Games as Information Systems

Geraldo Xexéo[1,2], Eduardo Mangeli[1], Farmy Silva[1], Leandro Ouriques[1,3],
Luis Felipe Coimbra Costa[1] and Rafael Studart Monclar[1]

1 PROGRAMA DE ENGENHARIA DE SISTEMAS E COMPUTAÇÃO, COPPE/UFRJ, BRAZIL
2 DEPARTAMENTO DE CIÊNCIA DA COMPUTAÇÃO, IM/UFRJ, BRAZIL
3 CENTER FOR NAVAL SYSTEMS ANALYSES (CASNAV), BRAZILIAN NAVY

LUDES
Ludologia, Engenharia e Simulação

Engenharia de Sistemas e Computação
PESC/Coppe

COPPE UFRJ
Instituto Alberto Luiz Coimbra de
Pós-Graduação e Pesquisa de Engenharia

UNIVERSIDADE FEDERAL
DO RIO DE JANEIRO

CIÊNCIA DA COMPUTAÇÃO
UFRJ

INSTITUTO DE MATEMÁTICA
Universidade Federal do Rio de Janeiro

LUDES

- Ludology, Engineering and Simulation
- LUDES is a laboratory created to research Games and Simulations with the tools of Engineering, aiming to understand:
  - What is a game
  - Why people play games
  - What is quality for games
  - How to develop games
  - What are the impacts of games

SCAN ME

http://ludes.cos.ufrj.br

Summary

- Introduction
- What are Information Systems?
- Theories from Games Studies
- Defining Games as IS
- Examples
- Using IS in Game Design
- Conclusion

Introduction

Motivation

- Game design and development turned out to be a legitimate profession and industry.

- There are undergraduate and graduate courses in Game Design, Art, Programming and all others related to this subject.

- New knowledge is being defined by borrowing from other areas such as administration, management, art, narrative studies by creating new models, tools and practices both from empirical evidence and scientific investigation.

- Game industry has been using many elements from Information Systems (IS), but without any formal or theoretical approach.

Problem

There is not yet a set of widely accepted standard of practices for game conception, development, maintenance and study (Aleem, 2016) (O'Hagan2014)

Software engineering techniques may help game development to achieve maintainability, flexibility, lower effort and cost, and better design.

What are Informaition Systems?

What is a System?

- Set of interrelated components that function together in a meaningful way (Davis,1988), in which the whole system is greater than the sum of its components, since new properties emerge from the actions and interactions among them.

