Layered Languages of Ludology. The Core Approach

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It is not only for lack of trying that a good vocabulary for describing game experiences does not exist. It is downright hard to describe video games and experience of playing them.
Bruce Philips, September/October 2006

Preface

There does not yet exist anything that might be called a *Digital Games Science*.

Mathematicians talk about digital games [Bew 2005] using the apparatus of mathematics. Other authors use the terminology of cultural history [Hui 1949] or pedagogy [Fri 2004]. Those who have no specialized terminology at hand confine themselves to everyday speech [Kos 2005, SZ 2003]. It is difficult to imagine that these authors talk to each other mutually.

The game designer Greg Costikyan has nicely expressed the state of affair by his talk and publication title *I have no words & I must design*, a paper published in at least four different places [Cos 1994].

Bruce Philips, Microsoft Game Studios, knows the problem "from the trenches" and calls a spade a spade in saying *that a good vocabulary for describing game experiences does not exist* ([Phi 2006], p. 22).

But a digital games science will need its language. The present paper aims at a little contribution to the development of a language suitable for digital games research. Emphasis is put on the problem of describing the experience of playing a game–the issue addressed in [Phi 2006].

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Motivations of the digital games domain as an already huge and dynamically expanding market and as a field of social relevance due to the alleged impact of playing violent games are skipped in the present report.

Klaus P. Jantke

Contents

Abstract

The market for digital games has left the film market behind, and the joystick has clearly better market potentials than the box office. Digital games are attracting increasing public interest due to the alleged social impact of playing violent games. Recently, the academia has found digital games an area of research, development, and teaching. But there is not yet any digital games science. Those who speak about digital games have no language. More precisely, mathematicians speak about digital games in the language of mathematics and psychologists speak about digital games using their own topical language. There seems to be not much desire to talk to each other, and there is not much hope to understand each other. Because digital games are both entertainment media and complex IT systems at the same time, the research needs to be interdisciplinary. An interdisciplinary digital games science urgently needs an appropriate language. The present papers aims at languages for describing digital games, digital game play, and crucial phenomena of successful game design. The present approach has its roots both in social studies such as systematic film analysis and in theoretical computer science such as formal language theory. The intended contribution is an amalgamation of description and investigation technologies from seemingly irreconcilable sources.

1 Digital Games Interdisciplinary & Embedded

Digital games are entertainment media and information processing systems as well. From the perspective of information technologies (IT), digital games are in many cases equipped with a certain amount of what is called artificial intelligence (AI). Digital games studies, therefore, require a variety of competencies and the ability to bridge the gap between different disciplines. Those studies that persist in the viewpoint of exclusively social sciences will fail as well as those undertaken inside the boundaries of IT only. Digital games science is interdisciplinary by nature.

Both as entertainment media and as widely distributed IT systems that can be found in millions of private homes, digital games relate to a large portion of human culture. They are embedded into the social life and have references to issues of technological progress such as the availability of large bandwidth networks, e.g., and to other forms of art such as literature and film, e.g.

When speaking about digital games, there may arise the need to talk about those issues. For instance, the pleasure of playing some massively multi-player online role-playing game (MMORPG) may depend very much on the quality of the available technical environment. Psychological effects such as fun [Kos 2005] and flow [Csi 1991] need to be technically enabled.

The language issues of talking about the hardware basis, the software basis, and the networking conditions of game playing are not considered in the present approach.

When speaking about digital games, there may arise the wish to relate games to books and films. For instance, the point & click criminal adventure AGATHA CHRISTIE: AND THEN THERE WERE NONE derives from Agatha Christie's novel with the corresponding title. The quite creepy horror/survival adventure CALL OF CTHULHU relates to Howard P. Lovecraft's novel of the same name [Lov 1999]. The point & click criminal adventure THE DA VINCI CODE reflects the film[1] of this title by Ron Howard, 2006, after a screenplay by Akiva Goldsman and this screenplay somehow reflects Dan Brown's best-selling novel [Bro 2004]. The special relationship of the stealth adventure SPLINTER CELL to the literature is even more involved. The author Tom Clancy who became famous with his novel "The Hunt for Red October" [Cla 1984] is not the author of the book [Mic 2005] about the game.

