Programming Fundamentals

General Course Information

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Programming Fundamentals

- **What is computer programming?**
  - The process of writing, testing and maintaining a computer program for accomplishing a specific task.

- **What is a computer program?**
  - A sequence of instructions that automate the process of performing a task for solving a specific problem.

- **How to write a computer program?**
  - A computer program is written using a programming language.

Programming Fundamentals

- **What is a programming language?**
  - A programming language is a vocabulary and set of grammatical rules for instructing a computer to perform specific tasks.
  - Examples of programming languages: C, C++, C#, Java, JavaScript, HTML, PHP, Python, Lua, Processing, Ruby, Objective-C, Prolog, Go, …
- **What is the best programming language?**
  - There is no "best programming language". It depends on the goals of the application, platform, programmer's skills, etc.

Programming Fundamentals

- Professor: Edirlei Soares de Lima
  - Education:
    - B.Sc. in Computer Science – UnC
    - M.Sc. in Computer Science – UFSM
    - Ph.D. in Computer Science – PUC-Rio
  - Teaching Experience: PUC-Rio, UNIRIO, UERJ, IADE-UE
  - Game Experience:
    - Game Engines: RPG Builder, 3D Game Builder (http://www.3dgamebuilder.com.br/);
    - Research Projects: most are related with Logtell (http://www.icad.puc-rio.br/~logtell/);
    - Games: Krimson (Best Game Award at SBGames 2010 – Indie Game Development Festival), and several other prototype games.
  - More Information: http://www.inf.puc-rio.br/~elima/

Programming Fundamentals

- Games & Apps Development:
  - Study the fundamentals of computer programming in a game development context.

- Learning Outcomes:
  1. Understand the concepts of algorithm and program
  2. Construct algorithms to solve specific problems
  3. Implement simple graphical and interactive applications
  4. Apply the concepts learned in the development of small-size computer games

Programming Fundamentals

- Module Content:
  1. Introduction to programming: concepts of algorithm and program
  2. Introduction to Lua: variables, data types, operators and functions
  3. Introduction to computer graphics: coordinates, color, transparency, and Löve 2D
  4. Conditional statements and user interaction
  5. Loops and images
  6. Vectors, physics and collision detection
  7. Arrays, matrices, animations and level representations
  8. Music and audio effects
  9. Introduction to artificial intelligence

Method

- Project-Based Learning:
  - Learn by doing;
  - Teamwork;
  - "Large" project;

- Active and experiential learning:
  - Theoretical concepts;
  - Practical examples;
  - Implementation exercises;

- Programming Language: Lua

Evaluation

- Continuous Assessment (bipartite):
  - [60%] Intermediate assessment:
    - [30%] Individual exercises on the concepts learned;
    - [20%] Project with Math, Physics and Games I;
    - [50%] Game prototype (2nd delivery) (within the semester's PBL team project).
  - [40%] End of term assessment:
    - [100%] Final delivery of the team project (within the semester's PBL team project) with individual discussion.

- Final Assessment:
  - [100%] Individual project development, delivery, and discussion.

Evaluation

- Project deliveries:
  - **1nd delivery**: game specification
    - No evaluation for Programming Fundamentals.
  - **2nd delivery**: working prototype
    - General code organization and indentation, appropriate use of variables, well-structured loops, appropriate use of arrays, functions and correct physics simulation.
  - **3rd delivery**: final version
    - Same as the 2nd delivery + overall code complexity and game experience.

Lua Programming Language

- Lua is a powerful, fast, lightweight, embeddable, free and open-source scripting language designed for general purposes.

- In video game development, Lua is one of the most popular scripting language for game programming.

- Lua was developed by a team of researchers at PUC-Rio (Pontifical Catholic University of Rio de Janeiro) in Brazil.
  - Currently, PUC-Rio has an entire laboratory (LabLua) dedicated for the development and maintenance of the Lua language.