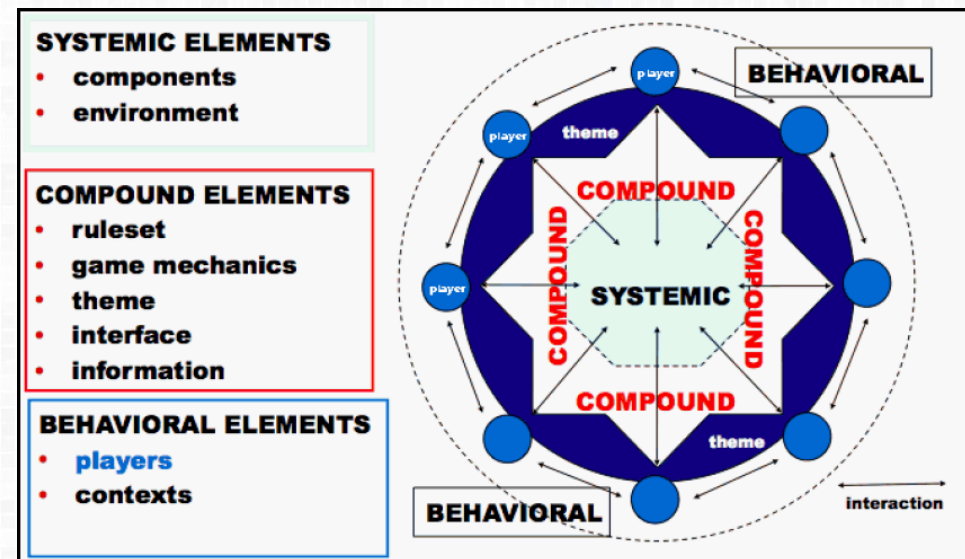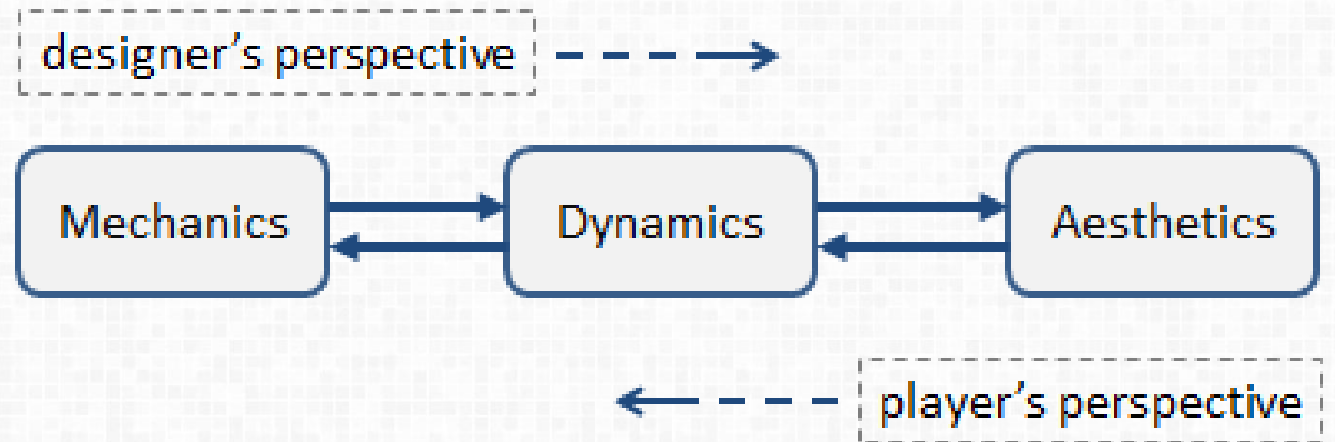- These properties do not exist in the parts when isolated (Bunge, 1979)
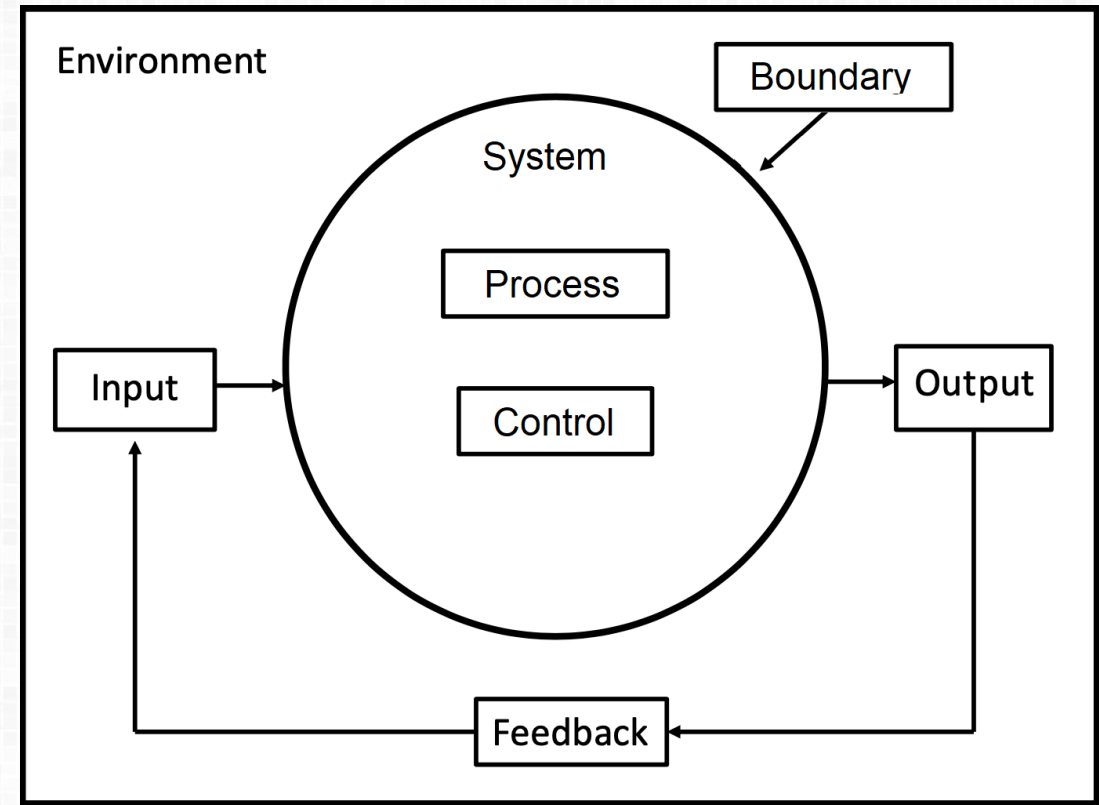
Information Systems