The language issues of talking about the literature and film embedding of digital games are not considered in the present approach.

The author's research is focused on the description of game playing experience. For a justified intuitive approach, we try to answer the question how to tell a game.

[1] Even if you don't like the film after you have been reading the book by Dan Brown or, even worse, you don't like the book and, thus, refrain from getting into the film, it is worth seeing it, at least, for its many goofs. Just for illustration, in the film's final sequence, when Langdon is on the top of Louvre's inverted glass pyramid, the traveling movement of the camera operator and his assistant are seen by the glass reflection. Many more great goofs are waiting for you.

2 How to Tell a Game Playing Experience?

There are Babylonian utterances about digital games ranging from the tongue and viewpoint of cultural history [Hui 1949] (first published as [Hui 1938]) through psychological pedagogy [Fri 2004] to mathematics [Bew 2005] complimented by almost uncountably many everyday speech discussions [Kos 2005, SZ 2003].

Choose your favorite language and ask yourself: Can you really tell a game? Can you describe a player's experience when playing? Can you describe a game play sufficiently clear such that flaws like those reported in [Jan 2006b] show? How do others report games? How do players experience games?

When human players would be able to tell us their game playing experience, we had a basis for at least some first investigations in what happens when a game is plaid, how a human recipient is affected by the events happening in the game, and the like.

But humans have difficulties in reporting game playing experiences [Phi 2006]. It might be somehow similar, but a little easier to tell the experience of watching a film. Therefore, related research will be taken as one of the inspirational sources of the present work (see chapter 3).

But digital games are more than highly interactive entertainment media. They are IT systems that change their states under the influence of human players. The game state concept is crucial for understanding and speaking of digital games (see chapter 4).

Furthermore, it will be insufficient to adopt the one or the other perspective and to choose from time to time the one or the other terminology when talking about games. We want to speak about playing experiences described in high level terminology, but may need to refer to details of a complex system's state. When you speak about watching a film, you rarely speak about the movie system's state between two cuts. The film state does not matter. But game states do.

Let me tell the experience of playing the very simple game Neutron from the generic game development platform of "Zillions of Games". I am playing White and the computer plays Black.

Players move in turn. A player's goal is to bring the "neutron", i.e., the golden ball shown in figure 1 to the row in which the opponents pawns are initially placed. Alternatively, a player looses the game if he is not able to move the neutron.

A cell of the board can accommodate only one piece. There is no capturing.

Figure 1: Initial state of Neutron

The initial move of White is exceptionally just a single pawn move. All other moves consist of two sub-moves; first a pawn is moved followed by a move of the neutron. Moving means to shift the pawn or neutron straight along some row, some line, or some diagonal to the last free cell.

Cells are named as known from Chess boards, e.g. The rows of the board shown in figure 1 are numbered from 1 to 7. The vertical lines of cells are named by letters ranging from a to g.

For illustration, my initial move was to push the pawn from cell f1 to cell f6 denoted by ”W: pf1–f6”. Black responded with its two sub-moves ”B: nd4–a4” and ”B: pa7–a2”. You can ”tell a game” like that; Chess players are used to do so. Here is the whole game (read column by column; some sub-moves are labeled):

W: pf1–f6
B: nd4–a4
B: pa7–a2
W: na4–a2
W: pe1–a5
B: na2–a4
B: pb7–b2
W: na4–a2
W: pc1–c6
B: na2–a4
B: pg7–g2
W: na4–a2
W: pb1–g6
B: na2–a4
B: pd7–d2
W: na4–a2
W: pa1–c1
B: na2–e6
B: pb2–e5
W: ne6–a2
W: pc1–c5 [α]
B: na2–e6
B: pg2–d5 [β]

W: ne6–g4
W: pc6–e6
B: ng4–g5
B: pd5–d3
W: ng5–e3
W: pd1–a4
B: ne3–g3
B: pc7–c6
W: ng3–e3
W: pg1–g5
B: ne3–g3
B: pc6–g2
W: ng3–f4
W: pc5–e3
B: nf4–g3
B: pd2–b4
W: pg3–f4
W: pa5–d5
B: nf4–g3
B: pe7–c5
W: ng3–g4
W: pe6–f5

B: ng4–g3
B: pc5–d4
W: ng3–g4
W: pe3–g3
B: ng4–e4
B: pf2–e3 [γ]
W: ne4–g4
W: pg5–f4
B: ng4–g5
B: pd3–d1
W: ng5–g4
W: pd5–f3 [δ]
B: ng4–g5
B: any move
W: ng5–g4
W: pg6–g5
and W wins.

