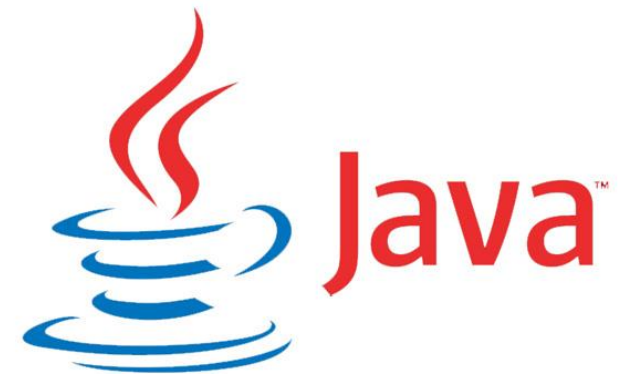


Pengantar Pemrograman dengan Bahasa Java

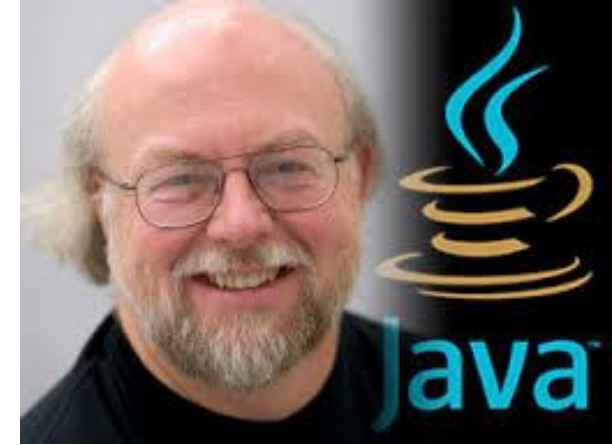
IF2123 Aljabar Geometri

Oleh: Rinaldi Munir



Sekolah Teknik Elektro dan Informatika
ITB

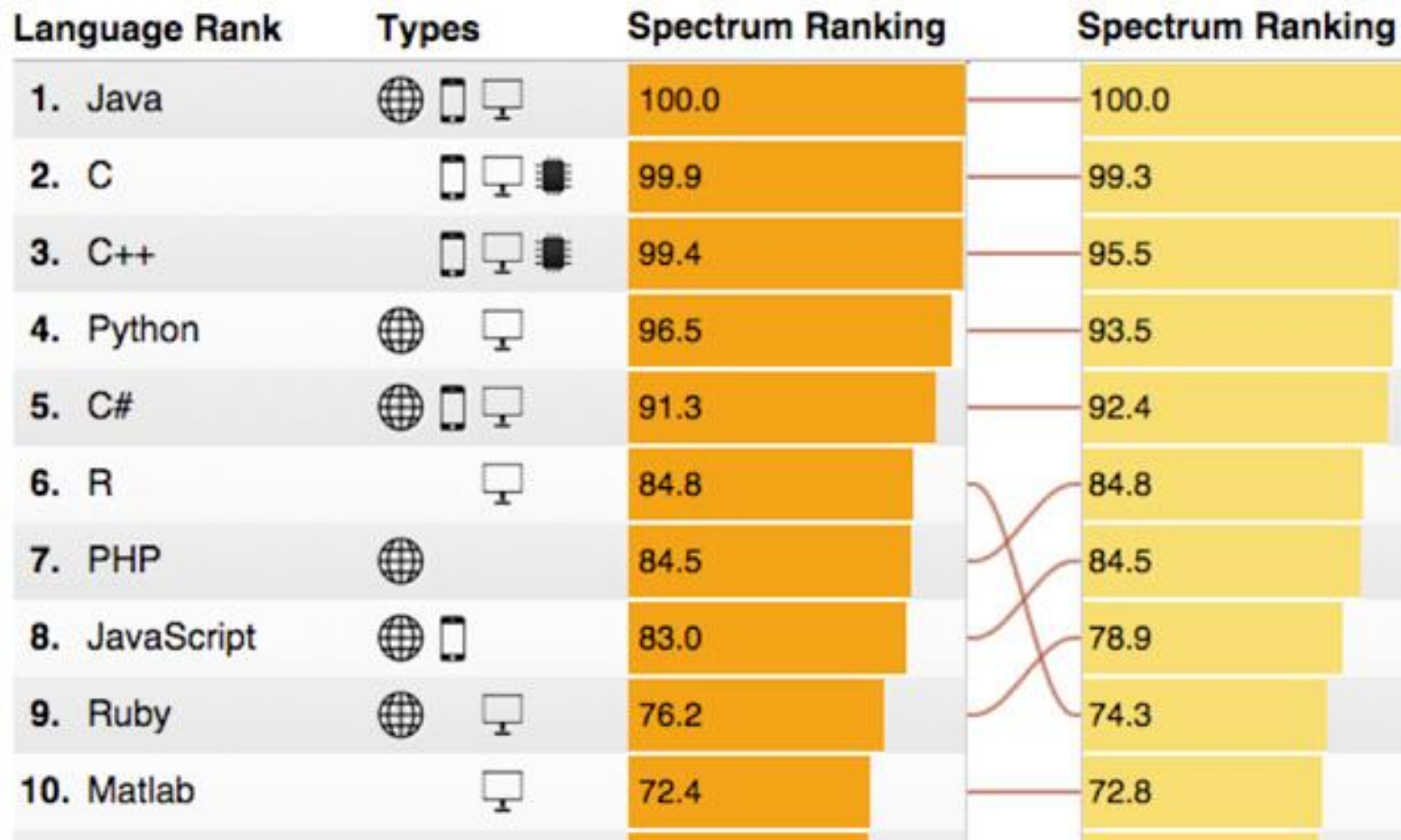
Sejarah Bahasa Java



James Gosling

- Bahasa java dibuat oleh James Gosling saat masih bergabung di *Sun Microsystems* dan dirilis tahun 1995.
- Bahasa Java dapat dijalankan pada berbagai komputer dan *platform* sistem operasi.
- Slogan Java: *Write once, run anywhere!* (Tulis sekali, jalankan di manapun)
- Java adalah bahasa pemrograman bersifat umum (*general purpose*)
- Sintaks Bahasa Java diadopsi dari Bahasa C dan C++ tetapi lebih sederhana
- Nama “java” diambil dari jenis kopi yang diminum oleh James Gosling saat itu.

- Java termasuk Bahasa pemrograman yang populer untuk mengembangkan aplikasi, termasuk aplikasi berbasis web.








Gambar 1. Sepuluh (10) bahasa pemrograman top 2015:

- Pada tahun 2017, Bahasa Java turun ke peringkat 3

Language Rank	Types	Spectrum Ranking
1. Python	 	100.0
2. C	  	99.7
3. Java	  	99.5
4. C++	  	97.1
5. C#	  	87.7
6. R		87.7
7. JavaScript	 	85.6
8. PHP		81.2
9. Go	 	75.1
10. Swift	 	73.7

Gambar 2. Sepuluh (10) bahasa pemrograman top 2017

- 2018

Language Rank	Types	Spectrum Ranking
1. Python	  	100.0
2. C++	  	99.7
3. Java	  	97.5
4. C	  	96.7
5. C#	  	89.4
6. PHP		84.9
7. R		82.9
8. JavaScript	 	82.6
9. Go	 	76.4
10. Assembly		74.1

Gambar 3. Sepuluh (10) bahasa pemrograman top 2018

IEEE Ranked the Top Programming Languages of 2019.

2019

Rank	Language	Type	Score
1	Python	  	100.0
2	Java	  	96.3
3	C	  	94.4
4	C++	  	87.5
5	R		81.5
6	JavaScript		79.4
7	C#	   	74.5
8	Matlab		70.6
9	Swift	 	69.1
10	Go	 	68.0

Sumber:

<https://learnworthy.net/ieee-ranked-the-top-programming-languages-of-2019/>

2020

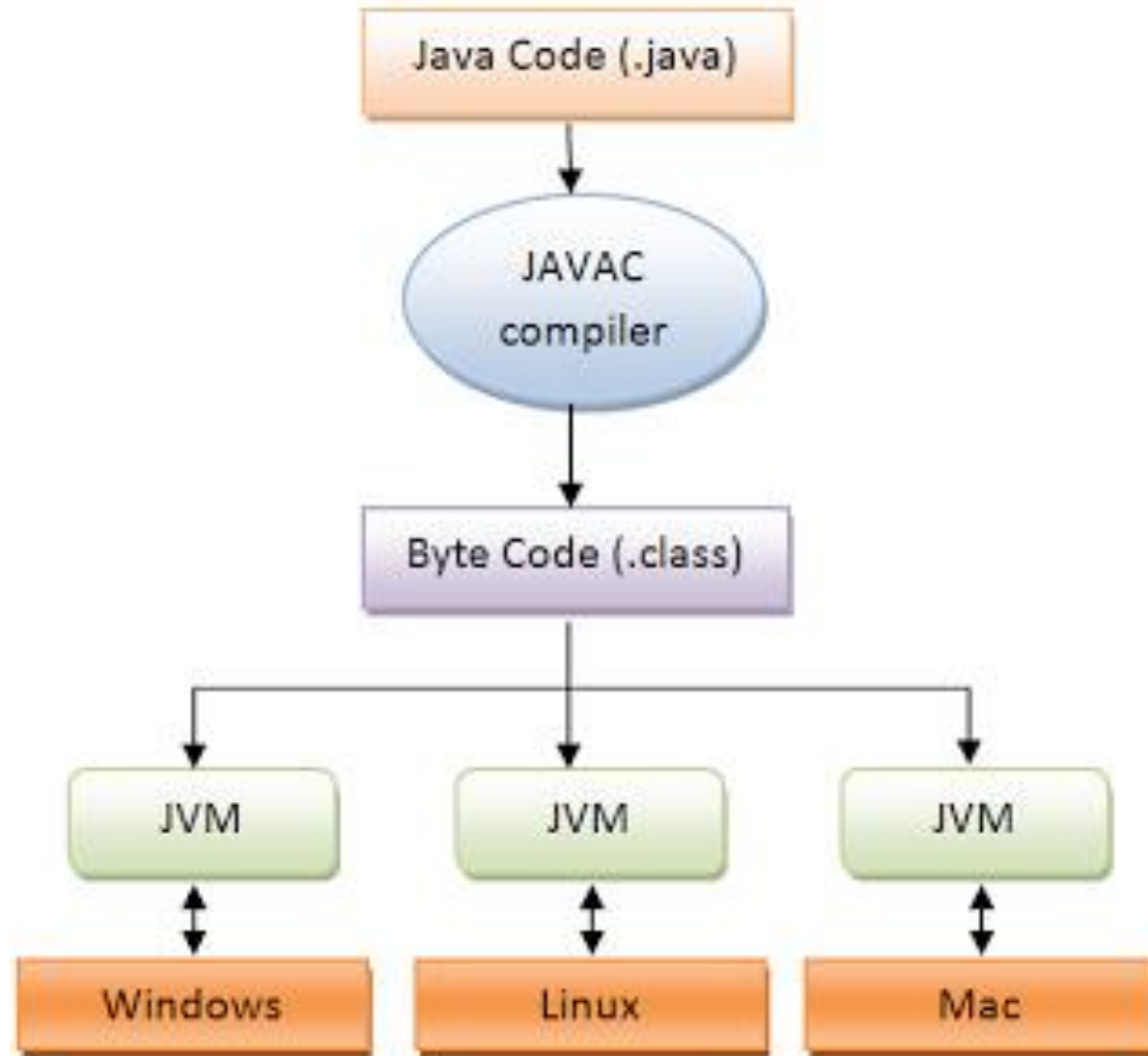
IEEE Ranked the Top Programming Languages of 2020

Rank	Language	Type	Score
1	Python ▾	  	100.0
2	Java ▾	  	95.3
3	C ▾	  	94.6
4	C++ ▾	  	87.0
5	JavaScript ▾		79.5
6	R ▾		78.6
7	Arduino ▾		73.2
8	Go ▾	 	73.1
9	Swift ▾	 	70.5
10	Matlab ▾		68.4

Teknologi Java = Bahasa pemrograman + platform

Java Sebagai Bahasa Pemrograman

- Bahasa java memiliki karakteristik: *sederhana, berorientasi objek, interpreted, terdistribusi, tangguh, portable, memiliki kinerja tinggi, aman, dinamis*. (Baca di: <http://java.sun.com/docs/white/langenv/>)
- *Compiler* java mengubah kode program menjadi bahasa *intermediate* yang disebut *java bytecode*. Kemudian *interpreter* Java bernama JVM (*Java Virtual Machine*) melakukan interpretasi *bytecode* setiap kali *bytecode* tersebut dijalankan.