Arrangement of people, data, processes, and information technology that interact to collect, process, store, and provide as output the information needed to support an organization (Whitten and Bentley, 2007)

Theories From Game Studies
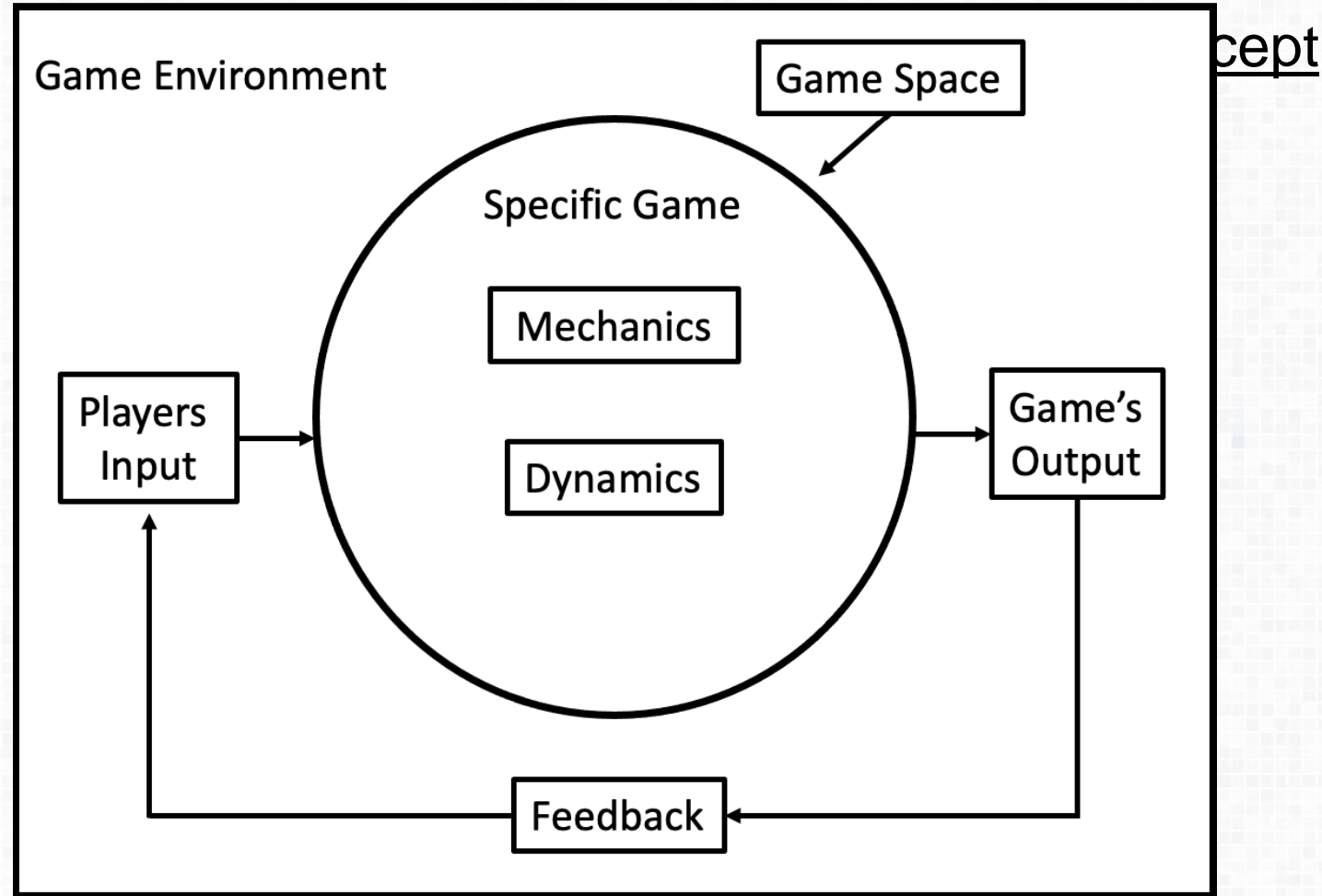
Theories from Game Studies