White wins by completely blocking up the neutron. Alternatively, White may win differently in not playing ”W: pd5–f3” (see the sub-move at label δ above), but ”W: pf6–g5” or ”W: pg6–g5” instead. This forces Black to play ”ng4–e2” and White wins immediately (see figure 5).

However, even a simple game[2] should not be told like that, at least, not to a

[2] Too simple case studies do not easily generalize. There may be some doubts the studying structurally simple games like Chess, Go, Nine Men's Morris, or Neutron, e.g., might tell us anything valuable for analyzing and discussing contemporary MMORPGs. Those studies, at least, help to clarify particular language issues.

wider audience. Although it may be necessary to refer to individual moves and sub-moves, the key ideas of tactics and, perhaps, strategy when playing the game require a higher level terminology.

For illustration, figure 2 shows some critical moment after White's sub-move "W: pc1–c5" (see label α). Black attempts to hard-push White by moving the neutron to cell e6 and blocking its way back by "B: pg2–d5" (see label β). White hits back.

Figure 2: A critical move in NEUTRON

Instead of listing the sub-moves following label β, this is better expressed in words like this, e.g.:

"The neutron has only one place to go. After this sub-move I close the hole and have set up a barrier of three pawns in a row." The barrier mentioned in the description of playing is established by the three pawns then sitting on e6, f6, and g6 (see figure 3).

Figure 3: A barrier in NEUTRON

The mentioned barrier on display on the left forms the begin of a construction to block-up the neutron by white pawns.

It depends very much on the game which terminology allows for sufficiently clear and comprehensive descriptions of game playing experience.

The very simple game NEUTRON, naturally, shall not be overestimated. It just serves as an introductory example.

A final case of the game play shown on the previous page shall complete the present discussion. After Black's move "B: ng4–e4" and "B: pf2–e3" White is preparing the showdown. "W: pg5–f4" has caught the neutron at the board's right border. "W: pd5–f3" (see label δ) is closing the wall around the neutron.

Instead of telling the sub-move "W: pd5–f3" the phrase in higher level terms of "closing the wall of white pawns" characterizes what I did. There is no ambiguity at all. The experience is well reflected.

The low level description "W: pd5–f3" *implements* the higher level term of "closing the wall of white pawns" and, vice versa, "closing the wall of white pawns" is the *meaning* of "W: pd5–f3".

When the language levels are given, every meaning needs an implementation, but not every expression on the implementational level has a meaning.

Figure 4 finally shows how the game ends. The walling-up metaphor is a suitable description of what happens.

In case there are no such higher level semantic descriptions appropriate, there may be a need to fall back to the lowest level of game playing description.

In other words, telling a game may require different language levels within a single description. Individual digital game playing descriptions may appear as multi-layered.

Figure 4: Screenshot of the showdown

Figure5 illustrates the alternative end of the game caused by White's move "W: pg6–g5" instead of "W: pd5–f3". The resulting structural pattern on the board is named *a gun*. This shall be discussed briefly in the sequel.

Figure 5: A particular gun pattern

A gun is the name of a pattern after one player's move in which the neutron has exactly one cell of the board to go to. When the next player moves, the neutron behaves like a bullet that has to be fired in a predefined direction. This bullet hits its target, the final cell of the board to which it may be moved.

The gun pattern is a version of the generally known pattern of *zugzwang*[3].

Inside a closed wall, we do not talk about the gun pattern.

We call the pattern on the board shown in the present figure *a deadly gun* because one player (in this case White) is forcing the other one to fire the neutron in a way such that the one setting up the gun pattern wins with the next move.

