
# Design of computer video games

## 1. Introduction to computer games

*Boyan Bontchev*

# Agenda

- Introduction to computer games - history, definitions and basic concepts
- Entertainment and serious games
- Visualization methods
- Gameplay
- Competition and cooperation
- Player role
- Game genres
- Cultural, age and gender aspects
- Examples

# References


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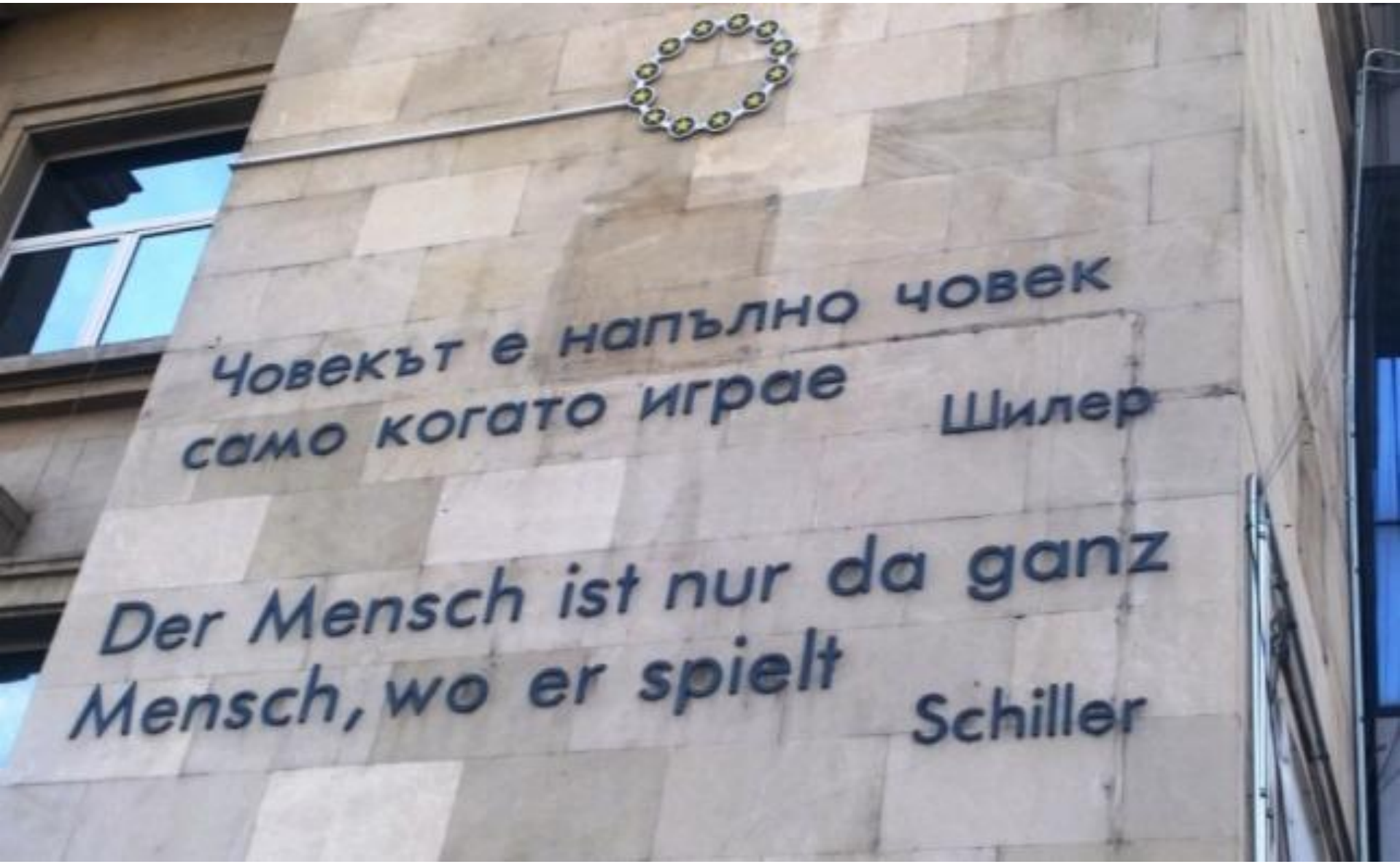

Човекът е напълно човек
само когато играе
Шилер
Der Mensch ist nur da ganz
Mensch, wo er spielt
Schiller

# Definition of a Game 1/2

A game as an activity with the following characteristics (*Roger Caillois, Les jeux et les hommes, 1957*):

- *fun*: the activity is chosen for its light-hearted character
- *separate*: restricted in time and place
- *uncertain*: the outcome of the activity is unforeseeable
- *non-productive*: participation does not accomplish anything useful
- *governed by rules*: the activity has rules that are different from everyday life
- *fictitious*: it is accompanied by the awareness of a different reality

# Definitions of a Game 2/2

- "A game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context." (Clark Abt, Serious Games, 1987)
- "A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome." (Katie Salen and Eric Zimmerman, Rules of Play, 2004)
- “These are the two things that video games are made of: real rules and fictional worlds” (Jesper Juul, Half-Real, 2005)
- A game is a type of play activity, conducted in the context of a pretended reality, in which the participant(s) try to achieve at least one arbitrary, nontrivial goal by acting in accordance with rules (Adams, E. Fundamentals of Game Design, 2010)

# Out of definition of a game

- *Competition* or *conflict (though in Rules of Play,* 2003, p. 80, Salen and Zimmerman, suggested an "artificial conflict.")
- *Fun* - fun is an emotional response to playing a game, not intrinsic to the game itself
- *Entertainment or recreation* - sometimes people play games for study, practice, or training in a serious subject. Therefore, we can distinct two types of games:
  - Entertainment games
  - Serious (applied) games

# Entertainment games

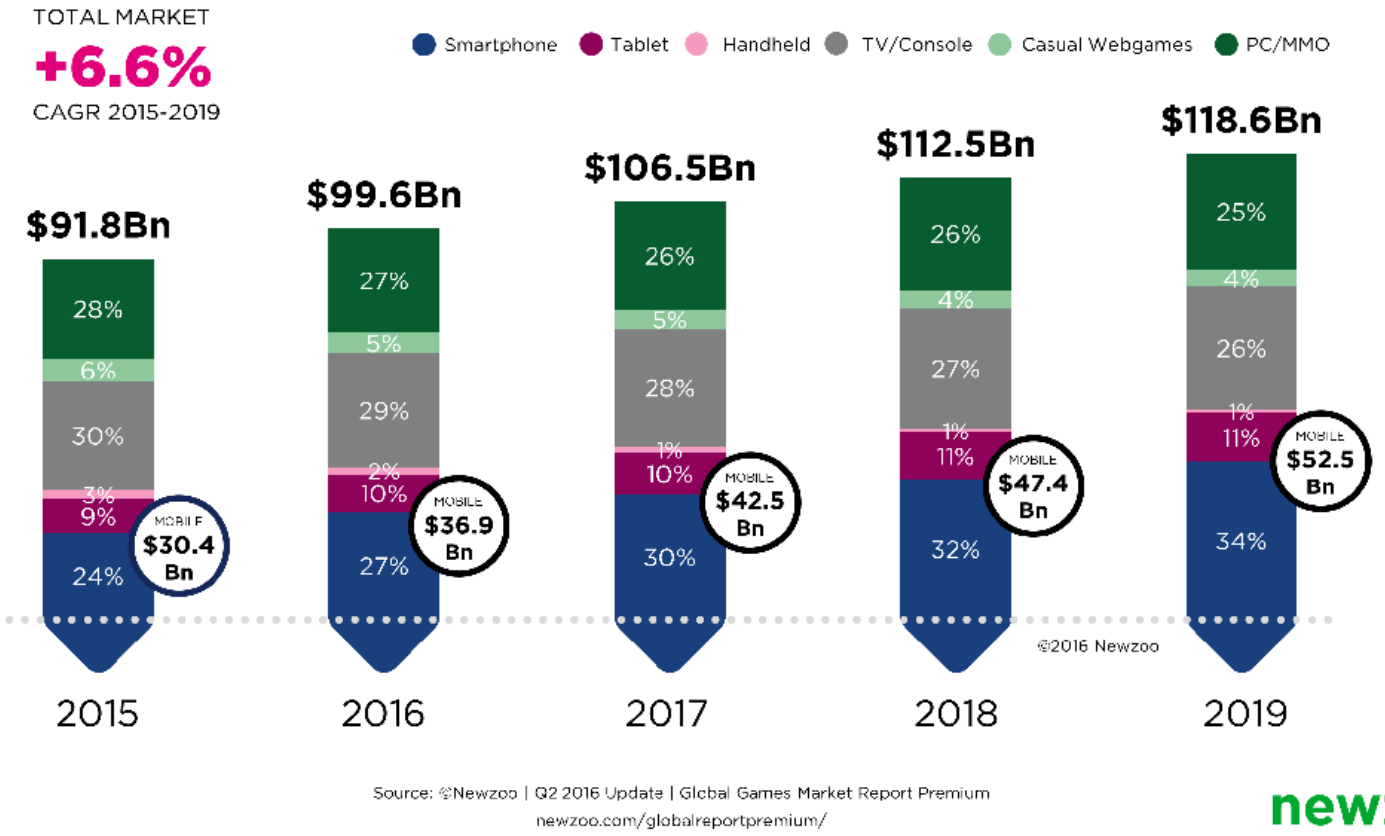
For 2017, see:

