Technische Hochschule Rosenheim

Modul- Fortgeschrittene Programmierkonzepte

Bachelor Informatik

X-Mas: Robocode

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What is Robocode?

- **Robocode** is an easy-to-use robotics battle simulator.
- **Robocode** is Open Source
- You create a *robot*, put it onto a battlefield, and let it battle to the bitter end against opponent robots created by other developers.
- **Robocode** comes with a set of pre-fab opponents to get you started, but once you outgrow them, you can enter your creation against the world's best in one of the leagues being formed @ TH Rosenheim.

Robocode Package

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Robocode offers complete development environment

- comes with its own installer
- built-in robot editor
- Java compiler

Robocode only pre-requires that a JVM (Java Virtual Machine) to exist already on the system

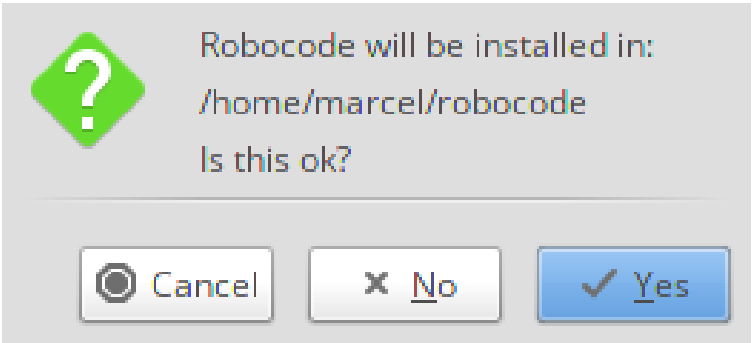
Everything a robot developer needs to get started is provided with the main Robocode distribution file: `robocode-xxx-setup.jar`

Robocode also supports developing robots using external IDEs like e.g. Eclipse, IntelliJ IDEA, NetBeans, Visual Studio etc.

How to get it?

- Go to https://sourceforge.net/projects/robocode/files/
- Download form `/robocode` the latest `*-setup.jar`
- Run the installer

```
$java -jar robocode-1.9.3.7-setup.jar
```



Components of Robocode

- When you activate Robocode, you will see two interrelated GUI windows, which form Robocode's IDE they are:
- The **Battlefield** :
  - Where the battle between robots plays out.
  - You can create save and open new or existing battles.
  - Provides statistics of any robot in the arena
- The **Robot Editor** :
  - A text editor for editing Java source code that make up your robot.
  - Create a robot compile it, and you are ready for battle

Anatomy of a Robot

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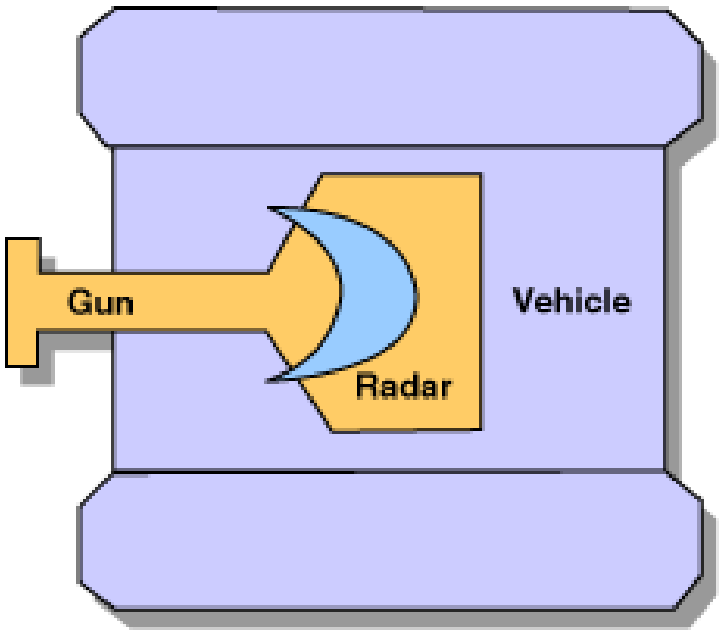
- A **robot** is a graphical tank!



- The robot has a rotating gun
- The robot has a rotating radar on top of the rotating gun
- Both can rotate independently in any direction. (**By default they are aligned**)

Anatomy of Robot Code

- All Robots have a class
  - Class name is name of robot
- All extend either `Robot` or `AdvancedRobot`
- All have a `run()` - method

And the code?

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Here is where you put your robot commands

```
package matworx;
import robocode.*;

public class GeneralPatton extends Robot
{
    /**
     * run: GeneralPatton's default behavior
     */
    public void run() {
        // Robot main loop
        while(true) {
        }
    }
}
```

What a robot can do?

