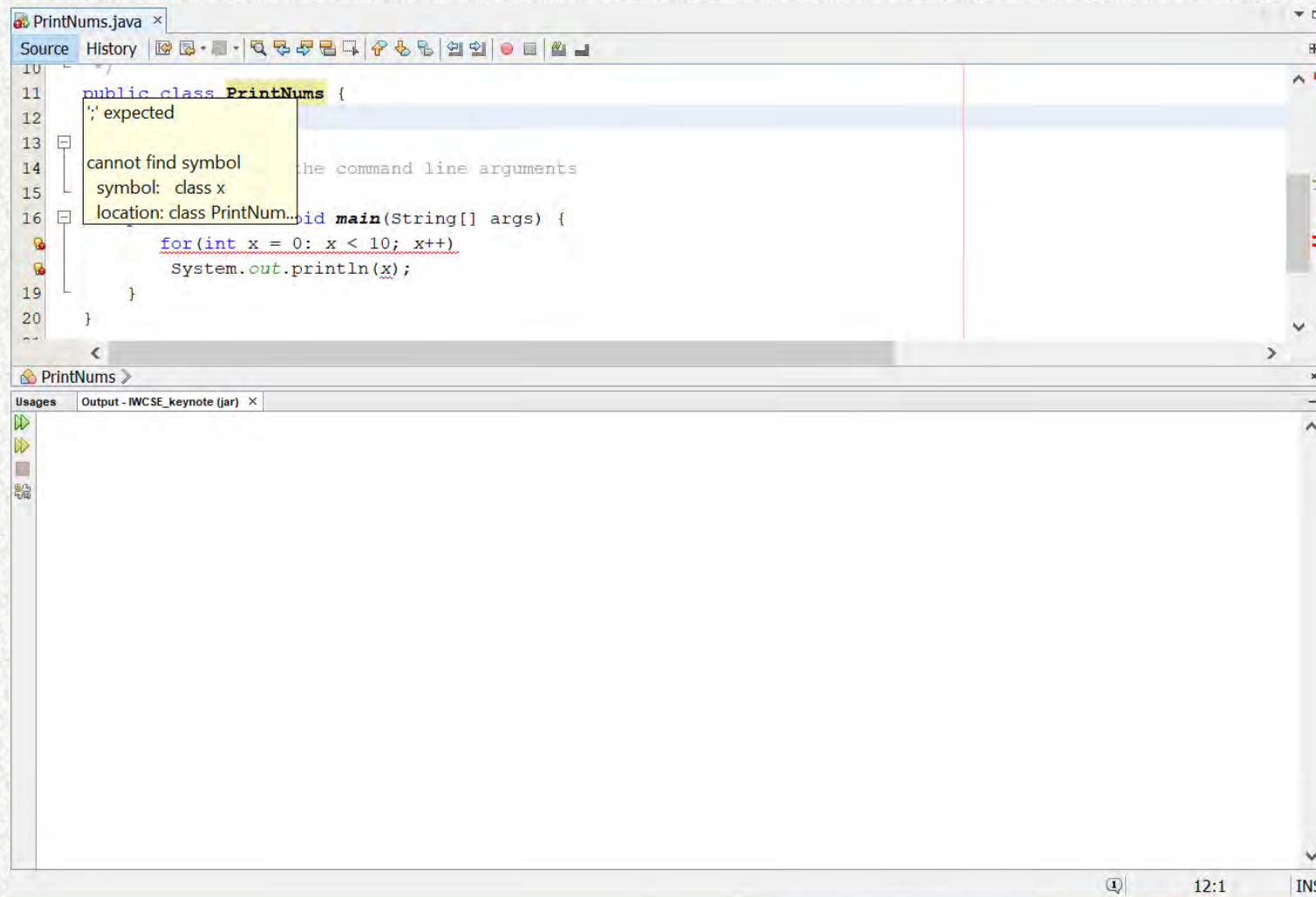
Netbeans (with error)

```
10
11 public class PrintNums {
12 |
13 |     /**
14 |      * @param args the command line arguments
15 |      */
16 |     public static void main(String[] args) {
17 |         for(int x = 0: x < 10; x++)
18 |             System.out.println(x);
19 |     }
20 | }
21
```

Without clicking compile we see:

- One big red underline
- Red lines and box in right margin
- Lightbulbs in left margin

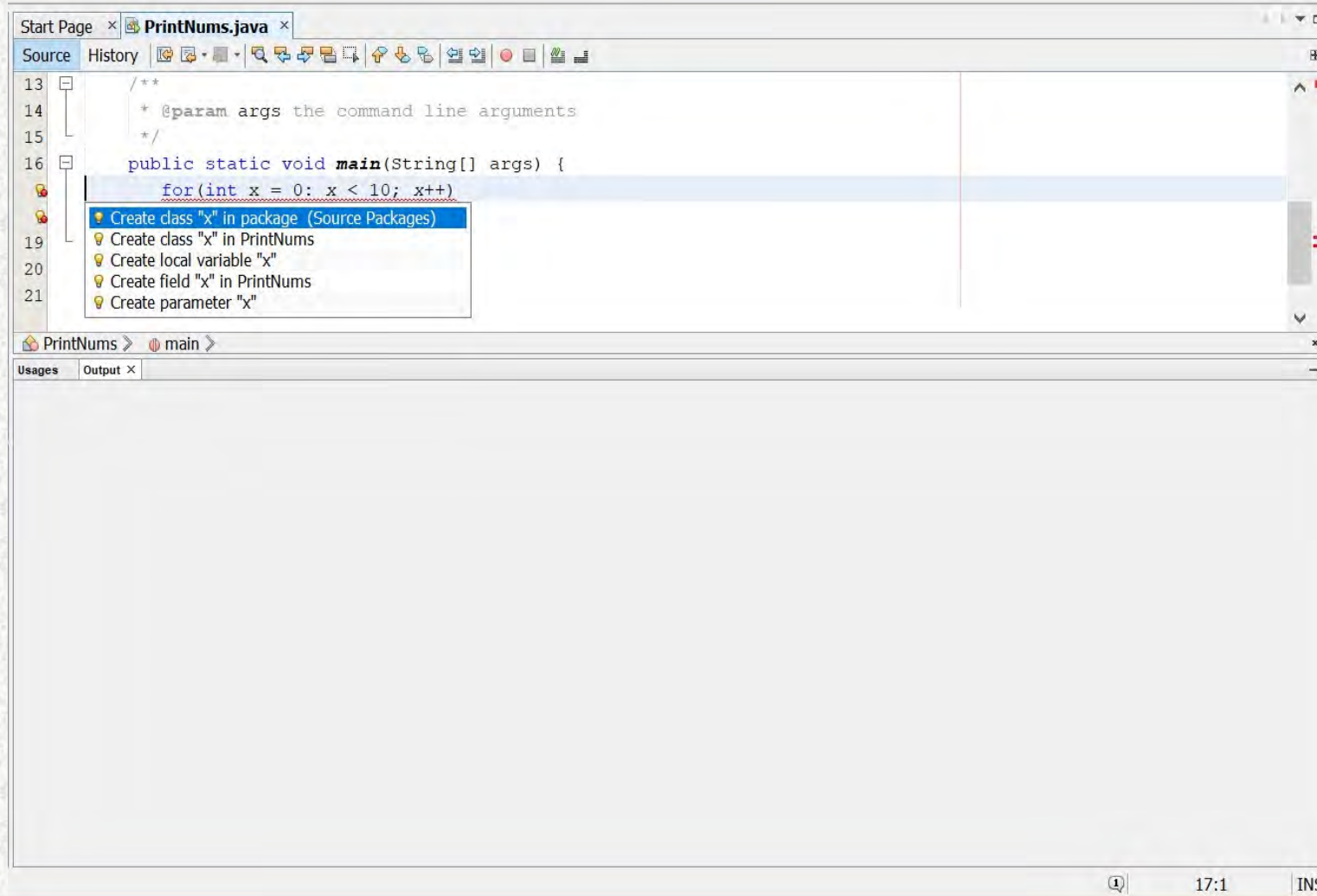
Netbeans (with error)



