Game Programming as a Non-Threatening Introduction to Functional Languages

A. Cortesi, G. Costantini, G. Maggiore

Ca’ Foscari University

Agenda

- Theory vs Practice
- Games as application field
- Formal definition of a game
- Case Study
- Implementation
- Future work

Theory vs Practice

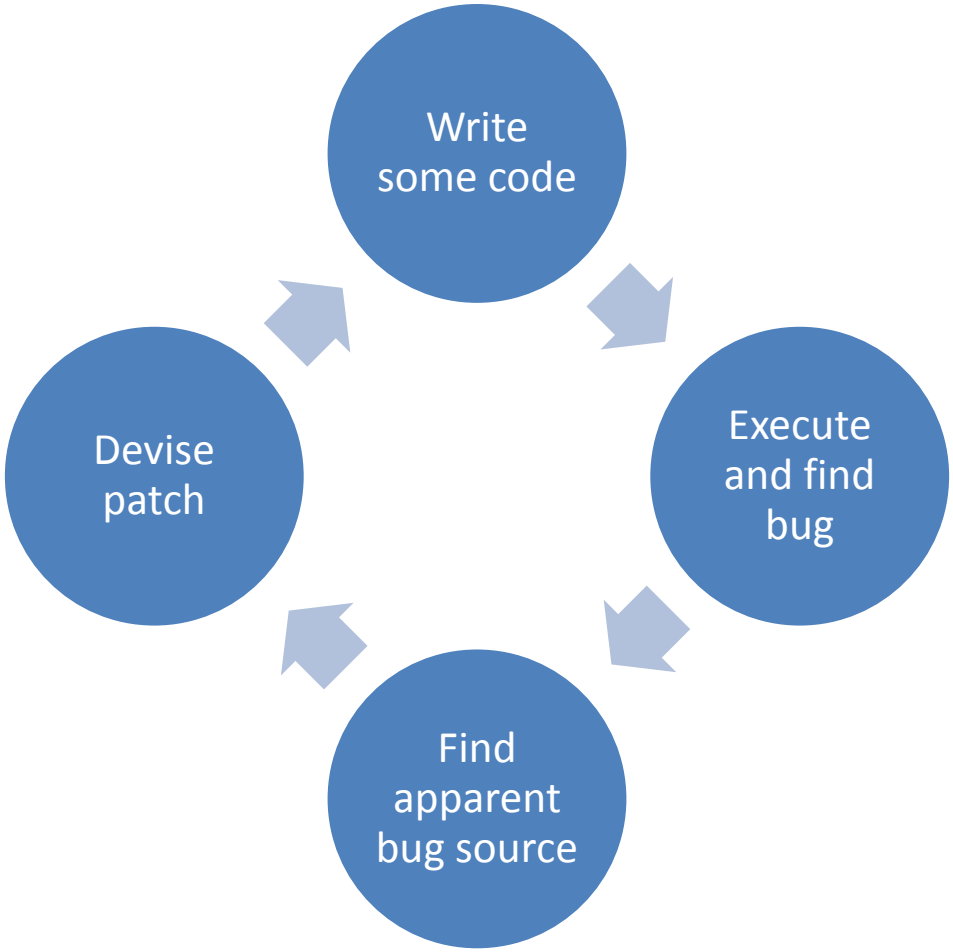
- Mathematics and programming are rarely studied closely together
- Many students see maths as a pointless torture ☺
- We need to remind ourselves: why do we teach maths to CS students?

Why maths to CS students?

Why maths to CS students?

To think before writing code.

Wild debugging



Causes: programming languages

Imperative

Flat structure, allows adding
patches without thinking much
(compile as long as added
code is locally compliant)

Causes: programming languages

Imperative

Flat structure, allows adding patches without thinking much (compile as long as added code is locally compliant)

Functional

Hierarchical structure, forces some analysis before plugging terms one inside the other

The plan

- Force students to program better…
- …with the constraints of formality
  1. Analyze the problem
  2. Define the dynamics of the solution
  3. Derive the shape of objects

