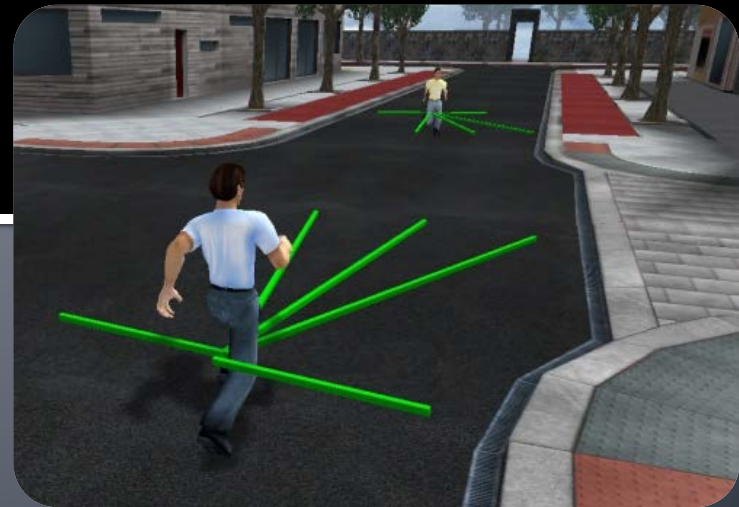Faculty of Mathematics and Physics
Charles University in Prague
24th March 2014

UT2004 & UE2 bots made easy!

Pogamut 3

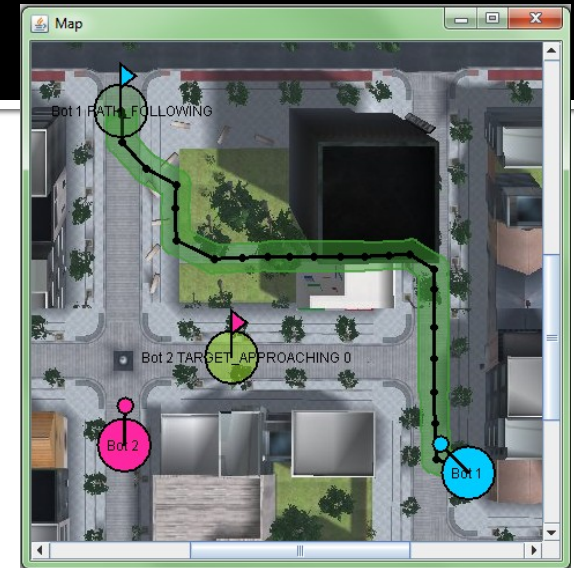## Lecture 4 – Steering Behaviors

Warm up!

- Fill the short test for this lessons
  - http://goo.gl/ip5o7y (char in the middle is small O)
  - 5 minutes limit

  - https://docs.google.com/forms/d/1BI-Yr4S7V0sBHg1WcaW1VYqWtQ4gQpN5bWiMUrW2w7M/viewform