- the best Xbox One games
- the best PS4 (Sony PlayStation 4) games
- the best Nintendo 3DS games
- the best PC games
- the best *indie* games
  - a video game created without the financial support of a publisher;
  - rely on innovation and on digital distribution.
- the best iPhone games
- the best Android games

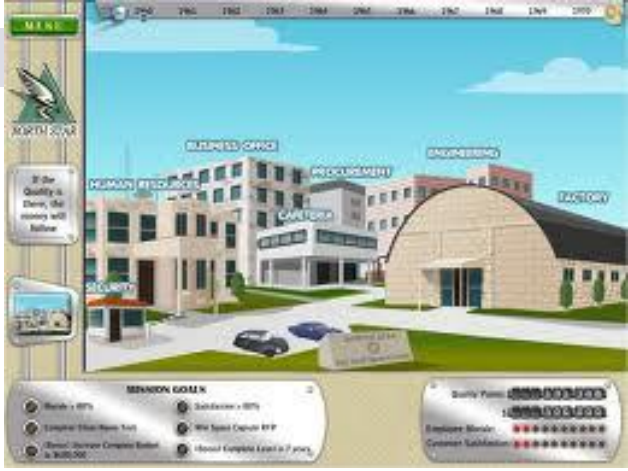


(at http://www.techradar.com/news/best-games-2017)

*Source*: https://newzoo.com/insights/articles/global-games-market-reaches-99-6-billion-2016-mobile-generating-37/



# Serious Games (SG)

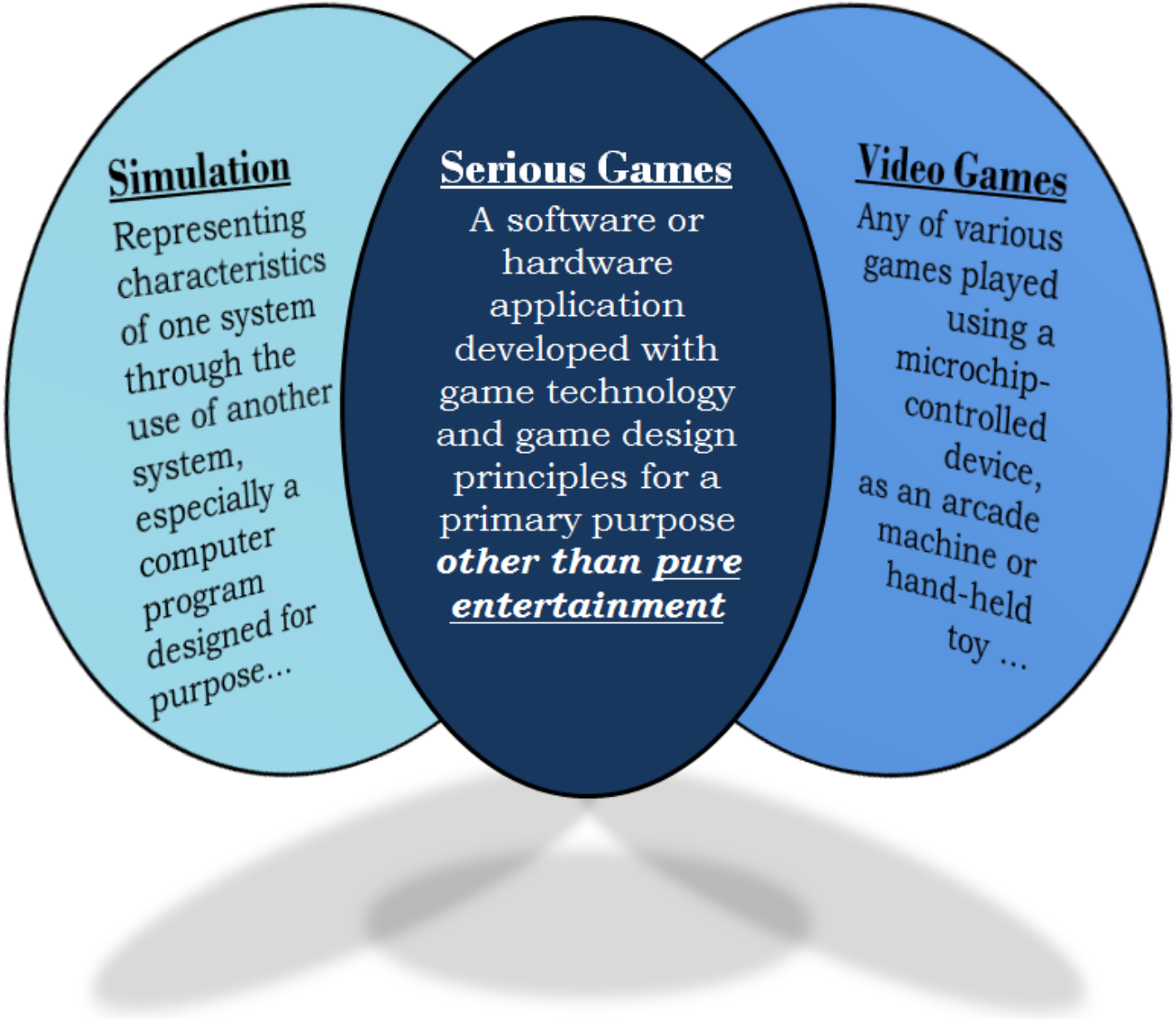


**Digital interactive applications** that allow users to **make specific experiences** that promote active and experiential paths of learning in various domain of human existence,

- through **virtual/augmented simulations**
- through **ludic** and **playing formats**

SG enable self-controlled, active and playfully learning

“A serious game is a digital game in which *education is the primary goal*, rather than entertainment” (Micheal & Chen, 2006).

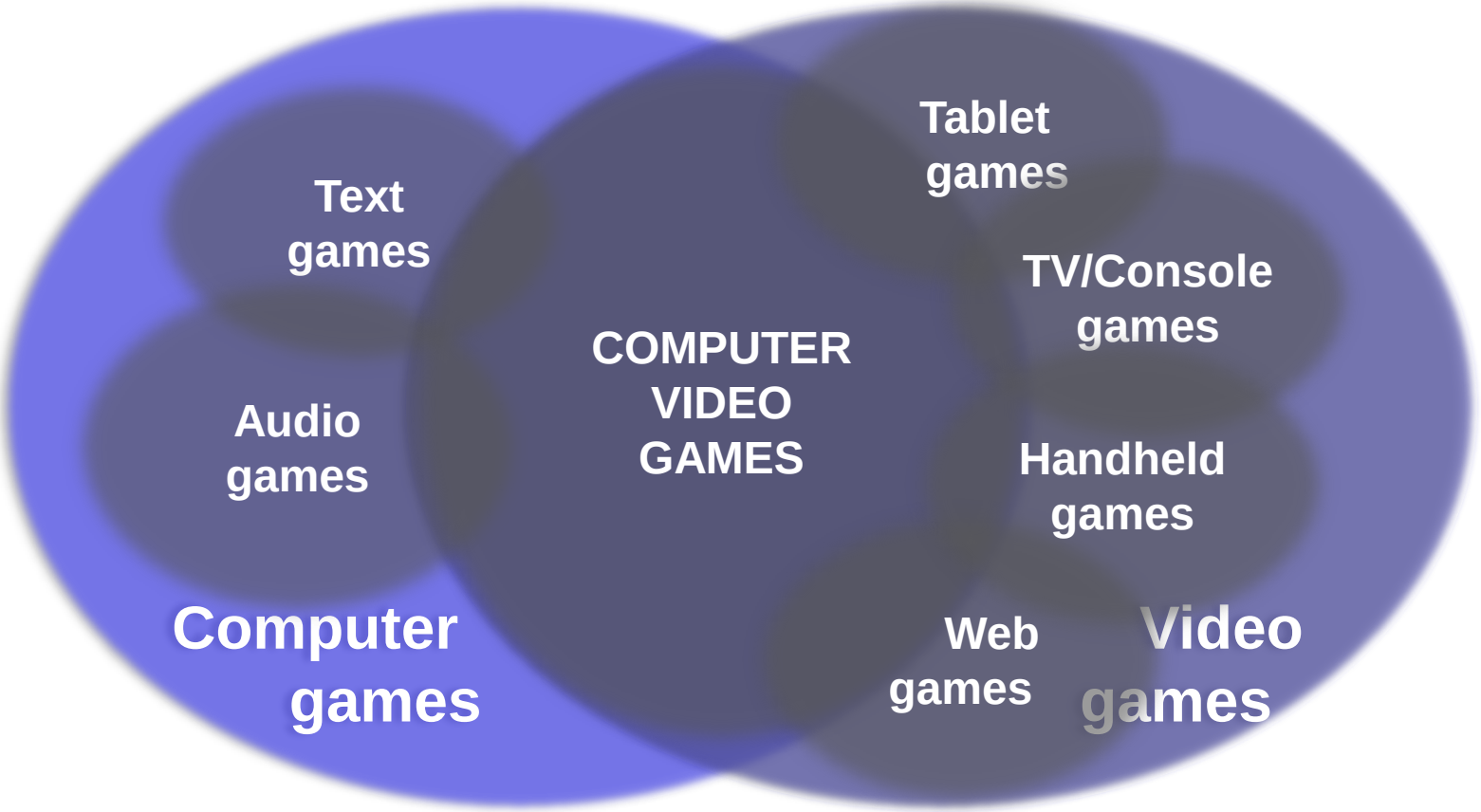

Simulation
Representing characteristics of one system through the use of another system, especially a computer program designed for purpose…
Serious Games
A software or hardware application developed with game technology and game design principles for a primary purpose other than pure entertainment
Video Games
Any of various games played using a microchip-controlled device, as an arcade machine or hand-held toy …