PUC
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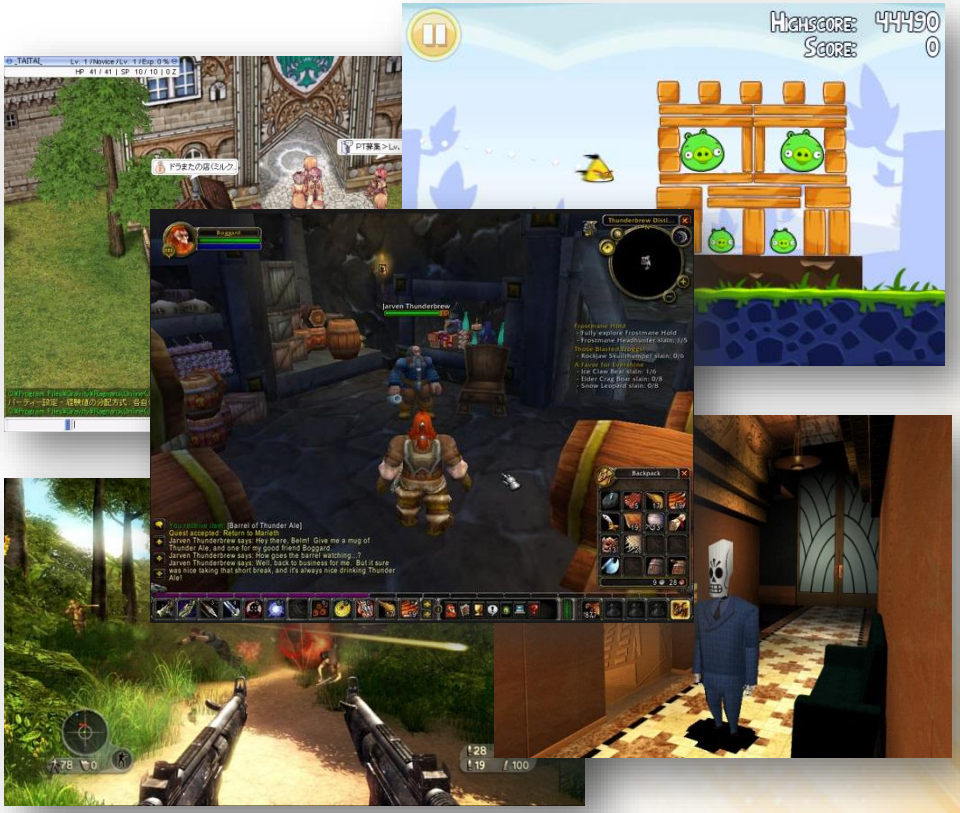
Lua Programming Language

- **Games that use Lua as scripting language:**
  - Angry Birds
  - Civilization V
  - Far Cry
  - Grim Fandango
  - Ragnarok
  - Dota 2
  - World of Warcraft



More at: https://en.wikipedia.org/wiki/Category:Lua-scripted_video_games

Löve 2D Framework

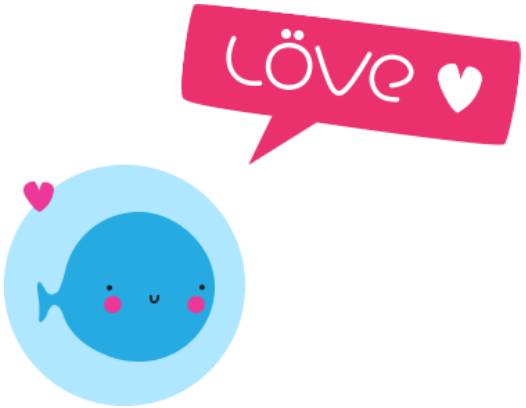
- **LÖVE is a framework to create 2D games in Lua.**
  - It comprises a library of functions to draw visual objects, control user interaction, simulate physics, play audio, and everything else a game needs.
  - It's free, open-source and multiplatform (Windows, Linux, Mac OS, Android, iOS, Web Browsers).

Example of Game (Lua + Löve2D)

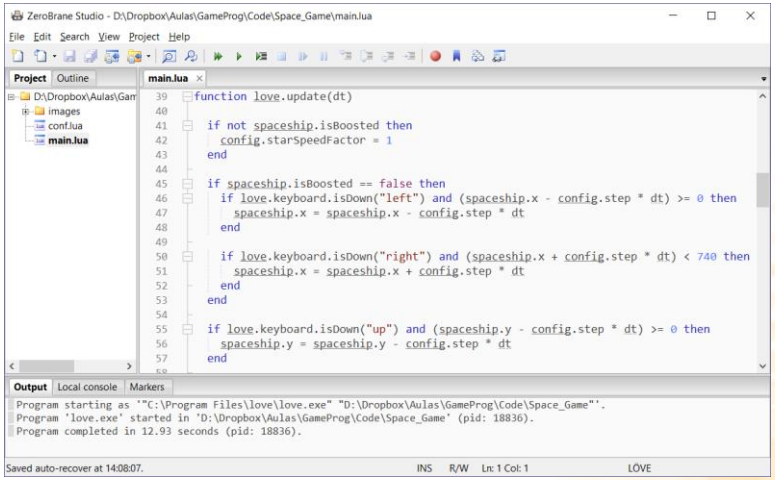
```
...
function love.draw()
  for i = 1, numStars do
    love.graphics.setColor(255 - stars[i].speed,
                           255 - stars[i].speed/2,
                           150, stars[i].speed*0.9)
    love.graphics.draw(star_image, stars[i].x,
          stars[i].y, 0, stars[i].speed/255 + 0.55)
  end

  love.graphics.setColor(255, 255, 255)

  if spaceship_isBoosted == false then
    love.graphics.draw(spaceship_image_normal,
                       spaceship_x, spaceship_y)
  else
    love.graphics.draw(spaceship_image_boosted,
                       spaceship_x, spaceship_y)
  end

  local totalLaserBeams = table.getn(lasers)

  for i = 1, totalLaserBeams do
    love.graphics.draw(laser_image, lasers[i].x,
                       lasers[i].y)
  end
end
...
```