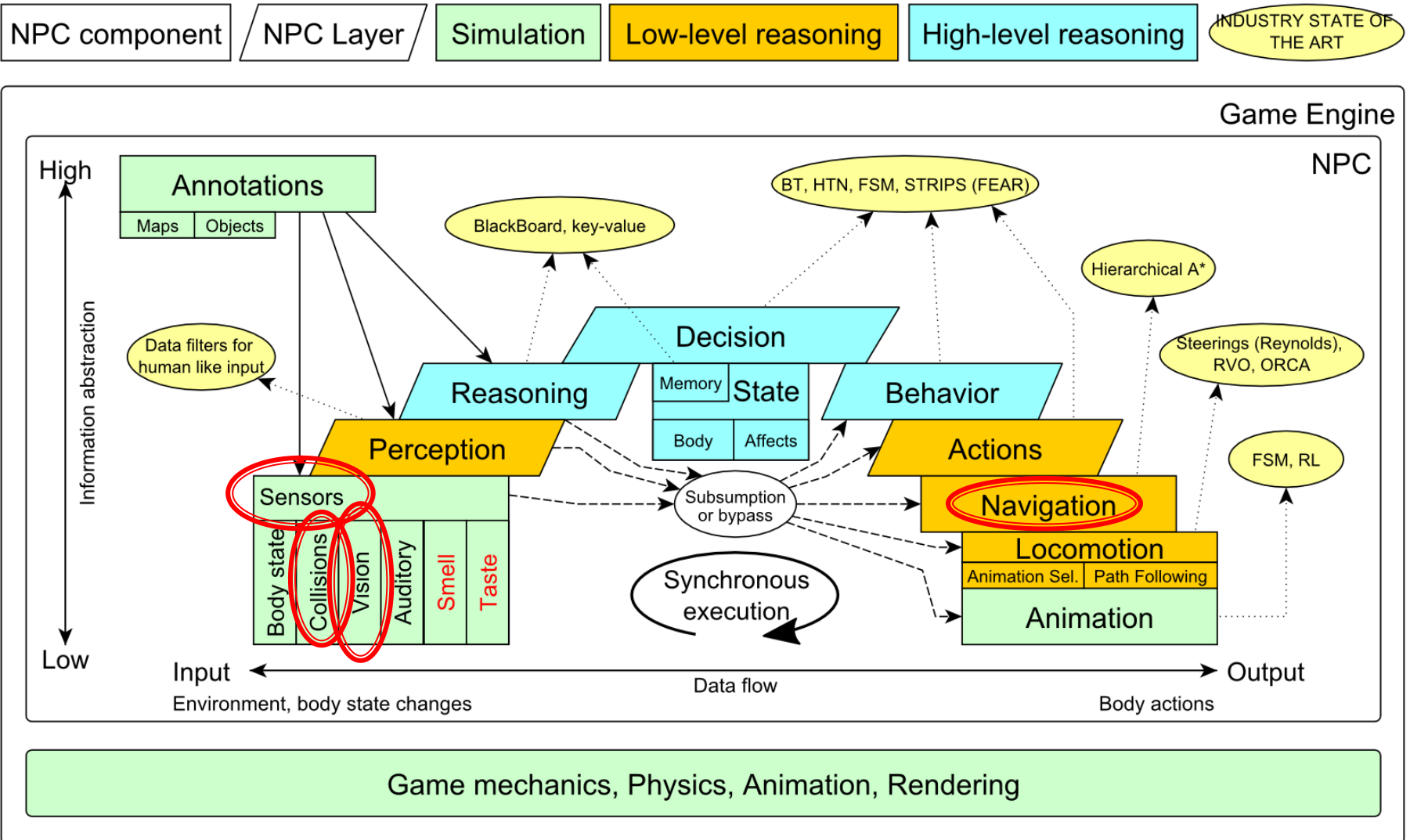# Today's menu

- **Steerings**
  - Steering Game
- **Steering Assignment**

Big Picture
Today

NPC component	NPC Layer	Simulation	Low-level reasoning	High-level reasoning	INDUSTRY STATE OF THE ART

Game Engine

NPC

High — Low (Information abstraction)

- Annotations
  - Maps | Objects

- BlackBoard, key-value

- BT, HTN, FSM, STRIPS (FEAR)

