



Exercise Design for Introductory Programming

Master Thesis

Marcel Kessler



„The truth is that no ideal strategy [to teach introductory programming] has yet been found, and that every approach has strengths and weaknesses.“

The Joint Task Force on Computing Curricula, IEEE Computer Society

- What were the weaknesses of 'Introduction to programming' 2003? How can they be improved?

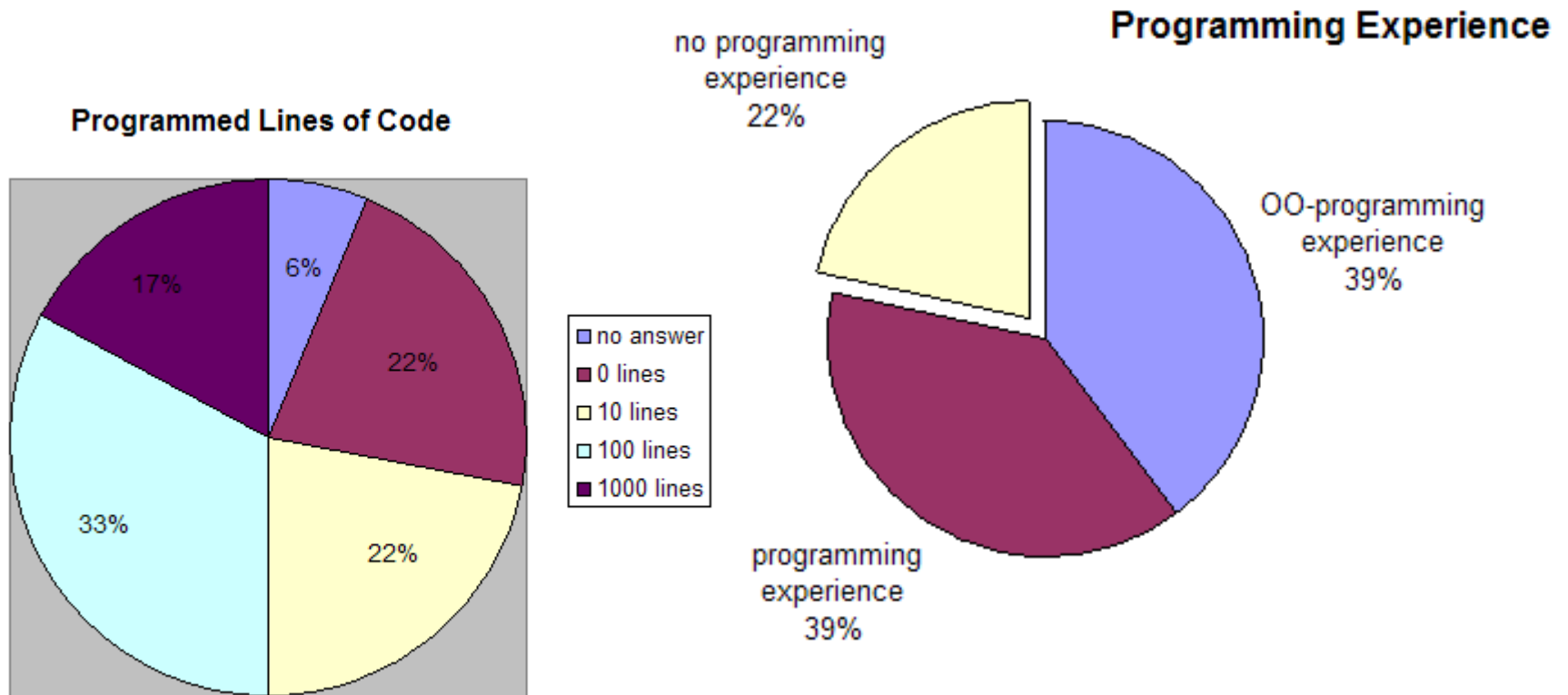


- Evaluation of 'Introduction to programming' 2003
 - Overview
 - TRAFFIC
 - Exercises
 - Conclusions
- The new TRAFFIC-extension: FLAT_HUNT
- The new exercises
- Summary and Outlook



Programming experience

- As we assumed, the students background is very diverse:





"TRAFFIC is missing a good documentation."