After we have seen an almost trivial example to warm up, we should direct our attention to digital games that come closer to the focus of public interest. For simplicity, we stick for a moment with one person games, i.e. games designed for an individual human player who gets engaged in game playing experiences with a computer. In some virtual world, the player may meet one or, perhaps, numerous digital counterparts usually called non-person characters (NPCs, for short). The possible amount of the human opponent's action may be literally unimaginably large.

[3]There is no general agreement about what shall be called zugzwang, as the phenomenon occurs in a large variety of games including rather complex digital games.

Pysikus is a comparably simple German point & click adventure designed for an educational purpose (see [Jan 2006b] for a critical analysis of a series of games including this one).

The player is landing with her spaceship in a fantasy world on a small planet that has to be rescued. Knowledge in physics is said to be helpful.

Figure 6: Physikus – a place to visit

After arrival, the player is unknowingly facing a first bottleneck. Whatever the player wants to do, it is necessary to enter the first house which comes into sight (see figure 6).

This game is very simple. There are only steps into four different directions allowed, straight forward (F), left (L), right (R), or turning backward (B). In every game state, the admissible steps are indicated by the appearance of the mouse cursor. Steps are performed by clicking to a point in this two-dimensional space indicating the direction of choice.

Facing a door, the player may either open or close the door (D). In front of certain gadgets, the player may start an (usually unknown) action (A) by clicking to the gadget. This option, again, is indicated by a change of the mouse cursor. There are a few more possibilities suppressed here. The system may react with certain activities drawn from a finite repository. Details are suppressed as well.

To have a brief notation, we call the set of all possible elementary actions $\mathcal{A}$. The set of all strings over $\mathcal{A}$ is denoted by $\mathcal{A}^*$.

At the beginning of the game Physikus, the player is forced to enter the house on display in figure 6 to find a particular gadget on some table and to activate it. The minimal sequence of steps to do so is $FFDFFFFDFLFFA$. There are, naturally, alternative ways. One may cruise around before entering the house.

In case of any game that does not break down before passing the first bottleneck, the game's initial sequence of moves eventually leads to exactly the same game state as the one reached after playing $FFDFFFFDFLFFA$. In formal terms, there is an equivalence relation $\sim$ from $\mathcal{A}^*$.

Although Chess players and some others are used to speak about game playing on the level of granularity provided by $\mathcal{A}^*$, this seems cumbersome for most digital games. In contrast, one may say $\ll$I go into the first house$\gg$ instead of $FFDFFFFDF$, $FFDFFFLBFFDF$, or any other equivalent string from $\mathcal{A}^*$.

Those are expressions on different language layers. The particular phrase $\ll$I go into the first house$\gg$ is, in fact, an atomic statement (a move) on the higher language layer. $\ll$I go into the first house$\gg$ is seen as the *meaning* of $FFDFFFFDF$ and, vice versa, $FFDFFFFDF$ is called an *implementation* of $\ll$I go into the first house$\gg$.

Other higher level expressions are, for instance, $\ll$I open the door$\gg$ and $\ll$I enter the house$\gg$. The description $\ll$I open the door$\gg$ does always refer to a uniquely determined door in dependence on the player's position in the virtual world. The implementation of this higher level action is simply D.

The expression $\ll$I enter the house$\gg$ may be seen of a higher language layer than $\ll$I open the door$\gg$ because it contains the latter as a sub-activity.

Ankh as shown in figure 7 is a German point & click adventure which allows to illustrate the present approach with emphasis on a few other aspects.

Figure 7: Two subsequent scenes in Ankh just two clicks (four moves) apart

The screen in the background of figure 7 shows the earlier scene. The inventory (subsequently named INV) displayed on top lists items acquired by the human player so far: a dirty shirt, a silver coin, a brush, a luxury dress, and a hanger.

Clicking with the right mouse button to the dirty shirt, moving it to the luxury dress, and clicking with the right mouse button to the dress, "combines" the items to a rope shown in the INV the next moment (front screen in figure 7).

The moves considered may be named as follows: $p-INV-n$ means to point to the nth item in the INV. $r-INV-n$ means a right mouse click accordingly. For readability, moves are enclosed in parentheses.