- Data filters for human like input

- Decision

- Hierarchical A*

- Reasoning | Memory | State | Behavior
  - Body | Affects

- Perception

- Steerings (Reynolds), RVO, ORCA

- Sensors
  - Body state | Collisions | Vision | Auditory | Smell | Taste

- Subsumption or bypass

- Actions

- FSM, RL

- Navigation

- Synchronous execution

- Locomotion
  - Animation Sel. | Path Following

- Animation

Input ← Data flow → Output

Environment, body state changes

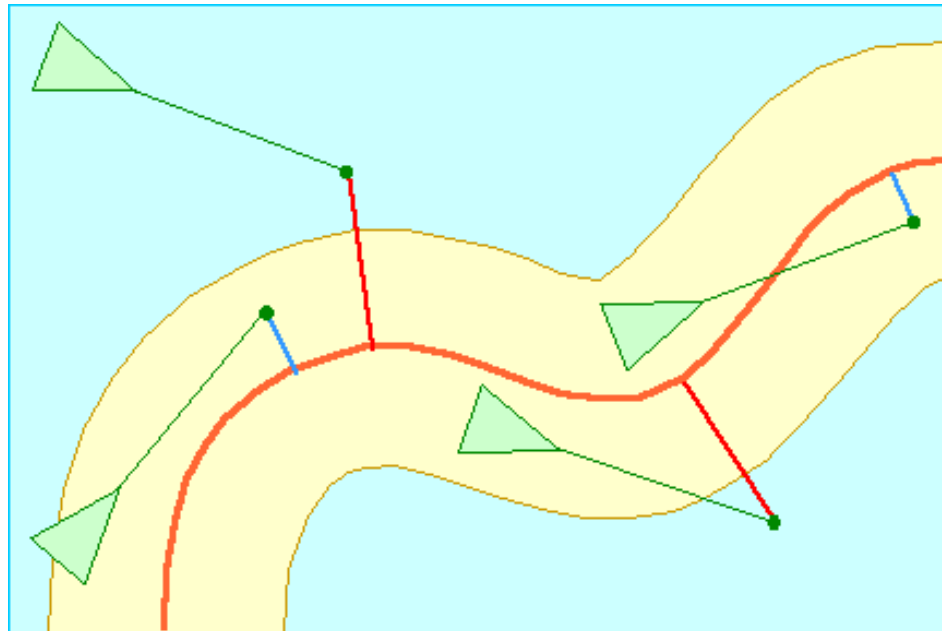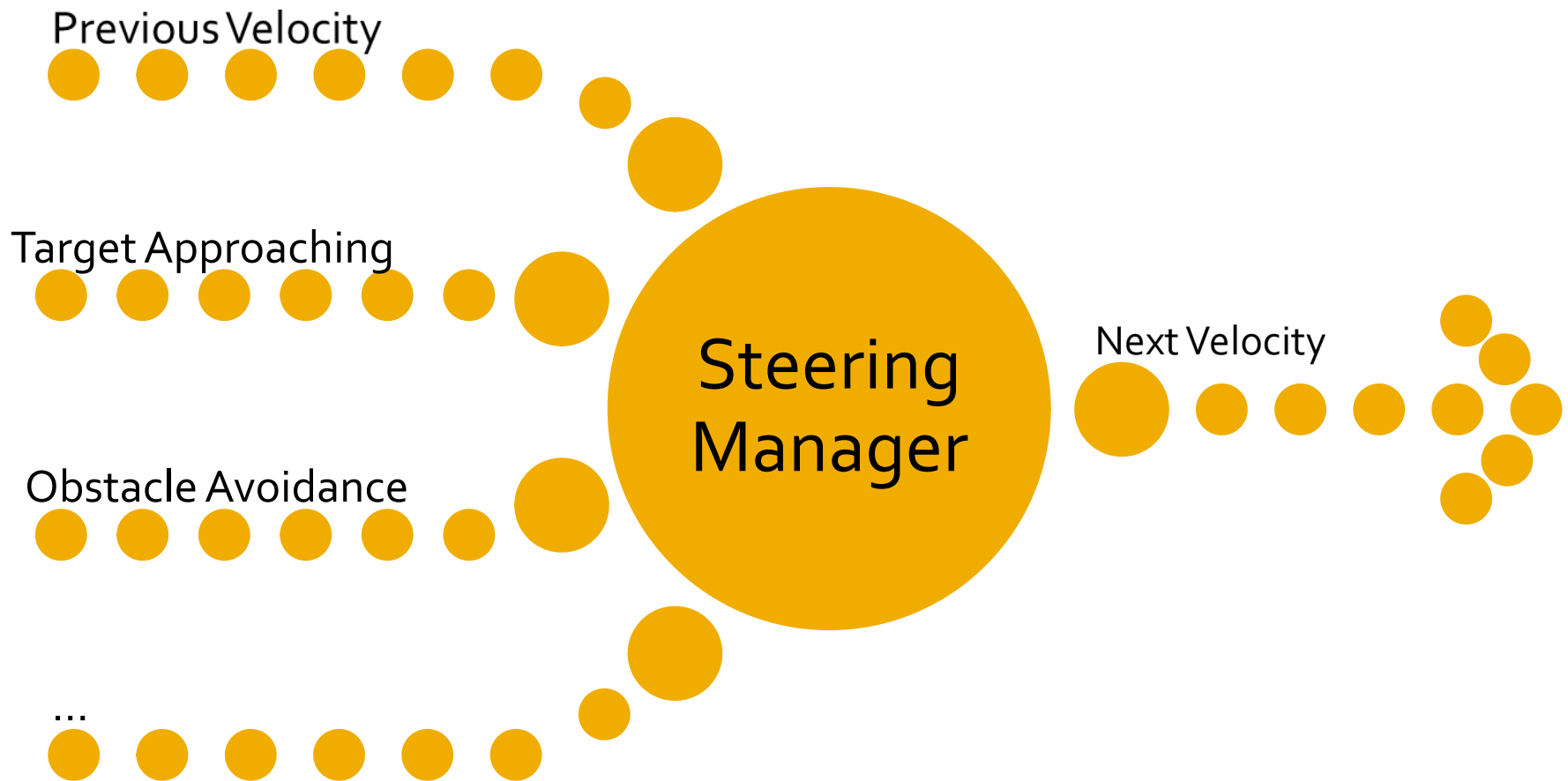Body actions

Game mechanics, Physics, Animation, Rendering

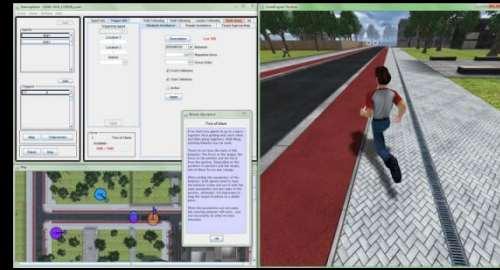# What is Steering?