"Few like TRAFFIC."

"TRAFFIC: too big and intransparent."

"Compilation of TRAFFIC at ETH takes half an hour."

"The software TRAFFIC was unstable and slow, even on very fast machines. I'd prefer another sample environment."

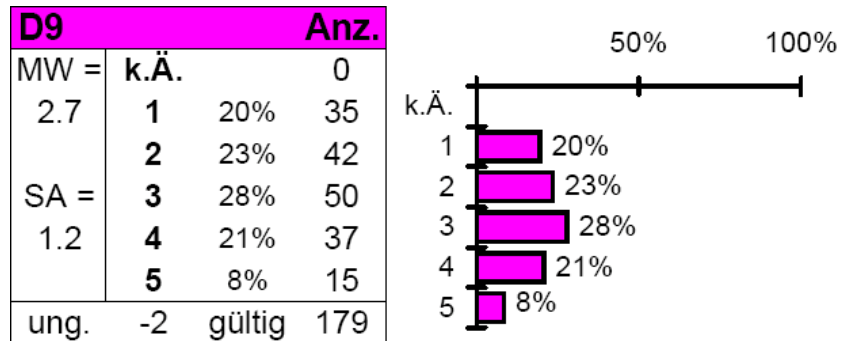
"Like this exercise because there is no TRAFFIC."

"Writing programs from scratch would be better."

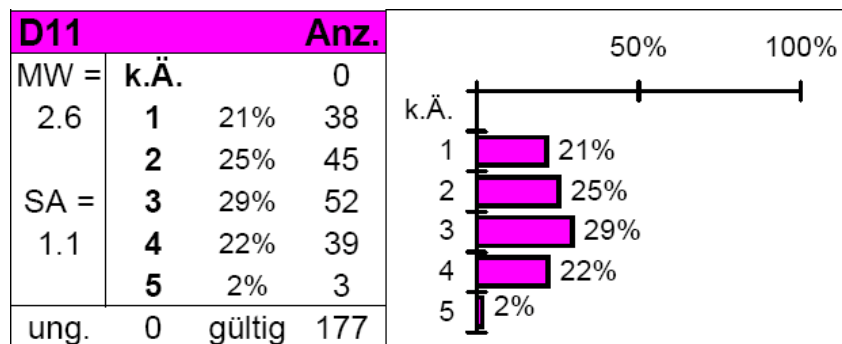
"Usually, if something doesn't work I think that it's my fault, but TRAFFIC also has bugs. If you can't trust the base you're working on, learning becomes unpleasant."



- I liked the idea to work with a predefined software system (i.e. TRAFFIC).



- TRAFFIC was a useful basis for the exercises.





"I did not understand the questions."

"Giving examples would help us understanding what is asked."

"When to inherit and when to use it as a client?"

"Please print the exercises on rag-paper."

"It was a pity that we had to make a TRAFFIC extension.
Everybody should have a chance to do what he wants to do."

"Project based on TRAFFIC was not welcome."

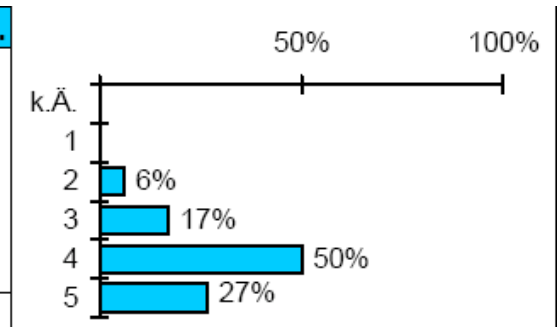
"Break project into parts, add milestones."



Things are not that bad...

- "Substantial improvement to last year's course."
- General impression of the course:

S18 Frage des Studiengangs INFK		Anz.
Gesamteindruck der Lehrveranstaltung: (k.Ä., 1: --, 2: -, 3: +-, 4: +, 5: ++)	k.Ä.	0
	1	0
	2	6% 9
	3	17% 25
	4	50% 73
	5	27% 39
MW = 4.0	SA = 0.8	ungültig 31
		gültig 146



- But there is room for improvement...