Alternatively, one might name the objects which a player may potentially collect abbreviating, e.g., the dirty shirt by ds and the luxury dress by ld. Moves are then written as $p-INV-ds$ and $p-INV-ld$, accordingly.

The four subsequent moves that lead from the one game state to the other on display in figure 7 are $(p-INV-1)(r-INV-1)(p-INV-4)(r-INV-4)$. The change of the game states shows in the inventory INV.

Playing a point & click adventure such as Ankh may be completely told as a sequence of such moves. The number of places to point and/or to click to is finite. Consequently, we may form a finite alphabet $\mathcal{A}$ as before. However, saying that ≪I combine the dirty shirt and the luxury dress to form a rope.≫ is surely more intuitive. This higher level move may be implemented by the four moves sequence $(p-INV-1)(r-INV-1)(p-INV-4)(r-INV-4)$ as well as by the alternative one $(p-INV-4)(r-INV-4)(p-INV-1)(r-INV-1)$.

It becomes obvious that speaking on a higher level of abstraction may result in some loss of detail.

When a digital game G is seen as a deterministic finite state machine with some distinguished unique initial state determining some formal language $\Pi(G)$ as sketched above, there is a simple unique correspondence between initial parts of sequences in $\Pi(G)$ and game states [HU 1979]. To say it less formally, every sequence of moves represents the state which is reached and every reachable state may be described by at least one sequence of moves. There is no need to introduce states into the language for telling a game.

Nevertheless, humans may find it comfortable to talk about game states. Therefore one should permit particular terminology for game state descriptions. In addition to $\mathcal{A}$, we may assume an alphabet $\mathcal{S}$ of state descriptions. $\Pi(G)$ and, simultaneously, $\Psi(G)$ are seen as formal languages in $(\mathcal{A}\cup\mathcal{S})^*$. It applies the particular requirement that in any $\pi\in\Pi(G)$ there do not occur immediately subsequent state descriptions s_1 and s_2 of $\mathcal{S}$ that are different from each other. This may be further simplified to the requirement that every state description has to be preceded by a move. Consecutive state descriptions are not allowed. The meaning should be obvious: State changes need to have causes.

However, to keep the technicalities simple, $\mathcal{S}$ is assumed to be empty within the formal treatment. This simplification does not restrict the expressive power of the present approach [HU 1979]. Intuitively, human players may talk about game states, but those utterances are simply ignored in the present core approach.

3 Adoptable Languages of Media Studies

Digital games are an important field of research because of the potential impact those entertainment media may have on the behavior of (some of) their recipients. Media research, in general, and systematic film analysis, in particular, [HP 1979], [Mer 1995], [Hic 1996], [Fau 2002], [Kor 2004], may serve as a demonstration case of how to approach the phenomenon of entertainment media.

Media may be dovetailed with literally all aspects of human life, and studying media such as film, for instance, has to take those relationships into account. The film Wild at Heart, David Lynch, 1990, may be seen as a prototypical example discussed in a variety of publications [Cor 1990], [Gif 1990], [Ahl 1991], [Fis 1992], [Rod 1995]. This love story in a troubled America may be discussed on very different levels taking many other issues from outside the film into account such as, just for illustration, this film's relation to the film The Wizard of Oz, Victor Fleming, 1939 (after L. Frank Baum's wonderful classic book [Bau 1900][4]). Wild at Heart is full of citations and analogies, and analyzing this film might require to know the story about Dorothy in the land behind the rainbow in detail.

However, the present approach is reduced to the author's core ideas, as expressed in the report's subtitle, refraining from discussions beyond the limits of the particular media under consideration. The focus is on immediate experience.

With respect to digital games, that focusing means that we are not dealing with language issues such as relating games to real-life events they are potentially reflecting. Thus, it is beyond the limits of the core approach to relate FPSs such as Call of Duty and Medal of Honor to the true history of World War II. Particular games such as the Super Columbine Massacre RPG are, therefore, beyond the scope of this work, because there is no reasonable way to deal with this game without referencing the deadly shooting at the Columbine High School in Littleton, CO, USA, in April 1999. Even such a reference might still be insufficient. The author of the game explains his motivation for developing this game. He stressed his interest in getting people engaged in discussions about the massacre's background. His game homepage hosts some related forum of discussion. The exchange of opinions shall be considered as well when dealing with the Super Columbine Massacre RPG.

