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ROBOCODE

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(with thanks to Ruth Letham, Shyam Reyal, Greg Bigwood, James Smith, Andrea Rendl, Kris Getchell, Tim Storer and Martin Bateman)

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What is ROBOCODE

- Developed by IBM®
- Programming game
- You develop strategies for your robot
- Write *Java*™ to control your robot

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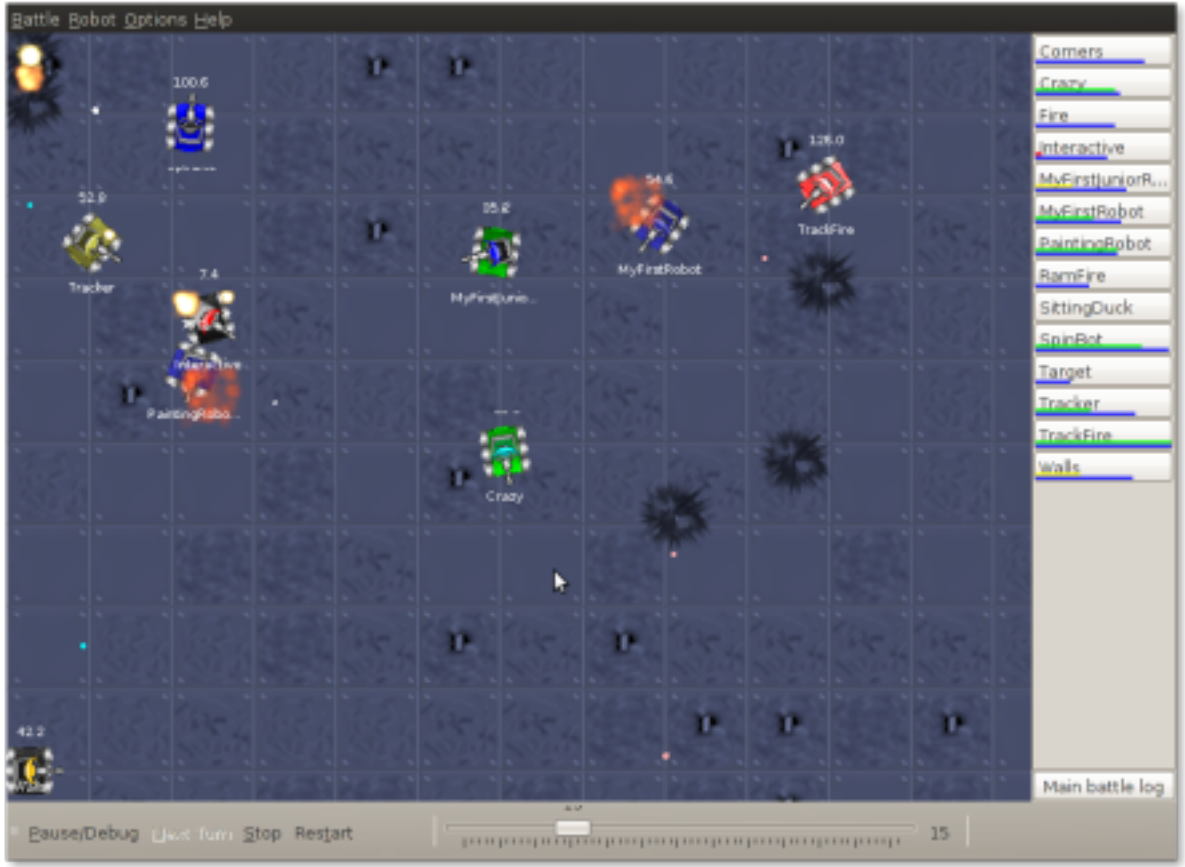

Write code in Java

- High-level
- Object-Oriented
- Case-sensitive (Foo, foo, FOO)

- ***"Write once, run anywhere"***

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Write code in Java

Java code for your robot

- package & import
- comments (/* ABC */ or // XYZ on one line)
- robot definition
  - **run**
  - **onScannedRobot** - what to do when you see a robot
  - **onHitByBullet** - what to do when you are shot
  - **onHitWall** - what to do if you bump into a wall
- Edit the program
  - change name of the author in the comment

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Change the color of your robot

import java.awt.Color;

setColors(Color bodyColor, Color gunColor, Color radarColor)
setColors(Color bodyColor, Color gunColor, Color radarColor, Color bulletColor, Color scanArcColor)

Example

```
public void run() {
        setColors(Color.ORANGE, Color.YELLOW, Color.GREEN);
}
```