Gambar 2. Proses kompilasi dan interpretasi program Java
(Sumber gambar: <http://belajarjava-19.blogspot.co.id>)

Java Sebagai Sebuah *Platform*

- *Platform* adalah lingkungan perangkat keras dan perangkat lunak untuk menjalankan program.
- Java adalah *platform* perangkat lunak untuk menjalankan program java.
- *Platform* java terdiri dari dua komponen:
 1. *Java Virtual Machine* (JVM)
 2. *Java Application Programming Interface* (Java API)
- JVM pada dasarnya adalah aplikasi sederhana yang ditulis dalam bahasa C untuk mengeksekusi program yang ditulis dalam bahasa Java.

- Cara kerja JVM: Pada saat eksekusi, JVM membaca *bytecode*, lalu mengubahnya ke bahasa mesin yang sesuai dengan komputer yang menjalankannya.
- Proses kompilasi bahasa java menghasilkan *bytecode* yang selalu sama untuk setiap sistem operasi atau jenis mesinnya, tetapi JVM akan mengubah *bytecode* menjadi bahasa mesin tujuannya.
- Java API merupakan *library* yang disediakan java untuk mengembangkan program java. Java API berisi sekumpulan komponen perangkat lunak yang memudahkan pemrogram java mengembangkan aplikasi.

Kakas Java

Untuk menulis program java, diperlukan beberapa kakas:

1. *Java Development Kit (JDK)*

Unduh paket JDK (*Java Development Kit*) java terbaru dari situs:


<https://www.oracle.com/java/technologies/javase/javase-jdk8-downloads.html>

atau <https://www.java.com/en/download/>


2. Editor teks

Sembarang editor teks seperti *Notepad*, *Ultraedit*, *Wordpad*, *Vi*, atau *Joe*

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Thank you for downloading this release of the Java™ Platform, Standard Edition Development Kit (JDK™). The JDK is a development environment for building applications, applets, and components using the Java programming language.

The JDK includes tools useful for developing and testing programs written in the Java programming language and running on the Java platform.








Important Oracle JDK License Update

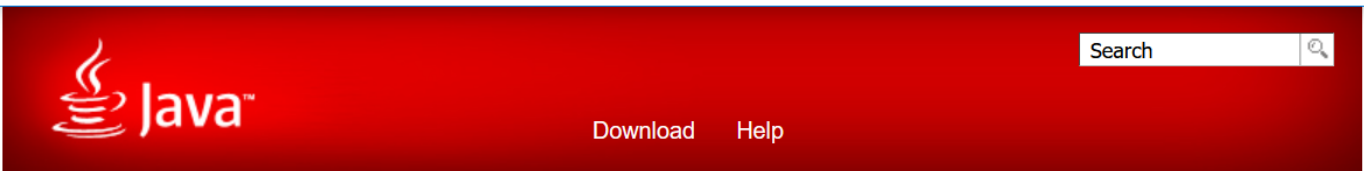
The Oracle JDK License has changed for releases starting April 16, 2019.

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Linux ARM 32 Hard Float ABI	73.4 MB	 jdk-8u261-linux-arm32-vfp-hflt.tar.gz
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Linux x86 RPM Package	121.92 MB	 jdk-8u261-linux-i586.rpm
Linux x86 Compressed Archive	136.81 MB	 jdk-8u261-linux-i586.tar.gz
Linux x64 RPM Package	121.53 MB	 jdk-8u261-linux-x64.rpm
Linux x64 Compressed Archive	136.48 MB	 jdk-8u261-linux-x64.tar.gz
macOS x64	203.94 MB	 jdk-8u261-macosx-x64.dmg



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Commercial license and support is available with a low cost [Java SE Subscription](#).

Oracle also provides the latest OpenJDK release under the open source [GPL License](#) at [jdk.java.net](#).

Java Download

- Untuk pengembangan aplikasi visual (*visual programming*), anda membutuhkan kakas pengembangan java yang mengintegrasikan:
 - JDK
 - Editor teks
 - Editor antarmuka pengguna (GUI = *Graphical User Interface*)
 - Manajemen aplikasi
 - *Debugger*
- Contoh kakas pengembangan java: *Netbeans* dan *Eclipse*

Netbeans

The screenshot shows the NetBeans IDE interface for a project named "ECMAScript6Sales". The interface includes a menu bar (File, Edit, View, Navigate, Source, Refactor, Run, Debug, Team, Tools, Window, Help), a toolbar with various icons, and a status bar at the bottom.

The left sidebar contains a "Projects" view showing the project structure:

- ECMAScript6Sales
 - Site Root
 - js
 - gen
 - authenticator.js
 - buyer.js
 - main.js
 - thing.js
 - src
 - authenticator.js
 - buyer.js
 - main.js
 - thing.js
 - bundle.js
 - index.html
 - Unit Tests
 - Important Files
 - package.json
 - npm Libraries
 - babel-cli
 - babel-preset-es2015
 - webpack

The main editor area displays three JavaScript files:

- buyer.js** (lines 1-20):

```
1  /**
2  * Buyer for obtaining Thing
3  * for an authenticated name.
4  * @param {type} name
5  * @returns {undefined}
6  */
7  import { verifyName } from './authenticator';
8  import { sendThing } from './thing';
9  import { sendApology } from './thing';
10
11  export function buyThing(name) {
12    console.log(name + " is trying to buy");
13    var verified = verifyName(name);
14    if(verified){
15      sendThing(name);
16    } else {
17      sendApology(name);
18    }
19    return verified;
20  }
```
- main.js** (lines 1-6):

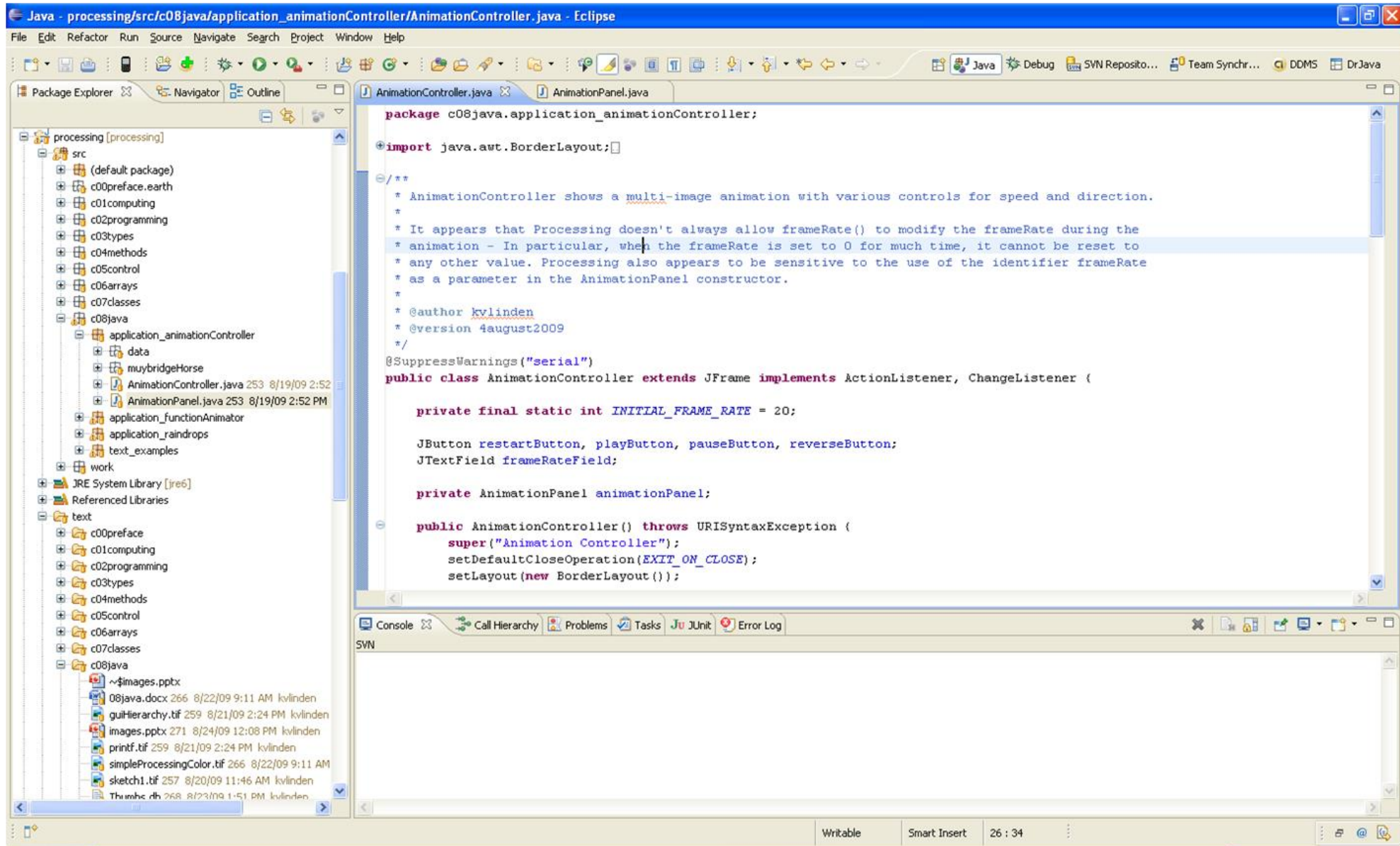
```
1  import { buyThing } from './buyer';
2
3  name = 'John Smith';
4  console.log(name + " enters the system");
5  var result = buyThing(name);
6  console.log("sale success " + result);
```
- authenticator.js** (lines 1-10):

```
1  /**
2  * Verifier for name.
3  * @param {type} name
4  * @returns {undefined}
5  */
6  export function verifyName(name) {
7    var requiredNameLength = 1;
8    console.log("authenticating " + name);
9    return name.length > requiredNameLength;
10 }
```
- thing.js** (lines 1-12):

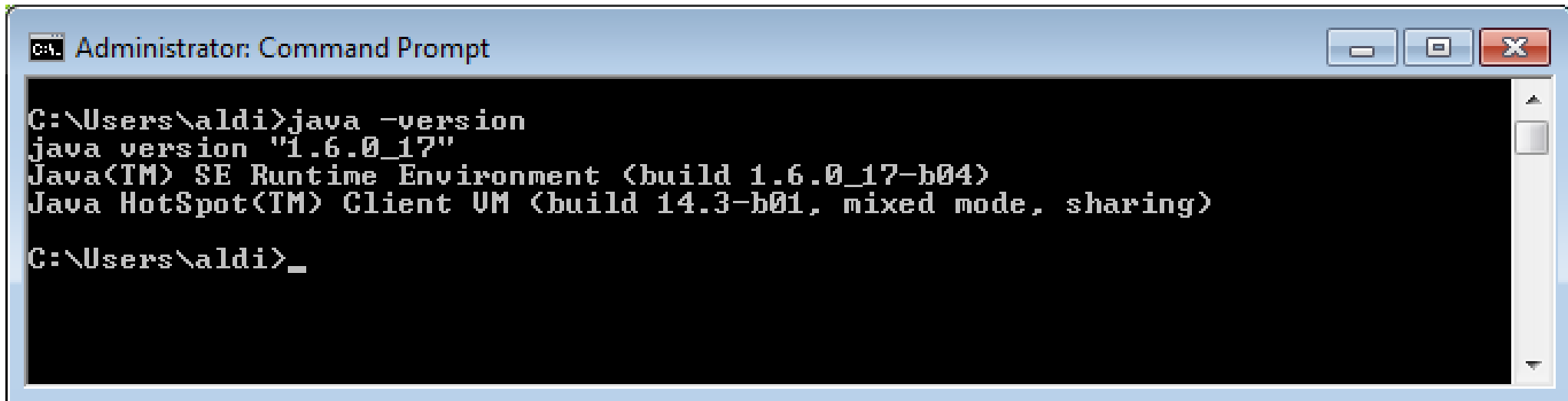
```
1  /**
2  * Send thing if authentication succeeds.
3  * @param {type} name
4  * @returns {undefined}
5  */
6  export function sendThing(name){
7    console.log("send thing to " + name);
8  }
9
10 export function sendApology(name){
11   console.log("say sorry to " + name);
12 }
```

The bottom-left "Navigator" panel shows a list of variables and functions: buyThing(name) : Boolean|undefined, sendApology, sendThing, and verifyName. The bottom-right status bar shows "9:1" and "INS".