- TRAFFIC has to be redesigned
 - Faster, more stable, less complex and better documented → Michela
 - More interesting → FLAT_HUNT game
- Exercises and project
 - State exercise goals, ask clearer questions
 - Provide hints and examples
 - Include „stand-alone“ exercises
 - Base project not only on TRAFFIC












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- Extension to Michela's new TRAFFIC library
- Boardgame à la „Scotland Yard“
 - Round-based
 - Use public transport in a city
- Exercises based on FLAT_HUNT
- TOUCH_APPLICATION includes examples from „Touch of Class“ textbook



FLAT_HUNT: The story

- Estate agent: 
 - Goes around in Zurich to rent flats
- Flat hunters:        
 - Students starting at ETH, desperately trying to find a flat
- 4 gaming modes:
 - Hunt
 - Escape
 - Versus
 - Demo



FLAT_HUNT: Demo

Game settings

Game Mode: Hunt Escape Versus Demo

Hunters: 4

Map Size: Little Map Big Map

Start Cancel

Round 4: tram
Round 3: tram; Central -> Sonneggstrasse
Round 2: tram; Loewenplatz -> Central
Round 1: bus; Hauptbahnhof -> Loewenplatz

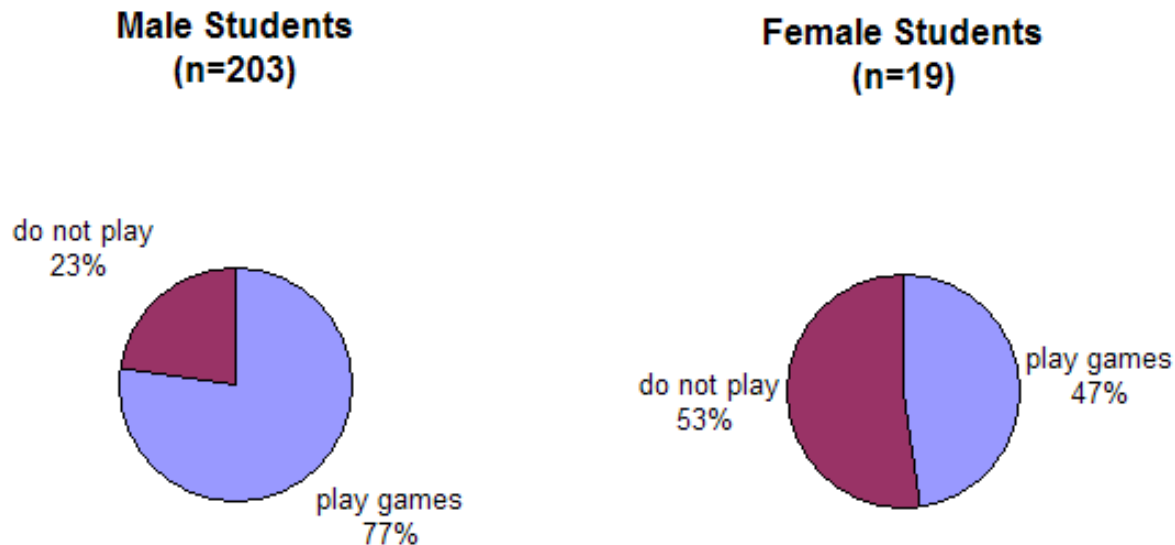
Agent	Hunter 1	Hunter 2	Hunter 3	Hunter 4
Rail tickets: 4 Tram tickets: 21 Bus tickets: 9				

Play: Agent
Round: 5
Flat hunters:
Place: Dammweg
Place: Waidspital
Place: Kronenstrasse
Place: Beckenhof
Estate agent:
Place: Roeslistrasse



Why a game?

- Video game programming is one of the most motivating topics for computer science students.
Ricardo Jimenez-Peris, Sami Khuri, and Marta Patino-Martinez. Adding breadth to cs1 and cs2 courses through visual and interactive programming projects.
- The students themselves are plausible end-users.
Guttorm Sindre, Steinar Line, and Ottar V. Valvag. Positive experiences with an open project assignment in an introductory programming course.
- Game playing is what students got interested in computers.
Katrin Becker. Teaching with games: the minesweeper and asteroids experience.





