**Exercise Question:** Now, introduce the following method definitions to the Complex class seen above, and then use javap to disassemble the compiled bytecode (.class) file.

public Complex plus(Complex b){  
    Complex a = this;  
    double real = a.re + b.re;  
    double imag = a.im + b.im;  
 return new Complex(real, imag);  
}  
  
public static void main(String[] args){  
 Complex a = new Complex(5.0, 6.0);  
 Complex b = new Complex(-3.0, 4.0);  
    System.out.println(”a + b = ” + a.plus(b));  
}

* How many local variables are created in the stack frame of **plus** method? List all of them and mention their slot numbers as well as data types.
* Which instructions in the bytecode for **plus** method correspond to the Java source code?
* What is the purpose of invokespecial instruction in the bytecode of **plus** method?

public Complex plus(Complex);

Code:

0: aload\_0

1: astore\_2

2: aload\_2

3: getfield #2 // Field re:D

6: aload\_1

7: getfield #2 // Field re:D

10: dadd

11: dstore\_3

12: aload\_2

13: getfield #3 // Field im:D

16: aload\_1

17: getfield #3 // Field im:D

20: dadd

21: dstore 5

23: new #4 // class Complex

26: dup

27: dload\_3

28: dload 5

30: invokespecial #5 // Method "<init>":(DD)V

33: areturn

LineNumberTable:

line 12: 0

line 13: 2

line 14: 12

line 15: 23

How many local variables are created in the stack frame of **plus** method? List all of them and mention their slot numbers as well as data types.

There are 5 Local Variables.

|  |  |
| --- | --- |
| 0 | “this” |
| 1 | Complex b |
| 2 | Complex a |
| 3 | double real |
| 5 | double imag |

Which instructions in the bytecode for **plus** method correspond to the Java source code?

|  |  |
| --- | --- |
| public Complex plus(Complex b){     Complex a = this;     double real = a.re + b.re;     double imag = a.im + b.im;  return new Complex(real, imag); } |  |
| Complex a = this; | 0: aload\_0  1: astore\_2  2: aload\_2 |
| double real = a.re + b.re; | 2: aload\_2  3: getfield #2 // Field re:D  6: aload\_1  7: getfield #2 // Field re:D  10: dadd  11: dstore\_3 |
| double imag = a.im + b.im; | 12: aload\_2  13: getfield #3 // Field im:D  16: aload\_1  17: getfield #3 // Field im:D  20: dadd  21: dstore 5 |
| return new Complex(real, imag); | 23: new #4 // class Complex  26: dup  27: dload\_3  28: dload 5  30: invokespecial //Method"<init>":(DD)V  33: areturn |