Hovering over a lightbulb gives us:

- pop-up with what seems to be one short message, and another truncated message, but there is no way to see the missing text
- When you move the cursor, the window disappears

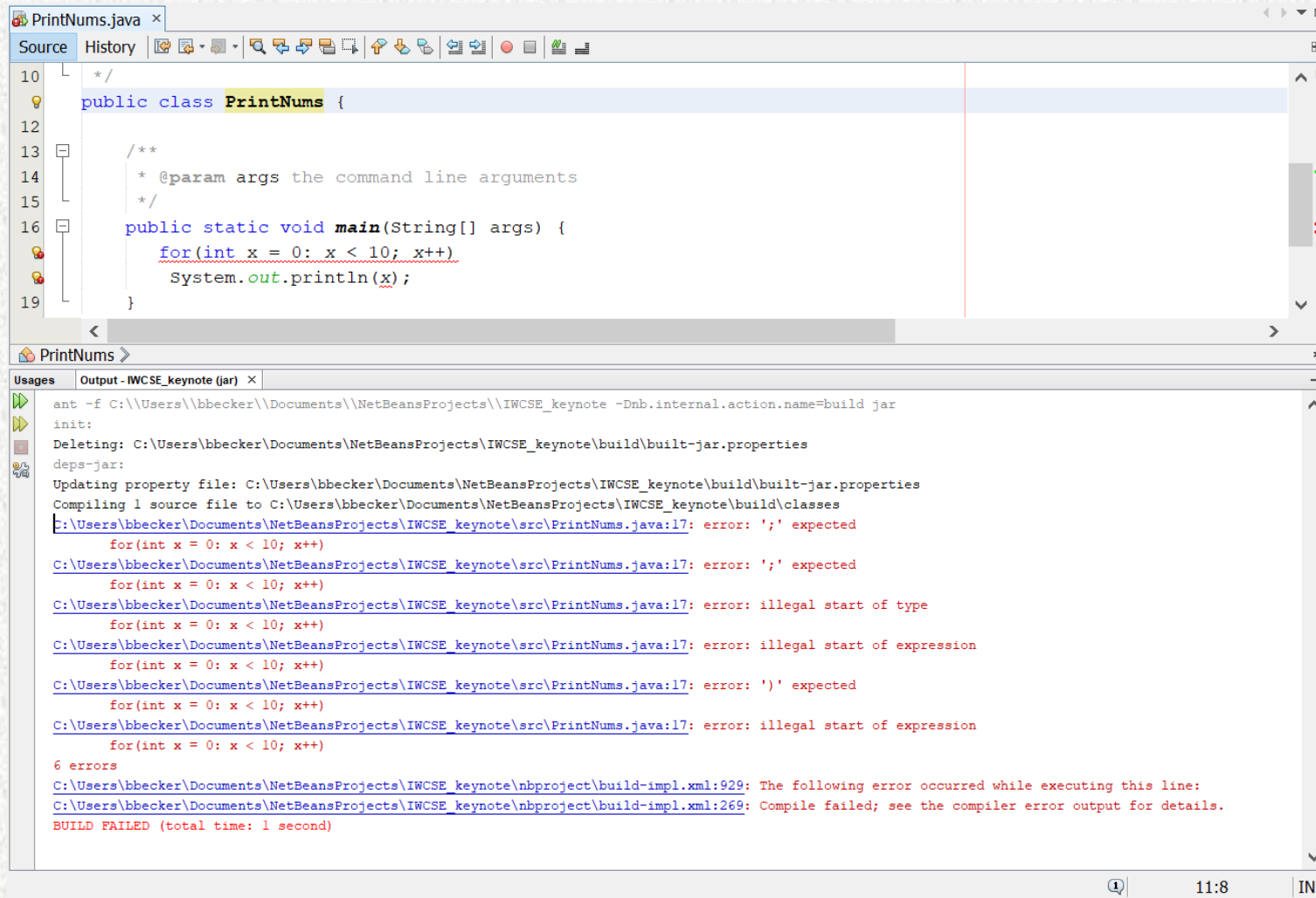
Netbeans (with error)



Clicking the first lightbulb we get:

- A list of what seem to be suggestions
- I clicked one of these and what happened was too complicated to present
- ***It was not a fix***

Netbeans (with error)



The screenshot shows the NetBeans IDE interface. The top window displays the source code for `PrintNums.java`. The code is as follows:

```
10  */
11  public class PrintNums {
12
13      /**
14       * @param args the command line arguments
15       */
16      public static void main(String[] args) {
17          for(int x = 0; x < 10; x++)
18              System.out.println(x);
19      }
```