- MDA framework
- Järvinen Elements
- Classical Game Theory
- Procedural Rethorics

designer's perspective - - - →

Mechanics → Dynamics → Aesthetics

← - - - player's perspective

SYSTEMIC ELEMENTS
- components
- environment

COMPOUND ELEMENTS
- ruleset
- game mechanics
- theme
- interface
- information

BEHAVIORAL ELEMENTS
- players
- contexts

player theme BEHAVIORAL
COMPOUND
COMPOUND SYSTEMIC COMPOUND
COMPOUND
BEHAVIORAL theme interaction

Defining Games as Information Systems

Defining Games as IS

Game Environment

Game Space

Specific Game

Mechanics

Dynamics

Players Input

Game's Output

Feedback

# Elements of Games Mapped to IS
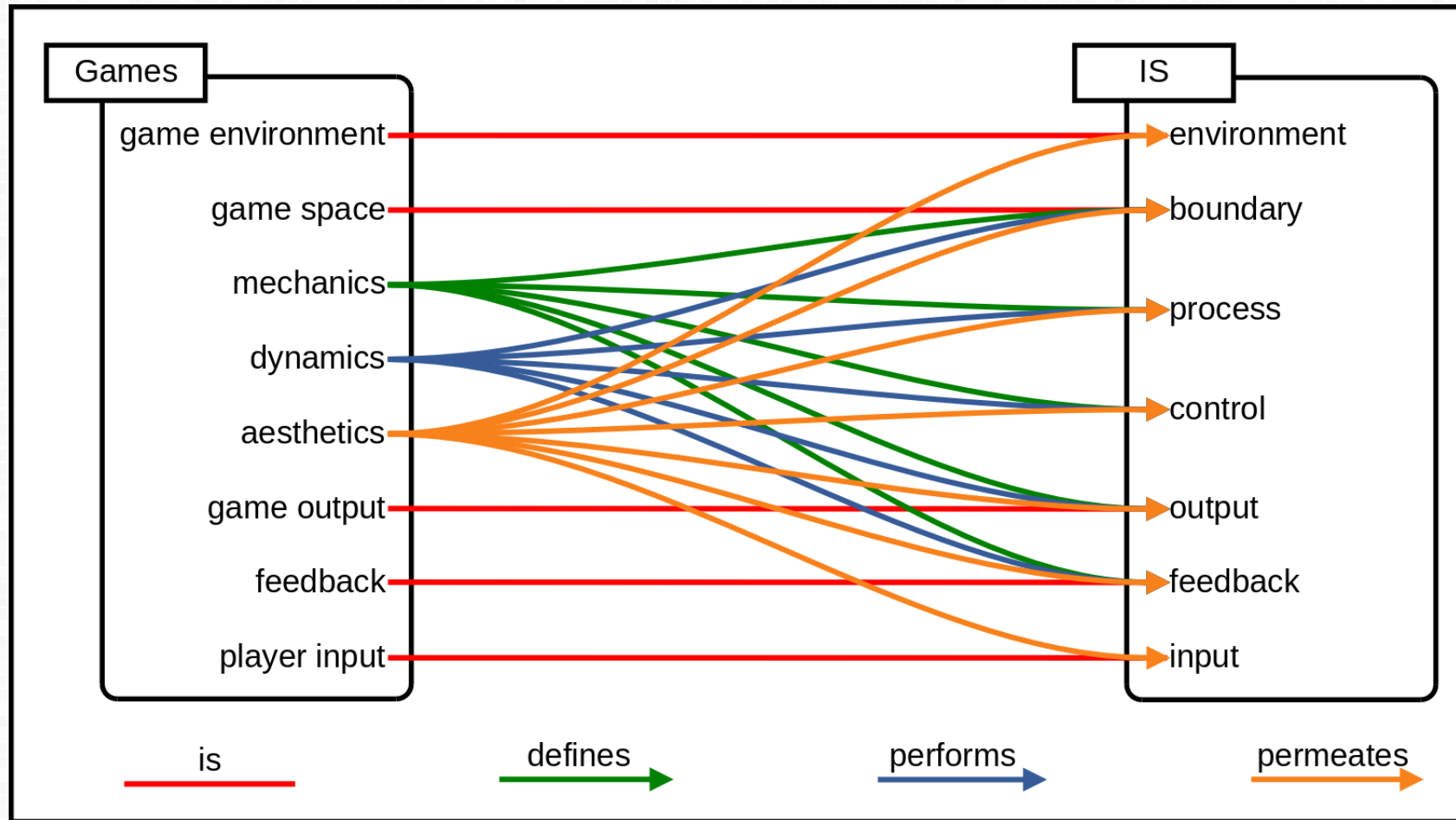
Video Game Examples
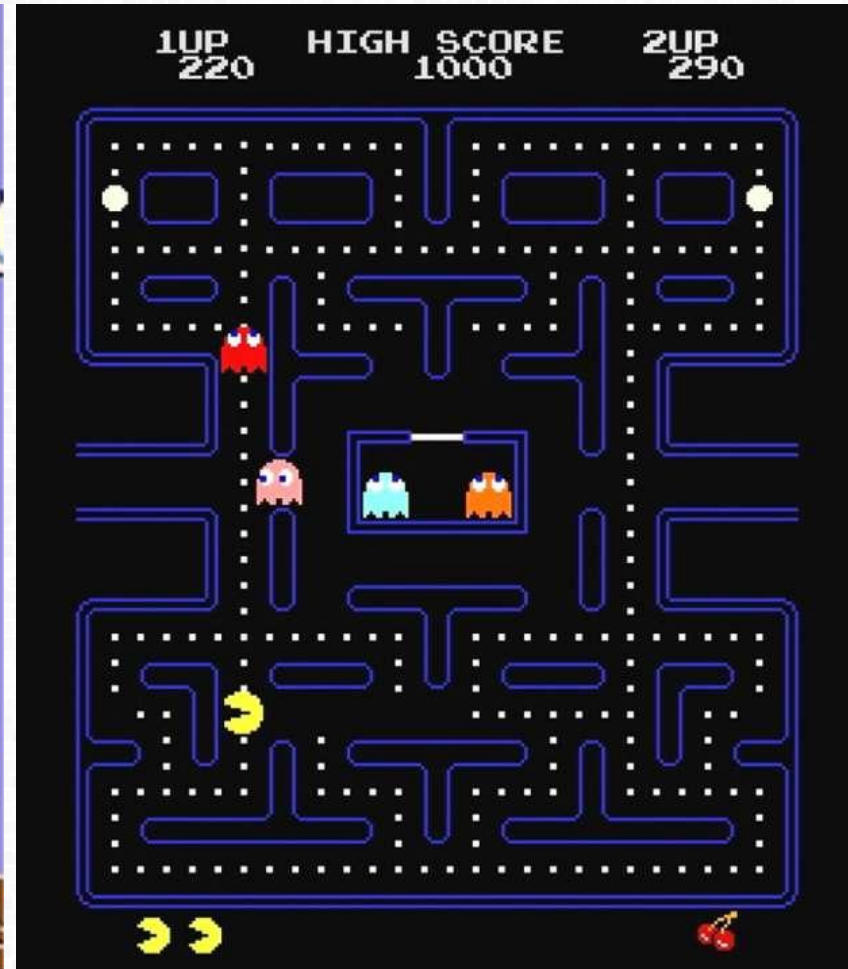
- The game space is the Mushroom Kingdom.
- The avatar must overcome many stages within the kingdom.
- Player's input moves the avatar towards the end of the stage and face enemies. Game mechanics are mainly move and attack.
- Game dynamics are jump, throw fireballs, hit or break bricks.
- Game outputs are the game score, the number of coins collected, the number of lives and the avatar progress through the stage.
- Game feedback reveals whether Mario is at a safe distance from enemy attacks and level threats.

Pac Man – Game Space and More

- Pac-Man's game space is the maze itself. Player's input moves the token through the maze.

- The game has two simple mechanics: move and eat.

- Game dynamics are basically chase and escape.

- Dillon also include attack and reach as dynamics.

- Game outputs are the game score, the level and the position of the token and the ghosts.