# Computer games

audio game,
text game

- Computer game - a game played using a computer, typically a video game (https://en.oxforddictionaries.com/)
- Video game - an electronic game played by means of images on a video screen and often emphasizing fast action (https://www.merriam-webster.com/dictionary/)
- Video games have also been referred to as “digital games,” “electronic games”, or “computer games” (Perron & Wolf, 2009, pp. 6–8).

# Computer video games

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# Visualization methods 1/3

- 2D - two-dimensional games like Super Mario Bros
  - old video games
  - board games
  - games for devices with low performance

# Visualization methods 2/3

- 2,5D (two and a half dimensional, three-quarter perspective and pseudo-3D) – describes
- 2D graphical projections used to cause images or scenes to simulate the appearance of being  when in fact they are not, or
- play in an otherwise 3D video game that is restricted to a two-dimensional plane or has a virtual camera with a fixed angle


*See http://explainervideoly.com/blog/difference-between-2d-2-5d-3d-animation/*

# Visualization methods 3/3

- Three-dimensional video games could make your memory better *right there* (the hippocampus).
- Experiment: 69 college students (who weren't gamers) split into 3 groups:
  - Two groups assigned to play either a 2D game (*Angry Birds*), or a 3D game (*Super Mario 3D World*) for 30 minutes every day over two weeks.
  - A control group didn't play any games, to establish a baseline.
- Results: 3D can boost performance on memory tests by up to 12 percent



*See http://www.popsci.com/three-dimensional-video-games-could-make-your-memory-better /*

# Play

PLAY - doing an enjoyable and/or entertaining activity:

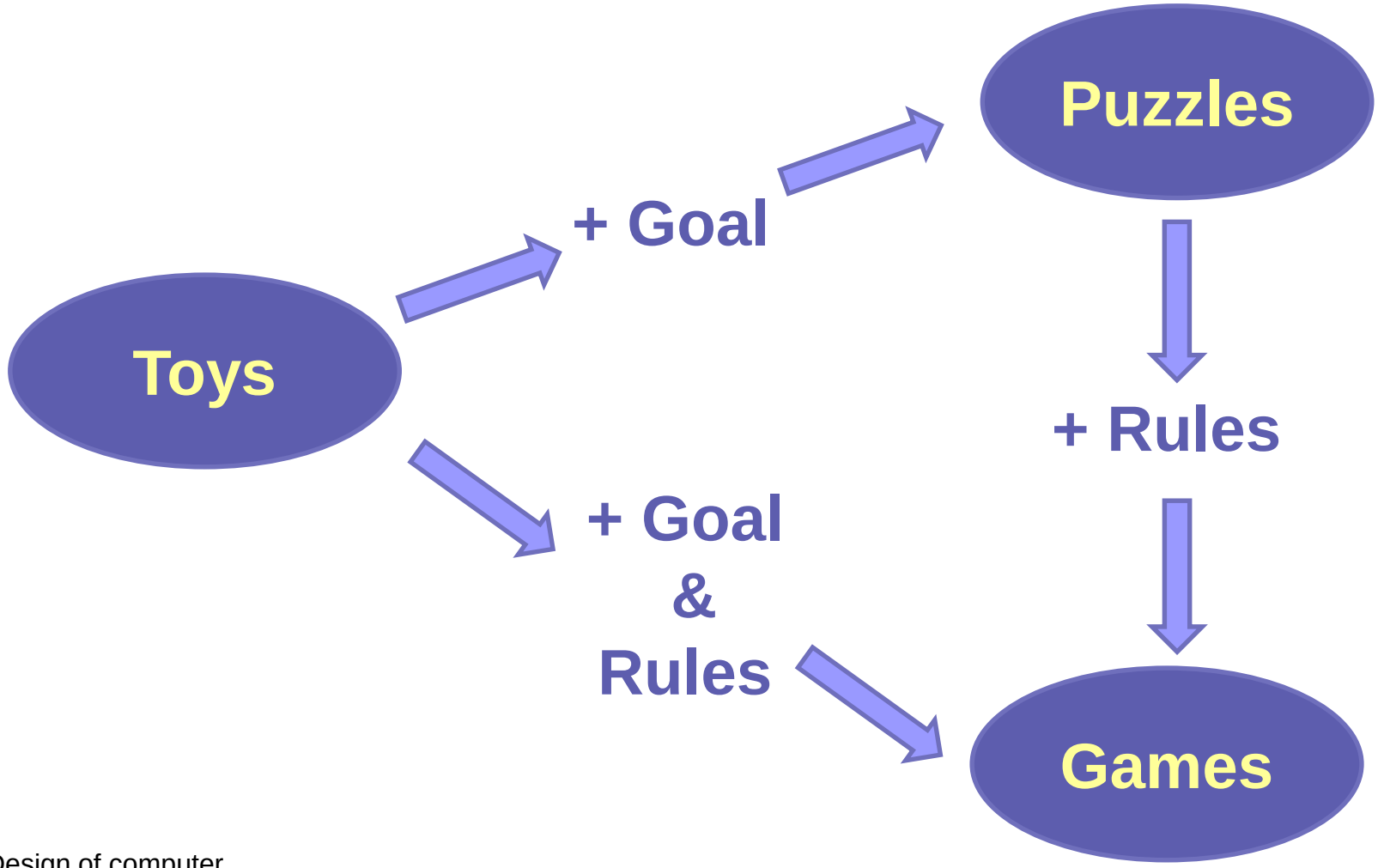
- Play is a participatory and interactive form of entertainment - reading a book or watching a play is not *passive*, but it is not *interactive* in the sense of modifying the content
- When you play a game, you can make different choices and have a different experience
- Play ultimately includes the freedom to act and the freedom to choose *how* you act.
- This freedom is constrained by the rules, and this requires you to be clever, imaginative, or skillful in your play

# Types of play

- Playing with toys
- Solving puzzles
- Taking part in a game

**What is the difference!**

# Toys, puzzles and games 1/2



# Toys, puzzles and games 2/2

- Toys ***model*** other objects (e.g., a baby doll resembles a real baby) and might ***suggest*** an appropriate way to play, but the suggestion is not a rule
- The essential elements of a game are:
  - Rules - ***instructions*** that ***dictate*** how to play
  - Goals - particular ***objectives*** that you are trying to achieve
  - Play - a ***participatory*** form of entertainment, whereas books/films/theater/… are ***presentational*** forms
  - Pretending - the act of creating a ***notional reality*** in the mind