Field of application

- To apply this, we need programs that
  - Are not trivial
  - Can easily generate messy code
  - Are interesting to work with

```
Running startup scripts for runlevel 3
Generating SSH1 RSA key
Generating public/private rsa1 key pair.
Your identification has been saved in /etc/ssh/ssh_host_key.
Your public key has been saved in /etc/ssh/ssh_host_key.pub.
The key fingerprint is:
11:5f:63:6f:fd:81:76:db:5d:98:c4:9b:ed:fb:ed:3a
Generating SSH2 RSA key
Generating public/private rsa key pair.
Your identification has been saved in /etc/ssh/ssh_host_rsa_key.
Your public key has been saved in /etc/ssh/ssh_host_rsa_key.pub.
The key fingerprint is:
c8:1d:ae:cd:0d:99:55:f6:84:ee:ca:da:9a:6e:e2:9b
Generating SSH2 DSA key
Generating public/private dsa key pair.
Your identification has been saved in /etc/ssh/ssh_host_dsa_key.
Your public key has been saved in /etc/ssh/ssh_host_dsa_key.pub.
The key fingerprint is:
71:a4:99:ce:93:1f:9c:c1:d6:55:7f:b6:1b:bb:76:63
Starting OpenSSH daemon...

-----------------------------------------------
  Welcome to Lintrack - to route or to bridge
-----------------------------------------------

You are running Linux 2.6.17.13-lt6 on i686
Today is Sun Oct 22  2006, 12:40:05

venus.lan login:
```

```
Running startup scripts for runlevel 3
Generating SSH1 RSA key
Generating public/private rsa1 key pair.
Your identification has been saved in /etc/ssh/ssh_host_key.
Your public key has been saved in /etc/ssh/ssh_host_key.pub.
The key fingerprint is:
11:5f:63:6f:fd:81:76:db:5d:98:c4:9b:ed:fb:ed:3a
Generating SSH2 RSA key
Generating public/private rsa key pair.
Your identification has been saved in /etc/ssh/ssh_host_rsa_key.
Your public key has been saved in /etc/ssh/ssh_host_rsa_key.pub.
The key fingerprint is:
c8:1d:ae:cd:0d:99:55:f6:84:ee:ca:da:9a:6e:e2:9b
Generating SSH2 DSA key
Generating public/private dsa key pair.
Your identification has been saved in /etc/ssh/ssh_host_dsa_key.
Your public key has been saved in /etc/ssh/ssh_host_dsa_key.pub.
The key fingerprint is:
71:a4:99:ce:93:1f:9c:c1:d6:55:7f:b6:1b:bb:76:63
Starting OpenSSH daemon...

-------------------------------------------------
  Welcome to Lintrack - to route or to bridge
-------------------------------------------------

You are running Linux 2.6.17.13-lt6 on i686
Today is Sun Oct 22  2006, 12:40:05

venus.lan login:
```

Games as application field

- Games are:
  - Fun
  - Engaging
  - Familiar to most students
  - ...but also...
  - Complex to program!
- Games present engineering and performance issues