Moving

- **Movement** is controlled by **ahead()** and **back()**
- **Direction of travel** is controlled by **turnLeft()** and **turnRight()**
- **Direction of the gun** is controlled by **turnGunLeft()** and **turnGunRight()**

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Moving

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- Need to know how far to move (**pixels**) or turn (**degrees**)
- This code makes the robot:
  - moveforward
  - spin around clockwise
  - move backwards
  - spin its gun counter-clockwise

```
ahead(100);
turnRight(360)
back(50);
turnGunLeft(360);
```

Shooting

- Shooting is controlled by **fire()**
- When you see a robot an **event** is triggered
  - **onScannedRobot()** is executed

```
public void onScannedRobot(ScannedRobotEvent e) {
        fire(1);
}
```

```
public void onScannedRobot(ScannedRobotEvent e) {
        fire(1.5);  // MAX is 3
}
```

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```
public void onScannedRobot(ScannedRobotEvent e) {
        fire(1);
}
```

- Want to pack more of a punch?

```
public void onScannedRobot(ScannedRobotEvent e) {
        fire(10); // This will be equal to fire(3);
}
```

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```

Be Careful!
Firing costs energy

No energy = Sitting Duck!

Shooting

The more you shoot, the more power is spend

- (4 * power) damage if it hits another robot.
- If power is greater than 1, it will do an additional 2 * (power - 1) damage.
- You will get (3 * power) back if you hit the other robot.

Taking Fire

- If you are dishing it out, you are probably going to take some hits too
- When your robot gets shot, another **event** is triggered
  - **onHitByBullet()** is executed

Taking Fire

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- Try changing your direction by a fixed amount and moving away

```
public void onHItByBullet(HitByBulletEvent e) {
        turnLeft(90);
        back(100);
}
```

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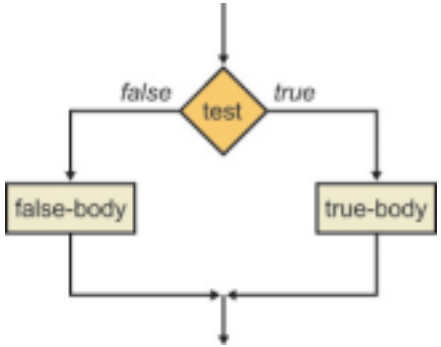
If … else Conditions

- Used to make ***Boolean*** *(true/false)* decisions in code
  - do one thing, or another thing depending on a condition
- Basic Structures

```
if (<condition>) {
        // code
}
```

```
if (<condition>) {
        // code
}
else {
        // code
}
```



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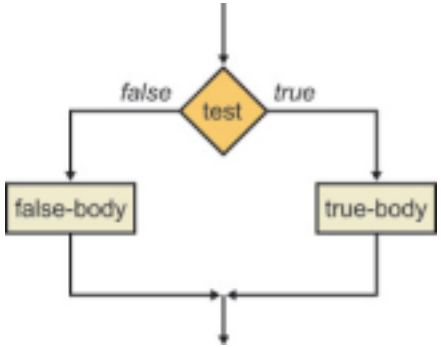

- Condition is enclosed in parentheses **()**
- Action is enclosed in braces **{}**
- Use **! (*NOT*)**, **&& (*AND*)** and **|| (*OR*)** to make more complex conditions

Example

- Strategy: When I see an enemy, it is close by and I have lots of energy fire hard at it, otherwise just fire a basic shoot

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- Strategy: When I see an enemy, it is close by and I have lots of energy fire hard at it, otherwise just fire a basic shoot
- When **onScannedRobot** is executed
  - **e** contains information about the robot we scanned
  - Get the distance of the scanned robot with **e.getDistance()**
  - Get energy of my robot with **getEnergy()**

```
public void onScannedRobot(ScannedRobotEvent e) {
        if (e.getDistance() < 50 && getEnergy() > 50) {
                fire(3);
        } else {
                fire(1);
        }
}
```

Variables

- You can also make use of variables

```
public void onScannedRobot(ScannedRobotEvent e) {
        double myEnergy = getEnergy();
        double enemyDistance = e.getDistance();

        if (enemyDistance < 50 && myEnergy > 50) {
                fire(3);
        } else {
                fire(1);
        }

        if (myEnergy > 40) {
                turnLeft(120);
                fire(2);
        }
}
```

Example 2: Shooting

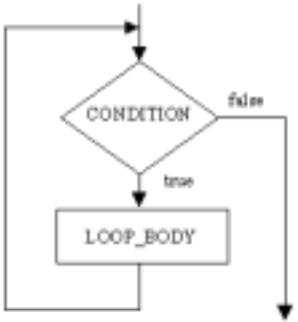
You cannot fire if your gun is overheated