Raph Koster, *A Theory of Fun for Game Design,* 2004, p. 36

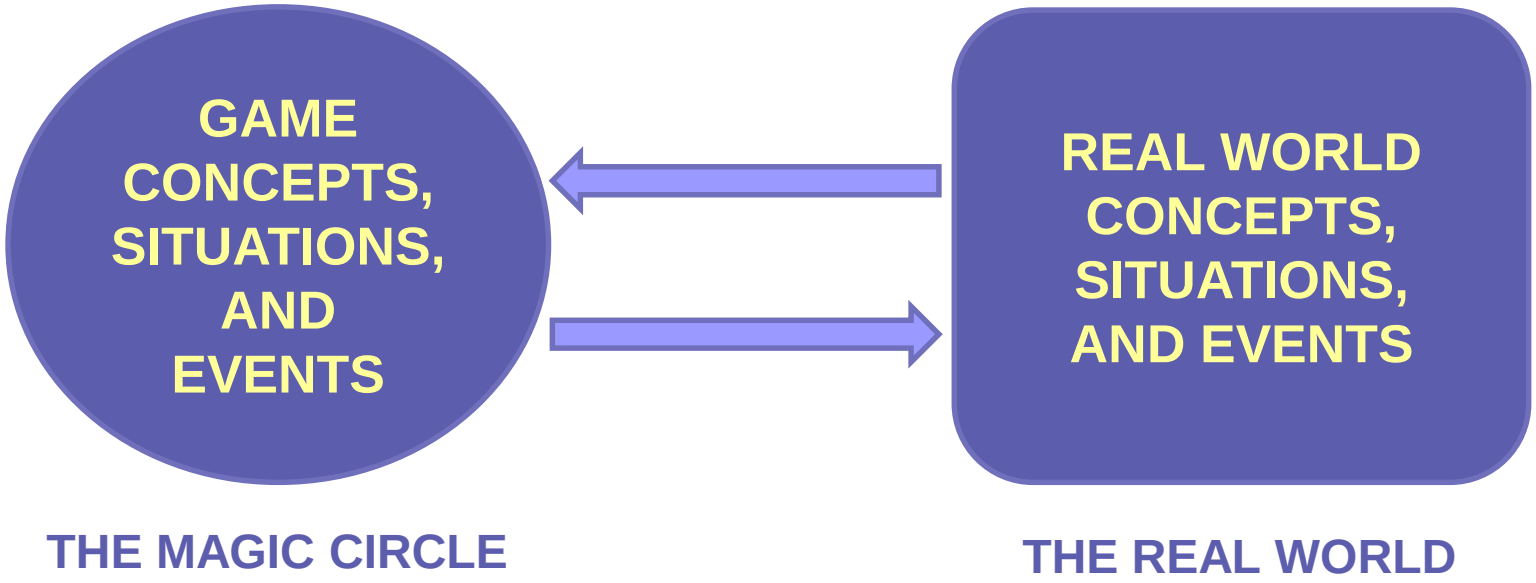
# Pretending and “Magic circle”

- Pretending = creating a ***notional reality*** in the mind = one element of game definition
- Notional reality in the mind = **magic circle**, or **playground** (Johan Huizinga, *Homo Ludens,* 1938):
  - related to the concept of imaginary worlds in fiction and drama
  - connected to ceremonial, spiritual, legal, and other activities
  - used by Salen & Zimmerman in “Rules of Play”, 2004

*Ludens* is derived from *ludus (lat.), which* refers to sport, play, school, and practice.

# The magic circle

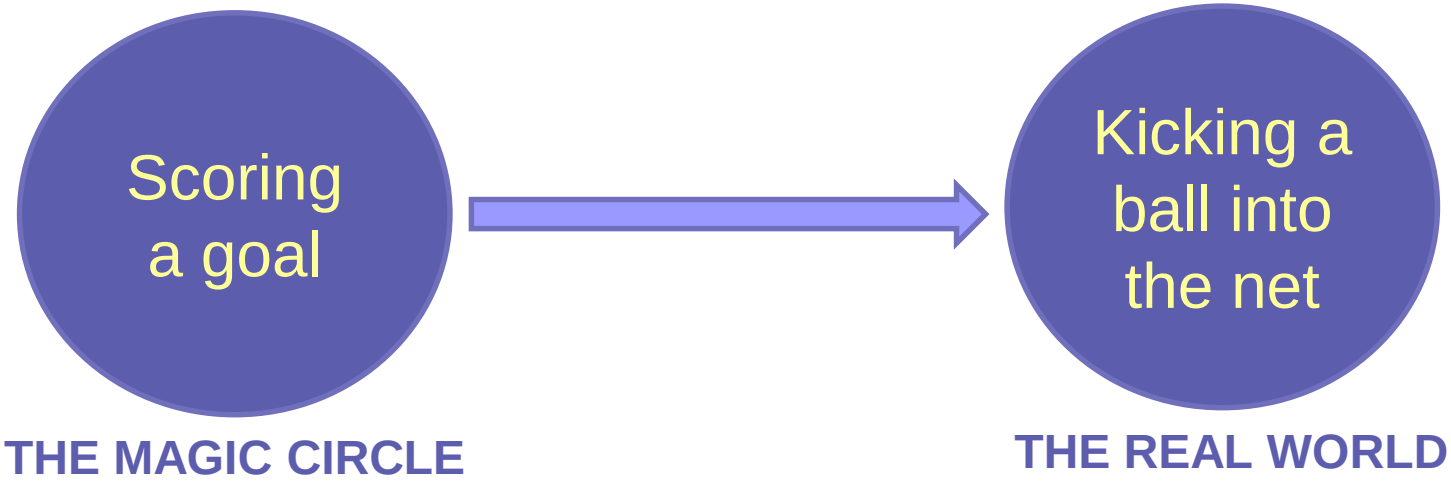
In games, the magic circle refers to the boundary that defines the boundary between reality and make-believe (ideas/activities that are meaningful in the game)



# Within the magic circle…

… the players agree to attach a temporary, artificial significance to situations and events in the game.

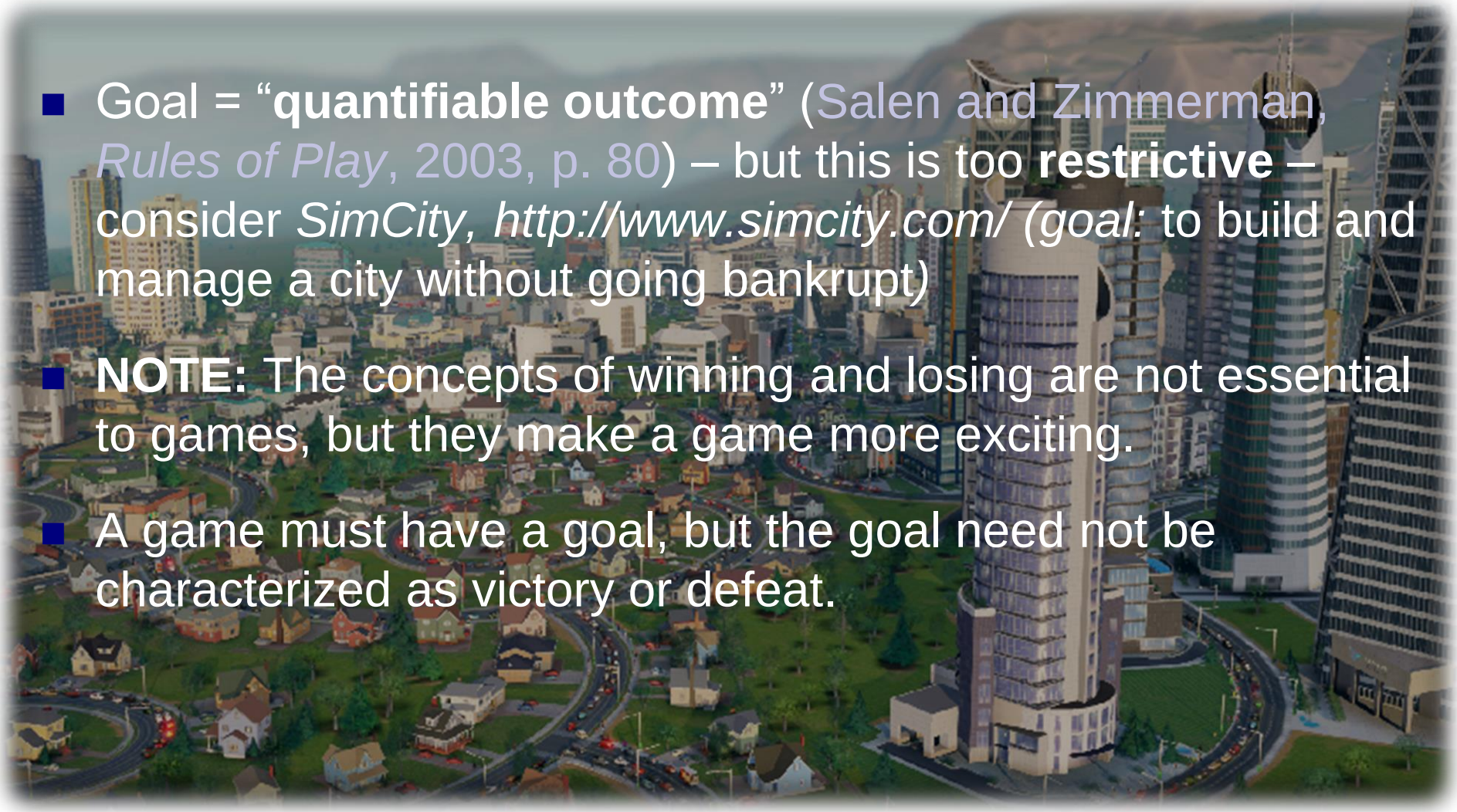
The magic circle comes into existence when the players join the game - in effect, when they agree to abide by the rules. It disappears again when they abandon the game or the game ends.