Eclipse

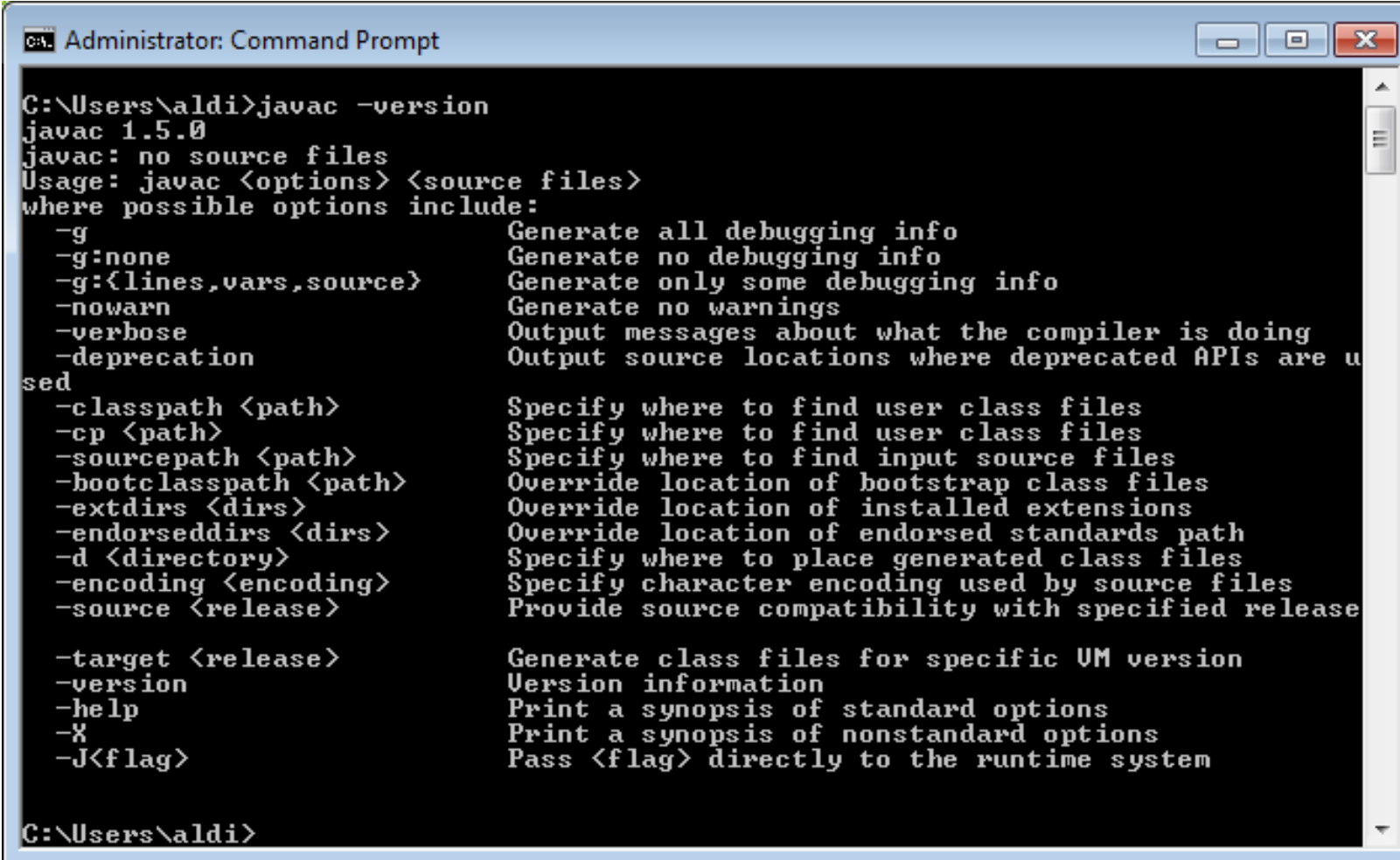


- Instalasilah JDK ke komputer anda dan ikuti semua instruksi untuk menginstalasinya.
- Aturlah nilai *environment variable* PATH melalui Control Panel > System > Advanced > Environment Variables
- Untuk mengetahui versi JRE (*java runtime environment*) yang terinstal:



```
Administrator: Command Prompt
C:\Users\aldi>java -version
java version "1.6.0_17"
Java(TM) SE Runtime Environment (build 1.6.0_17-b04)
Java HotSpot(TM) Client VM (build 14.3-b01, mixed mode, sharing)
C:\Users\aldi>_
```

- Untuk mengetahui versi JDK yang terinstal:



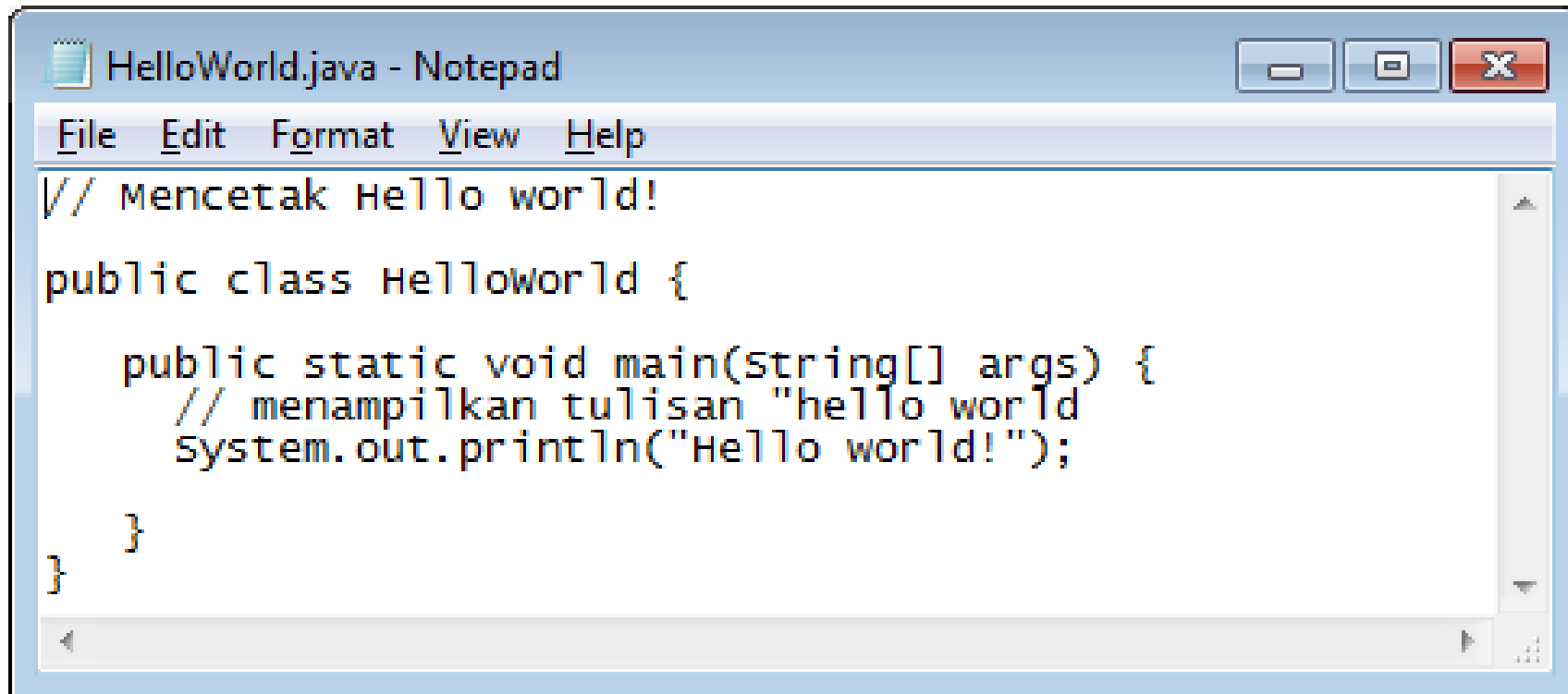
```
Administrator: Command Prompt
C:\Users\aldi>javac -version
javac 1.5.0
javac: no source files
Usage: javac <options> <source files>
where possible options include:
  -g                Generate all debugging info
  -g:none           Generate no debugging info
  -g:{lines,vars,source}  Generate only some debugging info
  -nowarn           Generate no warnings
  -verbose          Output messages about what the compiler is doing
  -deprecation      Output source locations where deprecated APIs are used
  -classpath <path> Specify where to find user class files
  -cp <path>        Specify where to find user class files
  -sourcepath <path> Specify where to find input source files
  -bootclasspath <path> Override location of bootstrap class files
  -extdirs <dirs>   Override location of installed extensions
  -endorseddirs <dirs> Override location of endorsed standards path
  -d <directory>   Specify where to place generated class files
  -encoding <encoding> Specify character encoding used by source files
  -source <release> Provide source compatibility with specified release

  -target <release> Generate class files for specific VM version
  -version          Version information
  -help            Print a synopsis of standard options
  -X               Print a synopsis of nonstandard options
  -J<flag>         Pass <flag> directly to the runtime system

C:\Users\aldi>
```

Program java-ku yang pertama

- Ketik program *HelloWorld* di bawah ini dengan editor teks, simpan dengan nama file `HelloWorld.java` (harus sama persis dengan nama class)

A screenshot of a Notepad window titled "HelloWorld.java - Notepad". The window has a menu bar with "File", "Edit", "Format", "View", and "Help". The text area contains the following Java code:

```
// Mencetak Hello world!  
  
public class Helloworld {  
  
    public static void main(string[] args) {  
        // menampilkan tulisan "hello world"  
        System.out.println("Hello world!");  
    }  
}
```

- Kompilasi program *HelloWorld* dari *command prompt*:

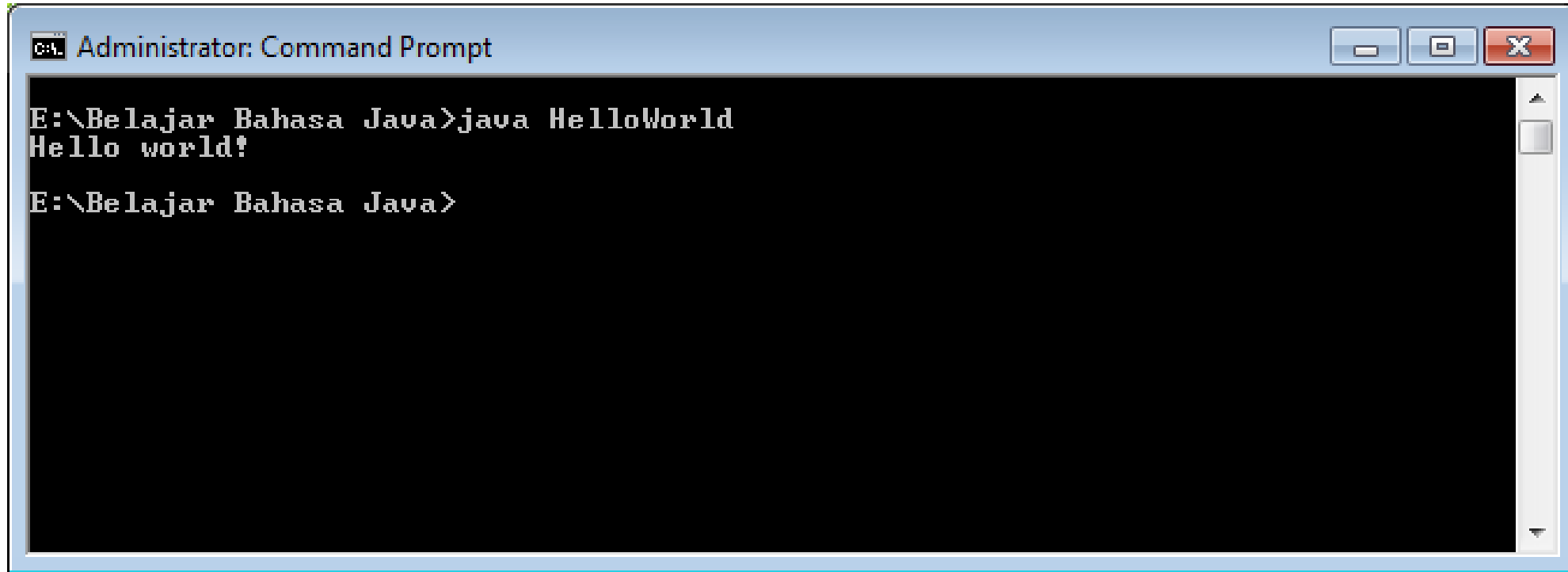


The image shows a screenshot of a Windows Command Prompt window titled "Administrator: Command Prompt". The window has a blue title bar with standard minimize, maximize, and close buttons. The main area is black with white text. The text shows the current directory as "E:\Belajar Bahasa Java" and the command "javac HelloWorld.java" being executed. The prompt returns to "E:\Belajar Bahasa Java>" after the command is run.

```
Administrator: Command Prompt
E:\Belajar Bahasa Java>javac HelloWorld.java
E:\Belajar Bahasa Java>
```

- Hasilnya sebuah arsip bernama `HelloWord.class`

- Jalankan arsip `HelloWorld.class` melalui *command prompt*:

A screenshot of a Windows Command Prompt window titled "Administrator: Command Prompt". The window has a blue title bar with standard minimize, maximize, and close buttons. The main area is black with white text. The text shows the current directory as "E:\Belajar Bahasa Java". The user has entered the command "java HelloWorld" and the output is "Hello world!". The prompt is now waiting for the next command.

```
Administrator: Command Prompt
E:\Belajar Bahasa Java>java HelloWorld
Hello world!
E:\Belajar Bahasa Java>
```

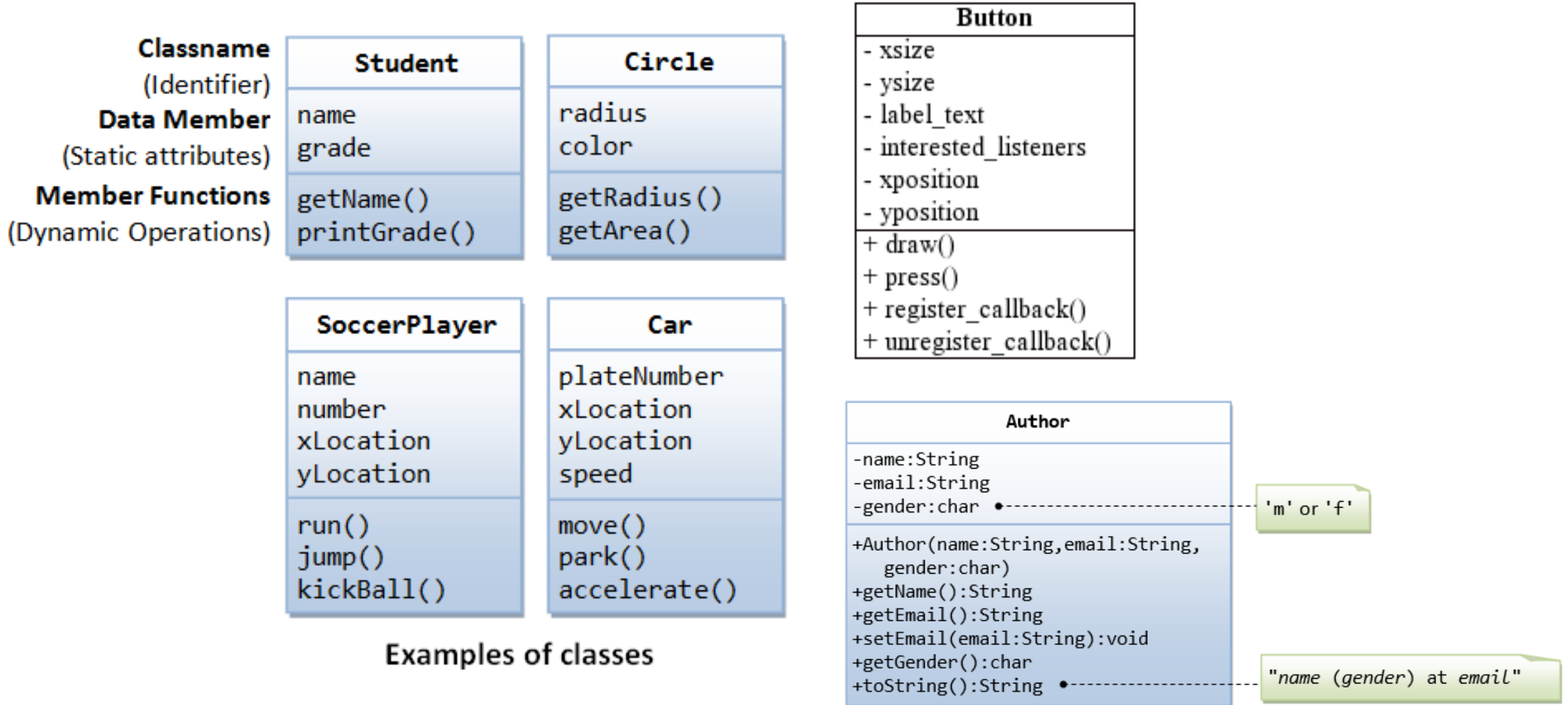
- Horeeee..., saya sudah bisa membuat program java!

Class

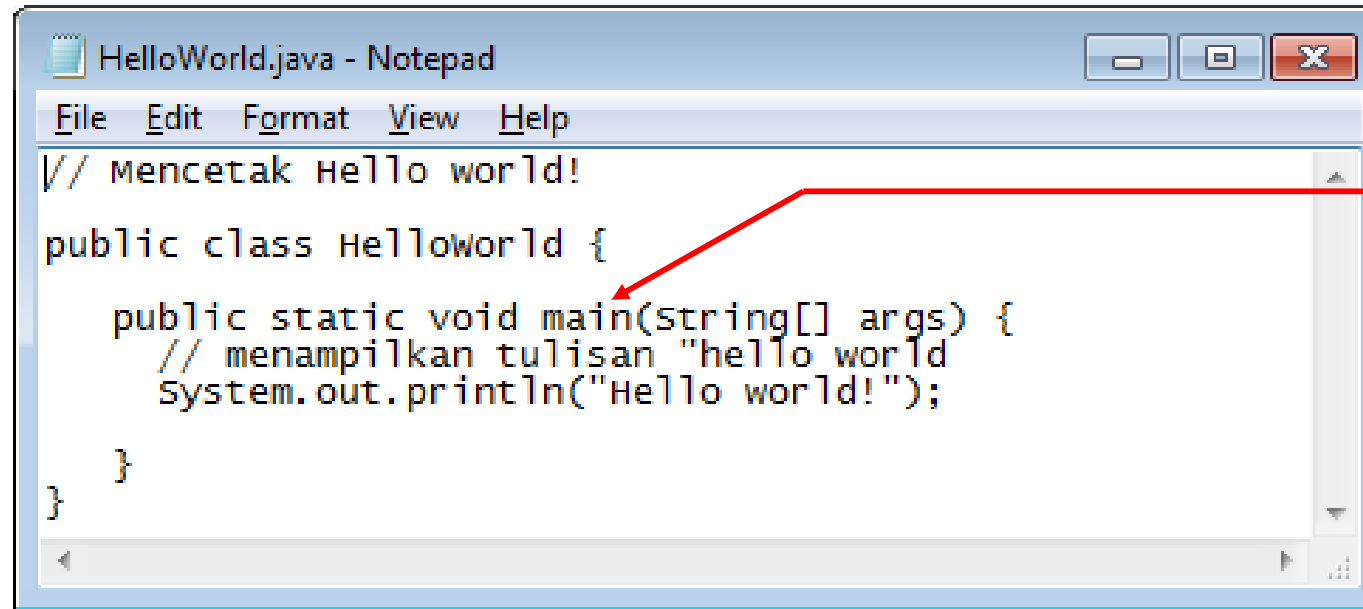
- Bahasa java adalah berorientasi objek. Struktur bahasa java terdiri dari kelas-kelas objek.
- Kelas adalah *blue-print* dari objek, sedangkan objek adalah instans dari kelas pada saat ruuning.
- Setiap kelas di dalam java memiliki *template*:

```
class NamaKelas {  
    // body kelas ditulis di sini  
}
```


- Di dalam kelas terdapat *atribut (data)* dan *method (function)*.
- Salah satu atau keduanya mungkin tidak terdapat di dalam kelas.



- Atribut di dalam kelas dinyatakan dengan variabel atau objek kelas lain.
- *Method* adalah operasi (prosedur, fungsi, atau konstruktor) yang dimiliki oleh sebuah kelas.
- Kelas HelloWorld tidak mempunyai atribut tetapi hanya mempunyai satu *method*, yaitu main:

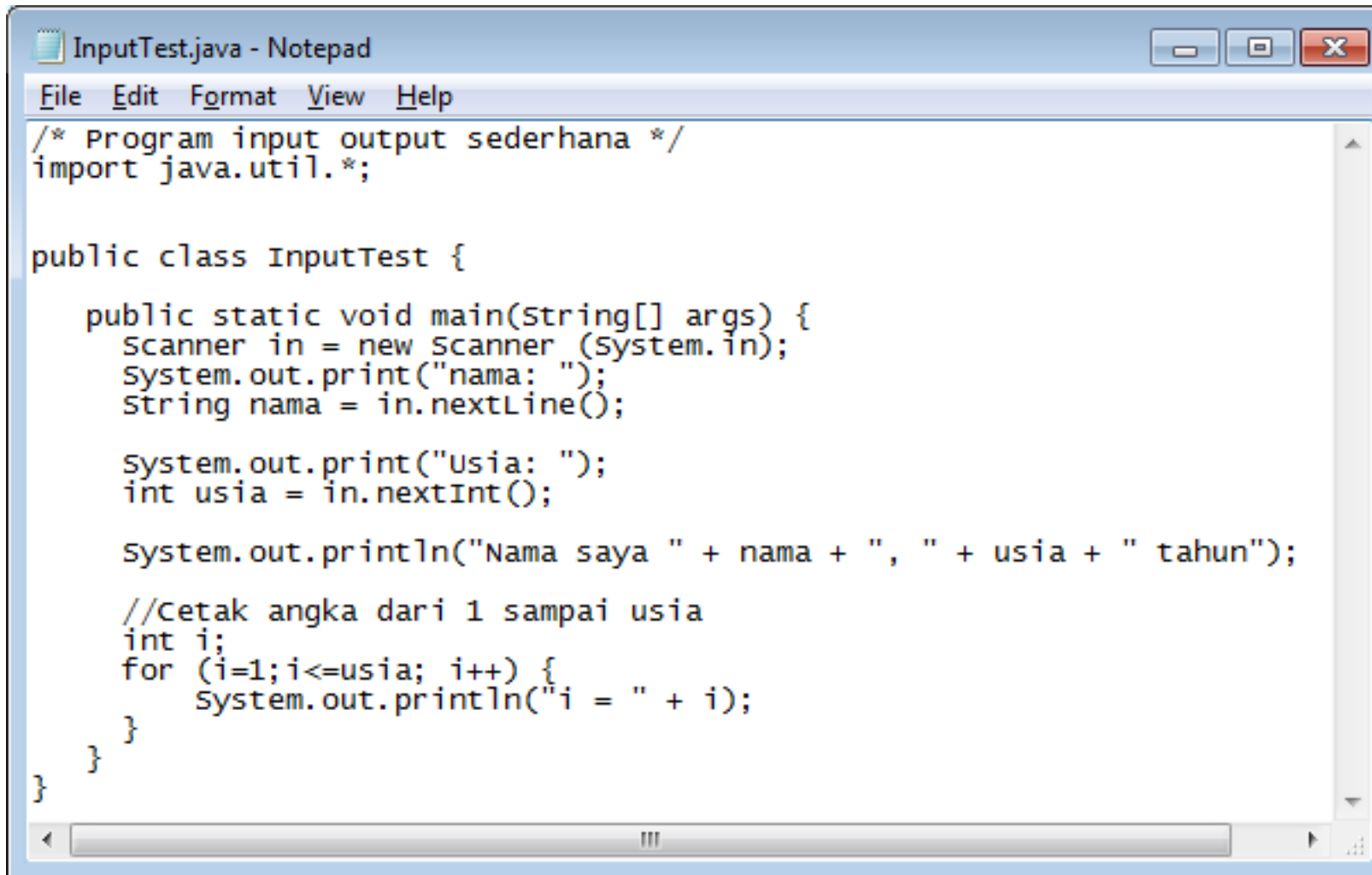


```
File Edit Format View Help
// mencetak Hello world!
public class HelloWorld {
    public static void main(String[] args) {
        // menampilkan tulisan "hello world"
        System.out.println("Hello world!");
    }
}
```

Method/function

- Lebih lanjut mengenai kelas dan objek akan dipelajari di dalam kuliah *Pemrograman Berorientasi Objek* (di semester 4)

Program Input/Output Sederhana



```
InputTest.java - Notepad
File Edit Format View Help
/* Program input output sederhana */
import java.util.*;

public class InputTest {

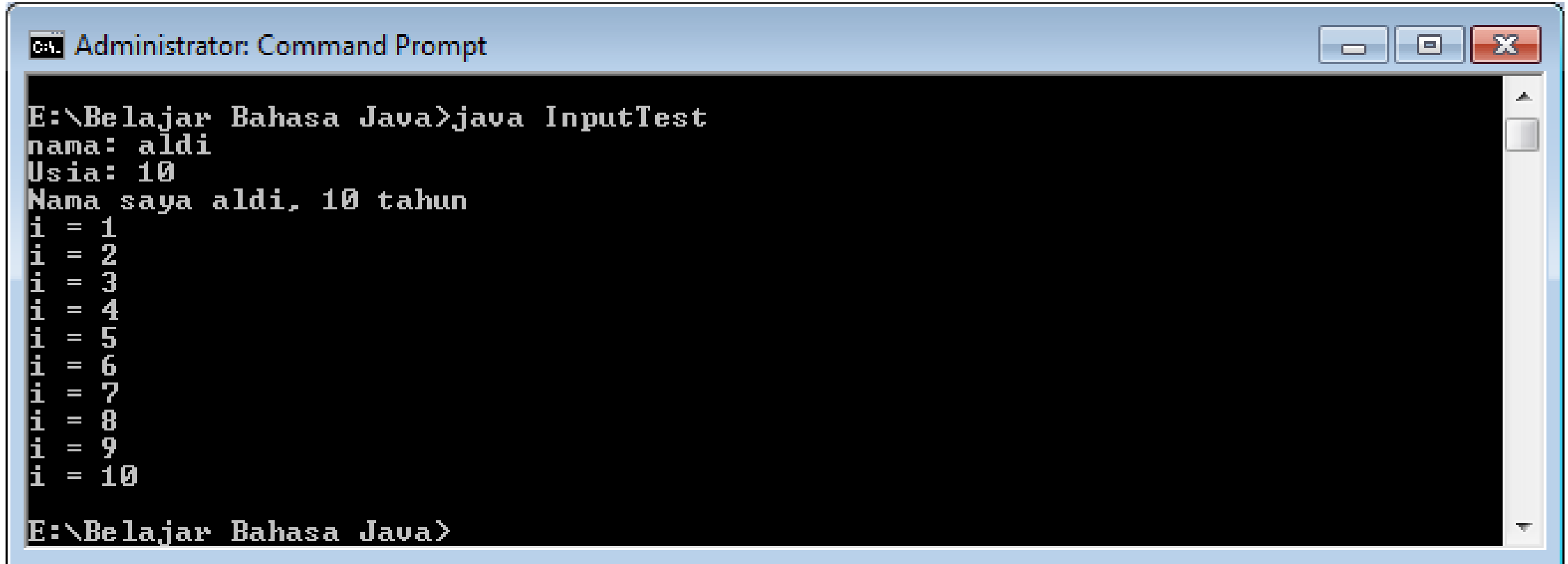
    public static void main(String[] args) {
        Scanner in = new Scanner (System.in);
        System.out.print("nama: ");
        String nama = in.nextLine();

        System.out.print("Usia: ");
        int usia = in.nextInt();

        System.out.println("Nama saya " + nama + ", " + usia + " tahun");

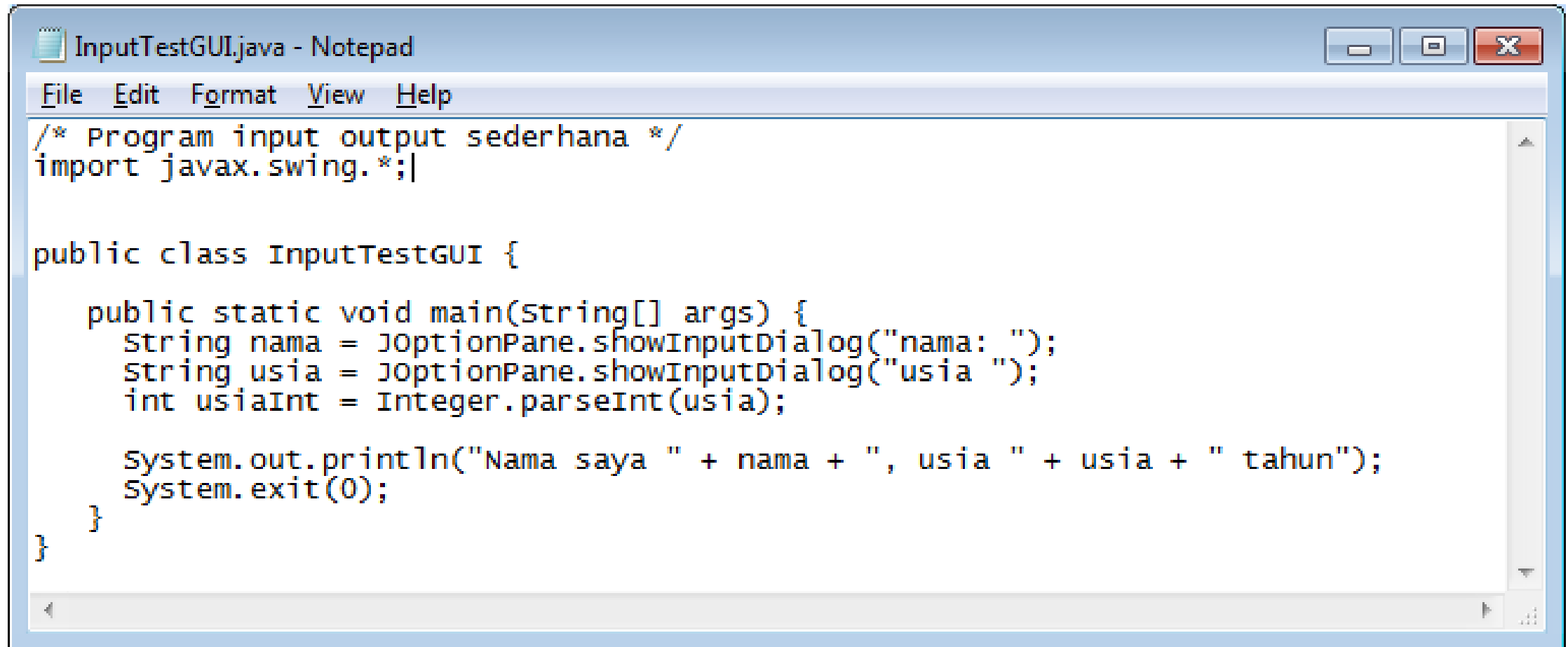
        //Cetak angka dari 1 sampai usia
        int i;
        for (i=1;i<=usia; i++) {
            System.out.println("i = " + i);
        }
    }
}
```

- Kompilasi `InputTest.java` dan jika sudah benar jalankan programnya:



```
Administrator: Command Prompt
E:\Belajar Bahasa Java>java InputTest
nama: aldi
Usia: 10
Nama saya aldi, 10 tahun
i = 1
i = 2
i = 3
i = 4
i = 5
i = 6
i = 7
i = 8
i = 9
i = 10
E:\Belajar Bahasa Java>
```

Program Input dengan GUI



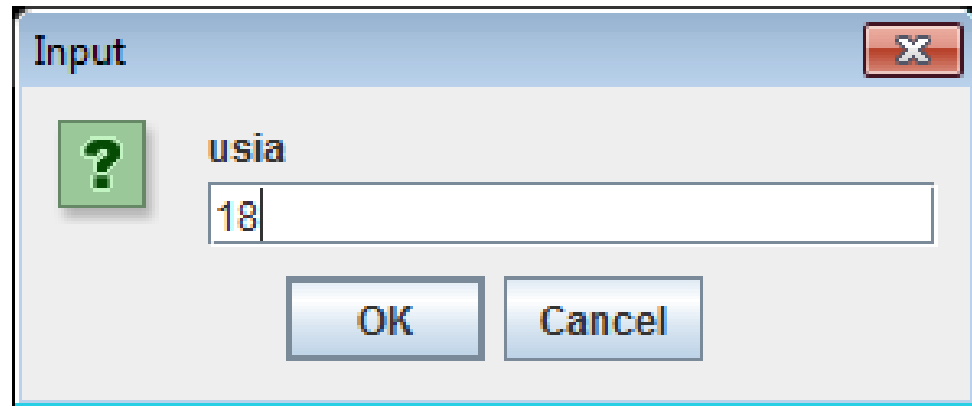
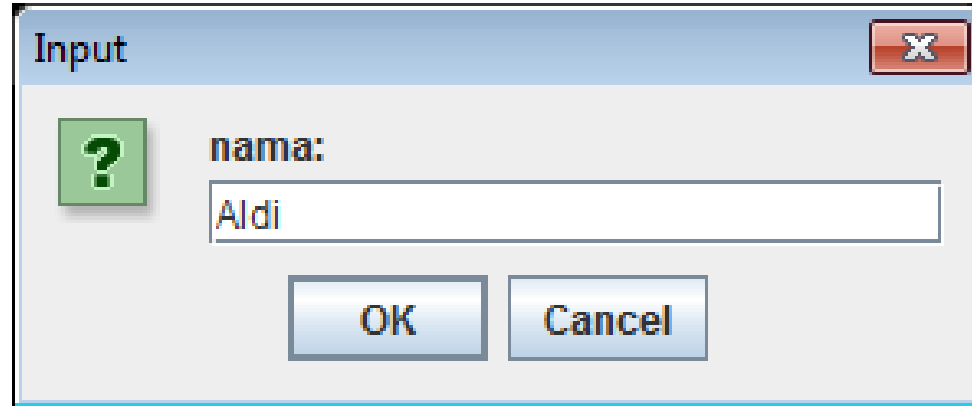
```
InputTestGUI.java - Notepad
File Edit Format View Help
/* Program input output sederhana */
import javax.swing.*;

public class InputTestGUI {

    public static void main(String[] args) {
        String nama = JOptionPane.showInputDialog("nama: ");
        String usia = JOptionPane.showInputDialog("usia ");
        int usiaInt = Integer.parseInt(usia);

        System.out.println("Nama saya " + nama + ", usia " + usia + " tahun");
        System.exit(0);
    }
}
```