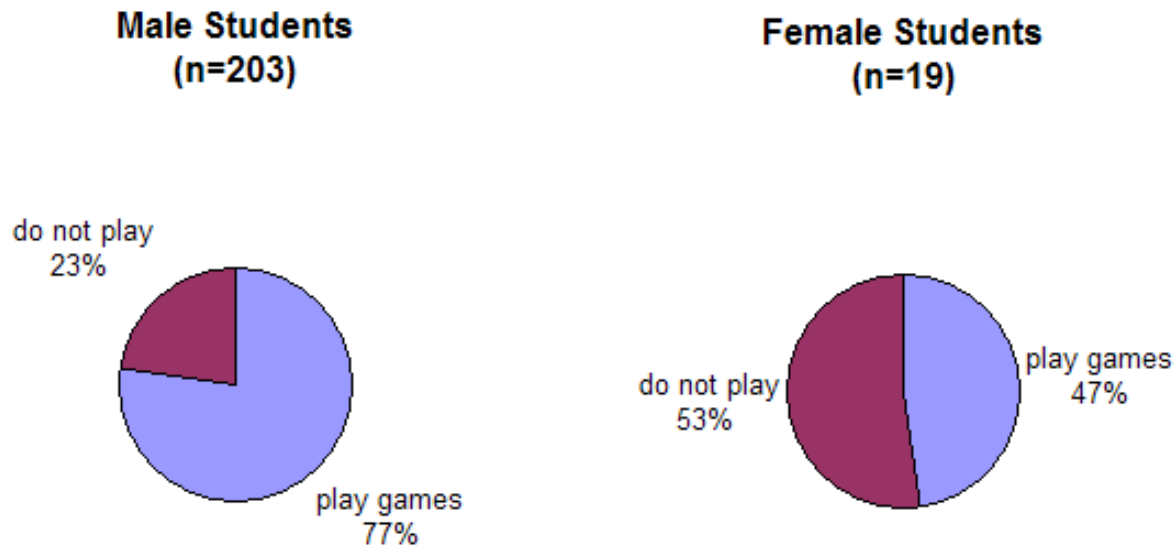
Why FLAT_HUNT?

- Girls prefer collaborative games and games that require thought.

Cecilia M. Gorriz and Claudia Medina. Engaging girls with computers through software games.