# Game goal 1/2

- A game must have a **goal** (or *object*), and it can have more than one
- Goalless play is not the same as game play
- There must be some **challenge** (nontrivial effort) involved in trying to achieve a game's goal
- Even creative, noncompetitive play still has a goal: **creation**
- The goal of the game is defined by the rules and is arbitrary because the game designers can define it any way they like.
- Examples…

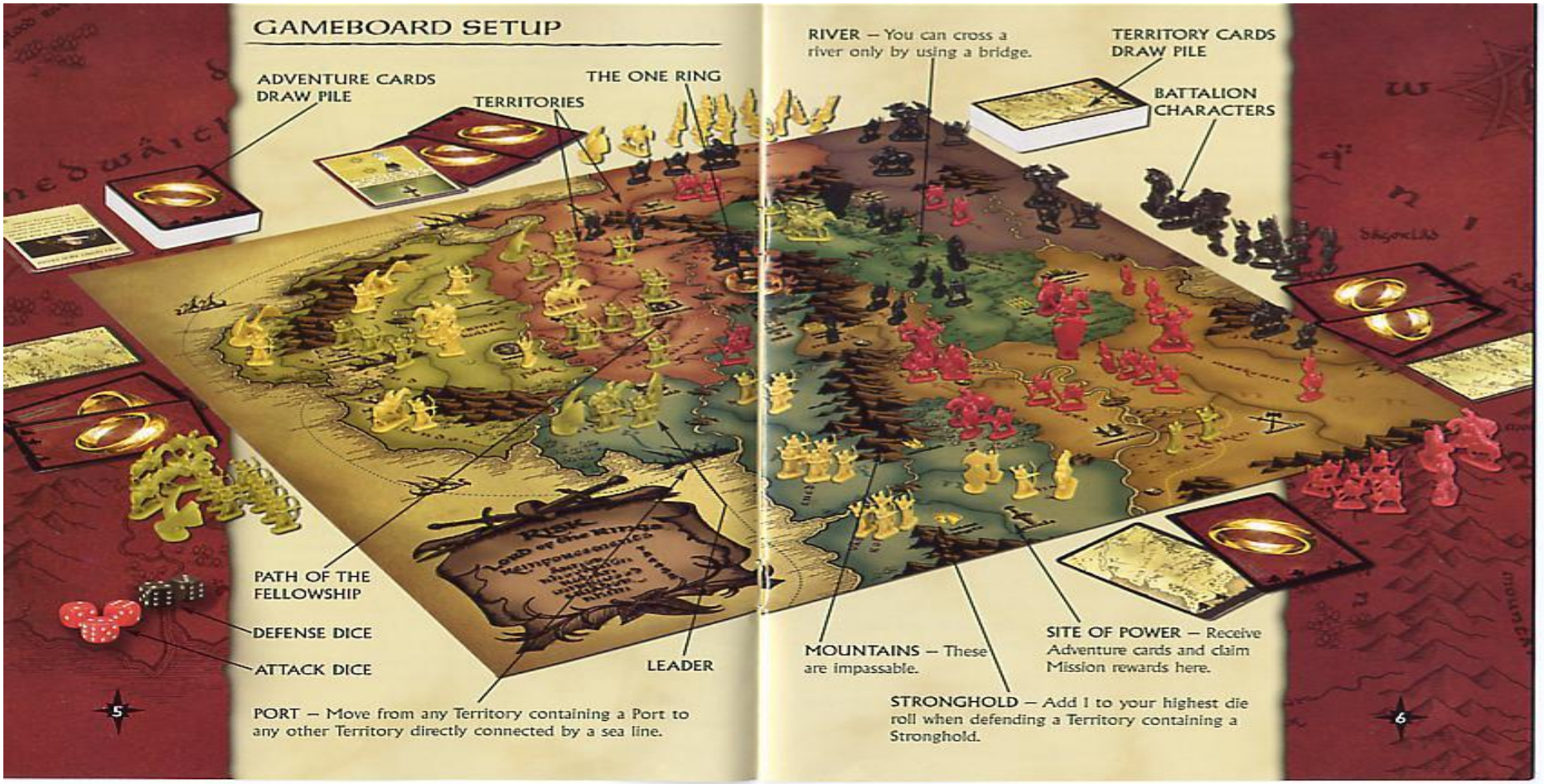
# Game goal 2/2



- Goal = "**quantifiable outcome**" (Salen and Zimmerman, *Rules of Play*, 2003, p. 80) – but this is too **restrictive** – consider *SimCity, http://www.simcity.com/ (goal:* to build and manage a city without going bankrupt*)*
- **NOTE:** The concepts of winning and losing are not essential to games, but they make a game more exciting.
- A game must have a goal, but the goal need not be characterized as victory or defeat.

# Game rules

- Rules are definitions and instructions that the players agree to accept for the duration of the game
- Every game has rules, even unwritten or taken for granted



# What the rules do define?

- The semiotics of the game - meanings and relationships of the various symbols that the game employs
- The gameplay = challenges and actions offered to players
- The sequence of play = progression of activities that make up the game.
- The goal(s) of the game (the objective of the game)
- The termination condition (if it has one).
- Meta-rules = rules about the rules:
  - indicate under what circumstances the rules can change or when exceptions to them are allowed:
  - immutable rules include instructions about when and how the mutable rules may be changed.

# DESIGN RULE: Avoid Trial and Error

- Provide adequate clues that enable players to deduce the correct resolution to a problem
- Avoid creating challenges that they can surmount only by trial and error


**NOTE** The most important benefit computers bring to gaming is that the computer relieves the players of the burden of personally implementing the rules. This frees the players to become deeply immersed in a video game.

# Gameplay

- Game designer Sid Meier: “a series of interesting choices” (Rollings and Morris, 2003, p. 61)
- Dino Dini: “interaction that entertains” (Dini, 2004, p. 31)
- techopedia.com: “the way players interact with a certain video or computer game. It is further characterized as the way the game is played, including the rules, the plot, the objectives and how to conquer them, as well as a player's overall experience”
- Ernest Adams: Gameplay consists of:
  - The **challenges** that a player must face to arrive at the object of the game
  - The **actions** that the player is permitted to take to address those challenges (Fundamentals of Game Design, 2014, p.11).

# Actions

The rules specify what *actions* the players may take:

- to overcome the challenges and achieve the goal of the game
- as optional actions that are not required to surmount a challenge but create more fun. E.g., in the *Grand Theft Auto* games, you can listen to the radio in the car (https://www.youtube.com/watch?v=ccfk6AOOgr0).

# Challenges in game

- A challenge is any task set for the player that is nontrivial to accomplish
- Overcoming a challenge must require:
  - either mental or
  - physical effort
- Challenges can be:
  - as simple as getting a ball through a hoop, or
  - as complex as making a business profitable.
- Challenges can be:
  - unique
  - recurring, or
  - continuing

For more: CHALLENGES FOR GAME DESIGNERS, by B. BRATHWAITE AND I. SCHREIBER, 2009

# Challenge types 1/3

| CHALLENGE TYPE | CLASSIC EXAMPLE |
|---|---|
| **Physical Coordination Challenges** | |
| Speed and reaction time | *Tetris* |
| Accuracy or precision (steering, shooting) | *Need for Speed* |
| Timing and rhythm | *Dance Dance Revolution* |
| Learning combination moves | *Street Fighter II* |
| **Formal Logic Challenges** | |
| Deduction and decoding | *Minesweeper* |
| **Pattern Recognition Challenges** | |
| Static patterns | *Brain Age* |
| Patterns of movement and change | *Sonic the Hedgehog*, behavior patterns of enemies |

# Challenge types 2/3

| CHALLENGE TYPE | CLASSIC EXAMPLE |
|---|---|
| **Time Pressure** | |
| Beating the clock | *Frogger* |
| Achieving something before someone else | *IndyCar Racing* |
| **Memory and Knowledge Challenges** | |
| Trivia | *You Don't Know Jack* |
| Recollection of objects or patterns | *Brain Age* |
| **Exploration Challenges** | |
| Identifying spatial relationships | *Descent*, navigating in three dimensions |
| Finding keys (unlocking any space) | *Ultima* |
| Finding hidden passages | *Doom* |
| Mazes and illogical spaces | *Zork* |
| **Conflict** | |
| Strategy, tactics, and logistics | *Warcraft*, commanding armies |
| Survival | *Pac-Man*, avoiding being caught |
| Reduction of enemy forces | *Space Invaders*, killing aliens |
| Defending vulnerable items or units | *Ico*, looking after a little girl who can't fight |
| Stealth | *Thief: The Dark Project*, avoiding being seen |

# Challenge types 3/3

| CHALLENGE TYPE | CLASSIC EXAMPLE |
|---|---|
| **Economic Challenges** | |
| Accumulating resources or points (growth) | *Civilization* |
| Establishing efficient production systems | *The Settlers* |
| Achieving balance or stability in a system | *SimEarth* |
| Caring for living things | *The Sims* |
| **Conceptual Reasoning Challenges** | |
| Sifting clues from red herrings | *Law and Order*, solving crimes |
| Detecting hidden meanings | *Planescape: Torment*, understanding characters' motivations from vague hints |
| Understanding social relationships | *Façade*, reconciling a quarreling couple |
| Lateral thinking | *The Incredible Machine*, building a machine from limited parts |
| **Creation/Construction Challenges** | |
| Aesthetic success (beauty or elegance) | *The Sims*, assembling a photo album |
| Construction with a functional goal | *SimCity* |

# DESIGN RULE: Gameplay Comes First

- Gameplay is the primary source of entertainment in all video games.
- When designing a game, it is the *first* thing to consider.