- Game feedback informs the position of the remaining dots in the maze, so the player must look for the best way to eat them and worry about getting away
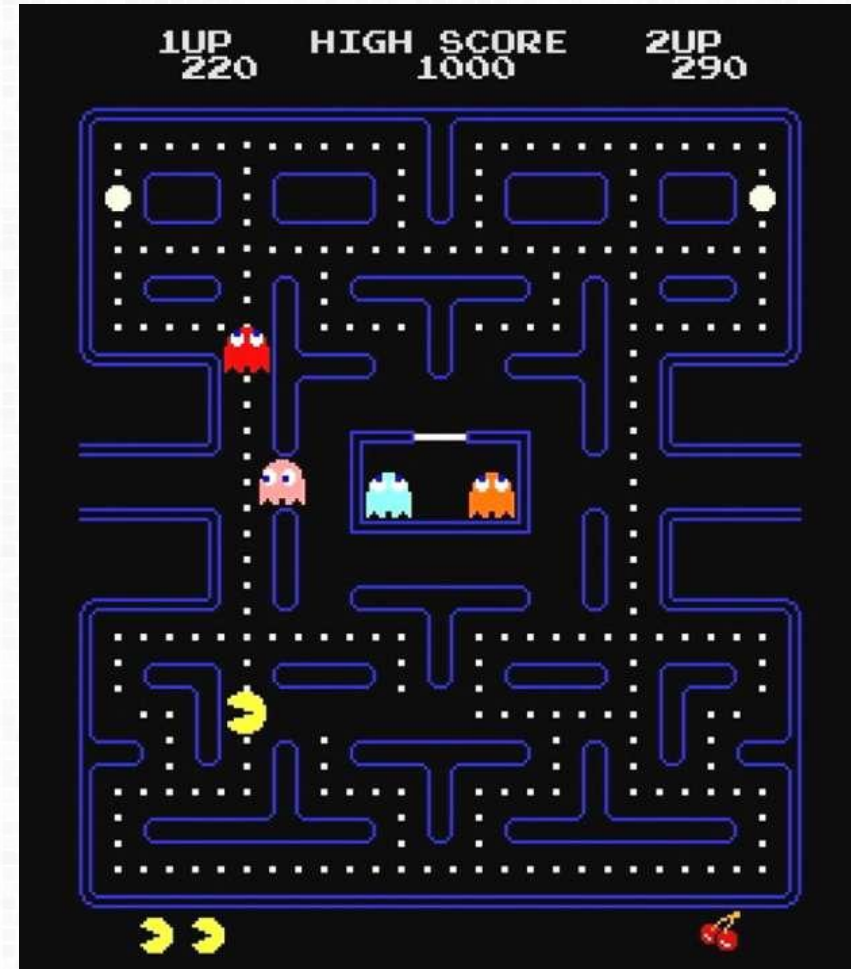
Board Game Examples

Monopoly – Processes

- Processes contained in Monopoly are represented by the mechanics that keep the game going.
- They are combined in the dynamics created by the players.
- For instance, when a token lands into a Chance space, the player must pick up a Chance card, which may result in positive or negative consequences as described in the card.
- Likewise, if a player rolls his dice, moves his token and it lands in an property already controlled by another player, he will need to pay a sum of money to the controlling player, which is taken from his ownership and added to the ownership of that property owner

Chess - Processes

♟ In Chess, after a player moves, game rules guide how the internal processes change the game state by moving the pieces.

♟ The rules also direct the controls to limit the actions of the player. For instance, they can only move the bishop diagonally.

♟ A capture occurs when the moved piece takes the place of another one from the opponent. The captured piece is then removed from the board.

♟ The changes in positions and the removal of the captured pieces are examples of outputs.

♟ The players use the returned information as a feedback and could adjust their future actions that will change the game state.

UNO – States (Simple)

♟ Therefore, it is possible to identify a simple state of each round at any time, since it suffices to know how many cards each player has in his hands.

♟ Each player's score, calculated at the end of each round, is made by adding up the card values of all his opponents who lost. The first player to reach 500 points, wins.