- Kompilasi `InputTestGUI.java` dan jika sudah benar jalankan programnya:



Program FindMonth

```
*FindMonth - Notepad
File Edit Format View Help
/* Program input output sederhana */
import javax.swing.*;

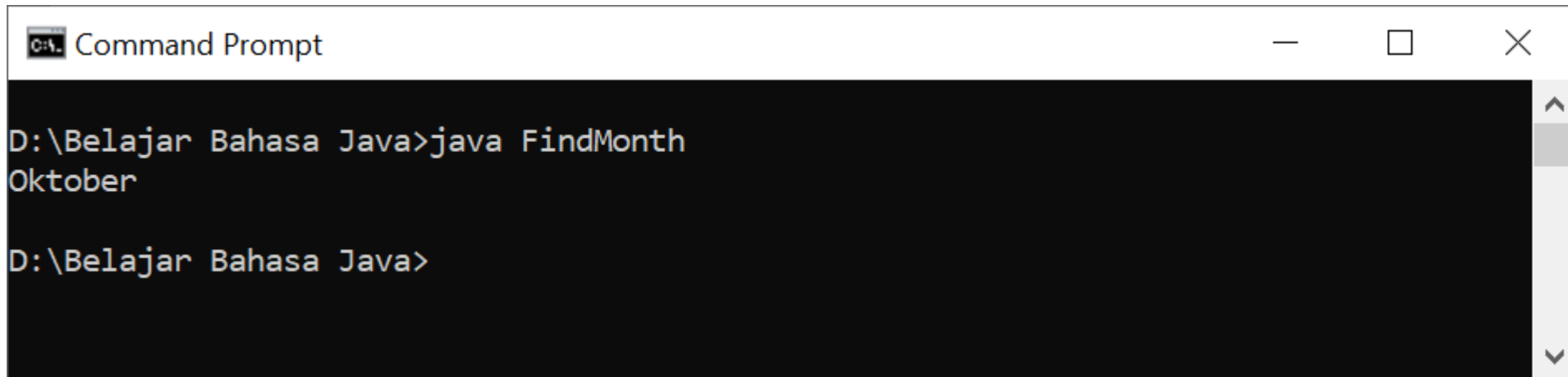
public class FindMonth {

    public static void main(String[] args) {

        String bulan = JOptionPane.showInputDialog("Bulan (1-12) ");
        int n = Integer.parseInt(bulan);
        switch (n) {
            case 1 : System.out.println("Januari"); break;
            case 2 : System.out.println("Februari"); break;
            case 3 : System.out.println("Maret"); break;
            case 4 : System.out.println("April"); break;
            case 5 : System.out.println("Mei"); break;
            case 6 : System.out.println("Juni"); break;
            case 7 : System.out.println("Juli"); break;
            case 8 : System.out.println("Agustus"); break;
            case 9 : System.out.println("September"); break;
            case 10 : System.out.println("Oktober"); break;
            case 11 : System.out.println("November"); break;
            case 12 : System.out.println("Desember"); break;
            default : System.out.println("Input tidak valid"); break;
        }

        System.exit(0);
    }
}

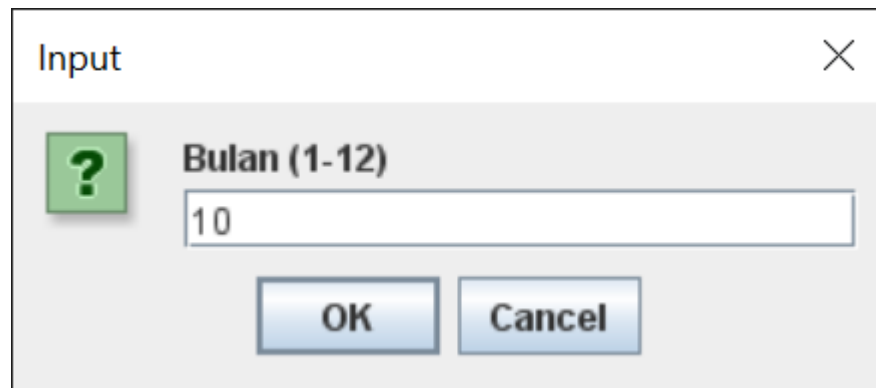
Ln 4, Col 1    100%    Windows (CRLF)    UTF-8
```



Command Prompt

```
D:\Belajar Bahasa Java>java FindMonth
Oktober

D:\Belajar Bahasa Java>
```

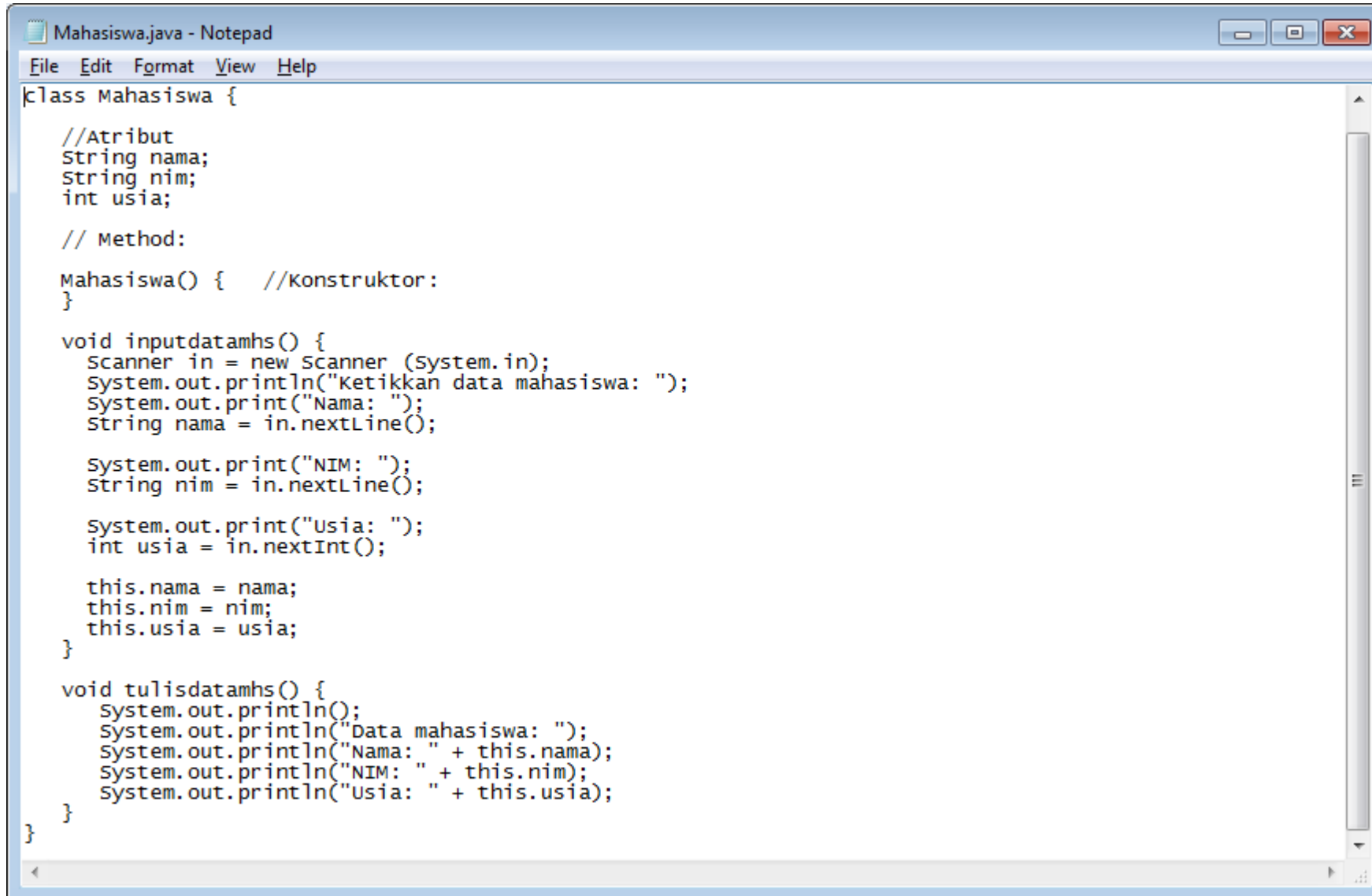


Input

 Bulan (1-12)

OK Cancel

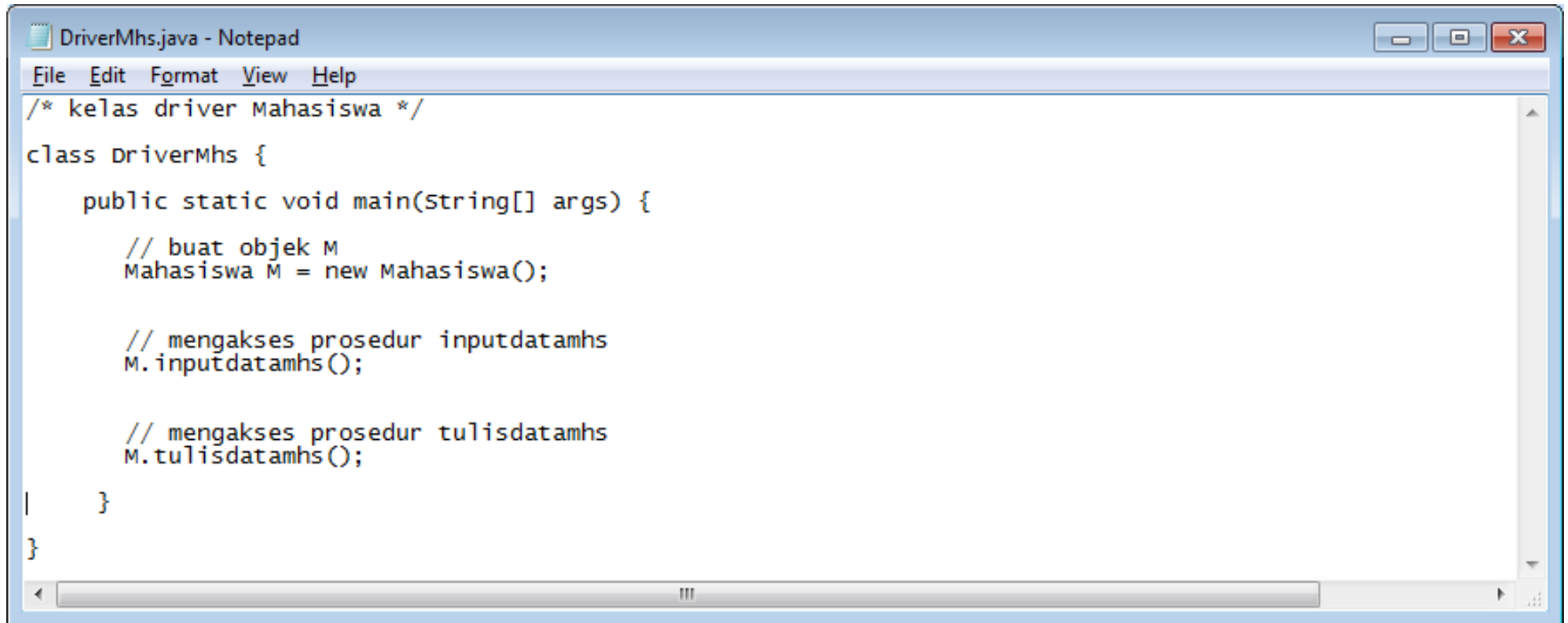
Kelas Mahasiswa



```
class Mahasiswa {  
  
    //Atribut  
    String nama;  
    String nim;  
    int usia;  
  
    // Method:  
  
    Mahasiswa() { //konstruktor:  
    }  
  
    void inputdatamhs() {  
        Scanner in = new Scanner (System.in);  
        System.out.println("Ketikkan data mahasiswa: ");  
        System.out.print("Nama: ");  
        String nama = in.nextLine();  
  
        System.out.print("NIM: ");  
        String nim = in.nextLine();  
  
        System.out.print("Usia: ");  
        int usia = in.nextInt();  
  
        this.nama = nama;  
        this.nim = nim;  
        this.usia = usia;  
    }  
  
    void tulisdatamhs() {  
        System.out.println();  
        System.out.println("Data mahasiswa: ");  
        System.out.println("Nama: " + this.nama);  
        System.out.println("NIM: " + this.nim);  
        System.out.println("Usia: " + this.usia);  
    }  
}
```