# Symmetry and asymmetry 1/2

- In a *symmetric* game, all the players play by the same rules and try to achieve the same victory condition.
- if all players start in the same state, they all have an equal chance of winning (in case of equal skill levels). Examples:
  - Basketball is a symmetric game
  - Chess is an (almost) symmetric game - only the weakest pieces on the board can move on the first turn, and they cannot move very far or establish a dominant position

# Symmetry and asymmetry 2/2

- In an *asymmetric* game, different players may play by different rules and try to achieve different victory conditions
- In asymmetric games, it is much more difficult to determine in advance whether players of equal skill have an equal chance of winning.

Fox and Geese: an asymmetric medieval board game

# Competition and cooperation

- *Cooperation* - players try to achieve the same or related goals by working together.
- *Competition* - players have conflicting interests; they try to accomplish mutually exclusive goals. **Modes**:
  - **Two-player competitive ("you versus me")** – such as chess and backgammon
  - **Multiplayer competitive ("everyone for himself")** - *Monopoly*, poker, and individual sport games
  - **Multiplayer cooperative ("all of us together")** - all the players cooperate to accomplish the same goal. *LEGO, Star Wars*, *Gauntlet...*.
  - **Team-based ("us versus them")** - team sports, bridge.

# Competition modes (cont.)

- **Single-player ("me versus the situation")** – solitaire, card games, arcade video games (*Mario* series by Nintendo)
- **Hybrid competition modes** - specifically permit cooperation at times, even if the overall context of the game is competitive.
  - In *Diplomacy*, players may coordinate their strategies, but they also may abandon their agreements to their own advantage if they wish.
  - *Monopoly*, by contrast, does not permit cooperation because it gives the cooperating players too much of an advantage against the others.

MMO = **massively multiplayer online** game

# Presenting a game world

- One of the goals of game developers: to present game worlds that seem as real as the fictional worlds in television or film.
- *Augmented reality* - adds graphics, sounds, haptic feedback and smell to the natural world as it exists
- *Mixed reality* – merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time

**DESIGN RULE: You Can't Please Everyone**

It is not possible to design an ideal game that pleases everyone, because everyone does not enjoy the same thing.

# Usage of artificial intelligence (AI)

- **Strategy -** determining the optimal action by considering the possible consequences of a variety of available actions.
  - Arthur Samuels (IBM, 1959) developed *checkers* game learning from its mistakes and eventually becoming good enough to beat expert human players
  - Modern video games usually have both *hidden information* and a large element of *chance*, so a strategy is more difficult to compute
- **Pathfinding** - finding the most advantageous routes through a simulated landscape filled with obstacles
- **Natural language parsing & generation**
- **Pattern recognition** – voice, face, physiology, gestures…
- **Simulated non-player characters (NPC)**

# Other entertaining issues

- *Aesthetics* of the game world, interface graphics, animations, physics of moving objects, …
- *Harmony* - the feeling that all parts of the game belong to a single, coherent whole
- *Storytelling* – video games can mix story-like entertainment and game-like entertainment almost seamlessly
- *Interactive entertainment*
- *Risks* - need *rewards*
- Novelty
- Learning
- Creative and expressive play

# Immersion

- “deep mental involvement in something” (Google)
- in virtual reality: perception of being physically present in a non-physical world

Immersion types:

- **Tactical immersion –** so called *Tetris trance* in high-speed action games
- **Strategic immersion** - when you are deeply involved in trying to win a game, like the immersion of the chess master:
  - observing
  - calculating
  - planning
- **Narrative immersion** is the feeling of being inside a story, completely involved and accepting the world and events of the story as real

# Socializing in multiplayer games

- **Multiplayer local** gaming - two or more people playing together in one place
- **Networked play** (**multiplayer distributed** gaming) – people playing against other people over a network at distributed locations
- **LAN parties** - events in which a group of people all get together in one room, but each has his own computer in a LAN
- **Group play** occurs when a group of people get together in one room to play a *single*-player game

NOTE: When designing a multiplayer game, it's important to think about the social aspect of entertaining people. By offering them chat mechanisms or other community-building facilities, you can extend the game's entertainment far beyond the gameplay alone.

# The player role and game genres

- **The role**: *What Is the Player Going to Do?*
- DESIGN RULE: Think About Player Actions First
- Do not start designing the story, avatar, game world, artwork, or anything else until you have answered the question “What is the player going to do?”
- Defining the player role in a game
- RPG = a role-playing
  game in which participants adopt the roles of imaginary char acters in an adventure under the direction of a Game Master
- **The game genre**: “*category of games characterized by a particular set of challenges, regardless of setting or game-world content”* (Adams, E. Fundamentals of Game Design, 2010)

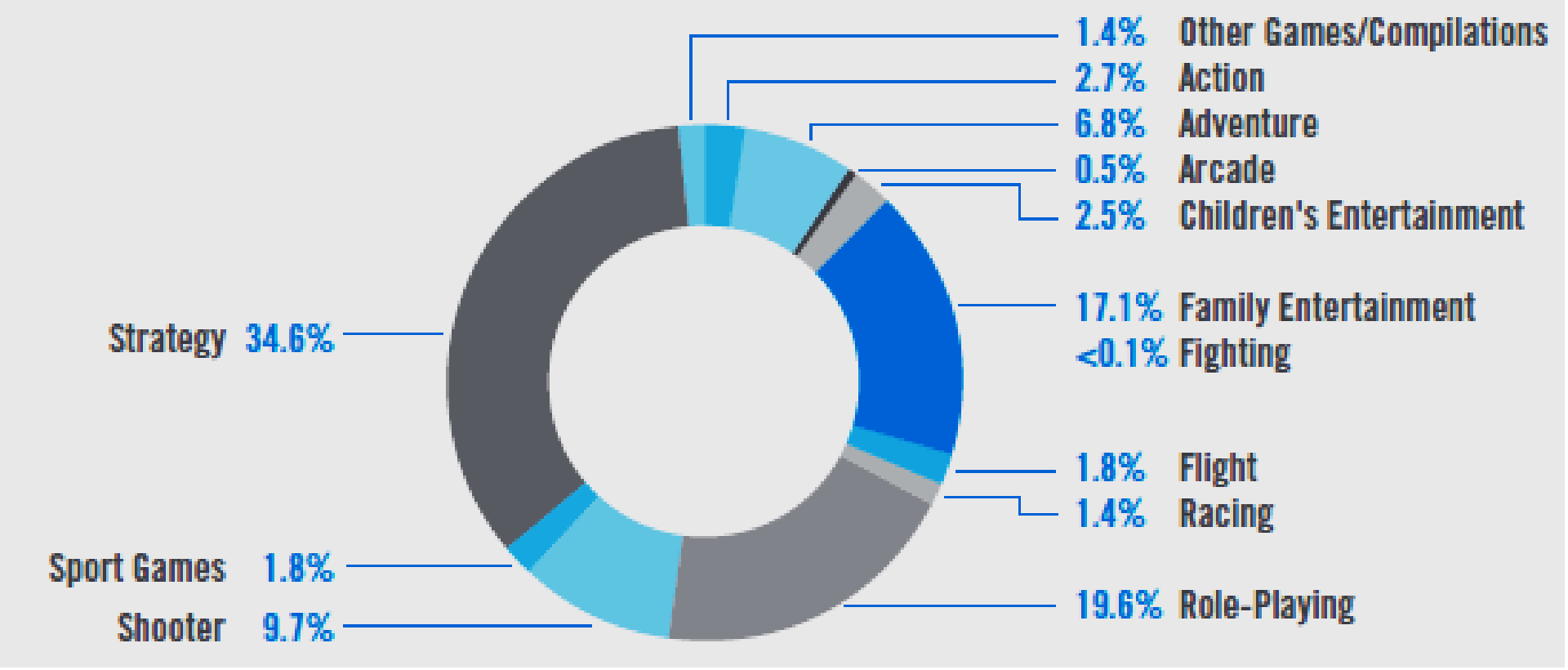
# Types of digital game genres 1/2


- Strategy games - decision-making alone or in a team, with situational awareness. Real-time strategy - no turns/wait for next decision
- Action games - include physical challenges; may also incorporate puzzles, races, and a variety of conflict challenges requiring good reflexes, often with stealth & shooting
- Role-playing games (RPG) - include player roles within a virtual world according specific narrative and controlled by game master. Often are massively multiplayer online (MMO) – over LAN or Internet