Tools and Methodologies

- Method for mapping the elements of business process models using BPMN (Classe, 2018)

- Software Product Line architecture was proposed to support the design of educational games (Martins, 2018)

- UML diagrams to represent game elements: characters, scenarios, actions and so on; and model games as finite state machines (Tang, 2008) (De Lope and Medina, 2016)

- Formal Framework - Machinations - to represent discrete game mechanics, which was inspired by the Petri Nets (Dormans, 2012)

Quality

- Fundamental aspect in the game design process

- ISO/IEC 25010:2011 standard describes a quality model for systems and software that can be applied to games

- Qualinet model for Quality of Experience (QoE) were used to build a taxonomy of factors, aspects, and features that are relevant to games (Möller, 2013)

Conclusion

Contributions

- Two conceptual models:
  - First model presents game components, which was extended from a conceptual model of systems
  - Second model correlates the IS concepts with game elements from theoretical models of games, for instance, the MDA Framework
- Paper can guide future works that lead towards a better understanding of the game design process and the emerging game engineering

Future Work

- Build a practical framework for analyzing games as IS
- Continue investigating recognized techniques in IS to incorporate them into the game designs developed by our research group

Obrigado!

References

Saiqa Aleem, Luiz Fernando Capretz, and Faheem Ahmed. 2016. Game development software engineering process life cycle: a systematic review. Journal of Software Engineering Research and Development 4, 1 (nov 2016), 30. https: //doi.org/10.1186/s40411-016-0032-7

Mario Bunge. 1979. Treatise on Basic Philosophy - Ontology II: A World of Systems. Treatise on Basic Philosophy, Vol. 4. Springer

Tadeu Classe, Renata Araujo, and Geraldo Xexéo. 2018. De Processos de Negócio para Jogos Digitais: Uma Proposta de Mapeamento. In Anais do XIV Simpósio Brasileiro de Sistemas de Informação. Sociedade Brasileira de Computação (SBC), RJ, Brazil, 465–472

Willian S. Davis and David C. Yen (Eds.). 1998.The Information System Consultant's Handbook: Systems Analysis and Design(1st ed.). CRC Press

R. P. De Lope and N. Medina-Medina. 2016. Using UML to Model Educational Games. In2016 8th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES). IEEE, Barcelona, Spain, 1– 4. https://doi.org/10.1109/VS-GAMES.2016.7590373

Joris Dormans et al.2012.Engineering emergence: applied theory for game design. Universiteit van Amsterdam, Netherlands

Gevã Martins, Welington Silva, Fernanda Campos, Victor Stroele, José Maria N. David, and Regina Braga. 2018. Construção de Jogos Educacionais através de Modelo de recursos. In Anais do XIV Simpósio Brasileiro de Sistemas de Informação. Sociedade Brasileira de Computação (SBC), 16–22.

S. Moller, S. Schmidt, and J. Beyer. 2013. Gaming taxonomy: An overview of concepts and evaluation methods for computer gaming QoE. In 2013 Fifth International Workshop on Quality of Multimedia Experience (QoMEX). IEEE, Klagenfurt am Wörthersee, Austria, 236–241. https://doi.org/10.1109/QoMEX.2013.6603243

Ann Osborne O'Hagan, Gerry Coleman, and Rory V. O'Connor. 2014. Software Development Processes for Games: A Systematic Literature Review. In Communications in Computer and Information Science. Springer Berlin, 182–193. https://doi.org/10.1007/978-3-662-43896-1_16

Stephen Tang, Martin Hanneghan, Tony Hughes, C Dennett, S Cooper, M Ariff Sabri, et al. 2008. Towards a domain specific modelling language for serious gam design. In 6th International Game Design and Technology Workshop. Liverpool John Moores University, Liverpool, UK, 10 pages

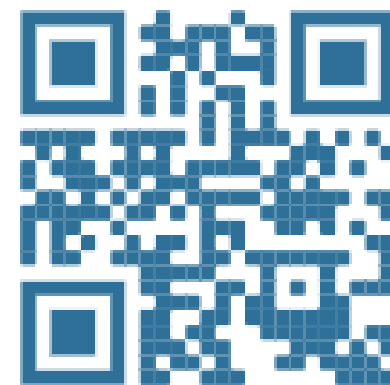Jeffrey Whitten and Lonnie Bentley. 2007. System Analysis and Design Methods (7th ed). McGraw-Hill.

Acknoledgments

- This study was supported by
  - the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) - Brasil under Grant RESOLUÇÃO NORMATIVA RN-017/2006
  - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) - Brasil under Grant Finance Code 001.
- Farmy Silva was supported by CNPq.
- Leandro Ouriques was supported by Brazilian Navy.
- Eduardo Mangeli and Luis Coimbra were supported by CAPES.