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Moving the robot

- `turnRight(double degree)` and `turnLeft(double degree)`
  - Turn the robot by a specified degree.
- `ahead(double distance)` and `back(double distance)`
  - Move the robot by the specified pixel distance; these two methods are completed if the robot hits a wall or another robot.
- `turnGunRight(double degree)` and `turnGunLeft(double degree)`
  - Turn the gun, independent of the vehicle's direction.
- `turnRadarRight(double degree)` and `turnRadarLeft(double degree)`
  - turn the radar on top of the gun, independent of the gun's direction (and the vehicle's direction).

More Commands

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- `setAdjustGunForRobotTurn(boolean flag)`
  - If the flag is set to true, the gun will remain in the same direction while the vehicle turns.
- `setAdjustRadarForRobotTurn(boolean flag)`
  - If the flag is set to true, the radar will remain in the same direction while the vehicle (and the gun) turns.
- `setAdjustRadarForGunTurn(boolean flag)`
  - If the flag is set to true, the radar will remain in the same direction while the gun turns. It will also act as if `setAdjustRadarForRobotTurn(true)` has been called.

Obtaining Robot Information

- `getX()` and `getY()`
  - get the current coordinate of the robot.
- `getHeading()`, `getGunHeading()`, and `getRadarHeading()`
  - get the current heading of the vehicle, gun, or radar in degrees.
- `getBattleFieldWidth()` and `getBattleFieldHeight()`
  - get the dimension of the battlefield for the current round.

Events

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Events are things that you react to.

In Robocode there are several you can react to:

- ScannedRobotEvent: Handle the ScannedRobotEvent by overriding the `onScannedRobot()` method; this method is called when the radar detects a robot.
- HitByBulletEvent: Handle the HitByBulletEvent by overriding the `onHitByBullet()` method; this method is called when the robot is hit by a bullet.
- HitRobotEvent: Handle the HitRobotEvent by overriding the `onHitRobot()` method; this method is called when your robot hits another robot.
- HitWallEvent: Handle the HitWallEvent by overriding the `onHitWall()` method; this method is called when your robot hits a wall.

First Robot

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```
package matworx;
import robocode.*;

public class MadBot extends Robot
{
    // <<Area 1>>
    // run method
    public void run() {
        ... // <<Area 2>>
        while(true) {
          ... // <<Area 3>>
        }
    }
    ... // <<Area 4>>
    public void onScannedRobot(ScannedRobotEvent e) {
        fire(1);
    }
}
```

More Code...

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```
package examples;
import robocode.*;

public class Patrol extends Robot{
    /*** run: Patrol's default behavior*/
    public void run() {
        // Fahrzeug nach Norden ausrichten
        turnLeft( getHeading());
        // Kanone nach Norden ausrichten
        turnGunLeft( getGunHeading());
        // Radar nach Norden ausrichten
        turnRadarLeft( getRadarHeading());

        while(true) {
            ahead( 128);            // Weiterfahren
            turnRadarLeft( 360);    // Rundum Scan durchführen
        }

    }
}
```

... and more

```
    /**
     * onHitWall: What to do when you hit a wall
     */
    public void onHitWall(HitWallEvent event) { // Gegen Wand gefahren!
        turnLeft(90);          // Linksdrehung um 90 Grad
    }
     /**
     * onScannedRobot: What to do when you see another robot
     */
    public void onScannedRobot(ScannedRobotEvent e) {
        double b = e.getBearing();  // Zielrichtung auslesen
        turnGunRight( b);           // Kanone auf Ziel
        fire(1);                    // Feuer!
        turnGunLeft( b);            // Kanone wieder in Fahrtrichtung
    }
    /**
     * onHitByBullet: What to do when you're hit by a bullet
     */
    public void onHitByBullet(HitByBulletEvent e) {
    }
}
```

Tank Basics: Energy

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- Tanks start with a certain amount of health (energy): **100**
- Tanks lose health by:
  - getting shot
  - bumping into things (the walls, other robots)
  - shooting bullets
  - fighting for too long
  - **Note**: tanks that hit each other lose equal amounts of health)
- Tanks gain health by shooting other tanks
- Tanks that run out of health by shooting too much are disabled
  - If the tanks bullet hits a target it can gain energy back

Game Play

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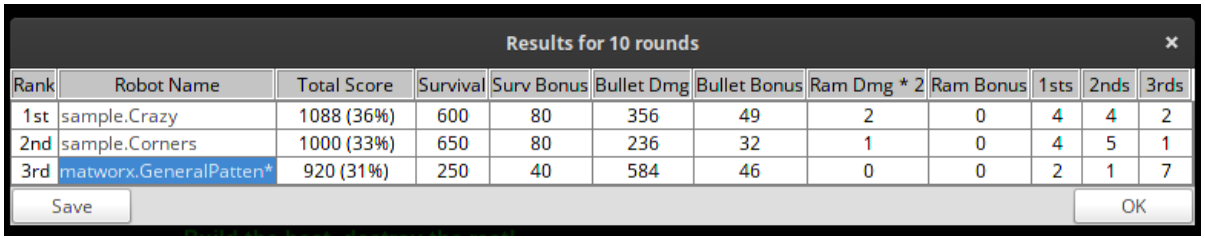
Point Distribution