# Types of digital game genres 2/2

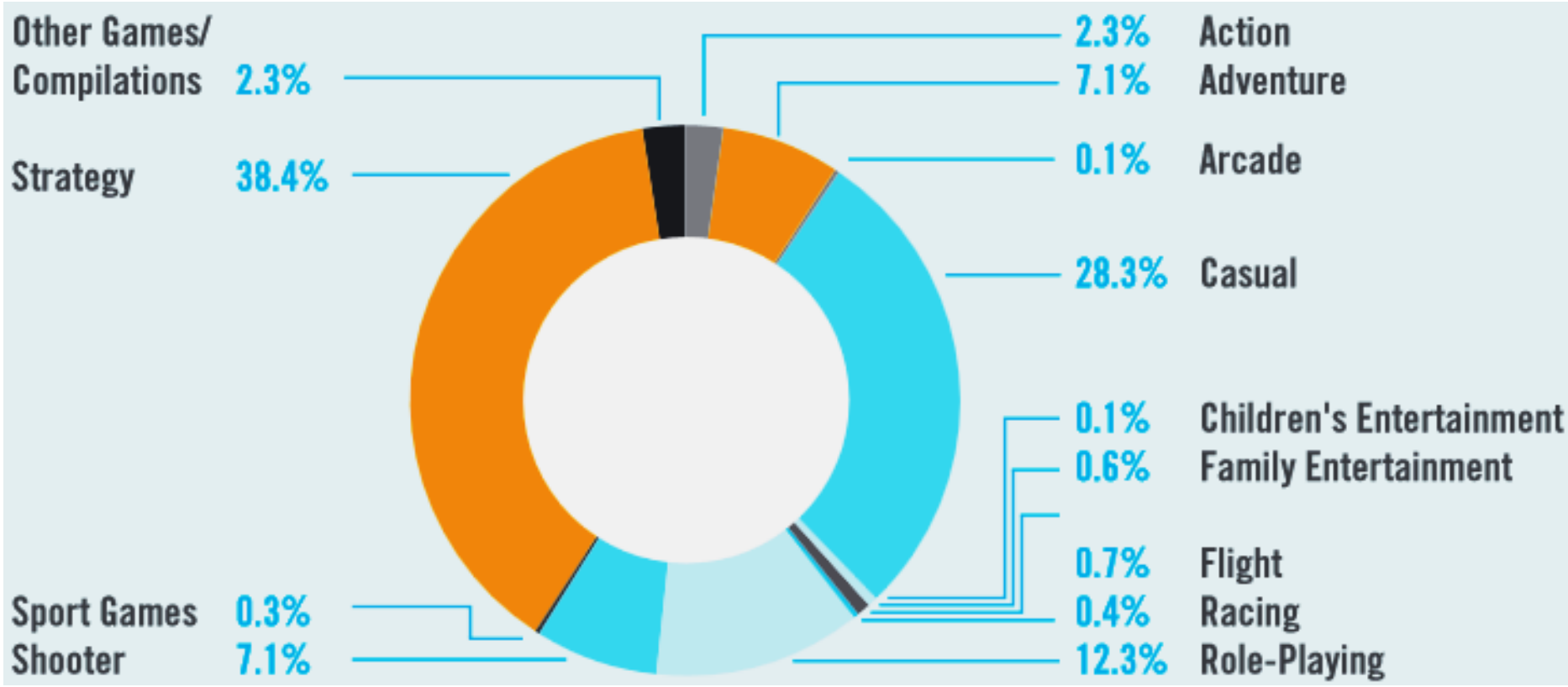

- Adventure games - adventures in a fantastic world with given mission and objectives
- Puzzle & board games – for logical/thinking skills
- Fighting - combats
- Sport games - real-world sport simulation
- Device simulation - of cars/aircrafts/tanks/...
- Casual games – for the mass audience of casual gamers, simple rules, short term play, lack of commitment typical for hardcore games

# Best-selling digital games genres in 2008




**Source: Essential Facts about the Computer and Video Game Industry, ESA, 2009**

# Best-selling digital games genres in 2013

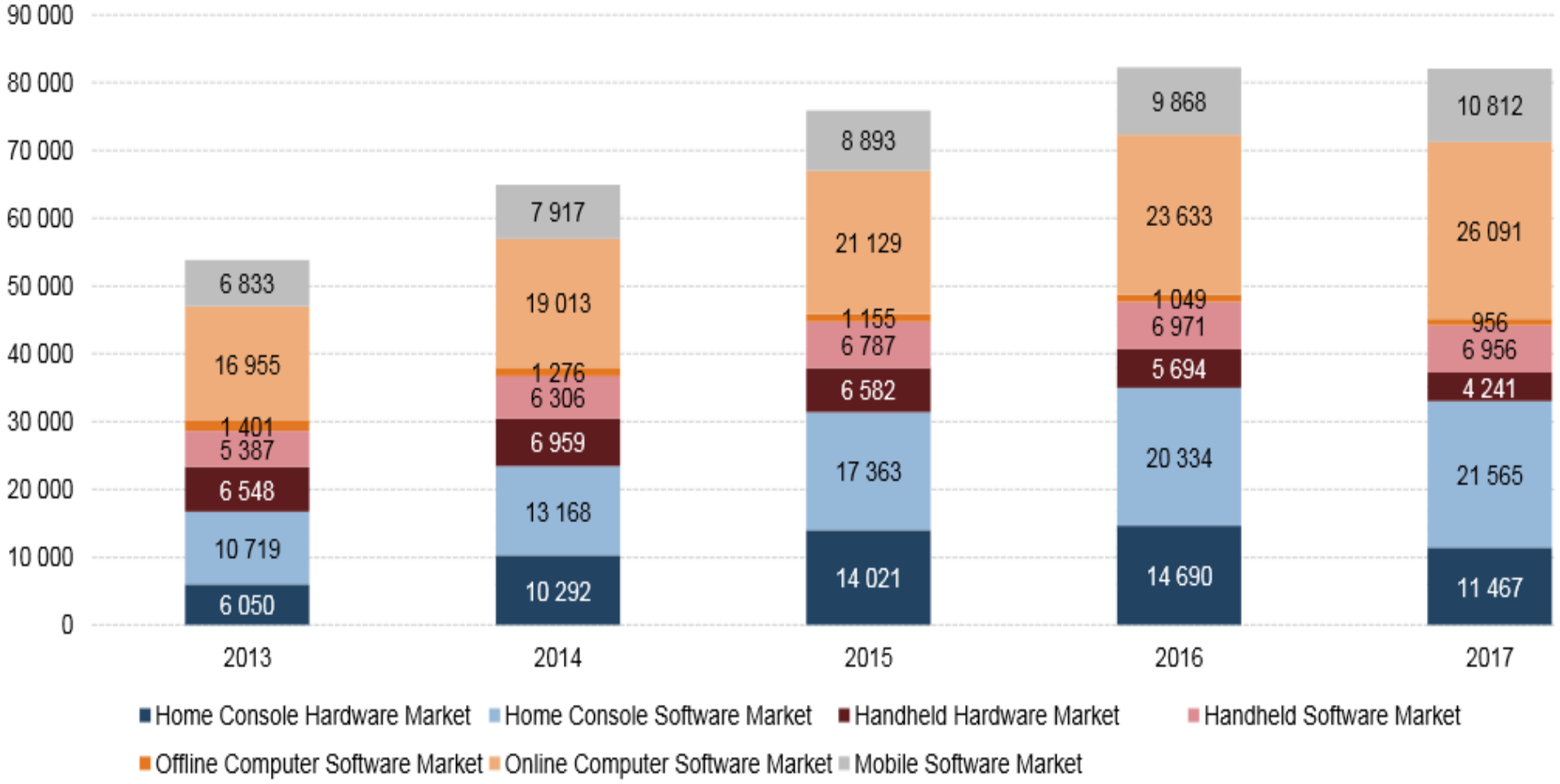



**Source: Essential Facts about the Computer and Video Game Industry, ESA, 2014**

# Hardware gaming platforms

- Arcade game machines
- PC (optionally with joysticks) – installable video games or/and accessible via Web
- Laptops and tablets – 33% of gamers play via WiFi
- Handheld/home video games console – Nintendo, Sega, Sony, Atari, 3DO, Engadget, …
- Mobile phones – 44% of gamers play via smartphones
- iTV