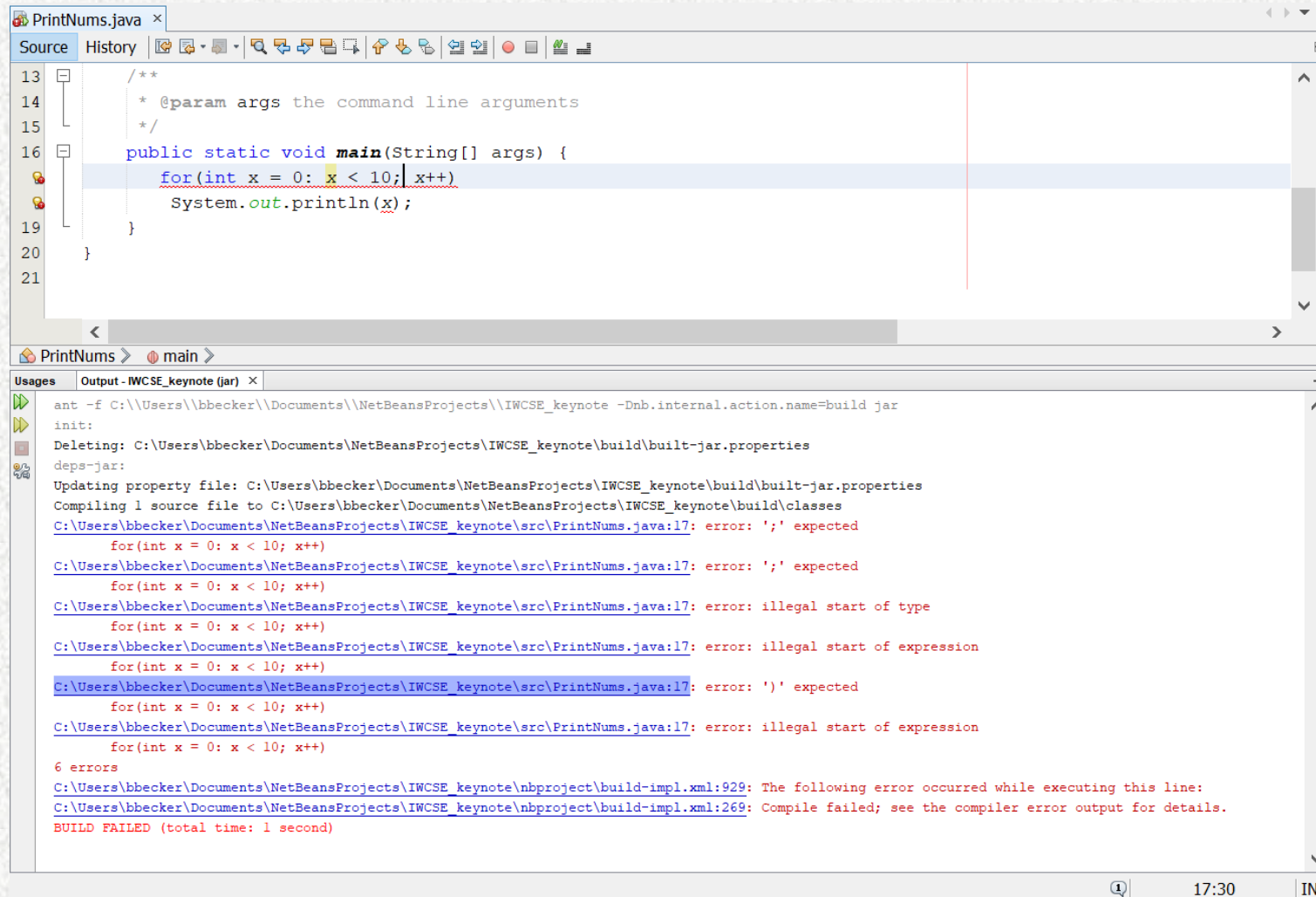
The bottom window shows the output of the compilation process. The output text is as follows:

```
ant -f C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote -Dnb.internal.action.name=build jar
init:
Deleting: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
deps-jar:
Updating property file: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
Compiling 1 source file to C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\classes
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of type
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ')' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
6 errors
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:929: The following error occurred while executing this line:
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:269: Compile failed; see the compiler error output for details.
BUILD FAILED (total time: 1 second)
```

Clicking compile gives us this in the output window:

- Similar to javac but more complicated
- Red text
- Black text
- Grey text
- What appear to be links

Netbeans (with error)



The screenshot shows the NetBeans IDE interface. The top window displays the source code for `PrintNums.java`. The code is as follows:

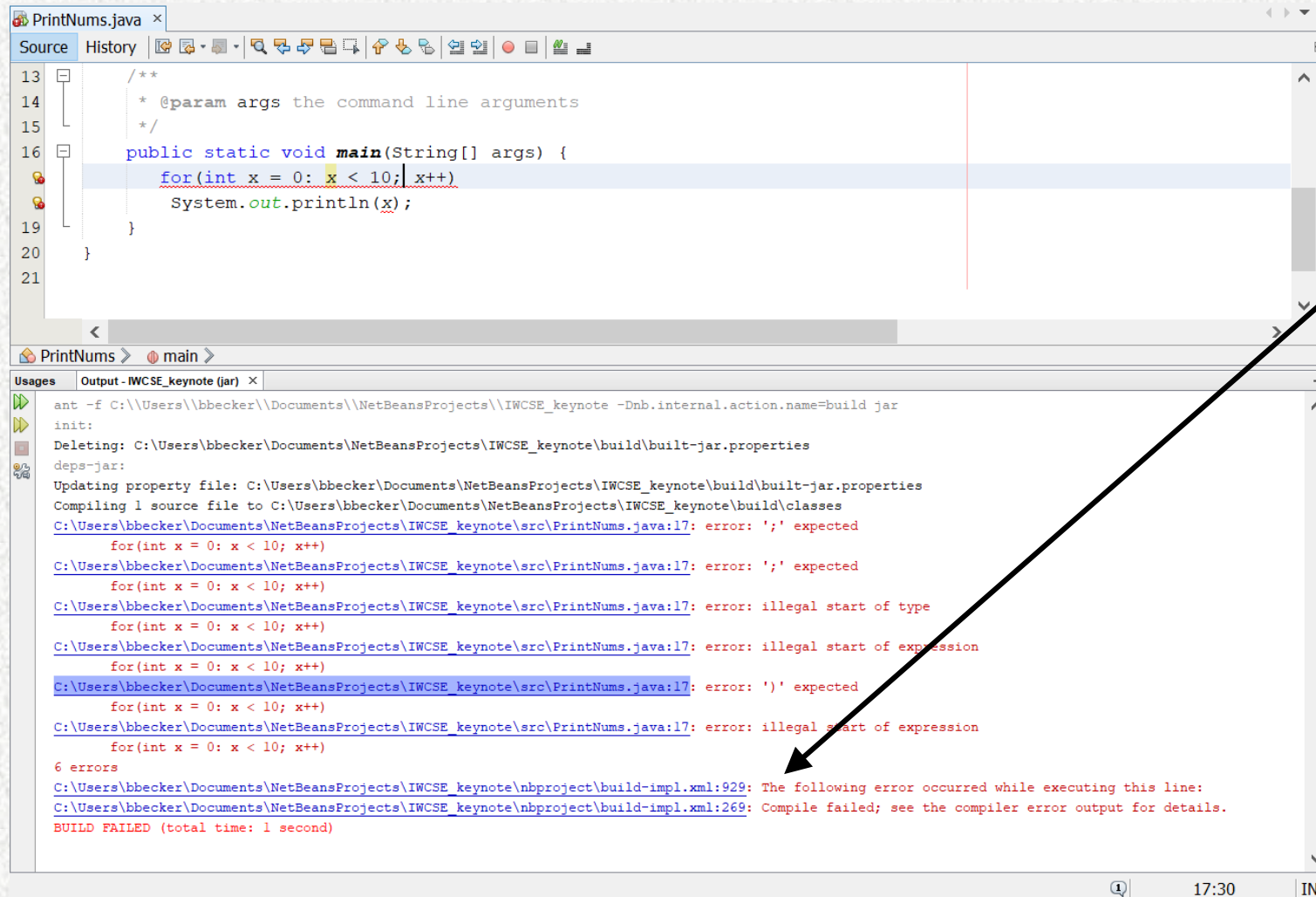
```
13  /**
14   * @param args the command line arguments
15   */
16  public static void main(String[] args) {
17      for(int x = 0; x < 10; x++)
18          system.out.println(x);
19  }
20  }
21
```