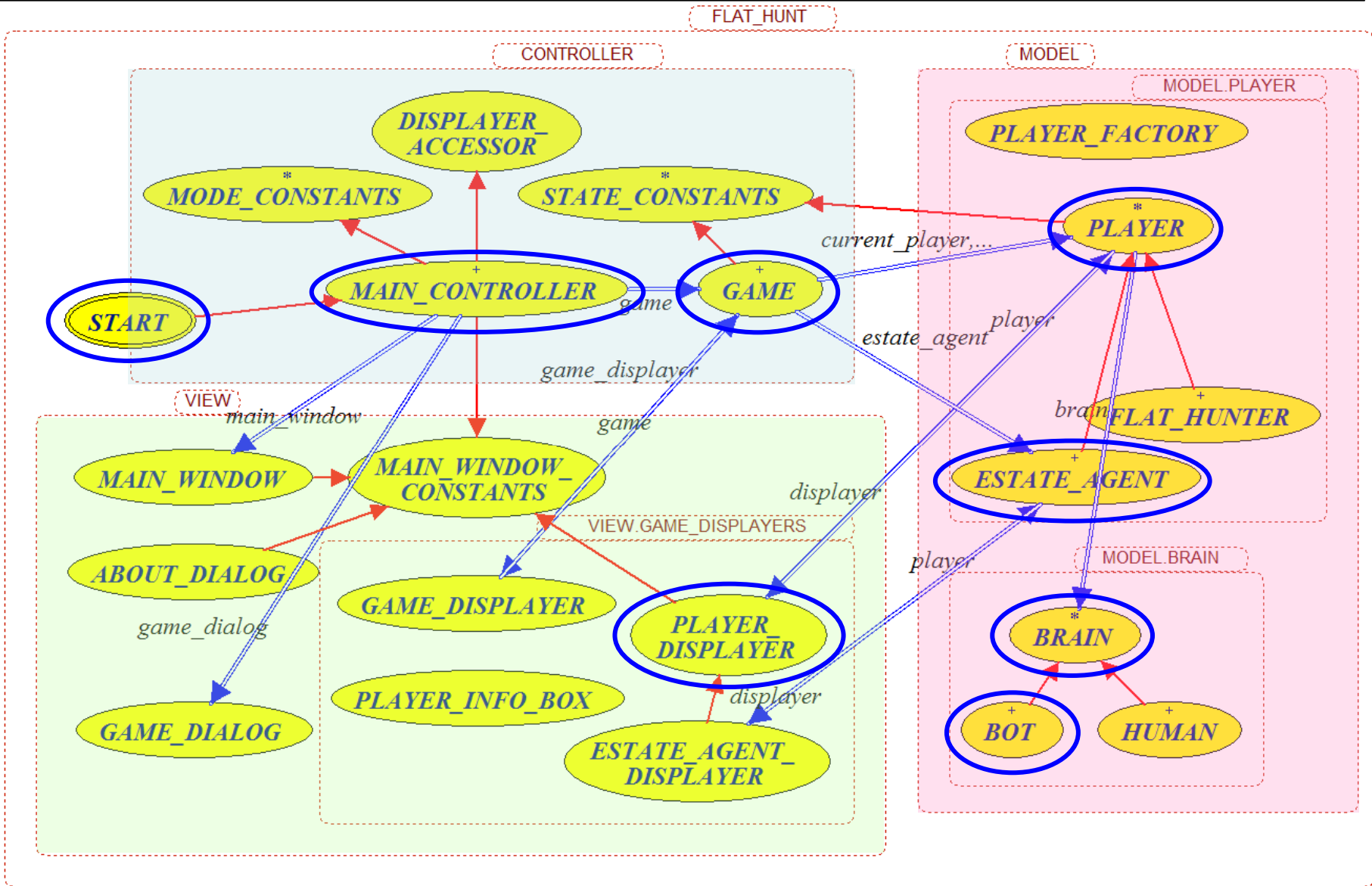
- Use a game that almost all students have tried. This puts the problem they are to solve in a context with which they are already familiar.

Katrin Becker. Teaching with games: the minesweeper and asteroids experience.