- Robots on the field when another robot dies – 50 points
- Last robot alive given extra points – 10 points per dead robot
- Every point of fire damage inflicted on target robot – 1 point
- Every opponent ram – 2 points per damage inflicted by ramming
- Killing a target robot by firing at it– 20% of total damage inflicted
- Death by ramming – 30% of total damage inflicted



Results for 10 rounds

Rank	Robot Name	Total Score	Survival	Surv Bonus	Bullet Dmg	Bullet Bonus	Ram Dmg * 2	Ram Bonus	1sts	2nds	3rds
1st	sample.Crazy	1088 (36%)	600	80	356	49	2	0	4	4	2
2nd	sample.Corners	1000 (33%)	650	80	236	32	1	0	4	5	1
3rd	matworx.GeneralPatten*	920 (31%)	250	40	584	46	0	0	2	1	7

Save OK

Tank Basics: Time

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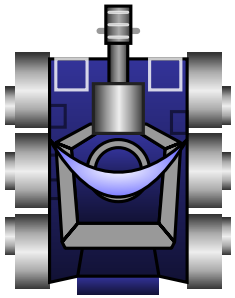
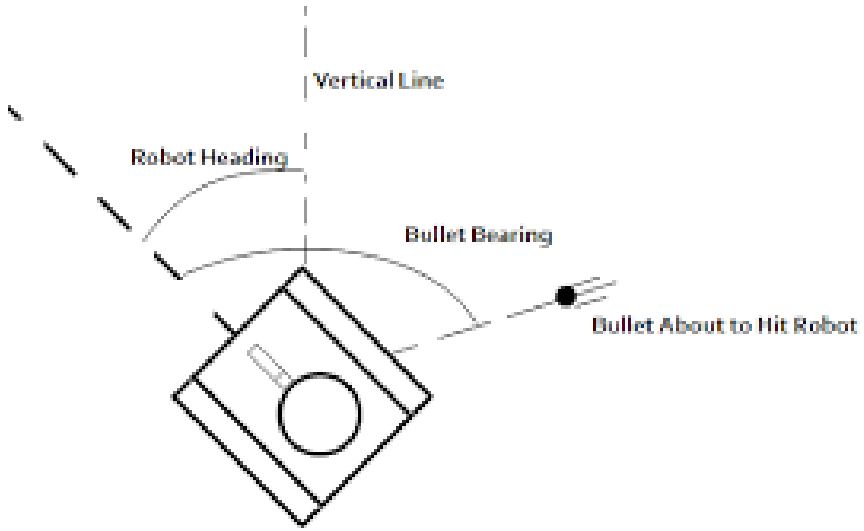
- Rotating the gun, radar, and vehicle takes time
  - Vehicle takes the longest amount of time
  - Radar takes the least amount of time
- Bullets take time to hit things (need to shoot where you expect the target to be when the bullet should arrive)
- Gun has a short cooldown period in between shots
- Radar must be pointed at a target to see it
  - Detects velocity, bearing, heading, and energy remaining.



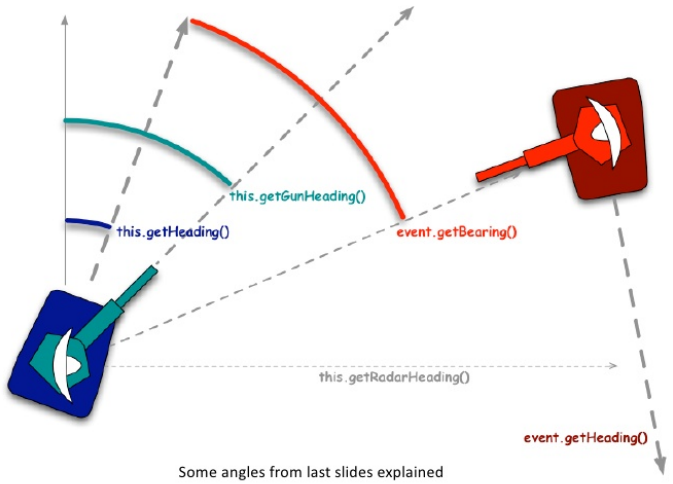
Tank Basics: Fire

- 3 levels of firing
  - **fire(1)** – costs the least health, does the least damage
  - **fire(2)** -costs intermediate health, does intermediate damage
  - **fire(3)** – costs the most health, does the most damage