The line `for(int x = 0; x < 10; x++)` is highlighted in blue. Below the code editor, the console window shows the output of the build process, including several compilation errors:

```
ant -f C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote -Dnb.internal.action.name=build jar
init:
Deleting: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
deps-jar:
Updating property file: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
Compiling 1 source file to C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\classes
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of type
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ')' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
6 errors
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:929: The following error occurred while executing this line:
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:269: Compile failed; see the compiler error output for details.
BUILD FAILED (total time: 1 second)
```

Clicking what looks to be a link highlights the “link” in blue and moves the cursor in the edit window
So, not really a link...

Netbeans (with error)



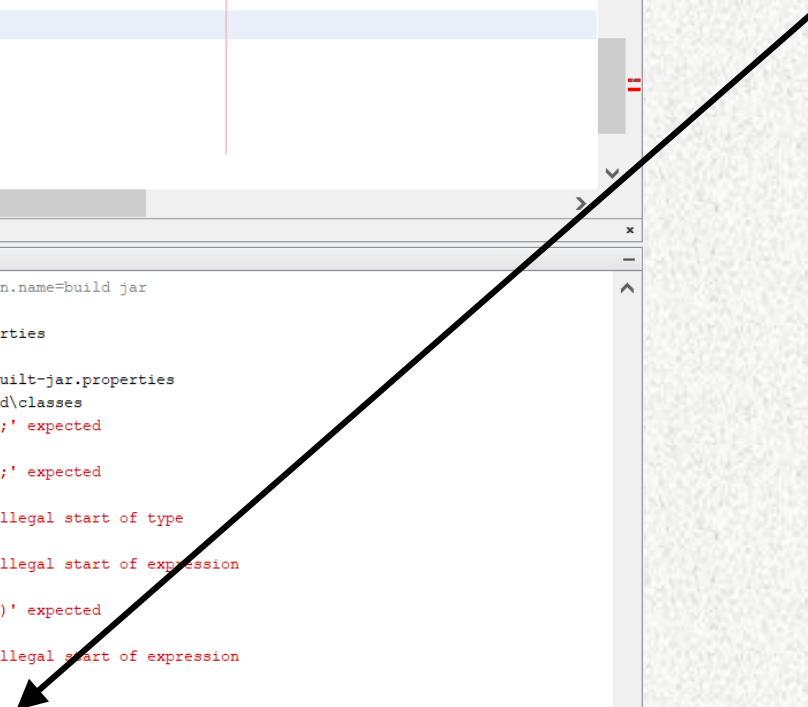
The screenshot shows the NetBeans IDE with a Java file named `PrintNums.java` open. The code in the editor is as follows:

```
13  /**
14   * @param args the command line arguments
15   */
16  public static void main(String[] args) {
17      for(int x = 0; x < 10; x++)
18          system.out.println(x);
19  }
20  }
21
```

The output console at the bottom shows the following error messages:

```
ant -f C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote -Dnb.internal.action.name=build jar
init:
Deleting: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
deps-jar:
Updating property file: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
Compiling 1 source file to C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\classes
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of type
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ')' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
6 errors
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:929: The following error occurred while executing this line:
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:269: Compile failed; see the compiler error output for details.
BUILD FAILED (total time: 1 second)
```

What about the links at the bottom?



Netbeans (with error)

```
264 <element name="customize" optional="true"/>
265 <sequential>
266 <property location="${build.dir}/empty" name="empty.dir"/>
267 <mkdir dir="${empty.dir}"/>
268 <mkdir dir="@{apgeneratedsrcdir}"/>
269 <javac debug="@{debug}" deprecation="${javac.deprecation}" destdir="@{destdir}" encoding="$+
270 <src>
271 <dirset dir="@{gensrcdir}" erroronmissingdir="false">
272 <include name="**"/>
273 </dirset>
274 </src>
275 <classpath>
276 <path path="@{classpath}"/>
277 </classpath>
278 <compilerarg line="${endorsed.classpath.cmd.line.arg}"/>
279 <compilerarg line="${javac.profile.cmd.line.arg}"/>
280 <compilerarg line="${javac.compilerargs}"/>
281 <compilerarg value="-processorpath"/>
282 <compilerarg path="@{processorpath}:${empty.dir}"/>
283 <compilerarg line="${ap.processors.internal}"/>
284 <compilerarg line="${annotation.processing.processor.options}"/>
285 <compilerarg value="-s"/>
286 <compilerarg path="@{apgeneratedsrcdir}"/>
287 <compilerarg line="${ap.proc.none.internal}"/>
288 <customize/>
289 </javac>
290 </sequential>
291 </macrodef>
292 </target>
```

project > target > macrodef > sequential

Usages Output - IWCSE_keynote (jar) x

>> ant -f C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote -Dnb.internal.action.name=build jar