Kelas DriverMhs

(yang menggunakan kelas Mahasiswa)

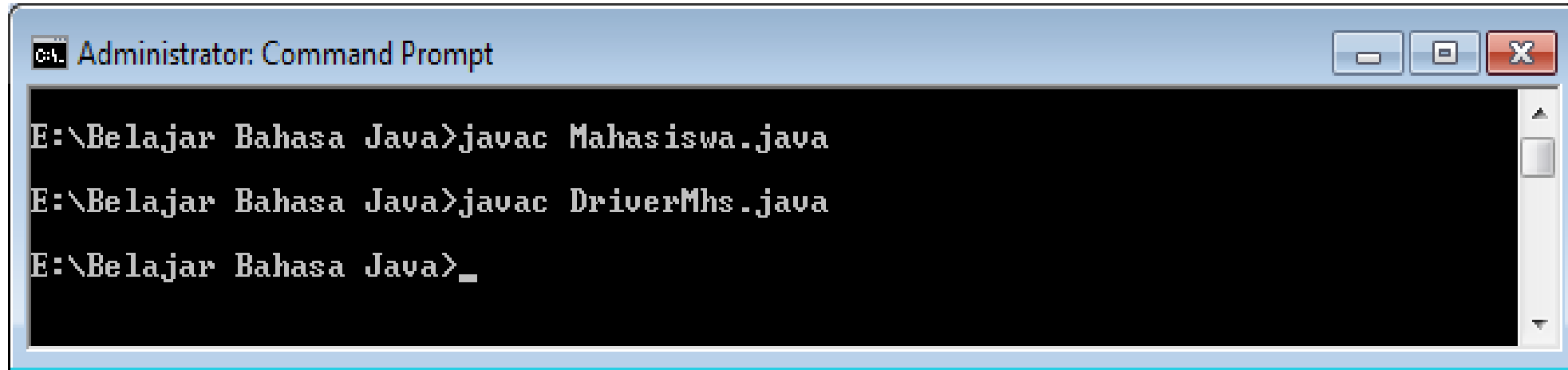


```
DriverMhs.java - Notepad
File Edit Format View Help
/* kelas driver mahasiswa */
class DriverMhs {
    public static void main(String[] args) {
        // buat objek M
        Mahasiswa M = new Mahasiswa();

        // mengakses prosedur inputdatamhs
        M.inputdatamhs();

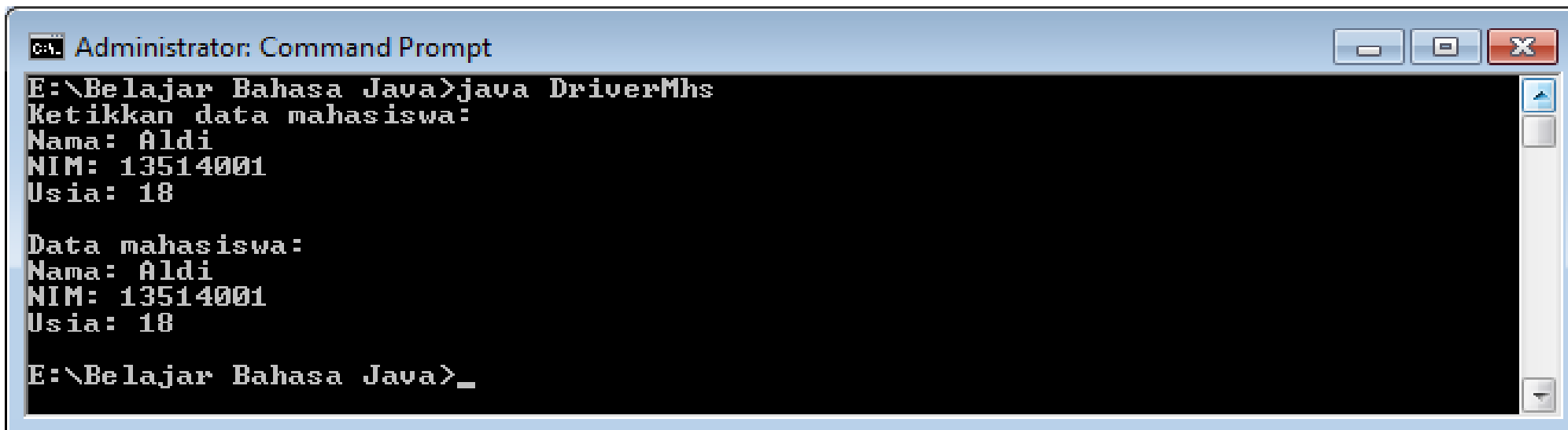
        // mengakses prosedur tulisdatamhs
        M.tulisdatamhs();
    }
}
```

- Kompilasi masing-masing Mahasiswa.java dan DriverMhs.java



```
Administrator: Command Prompt
E:\Belajar Bahasa Java>javac Mahasiswa.java
E:\Belajar Bahasa Java>javac DriverMhs.java
E:\Belajar Bahasa Java>_
```

- Jalankan kelas DriverMhs.class

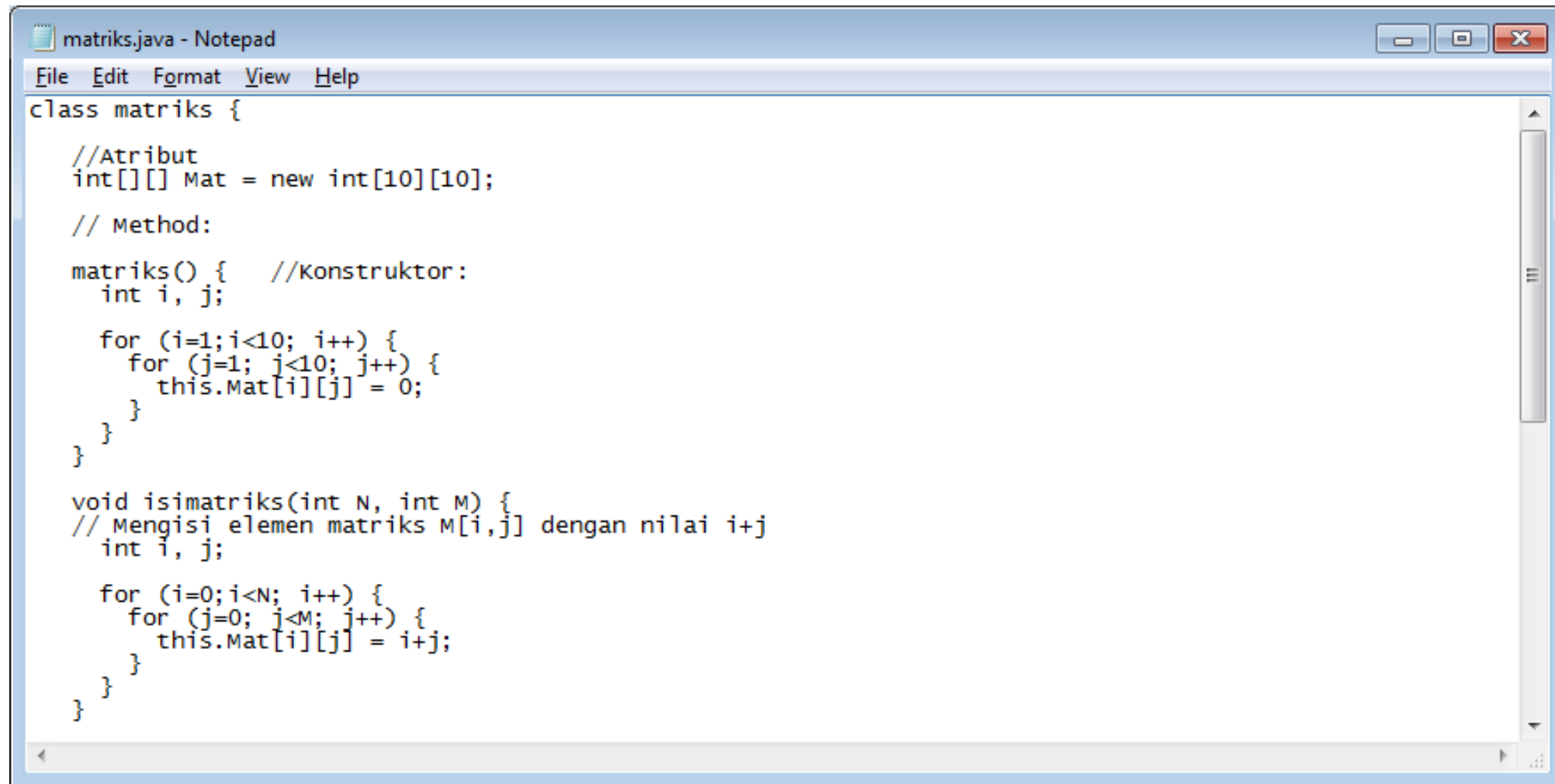


```
Administrator: Command Prompt
E:\Belajar Bahasa Java>java DriverMhs
Ketikkan data mahasiswa:
Nama: Aldi
NIM: 13514001
Usia: 18

Data mahasiswa:
Nama: Aldi
NIM: 13514001
Usia: 18

E:\Belajar Bahasa Java>_
```

Kelas Matriks



```
matriks.java - Notepad
File Edit Format View Help
class matriks {
    //Atribut
    int[][] Mat = new int[10][10];

    // Method:

    matriks() { //Konstruktor:
        int i, j;

        for (i=1;i<10; i++) {
            for (j=1; j<10; j++) {
                this.Mat[i][j] = 0;
            }
        }
    }

    void isimatriks(int N, int M) {
        // Mengisi elemen matriks M[i,j] dengan nilai i+j
        int i, j;

        for (i=0;i<N; i++) {
            for (j=0; j<M; j++) {
                this.Mat[i][j] = i+j;
            }
        }
    }
}
```