```
if (getGunHeat() == 0) {
        fire(Rules.MAX_BULLET_POWER);
}
```

While Loops

- Repeat a block of code any number of times while a condition holds
- Basic Structure

```
while (<condition>) {
        // code
}
```



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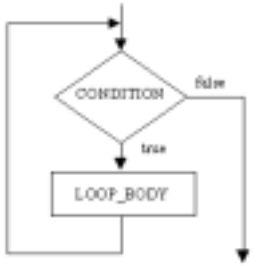

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- Use **! (*NOT*)**, **&& (*AND*)** and **|| (*OR*)** to make more complex conditions
- Example:

```
while (getEnergy() > 90) {
        fire(1);
}
```

```
double myEnergy = getEnergy();
while (myEnergy > 90) {
        fire(1);
}
```

Java Coding

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  - An open parenthesis **(** must have a matching closing parenthesis **)**
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- Instruction statements must end with **semicolon ;**
  - fire(1);
  - getDistance();

Java Coding

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Java Coding

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  - if (<condition>)
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- Parentheses enclose the information needed for a method
  - fire(1)
  - getEnergy()
- Braces mark the start and end of a section of code
  - public void run() { … }
  - if (<condition>) { … } else { … }
  - while (<condition>) { … }

Programming Hints

- If you do not know how to do something:
  - Dabble with the code - you might work out the solution by accident!
  - Use the notes provided for commands to the robots, scanning, shooting, turning, etc…
  - Ask the demonstrators in the Lab
  - Have a look on the internet
    - Google
    - http://robocode.sourceforge.net (good resource for code)
      - API: http://robocode.sourceforge.net/docs/robocode/
    - http://www.ibm.com/developerworks/library/j-tipstrats/
    - Boolean Algebra
      - http://law.lclark.edu/live/files/9385-boolean-basics

More resources

- Some more useful info on Robocode:
  https://sic2.host.cs.st-andrews.ac.uk/robocode-extra.html

- Some basic info on java:
  https://sic2.host.cs.st-andrews.ac.uk/basic-java.html
  https://learnxinyminutes.com/docs/java/

Design a Strategy

- Decide on your strategy and tactics
  - Choose your overall strategy
    - **Aggressive** - seek and destroy
    - **Defensive** - back to the wall/find a corner
    - **Neutral** - patrol route

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    - Shoot, turn, move?

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  - How do you want to react to them?
    - Shoot, turn, move?
- Writing your overall strategy and individual tactics down in English before you start to code will help you later

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Building your Robot

- Build your robot step-by-step
- Choose one tactic to start with:
  - Write the code
  - Fix any errors displayed
  - Test your robot against the sample robots
  - Check the robot is behaving as expected
  - Make any changes or improvements

- Do this for each tactic until you have built your entire strategy

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Create your new Awesome Robot!

- From the Editor
  - File → New → Robot
  - Name your robot (has to start with a capital case)
  - Package name: **django**

- Remember to write the author of the robot in the comment

```
/**
 * Franky - a robot by Simone Conte
 */
```

Starting a Battle

- From the menu bar, choose: **Battle → New**
- In the dialog box that appears:
  - click on button marked Add All
  - click on button marked Next
- Set Number of Rounds to 1
- Battlefield size using buttons on the right
  - *1000x1000* is a good size
- Click the Start Battle button to the being the **WAR!**

Q/A

- **Q**: My robot is not winning with the highest score, even though it is the only one left on the battlefield. Why is that the case?
- **A**: A robot that does not fire much, but "just" saves its energy is getting a lesser score than a robot that hits other robots with a lot of bullets.

- **Q**: How fast does a bullet travel?
- **A**: A bullet travels at a speed between 11.0 and 19.7 depending on the power. The more powerful the bullet, the slower. The formula to calculate it is velocity = 20 - (3 * power)

- **Q**: Which is the range of a bullet?
- **A**: A bullet has no range. It keeps going until it hits a robot or a wall.

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Rest of Session

- For the next 30 minutes
  - Design & build your robot
  - Use the slides, handout & online resources for programming tips
  - API Documentation accessible from **Robot Editor/Help → Robocode API**
  - Handout contains
    - a list of methods you are likely to use
    - example code showing loops, conditional statements, etc.

- We will be around to help.
- If you want to run something by us, put up your hand.
- For the last 15 minutes
  - Your robots will compete against each other on the big screen!