# World Video Game Market, 2013-2017 (millions EUR)




***Source: IDATE, December 2013***

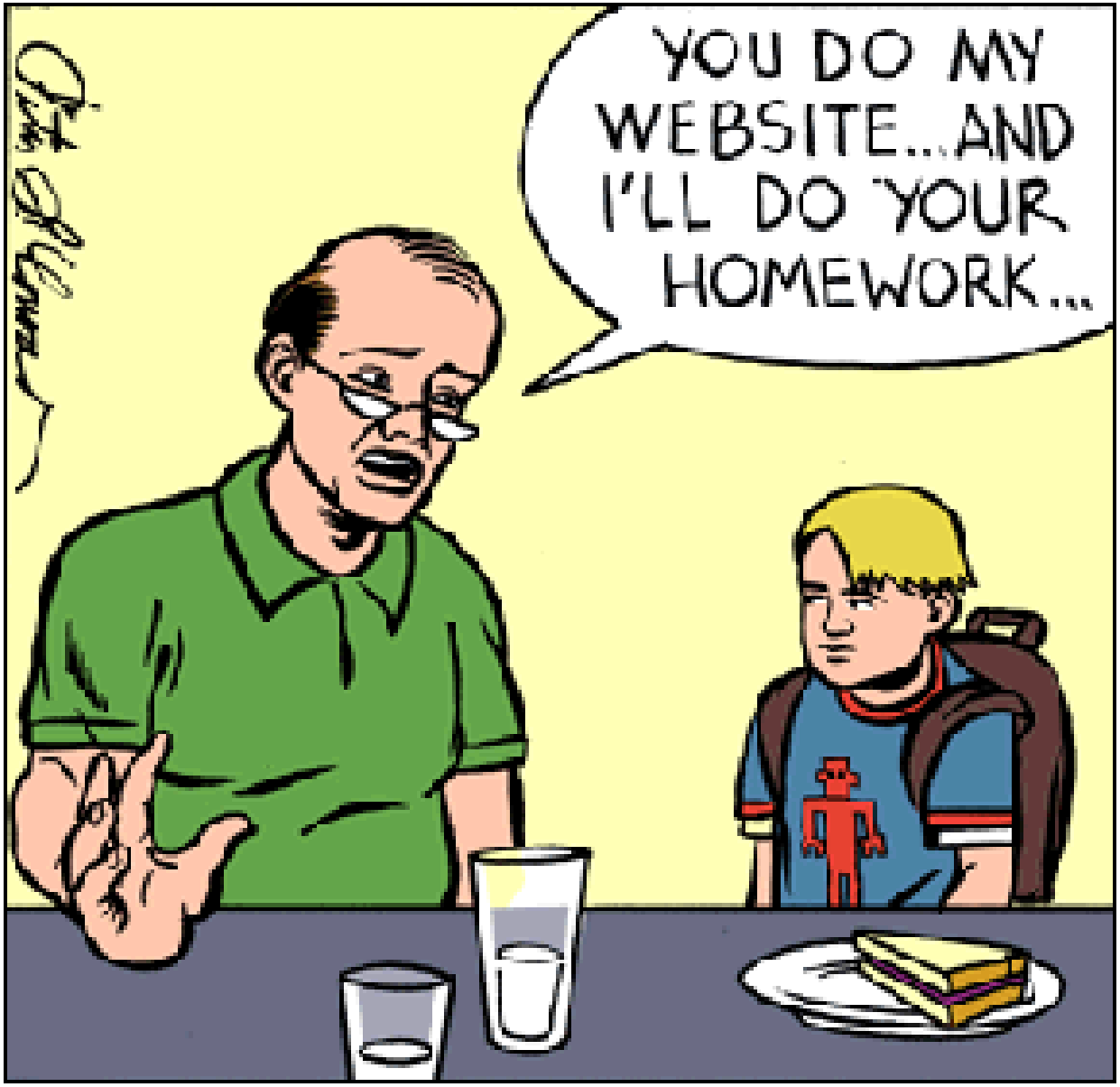
# Why such a success??


# The today reality: Digital Natives, Digital Immigrants


**Marc Prensky on the Horizon (MCB University Press, Vol. 9 No. 5, Oct. 2001)**

- Digital natives:
  - Grown up immersed in digital technology
  - Playing games is a norm
  - «New technologies» are «natural» dimensions of their environment (Beck & Wade 2004; Prensky 2007).

- Digital immigrants:
  - Bump with ICT rather later in their life
  - Forced to catch-up with technology every day


YOU DO MY WEBSITE...AND I'LL DO YOUR HOMEWORK...

# Digital Natives

- Specific styles of information acquisition:
  - Parallel more then linear/serial cognitive processing
  - Prevalence of *iconic system* than *linguistic*
  - More active attitude in cognitive process (Prensky, 2007)
  - Low tolerance for waiting-time to reach information
  - Low frustration and new awareness related to mistakes
  - Less concentration and attention abilities
  - First COOL then SCHOOL
  - .....

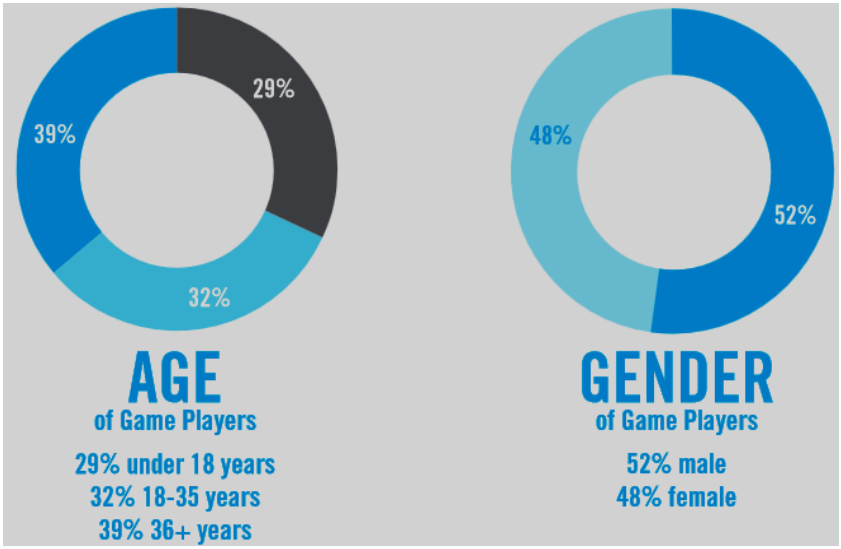
# Digital Natives do need:

- new learning devices
- new knowledge transduction formats: *from pure symbolic to audio-visual and experiential formats*
- new pedagogical methodologies and *informal* learning processes

# Computer video games for Natives

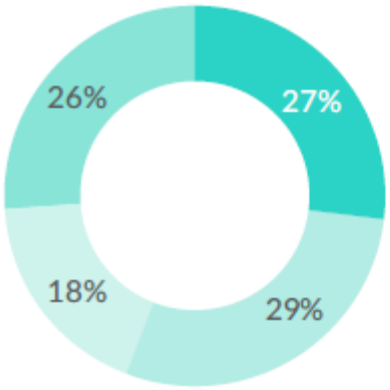
- give pleasure and emotions during the play
- strengthen creativity by imposing conflicts, competitions and challenging problem solving
- rules and set goals for provisioning structure and motivations
- satisfy the ego of the players/learners by appealing win states
- interactive and may be adaptive which engages the learners

*(Prensky, 2001)*



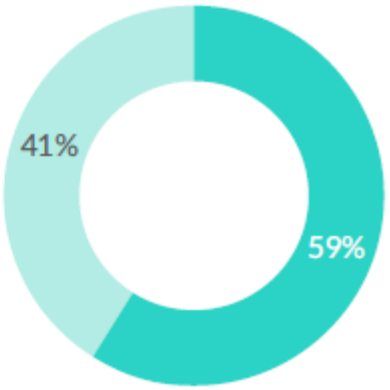

2014

2016




AGE
of Game Players

27% under 18 years
29% 18-35 years
18% 36-49 years
26% 50+ years




GENDER
of Game Players

59% male
41% female

The average game player is **31** years old (2014)

The average game player is **35** years old (2016)

The most frequent **FEMALE GAME PLAYER** is on average **44 years old** and the average **MALE GAME PLAYER** is **35 years old**

*Source: The Entertainment Software Assoc., 2014/2016*

# Target audience and player-centric design

- **The player-centric approach -** your design decisions affect a representative player's experience of the game

Defining

- **target audience** ("*Who am I trying to entertain?*")

  is not the same as

- **player-centric design** ("*Does this feature entertain a representative player from my target audience?*")

- Apply player-centric approach only *after* you have defined the target audience.

# Types of gamers based on their playing habits

- Power gamers – play really hard
- Social gamers - enjoy gaming for interacting with others
- Dormant gamers - love gaming but spend less time because are busy with other activities; play complex and challenging games
- Leisure gamers - play mostly casual games
- Incidental gamers - play games mainly out of boredom
- Occasional gamers - play mainly puzzle, word, and board games

*Source: Parks Associates, 2006*

# Choosing a target audience

- Core versus casual gamers – the last play for enjoyment of experience
- Men versus women
- Children versus adults
- Boys versus girls
- Players with disabilities
- Players of other cultures - *localization*

**STRIVE FOR INCLUSIVENESS, NOT UNIVERSALITY**

# Multi-cultural differences

- Geert Hofstede on multi-cultural teams:
  - Power Distance Index - level of power distribution and authoritarian managerial figure
  - Individualism / Collectivism - personal choice versus life long team devotion
  - Masculinity / Femininity:
    - masculine cultures respect competitiveness, team / organizational aggressiveness, ambition, accumulation of wealth, while
    - feminine cultures respect quality of life, rich relationships
  - Uncertainty avoidance - the level of uncertainity anxiety in a certain culture
  - Long / Short term orientation - the distance of society's horizon or importance of future versus past


Въпроси