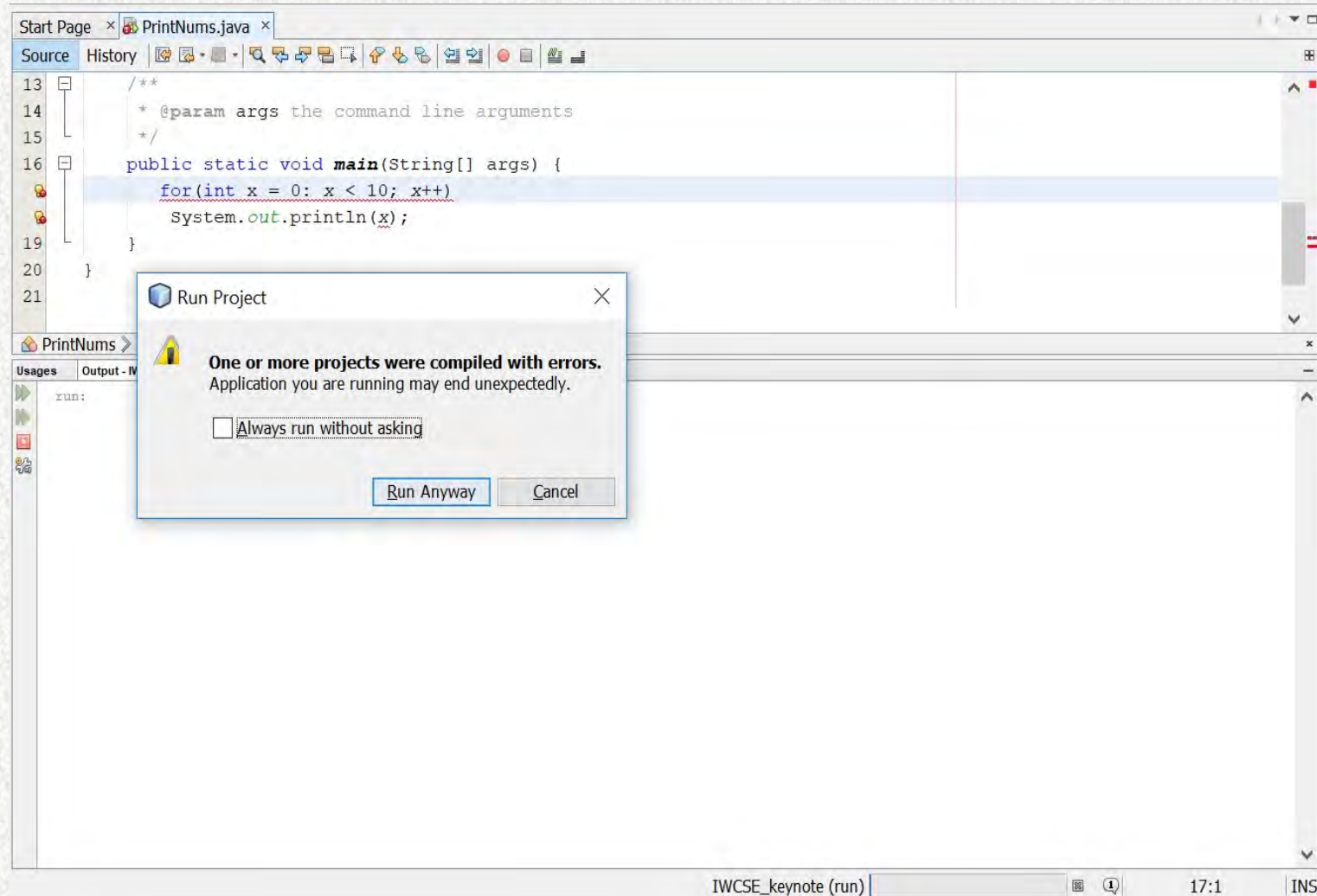
269:1 INS

Oh.

That did not help.

I guess I'll close
that window...

Netbeans (with error)