Software

- Löve 11.2: https://love2d.org/



- ZeroBrane Studio 1.80: https://studio.zerobrane.com/



Bibliography

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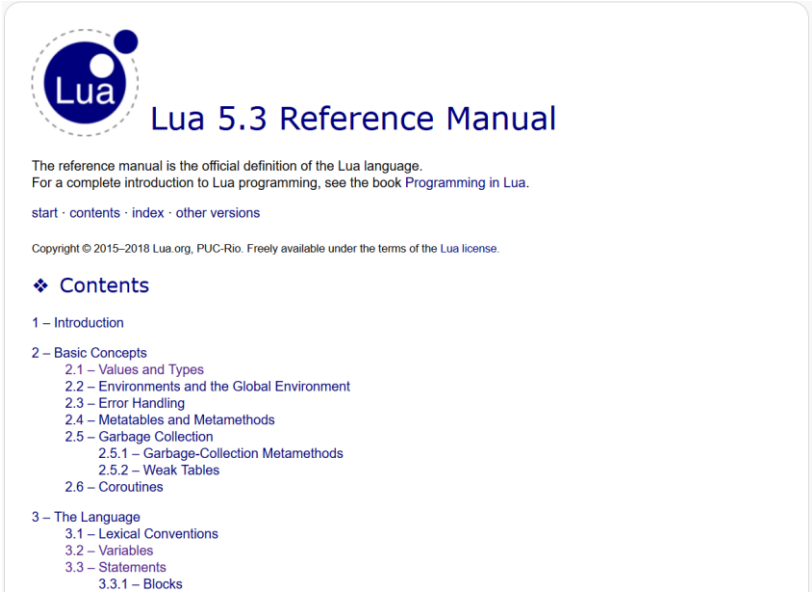
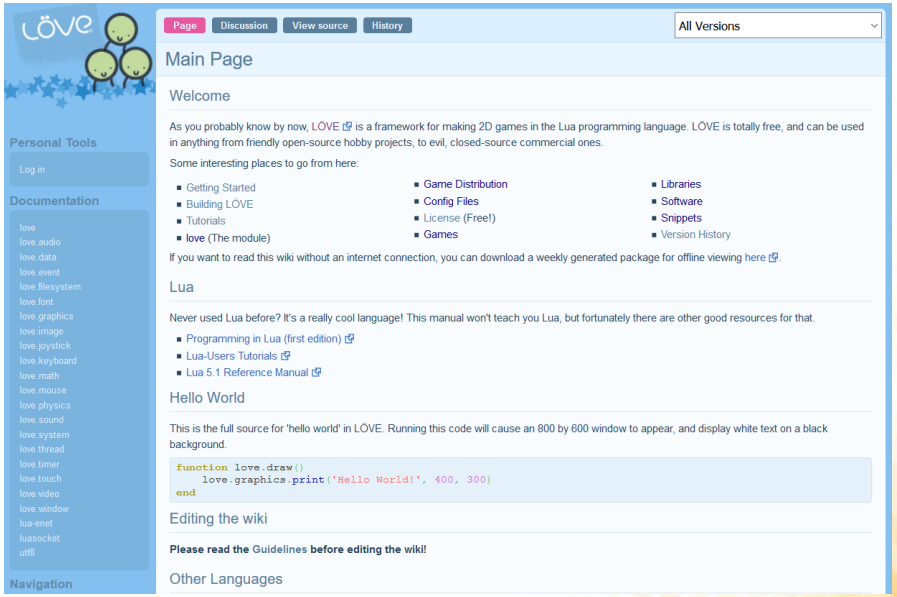
- Ierusalimschy, R., Figueiredo, L. H., Celes, W. (2015). **Lua 5.2 Reference Manual**. Samurai Media Limited. ISBN: 978-9888381227

- Christer, E. (2004). **Real-Time Collision Detection**. CRC Pres. ISBN: 978-1558607323

Web Resources

- Lua 5.3 Reference Manual: https://www.lua.org/manual/5.3/
- Löve Documentation: https://love2d.org/wiki/Main_Page





Programming Fundamentals

- Blackboard (Programming Fundamentals):
  - https://europeia.blackboard.com/
- Course Webpage:
  - http://www.inf.puc-rio.br/~elima/gameprog/
- Contact:
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