… Google: reynolds steering ☺
- Craig Reynolds
  - http://www.red3d.com/cwr/steer/

Steering Schema

Previous Velocity

Target Approaching

Obstacle Avoidance

...

Steering Manager

Next Velocity

Steering Schema

Previous Velocity v_t

weight w_0

Target Approaching s_1

weight w_1

$$\frac{w_0 \cdot v_{t-1} + \sum_{i \in I}(w_i \cdot s_i)}{w_0 + \sum_{i \in I} w_i}$$

Next Velocity v_{t+1}

Obstacle Avoidance s_2

weight w_2

. . .

$$I = \{i = 1, \dots, n \mid s_i \neq 0\}$$
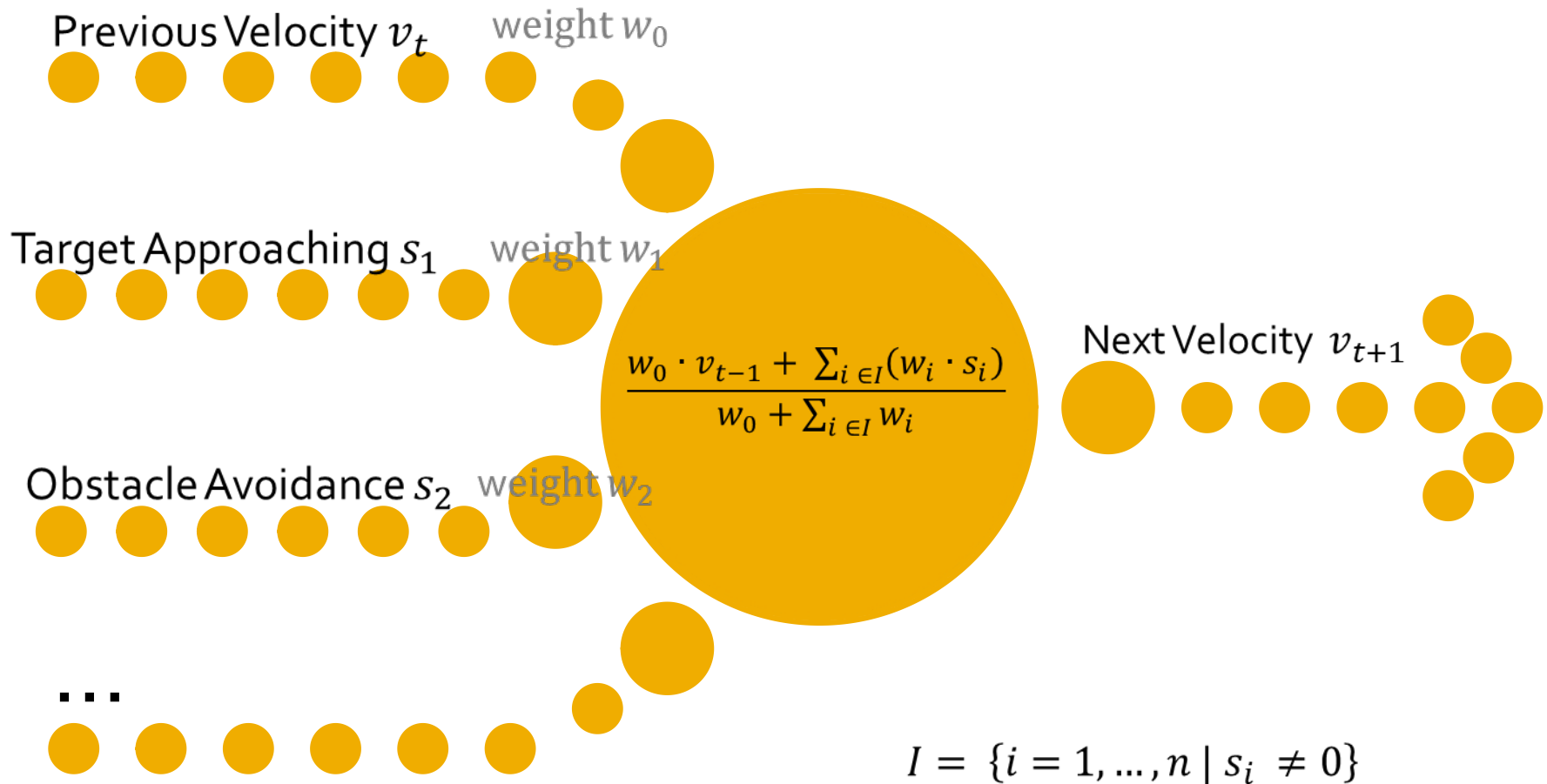
Steering Game

- Steering Tool & Steering Game website
  - http://goo.gl/NQsDrG
  - Contains explanation how to work with the game!