Game Definition

- is the game state
- A game is a triple

–

Game Definition

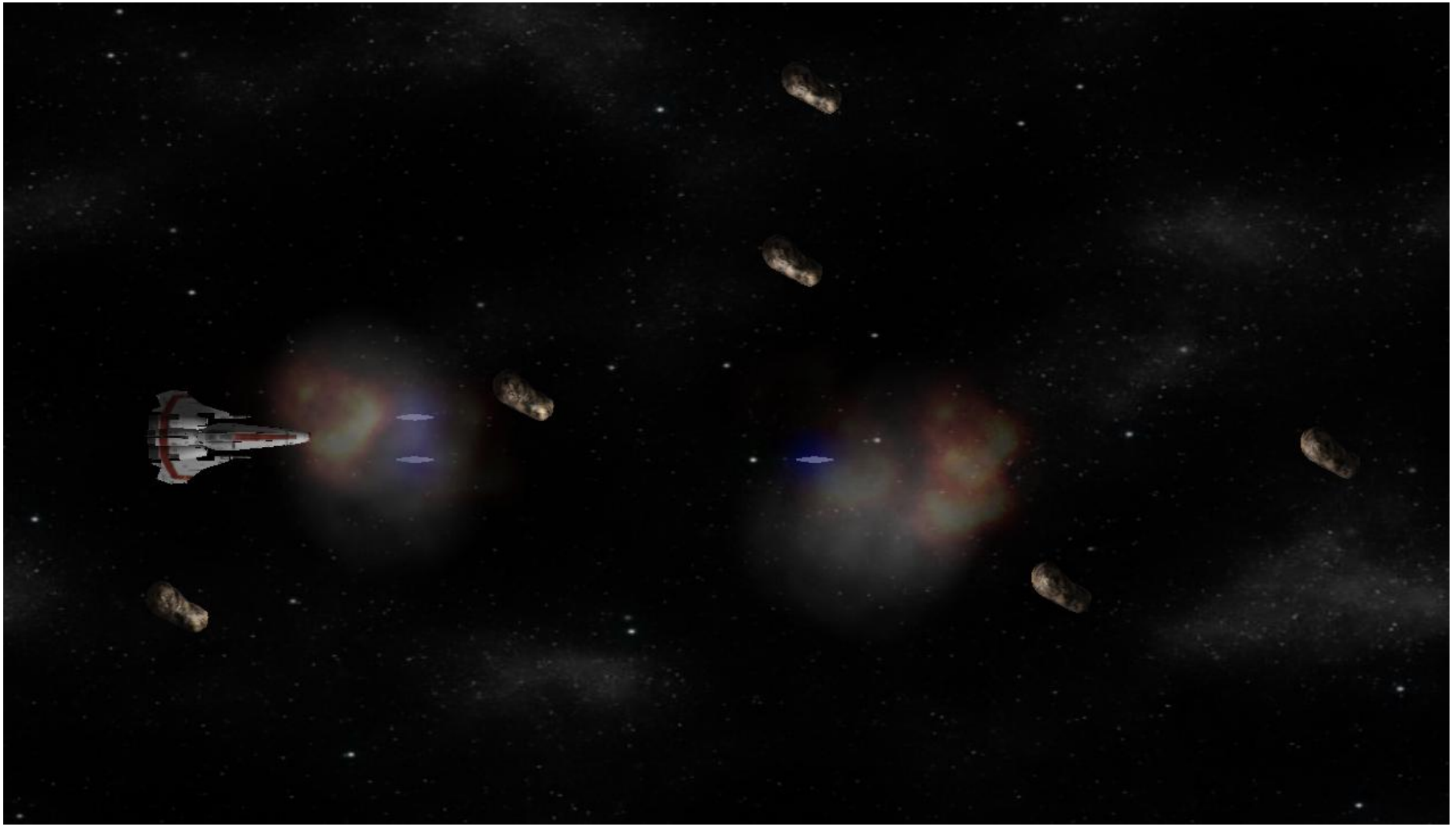
- is the game state
- A game is a triple

  –

1. = initial state
2. = update
3. = draw

- Update and draw

Case Study – The game



Case Study – State

Case Study – Initial State

=

- Depends on the graphics library
- Students do not really need much help here

Types

Types

Types

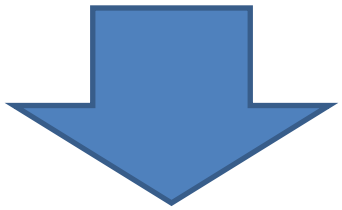
Types

Types

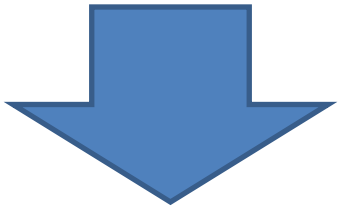
Implementation

- Language choice: F#
- Why?
  - Interoperates with .Net
  - Rich libraries
  - XNA for graphics (great library+toolset+XBox 360)
  - Visual Studio IDE with Intellisense
  - (Currently considering Haskell with .Net ☺)

Implementation



Implementation



let dx = GamePad.X
let dy = GamePad.Y

Future Work

- Managing more complex state
- Variable update functions
  -
  -
  - …
  -
- Gracefully introducing some state and effects
- Using inheritance

Conclusion

- Teaching CS today is a challenge
  - Students want cool technology
  - CS is becoming more and more complex
  - Laboratories are crucial
- Mathematics makes all the difference
  - It allows to give structure to solutions
  - It enables tackling complex problems
  - As long as the students can see it

Thank You

Questions?