Tank Basics: Radar

- Infinite range
- One degree scan width
- Returns enemy position, orientation, bearing, gun angle, and energy.
- Tank knows its own position, oreintation, bearing, gun angle, and energy



Some angles from last slides explained

Radar Strategies – Seeing other robots

- Locked scanning strategy – radar finds a target and sticks with it
  - Implemented by moving the radar back and forth a little to keep track of the robot, it could scan the direction based on the target robot's heading
  - Problem: Not good for bigger battles since you could pass by easier to kill robots
- Radar can be used to guess when an opponent's bullet has fired
  - Any ideas on how we could do this?
  - Look at what we can gather from the radar API

Choosing an Enemy

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- **Weakest Enemy** : Pick the guy with the lowest health
  - Problem: This target could be far away. Another robot could dip below target robot's health in the mean time!
- **Closest Enemy** : Pick the guy closest to you
  - Problem: He could be the winner. Dying earlier means you receive less points overall
- No explicit methods provided by Robocode

Movement Strategies

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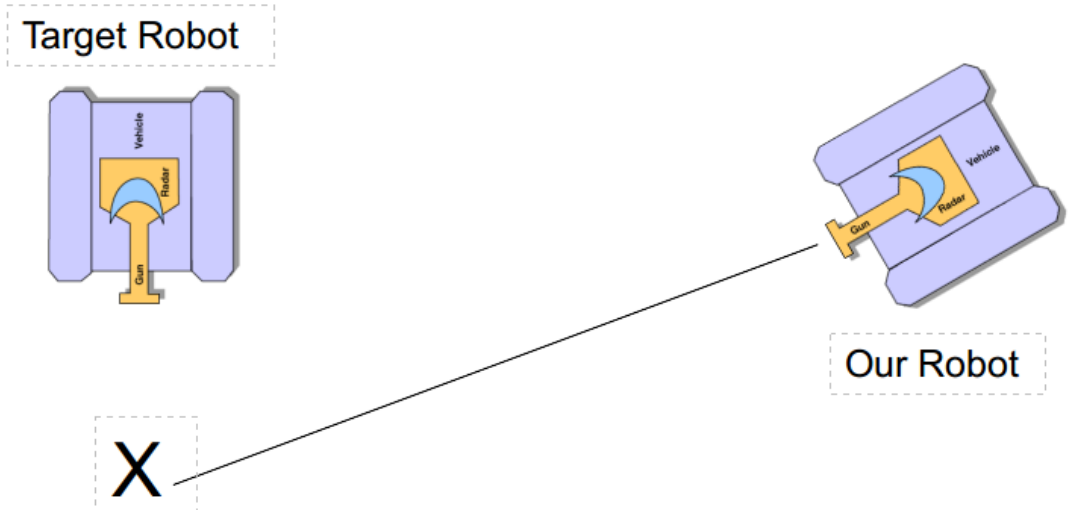
- None – easy to hit
- Straight line
  - Problem: Easy for enemies to predict
- Curve
  - Problem: Also easy for enemies to predict
- Oscillating
- Random
  - Problem: Run a larger chance of hitting walls
- Anti-gravity – keeps the robot from dangerous areas and attracts it toward advantageous areas

These and more discussed here – http://www.dinbedstemedarbejder.dk/Dat3.pdf

Shooting Strategies

- **Linear** – Assume that the robot is moving in a straight line, fire at where the robot should be in the time it takes to fire (Assumes constant velocity)
  - All robot motion can be approximated for a short period of time this way



Shooting Strategies

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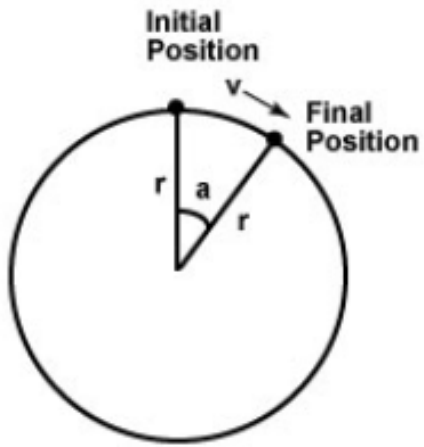
Circular

- change in x = cos(initialheading) *radius - cos(initialheading + changeinheading)* radius
- change in y = sin(initialheading + changeinheading) *radius - sin(initialheading)* radius



Some Links

- Download
- API Doc
- Robocode Wiki
- Youtube

Rulez

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- Every hour we run a *fight* of 10 rounds
- We will start at 11:00
- Last *fight* at 16:00
- 6 *fights* in sum
- Create a team: Team name is package name!
- Use the gitlab repo: https://inf-git.fh-rosenheim.de/inf-fpk/robots
- Check in only class file!
- One class only, no jars!

Comments

- Don't cheat!
- Learn and adjust your strategy!
- Have fun!

Final Thought!