- SteeringGame 2.0 Installer
  - http://goo.gl/JE6uho (o is actually zero)

- Files used in this lesson : PracticalsScenes
  - http://goo.gl/PlIlzE (P 'small L' 'big I' 'small L' E)

Steering Game
Starting the game

- You need to run 3 files in this order

1. Server. You will find it in the directory with the installed SteeringGame:
   - `c:\SteeringGame2.0\UnrealEngine2RuntimeDemo\System\start EmohawkServer.bat`
   - If the window about allowing communication of UCC appears, confirm Allow access.

2. 3D virtual environment (UE2Runtime). It will be in the same directory:
   - `c:\SteeringGame2.0\UnrealEngine2RuntimeDemo\System\start UE2Runtime.bat`
   - Wait 10s and then confirm OK. When the environments is loaded, press Esc.

3. The SteeringGame. Run the file:
   - **c:\SteeringGame2.0\SteeringGame.exe**
   - Loading could last some time (about 1 min).
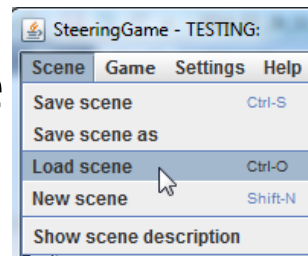
Steering Game
How it looks like
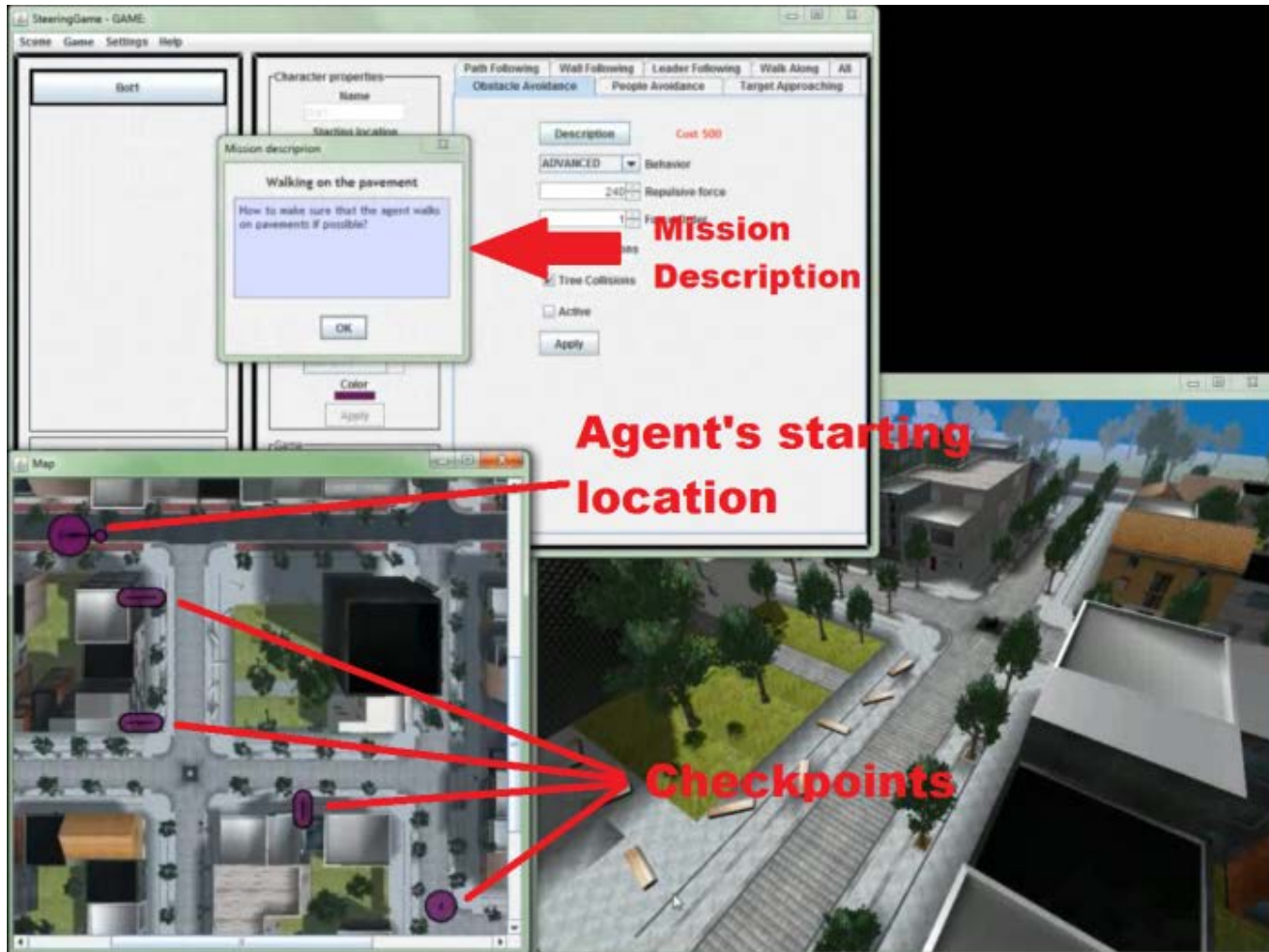
- Once you have Steering Game up-and-running