In contrast, the core approach to layered languages of ludology confines itself to inner game experience.

The topical literature of film analysis is full of coding schemes [Mer 1995] and discusses films by means of a variety of abstractions [Fau 2002], [Kor 2004]. Cuts of a film are frequently seen as elementary structures. Higher level statements are based on relating cuts, counting cuts, measuring durations and the like. Higher level descriptions group cut sequences and relate them to semantic concepts.

[4] The book is frequently cited as *The Wizard of Oz*, but its original title of the 1900 edition was *The Wonderful Wizard of Oz*, and some 1903 edition was named *The New Wizard of Oz*.

This is not the right place for an in-depth discussion of film analysis; the field is rather involved as a short look into the literature (see the publications cited above) reveals. Here, a sketch will do.

Picturing is an early cultural activity. Pictures are used to represent something not being present such as game in hunting, e.g. The usage of pictures enforces the belief in the existence of the one depicted–a magic power in some pictures, as Richard Hamann stresses [Ham 1980]. This does apply to motion pictures as well and extends to digital games.

There is a particular usage of pictures: to preserve the moment in time. The hope, the belief that this might work is closely related to the belief that the picture truly represents what happened. The human hope and belief is the deeper reason behind the magic power of pictures, films, and digital games.

Every film does consist of segments named cuts. Every cut shows the film's scenery from a particular camera perspective such as extreme long shot, long shot (in German, there is a finer distinction of Totale and Halbtotale in use), medium shot additionally attributed by the number of persons involved as single, two, three, and group medium shot (furthermore, the German classification knows a type between long shot and medium shot named Amerikanisch), medium close-up, close-up, and choker close-up. Another dimension is the angle from which a scenery is seen such as eye-level angle, high angle, and low angle. Furthermore, there may be camera moves within a cut such as panning and travelling, e.g.

A standard approach to film analysis is based on firstly describing a film as a sequence of annotated cuts (see [Fau 2002] and [Kor 2004], e.g., for details).

Sequences of cuts are grouped and simply called sequences. Sequences may be grouped in phases. To get an impression, Stanley Kubrick's film LOLITA, 1962, is usually seen as build of 42 sequences. Shorter sequences of the film such as the prologue and the epilogue have only two and three cuts, respectively, whereas the longest sequence ranging from time point 2:11:55 to 2:20:04 consists of 29 cuts.

Nicolas Roeg's film DON'T LOOK NOW, 1973, has a single erotic sequence of a bit more than three minutes length which consists of about 70 cuts (section 5.5).

First interesting properties of a film might be already discovered on the low level representation of cut scene sequences. For illustration, let us have a look at the sequence from DON'T LOOK NOW mentioned which may be formally seen as $c_1c_2c_3c_4c_5c_6c_7\ldots c_n$ being a finite string of cuts. Cuts appear like letters in a word.

Interestingly, alternating cuts of this scene belong to two different time intervals of the film's virtual time. The sequence of cuts $c_1c_3c_5\ldots c_n$ establishes some experience of the virtual characters of the film preceding in time their experience $c_2c_4c_6\ldots c_{n-1}$. In other words, every pair of cuts $c_{i-1}c_i$ (where i is an even number) draws the recipient's attention from a glimpse at an erotic scene to the time after. This elementary pattern repeats later on a much higher level of description.

MEMENTO, Christopher Nolan, 2000, is another case of exciting cut patterns.

For the present introduction, it is sufficient to see how virtual experience is represented as a string of symbols and analyzed accordingly.

4 Digital Games as Generators of Experience

Digital games are entertainment media and information processing systems as well. The present chapter stresses the IT perspective and aims at the introduction of appropriate formal concepts drawn from theoretical computer science studies. There is no hope for sufficiently expressive and in-depth digital games research, as long as the IT perspective is ignored or, at least, misunderstood to some extent. Social sciences alone are insufficient to deal with digital games.

Given any digital game G, we are interested in descriptions of game playing experience somehow similar to descriptions of motion picture experience. One has to decide about elementary building blocks similar to cuts in film description.