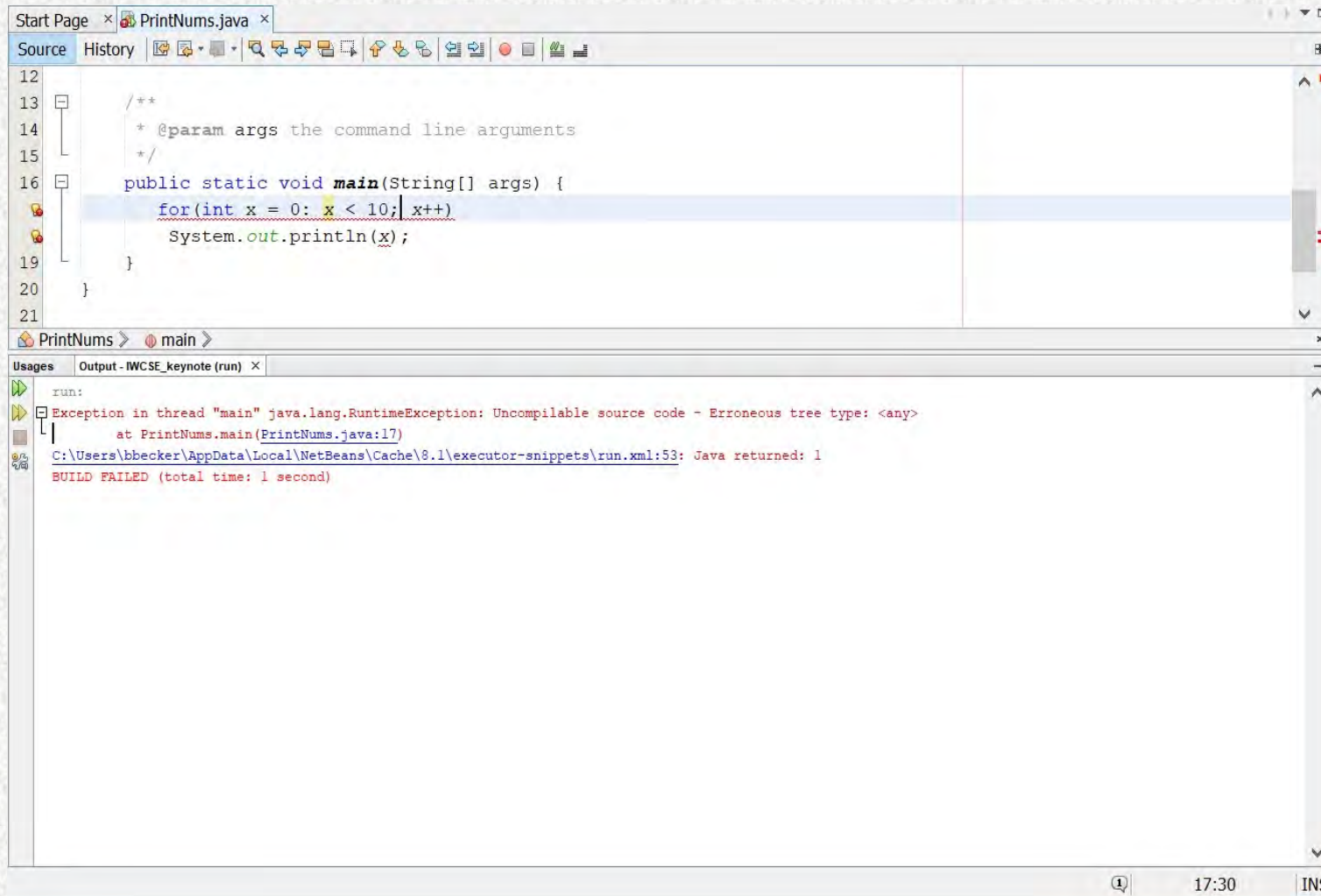


Clicking run gives us a warning window

Maybe then, the error doesn't matter?

Maybe my code will work anyway...?

Netbeans (with error)



```
12
13
14  /**
15   * @param args the command line arguments
16   */
17  public static void main(String[] args) {
18      for(int x = 0; x < 10; x++)
19          System.out.println(x);
20  }
21
```

PrintNums > main >

Output - IWCSE_keynote (run) x

```
run:
Exception in thread "main" java.lang.RuntimeException: Uncompilable source code - Erroneous tree type: <any>
    at PrintNums.main(PrintNums.java:17)
C:\Users\bbecker\AppData\Local\NetBeans\Cache\8.1\executor-snippets\run.xml:53: Java returned: 1
BUILD FAILED (total time: 1 second)
```

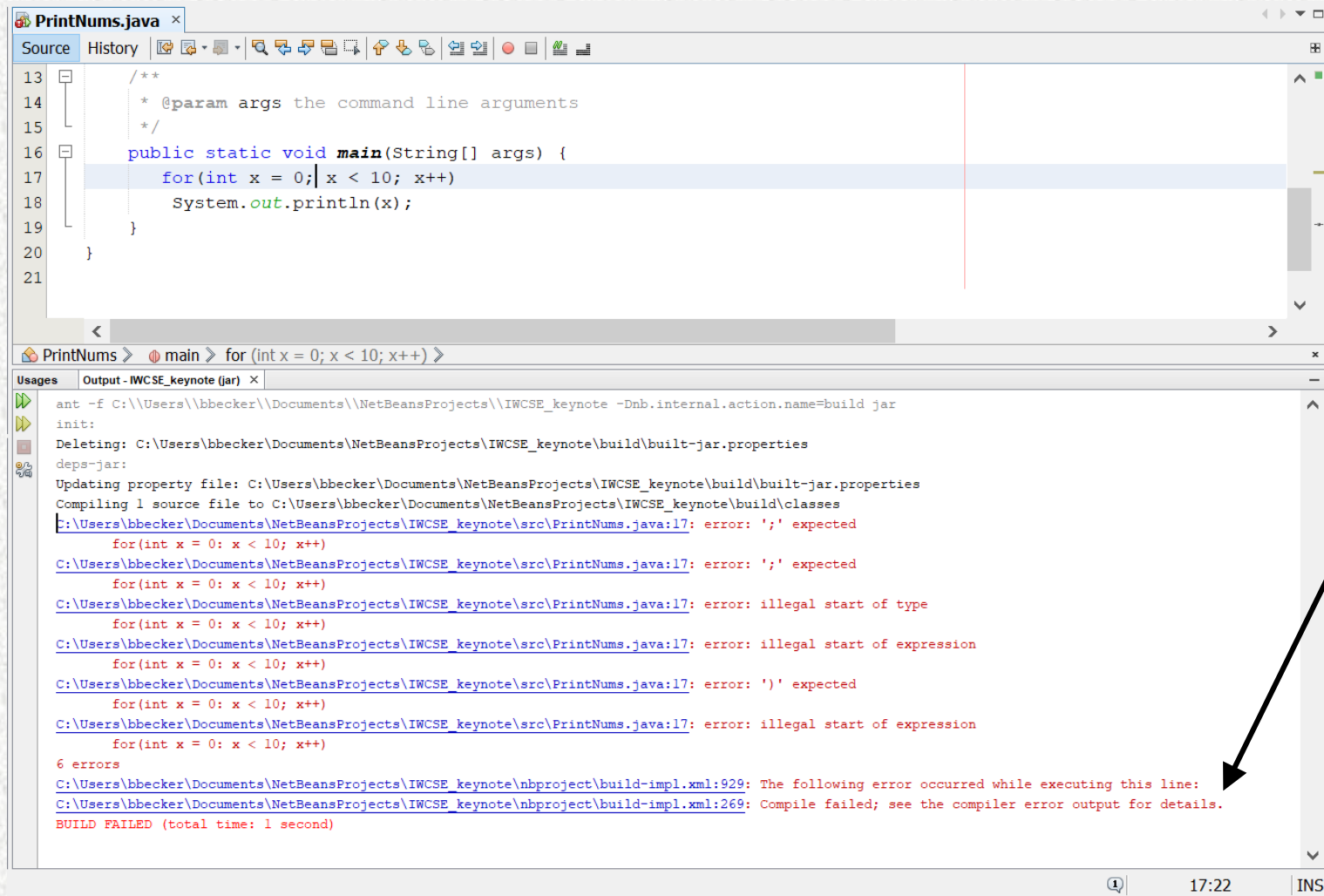
17:30 INS

I guess not

Clicking *Run Anyway* gives us this

Clicking compile again brings us back to where we were

Netbeans (error fixed)