1. Ok, ok, ok... Continue with training mission
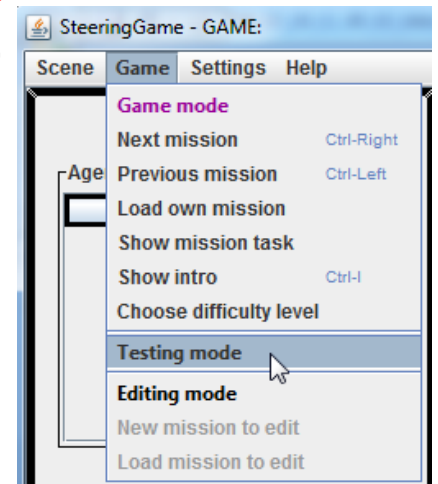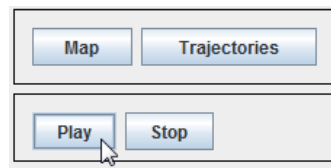

...
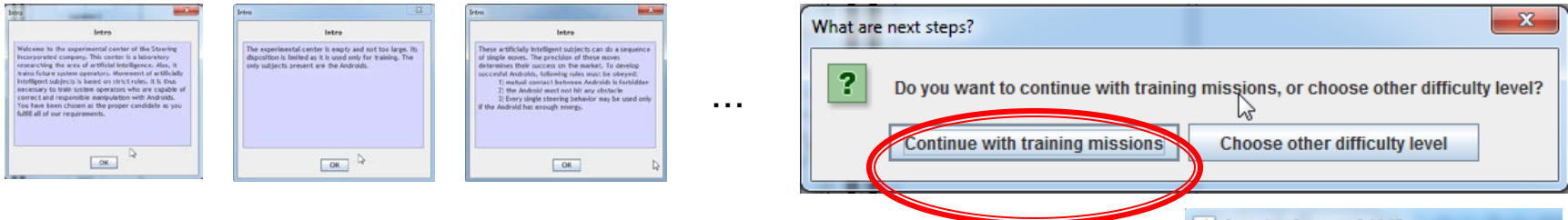
2. Then switch to TESTING MODE -------->