Kelas DriverMatriks

(yang menggunakan kelas Mahasiswa)

```
DriverMatriks.java - Notepad
File Edit Format View Help
/* kelas driver Matriks */
class DriverMatriks {
    public static void main(String[] args) {
        // buat objek P1
        matriks M = new matriks();

        // mengisi matriks
        M.isimatriks(3,4);

        // menulis matriks
        System.out.println("Isi matriks: ");
        M.tulismatriks(3, 4);

        // membuat matriks transpose
        int[][] M2;
        M2 = new int[4][3];
        M.transpose(3,4,M2);

        // Tulis matriks transpose
        System.out.println("Isi matriks transpose: ");
        int i, j;
        for (i=0; i<4; i++) {
            for (j=0; j<3; j++) {
                System.out.print(M2[i][j] + " ");
            }
            System.out.println();
        }
    }
}
```

```
matriks.java - Notepad
File Edit Format View Help

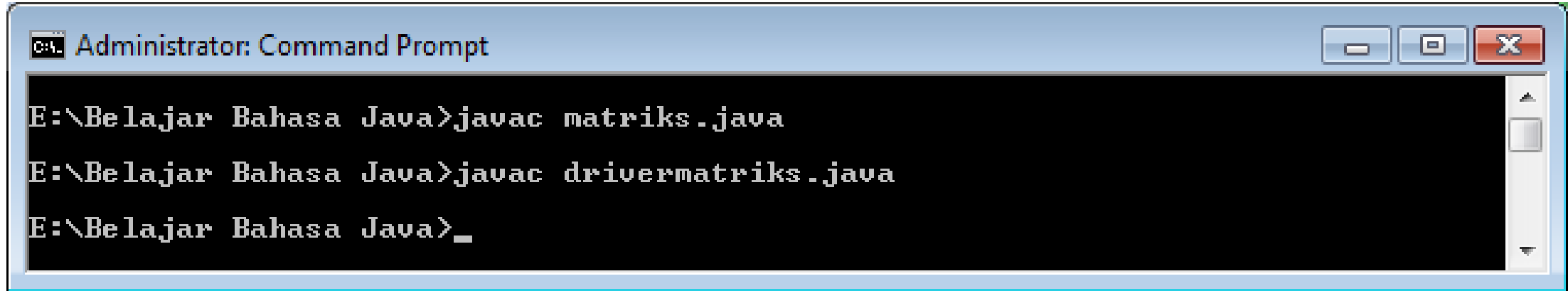
void tulismatriks(int N, int M) {
// Mencetak elemen-elemen matriks
int i, j;

for (i=0; i<N; i++) {
for (j=0; j<M; j++) {
System.out.print(this.Mat[i][j] + " ");
}
System.out.println();
}
}

void transpose(int N, int M, int Matt[][]) {
// Membuat matriks transpose;
int i, j;

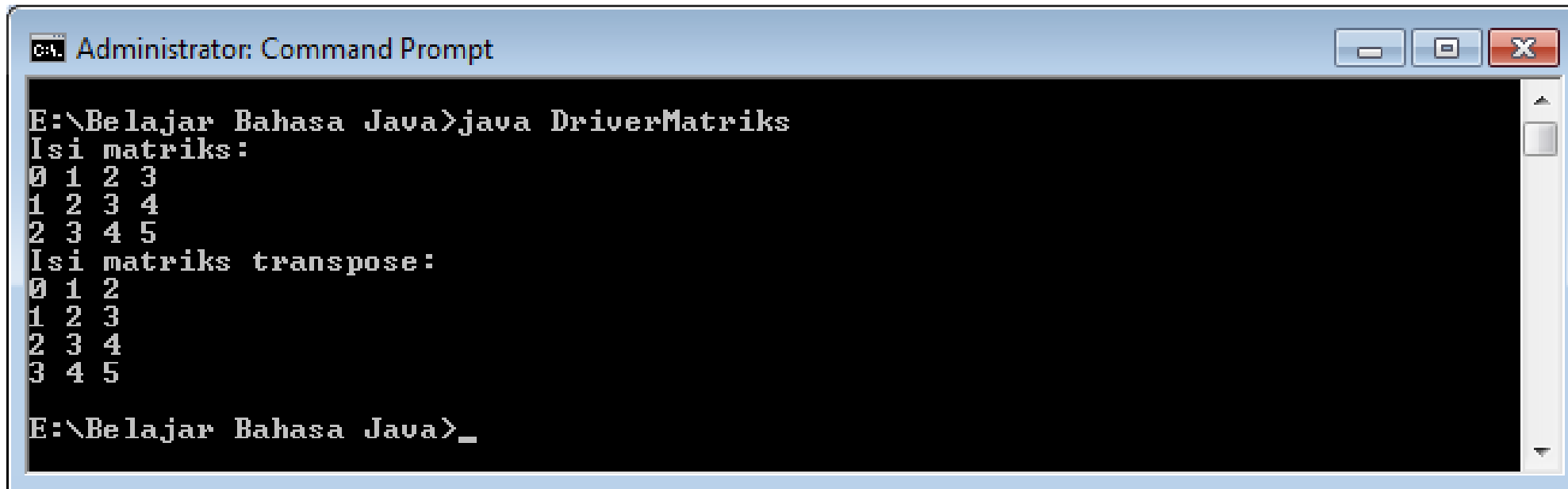
for (i=0; i<N; i++) {
for (j=0; j<M; j++) {
Matt[j][i] = this.Mat[i][j];
}
}
}
}
```

- Kompilasi masing-masing `matriks.java` dan `DriverMatriks.java`



```
Administrator: Command Prompt
E:\Belajar Bahasa Java>javac matriks.java
E:\Belajar Bahasa Java>javac drivermatriks.java
E:\Belajar Bahasa Java>_
```

- Jalankan kelas `DriverMatriks.class`



```
Administrator: Command Prompt
E:\Belajar Bahasa Java>java DriverMatriks
Isi matriks:
0 1 2 3
1 2 3 4
2 3 4 5
Isi matriks transpose:
0 1 2
1 2 3
2 3 4
3 4 5
E:\Belajar Bahasa Java>_
```

Kelas Stack

```
Stack - Notepad
File Edit Format View Help
/* kelas Stack */

class Stack {

    //Atribut
    public int TOP;
    public int[] s = new int[11];

    //Konstruktor:
    Stack() {
        this.TOP = 0;

        System.out.println("Telah dibuat sebuah stack");
        this.tulis();

    }

    // Metode lain:

    void tulis() {
        System.out.println("TOP = " + this.TOP);
    }
}

Ln 1, Col 1    100%    Windows (CRLF)    UTF-8
```



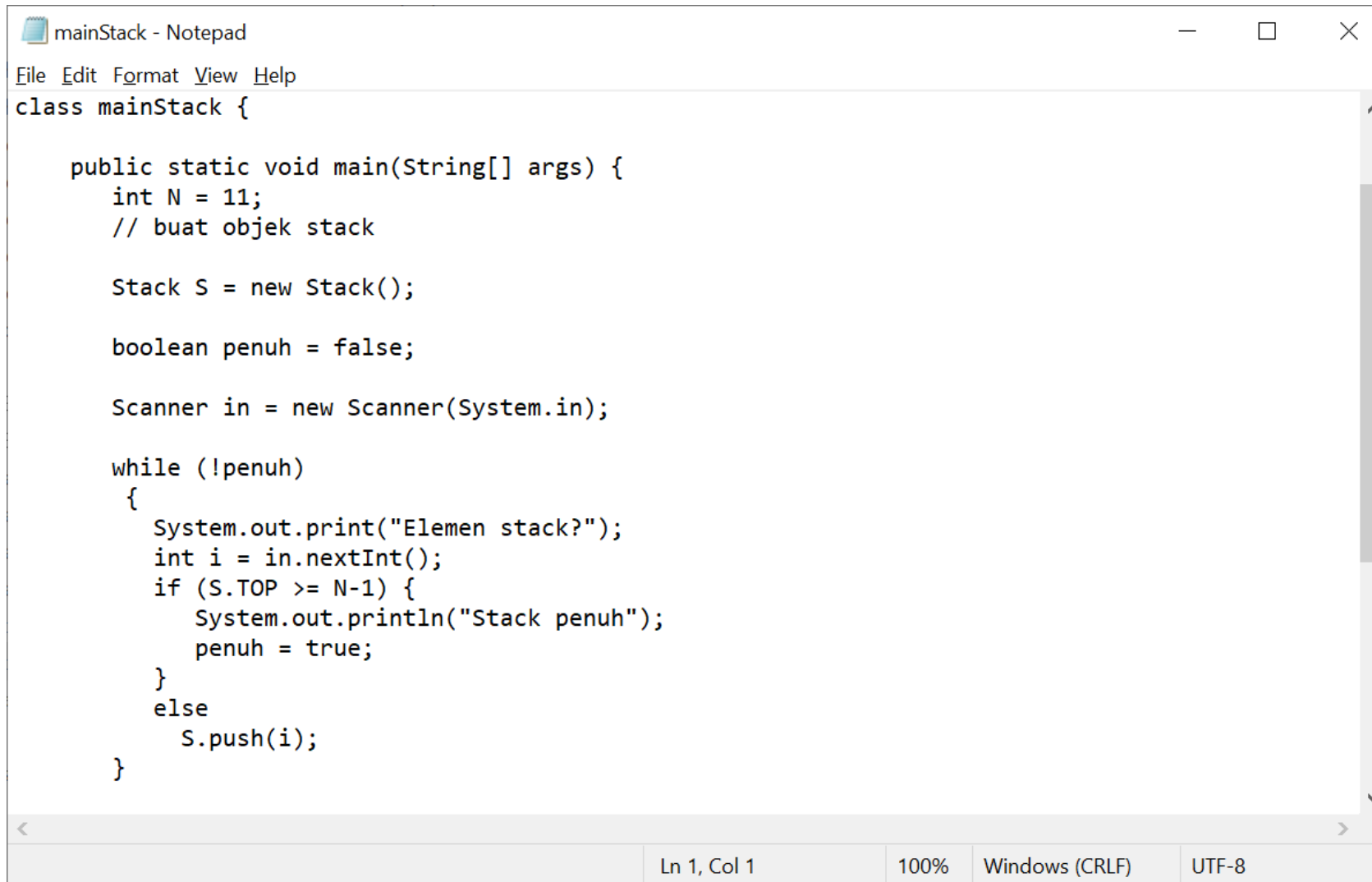
```
void tulis() {
    System.out.println("TOP = " + this.TOP);
}

void push(int x){
    this.TOP ++;
    //if (this.TOP > N-1)
    //    System.out.println("stack penuh");
    // else
    s[TOP] = x;
}

int pop(){
    if (this.TOP == 0) {
        System.out.println("stack kosong");
        return 0;
    }
    else {
        int x = s[TOP];
        this.TOP--;
        return x;
    }
}
}
```

Kelas mainStack

(yang menggunakan kelas Stack)



```
mainStack - Notepad
File Edit Format View Help
class mainStack {

    public static void main(String[] args) {
        int N = 11;
        // buat objek stack

        Stack S = new Stack();

        boolean penuh = false;

        Scanner in = new Scanner(System.in);

        while (!penuh)
        {
            System.out.print("Elemen stack?");
            int i = in.nextInt();
            if (S.TOP >= N-1) {
                System.out.println("Stack penuh");
                penuh = true;
            }
            else
                S.push(i);
        }
    }
}
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

```
S.tulis();

// mengakses elemens stack
int j = S.TOP;
while (j != 0)
{
    int x = S.pop();
    System.out.println("Nilai yang di-pop: " + x);
    j = S.TOP;
}

}
```

```
Command Prompt
D:\Belajar Bahasa Java>java mainStack
Telah dibuat sebuah stack
TOP = 0
Elemen stack?5
Elemen stack?7
Elemen stack?29
Elemen stack?12
Elemen stack?7
Elemen stack?18
Elemen stack?90
Elemen stack?23
Elemen stack?45
Elemen stack?44
Elemen stack?10
Stack penuh
TOP = 10
Nilai yang di-pop: 44
Nilai yang di-pop: 45
Nilai yang di-pop: 23
Nilai yang di-pop: 90
Nilai yang di-pop: 18
Nilai yang di-pop: 7
Nilai yang di-pop: 12
Nilai yang di-pop: 29
Nilai yang di-pop: 7
Nilai yang di-pop: 5
D:\Belajar Bahasa Java>
```

Referensi

Materi “Pengantar Pemrograman Bahasa Java” diambil dari berbagai sumber, antara lain:

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3. Wikipedia