The screenshot shows the NetBeans IDE interface. The top window displays the source code for `PrintNums.java`. The code is as follows:

```
13  /**
14   * @param args the command line arguments
15   */
16  public static void main(String[] args) {
17      for(int x = 0; x < 10; x++)
18          System.out.println(x);
19  }
20  }
21
```

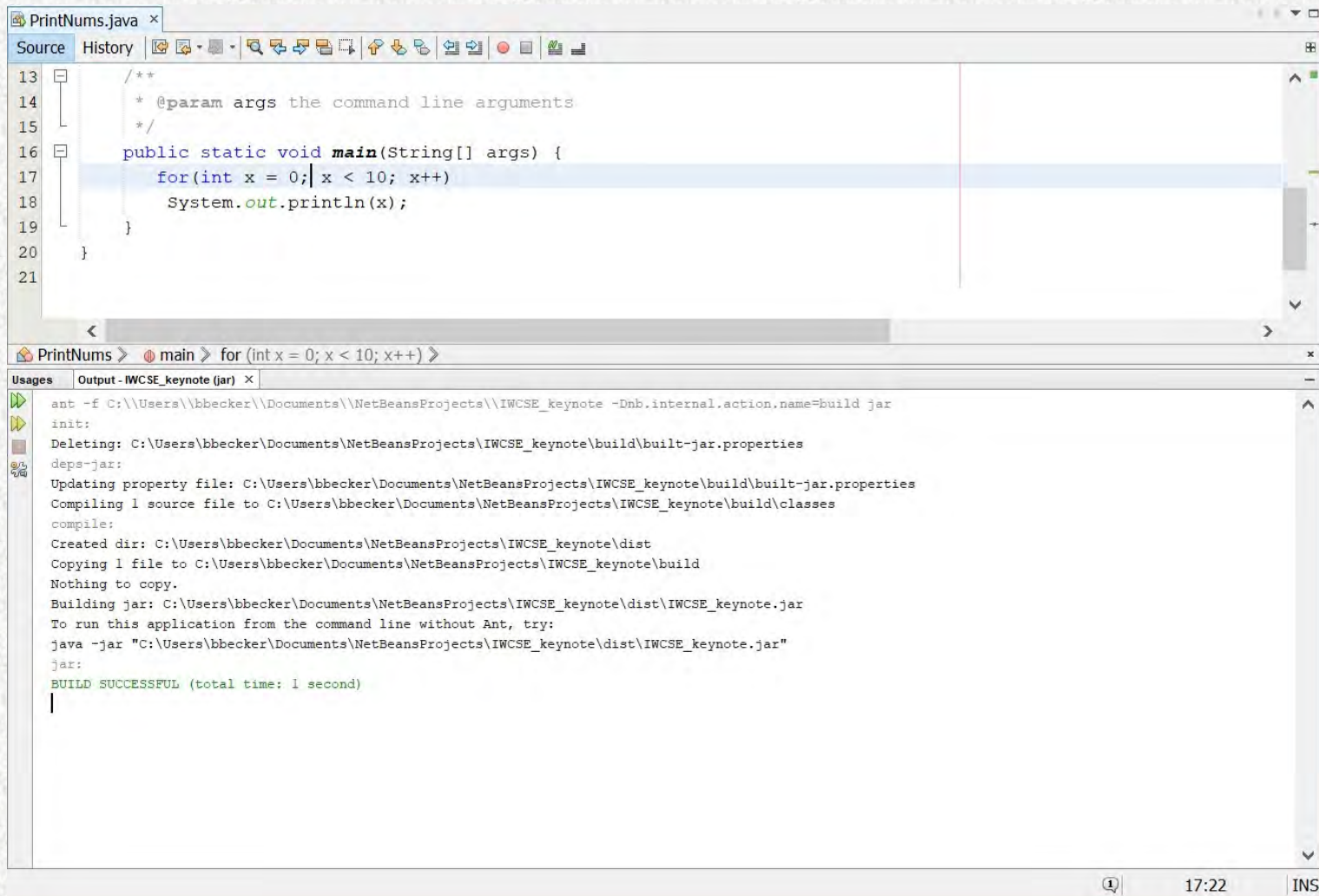
The bottom window shows the output of an Ant build process. The output includes several compiler error messages:

```
ant -f C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote -Dnb.internal.action.name=build jar
init:
Deleting: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
deps-jar:
Updating property file: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
Compiling 1 source file to C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\classes
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ';' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of type
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: ')' expected
    for(int x = 0; x < 10; x++)
                        ^
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\src\PrintNums.java:17: error: illegal start of expression
    for(int x = 0; x < 10; x++)
                        ^
6 errors
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:929: The following error occurred while executing this line:
C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\nbproject\build-impl.xml:269: Compile failed; see the compiler error output for details.
BUILD FAILED (total time: 1 second)
```

When error is fixed:

- Lightbulbs disappear
- Underlining disappears
- Red margin lines disappear
- Messages in output window persist
- This says “**compile failed; see the compiler error output for details**”
- Uh. What is this then? I thought **this was** the compiler error output
- And, I thought my code was fixed...

Netbeans (error fixed)



The screenshot shows the NetBeans IDE interface. The top window displays the source code for `PrintNums.java`. The code is as follows:

```
13  /**
14   * @param args the command line arguments
15   */
16  public static void main(String[] args) {
17      for(int x = 0; x < 10; x++)
18          System.out.println(x);
19  }
20  }
21
```

The bottom window shows the output of the compilation process:

```
ant -f C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote -Dnb.internal.action.name=build jar
init:
Deleting: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
deps-jar:
Updating property file: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\build-jar.properties
Compiling 1 source file to C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build\classes
compile:
Created dir: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\dist
Copying 1 file to C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\build
Nothing to copy.
Building jar: C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\dist\IWCSE_keynote.jar
To run this application from the command line without Ant, try:
java -jar "C:\Users\bbecker\Documents\NetBeansProjects\IWCSE_keynote\dist\IWCSE_keynote.jar"
jar:
BUILD SUCCESSFUL (total time: 1 second)
```



Clicking compile finally brings me to something that looks good!