3. Load first scene file
   - `OA_front_a_p.xml`
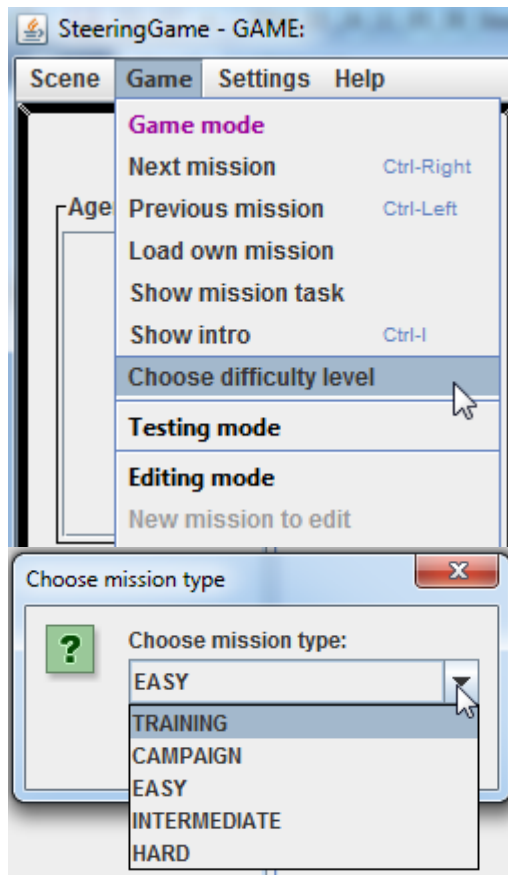
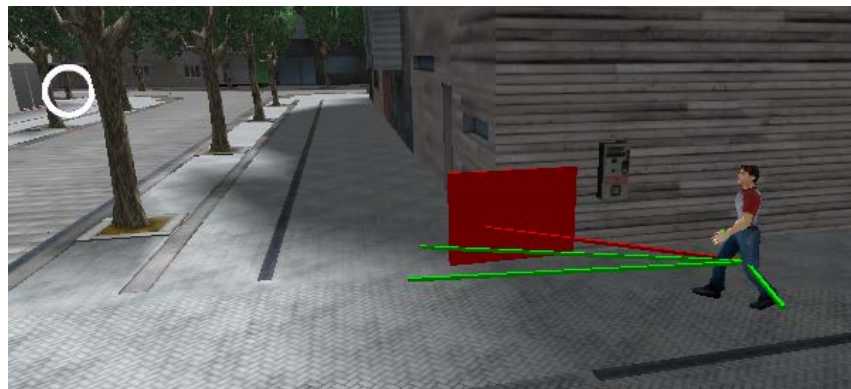3. Click "play" and look for the guy in UE2
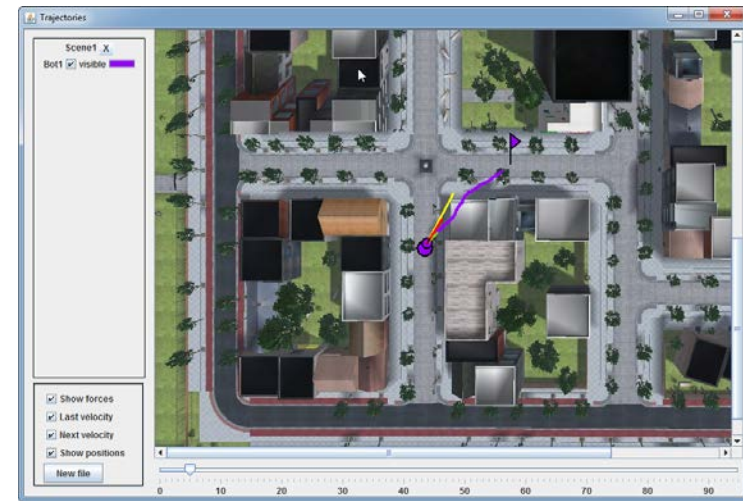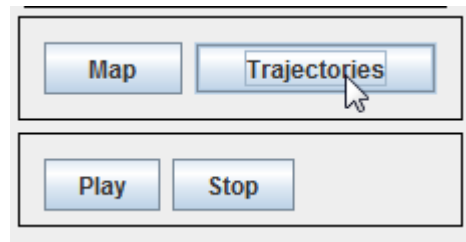   - Be patient!

Steering Game
Trajectories

Choosing difficulty level and iterating through missions.

Once you "play and stop" the steering, you can open "Trajectories" of bots and checkout step by step, what result steering force bots had.

When you succeed in the mission, the "Trajectories" are still holding the last run! Print-screen them as proofs!
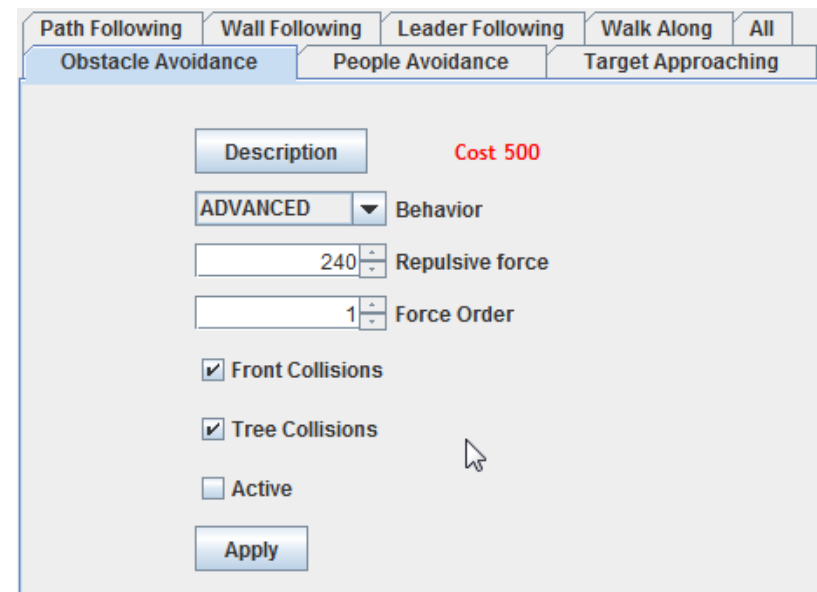
- ## Obstacle Avoidance