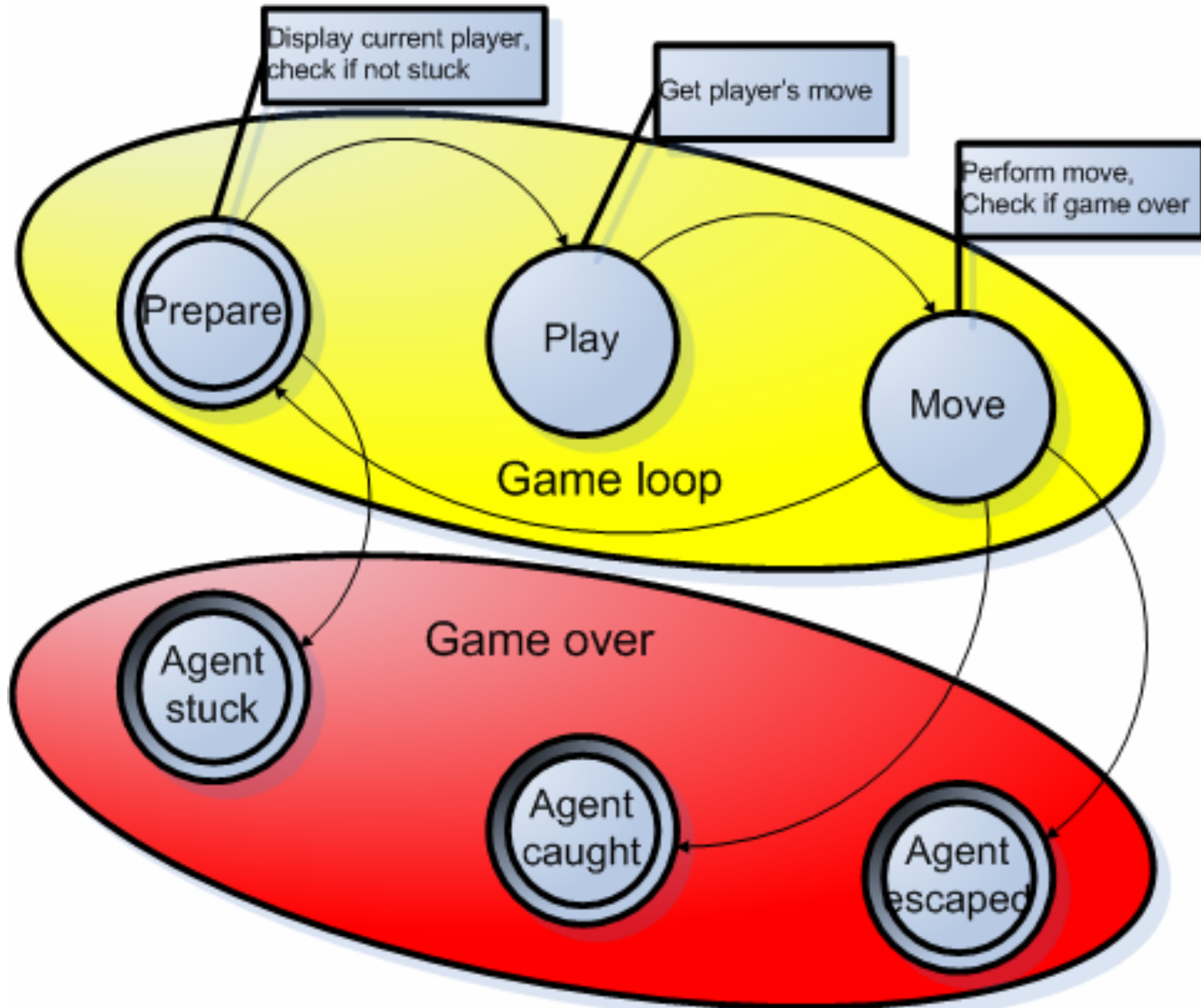


FLAT_HUNT in BON





Game states





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Description

You will do your first steps in programming. The class that you will change is called START. Open this class in EiffelStudio and perform the following tasks:

To do

1. Without changing anything in the class, click on "Launch". This will start the application, however, nothing will happen. Close the application.
2. In the feature start, between the *do* and the *end*, fill in the following text:

```
open_map ("zurich_big_city.xml")  
set_game_mode (Hunt)  
set_number_of_hunters (4)  
start_game
```

3. Compile the project again and launch it. It takes some time to load the map, but then you should be able to play FLAT_HUNT.
4. Try changing the modes of the game (see FLAT_HUNT documentation for more information):
 - Load a different map
 - Try different game modes
 - Change the number of players
(Try also negative values and values greater than 8)

What happens if you change the order of the calls?



Description

In the class *PLACE_DISPLAYER* in *FLAT_HUNT*, there is a feature called *agent_found_animation*. This feature gets called when the flat hunters find the estate agent. Up to now nothing happens, because there is just an empty loop.

Your task is to fill this loop, and try to make a nice animation whenever the agent is found. This could for example look like the figure on the right.

However, instead of circles, you might also want to draw lines or rectangles.



To do

Fill in the loop in feature *agent_found_animation* in class *PLACE_DISPLAYER*.



- Three options:
 1. Extend FLAT_HUNT (anything from better AI to real-time multiplayer internet-based game...)
 2. Implement Conway's Game of Life in Eiffel
 3. Do something they've always wanted to do
- Homogeneous groups (like in Info 4):

Please **do not** solve this assignment alone. Actually, you should do the project in **groups of three**. Try to form **uniform groups** concerning your programming experience, so that you can choose a task that is equally **challenging** for all the three of you.



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- Evaluation:
 - Inverted Curriculum worked
 - TRAFFIC needed redesign → FLAT_HUNT
- New exercises
 - Based on FLAT_HUNT game
 - More open project
- 'Introduction to programming' 2004
 - Hopefully even better than in 2003

"Designing assignments is one of the most personalized aspects of teaching, and therefore also one of the most gratifying."

Todd J. Feldman and Julie D. Zelenski, The Quest for Excellence in Designing CS1/CS2 Assignments

Thank you!

Questions?