Recap

- One short program, one syntax error, 5 environments
- We observed
 - Up to six error messages
 - but, sometimes one, and sometimes none (even when there were errors)
 - Artefacts directly related to this error
 - Behaviours directly related to this error
 - Other artifacts & behaviours, some less related to the error / more general

Artefacts related to the error (I think)

We saw:

- Lone messages
 - Long lists of messages
 - Nothing
 - Text-based 'output' messages (shown in separate window in IDEs)
 - "First" messages ("Shown", in BlueJ/Blackbox terminology)
 - Several "subsequent" messages
 - Underlining (red-squiggles)
 - Mysterious red lines| in the middle of lines of code|
 - Whole lines of code highlighted in red
 - Partial lines of code highlighted in red
 - Whole lines of code highlighted in yellow
 - Whole lines of text highlighted in blue
- Vertical red markers in left margin
 - Horizontal and square markers in right margin 
 - Lightbulbs 
 - Windows that appear on hover and disappear without allowing us to see what seems to be missing text
 - Windows with suggestions that would not fix the problem
 - A red cursor |
 - Red text
 - Black text
 - Green text
 - Grey text
 - Blue text links
 - Blue text that looks like a link but isn't

Behaviours related to the error

- Presentation of long lists of errors
 - Some of which are not *really* errors (at least not from the student's view)
- Message filtering - presentation of the first text-based message only
- At least three styles of pop-up windows with text
 - 'Static' windows that come and go with clicks
 - Some of that text seemingly wrong (and not in the javac output)
 - 'Semi-Transient' windows with text that came and went when 'compile' was clicked
 - These rotated in round-robin fashion
 - Transient windows that disappear when you try to interact with them
- Hyperlinks that pointed out errors in the code
 - Many that weren't real errors
- Hyperlinks that took me to XML code
- Suggestions that broke my code more than it was already
- The ability to execute code that wouldn't compile
- More...

Other artefacts & behaviours

- Syntax highlighting
- Bracket matching (which actually had me confused at one point)
- ‘Background’ compilation and ‘click-to-compile’
- The word “error” on multiple occasions which in many cases wasn’t a real error
- The words “**FAILED**”, “illegal” and “Terminated”*
- All kinds of skeleton code that a novice might not understand
 - In both the professional and pedagogical IDEs
- Mixing of automatic behaviour and behaviour requiring user input
- More...

*which, apparently, was part of a GOOD message

Four ways of indicating success with text

1. BUILD SUCCESSFUL (total time: 1 second)
2. Class compiled – no syntax errors
3. Process Terminated with no errors
- 4.

Number 4 is literally, nothing. That is what javac (at the command line) told me when the compilation was successful:

```
C:\Users\bbecker\Desktop\Junk>javac PrintNums.java  
C:\Users\bbecker\Desktop\Junk>_
```

Would you be confused if you were a beginner?



What are the effects of these artefacts and behaviours?

- How are students learning to program, possibly for the first time, supposed to navigate this, on top of learning:
 - the language
 - the environment (hopefully with the goal of adapting to other environments)
 - how to adhere to good practice / convention (indenting, variable naming, commenting, etc.)
 - problem solving
 - etc.
- ...and, maintaining momentum, desire, and the attitude to persevere

What I did not discuss and could be even more fundamental

1. The readability of error messages is not well studied

```
PrintNums.java:3: error: ';' expected
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: ';' expected
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: illegal start of type
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: illegal start of expression
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: ')' expected
    for(int x = 0: x < 10; x++)
                   ^
PrintNums.java:3: error: illegal start of expression
    for(int x = 0: x < 10; x++)
                   ^
```

Barik, 2018: <https://repository.lib.ncsu.edu/bitstream/handle/1840.20/35439/etd.pdf?sequence=1>

Becker et al. 2019 ITiCSE working group: <https://cszero.wordpress.com/2019/02/11/1826/>

What I did not discuss and could be even more fundamental

- 2. What happens (psychologically and metacognitively) with these negative words?** Especially when coupled with instantaneous feedback from a machine that a student might think can never be wrong, because they were probably told that, or given that impression...

Process Terminated
with no errors

BUILD

FAILED

De Lira, 2017: <https://dl.acm.org/citation.cfm?id=3105726.3105742>

Prather et al.: <https://dl.acm.org/citation.cfm?id=3106169>

What I did not discuss and could be even more fundamental

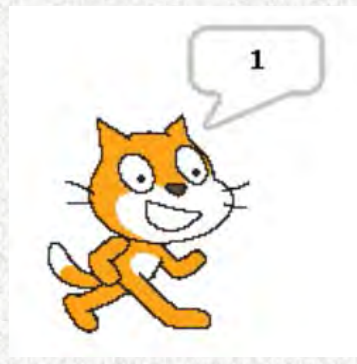
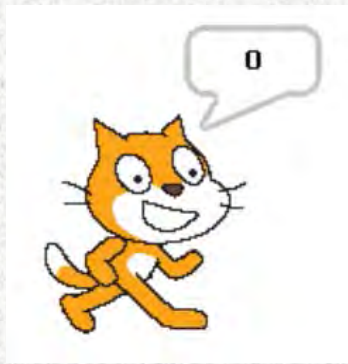
3. How are non-native English speakers, and non-English speakers impacted by this?

Illegal start of expression

- We already know that problem presentation can affect students, even when they are native speakers of English, and in particular if they are not
- Why would messages from an interface be any different?

What I did not discuss and could be even more fundamental

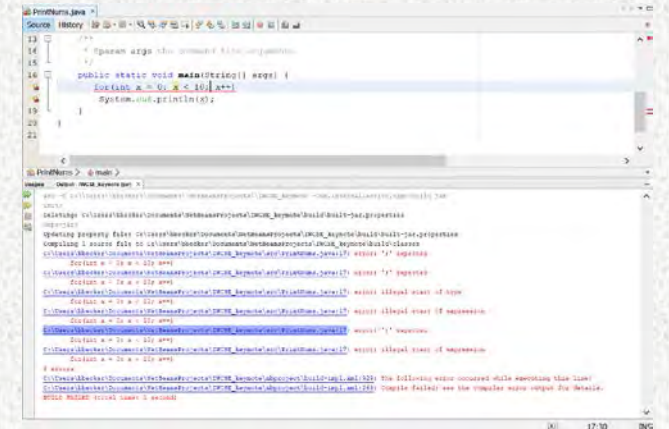
4. How do students that learned to program with block-based languages transition to these environments?



...



?



What I did not discuss and could be even more fundamental

5. **What about pedagogy?**

- We take feedback seriously in the classroom
- Shouldn't the feedback that environments provide be backed by sound pedagogical principles?

A few resources

Available at www.brettbecker.com/talks-panels-etc/

- Slides
- References mentioned here, and others related to this topic

Questions?