  - ### Front Collision – Why and how to solve it?

    - `OA_front_a_p.xml`

  - ### Tree Collisions – Why and how to solve it?

    - `OA_tree_a_p.xml`

- **People Avoidance**
  - **Oncoming** – How big has to be the steering force to prevent the collision? How to solve it better?
  - **Crossing** – What will happen? Why? How to solve it?

Path Following	Wall Following	Leader Following	Walk Along	All
Obstacle Avoidance		People Avoidance		Target Approaching

Description   **Cost 500**

ADVANCED ▼ Behavior

200 ⯅⯆ Repulsive force

300 ⯅⯆ Distance

☑ Circumvention

☑ Deceleration

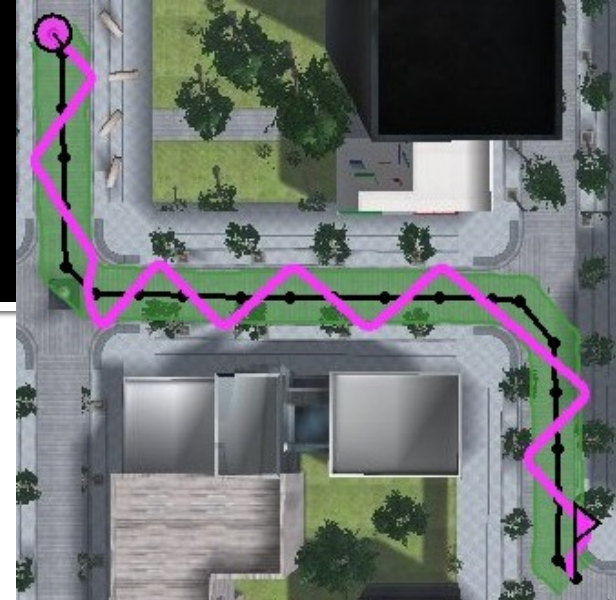☑ Acceleration

16 ⯅⯆ Projection

☐ Active

Apply

- ## Path Following
  - How to improve Path following
    - Smoother trajectory, more natural in curves)?
    - What will be the impact of longer Projection and Regulation Force and why?
  - ## Regulation Force
    - Find the ideal value.

Assignment 4
SteeringGame

- Download and install Steering Game
  - SteeringGame 2.0 installer
    - http://goo.gl/JE6uho

- Learn how to work with the game
  - http://goo.gl/NQsDrG

- Compulsory
  - Solve at least four EASY levels from the Steering Game
    ~ 1 point each
  - Solve two INTERMEDIATE levels from the Steering Game
    ~ 3 points each
  - *10 points*

- Bonus (up-to 10 points)
  - Solve two HARD levels from the Steering Game
    ~ 5 points each
  - *Up to 10 points*

Assignment 4
SteeringGame

- After finishing the level, save trajectories of your solution AND make a screenshot with your trajectory!

- Name files as "`Level-Difficulty-X`" (without quotes of course), where X is the actual number of the level from chosen difficulty.

Send us finished assignment

Via e-mail:
- *Subject*
  - "Pogamut homework 2014 – Assignment X"
    - Replace 'X' with the assignment number and the subject has to be without quotes of course
    - …or face -2 score penalization
- *To*
  - jakub.gemrot@gmail.com
    - Jakub Gemrot (Tuesday practice lessons)
  - michal.bida@gmail.com
    - Michal Bida (Monday practice lessons)
- *Attachment*
  - Completely zip-up your folders containing level solution, level solutions are named "Level-DIFFICULTY-X" where DIFFICULTY is level's difficulty and X is the actual number of the level of the chosen difficulty (or face -2 score penalization)
- *Body*
  - **Please send us information about how much time it took you to finish the assignment + any comments regarding your implementation struggle**
    - *Information won't be abused/made public*
    - *In fact it helps to make the practice lessons better*
  - Don't forget to mention your full name!