Readers not familiar with theoretical computer science terminology are invited to some thought experiment–*Gedankenexperiment* is the German word which has been in use even in English language based discussions and publications almost a century ago. It is worth to try it out.

It is intuitively rather clear that digital games serve as generators of the human player's experience. But how to tell what a player experiences? And how to tell that with a precision respecting the digital game's character as an IT system?

Elementary expressions of game descriptions are called moves. When some particular game G is given, $\mathcal{A}$ is used to denote the finite alphabet of moves that are taken into account[5]. The perspective of the present approach is that playing a game is reported, at least on the lowest level of expression, as a finite sequence π of moves from $\mathcal{A}$. Because $\mathcal{A}^*$ is a folklore notation of the set of all finite sequences over $\mathcal{A}$, one may write $\pi \in \mathcal{A}^*$.

Readers with a good theoretical background may see $\mathcal{A}^*$ as an algebra with the operation of concatenation $\circ$. Together with the empty string ε it forms a monoid. Usually, this monoid is surely not free. As sketched at the end of chapter 2 above, there is an equivalence relation $\sim$ in the algebra of moves $[\mathcal{A}^*, \circ, \varepsilon]$.

With a given game G, there is the set of all potential game plays $\Pi(G) \subseteq \mathcal{A}^*$. According to the nature of the game G as a computer program, $\Pi(G)$ is recursively enumerable. It may be even recursively decidable.

However, to the Digital Games Science it is relevant to understand and study what is really played. $\Psi(G)$ denotes the subset of game experiences from $\Pi(G)$ that really occur. Digital game designers may have something different in mind. Designers of digital games anticipate–mostly implicit and not well-articulated–some players' experiences $\Phi(G)$.

A sound game design arrives at $\Phi(G) \subseteq \Psi(G) \subseteq \Pi(G)$ or $\Phi(G) \subset \Psi(G) \subset \Pi(G)$, more realistically.

Formalists have to acknowledge that $\Phi(G)$ and $\Psi(G)$ are not formally defined.

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[5]We have to be aware of the difficulty that "the right concept" of moves is not given by nature. For illustration, the reader may consult the Flash game ZOOKEEPER which may be easily found in the Internet. According to the author's experience in discussions with students, it is not easy to agree about what a computer's move shall be.

5 Layered Languages – The Core Approach

This paper like any other publication needs to be focused. For the present report, the author decided to suppress all issues that go explicitly beyond the limits of the game playing experience itself such as

- relating digital game stories to their sources in literature, for illustration, the survival game Call of Cthulhu to H. P Lovecraft's novel [Lov 1999] or the criminal adventure The Da Vinci Code to [Bro 2004],
- relating digital games to a priori or a posteriori films like, for illustration, The Da Vinci Code to Ron Howard's 2006 film or the fantasy survival games of the Final Fantasy series to Hironobu Sakaguchi's film (2001),
- relating digital games of the genre of World War II shooters, e.g., to history,
- relating digital games to originally underlying board games or card games and vice versa; the digital games of The Settlers game series interestingly precede the board game Die Siedler von Catan by Klaus Teuber,
- relating games features to arising mental states from fear or even angst through variants of tension to sexual excitement,
- estimating the importance of music for the pleasure of playing games, for instance, the music virtually broadcasted by virtual radio stations and–really, not virtually–received in virtual cars in Grand Theft Auto,
- asking for the potentials of addiction in digital games and studying the changes in human behaviors when playing games takes over,
- relating violent behavior such as the 1999 deadly shooting at the Columbine Highschool, Littleton, CO, USA, or the 2002 amok run at the Gutenberg Highschool in Erfurt, Germany.

Those issues allow for a large variety of interesting in-depth investigations and discussions, for instance, how atmosphere arising when reading a book[6] might be provoked similarly or not during game playing or how the crucial game mechanics of a board game can be implemented or not. The latter question is quite trivial for Chess, Go, Nine Men's Morris, Shogi, and other games of this type. But how is Die Siedler von Catan related to The Settlers series?

It is intended to deal with the surely relevant topics listed above as soon as more comprehensive case studies have been undertaken and more experience with the core approach has been gained.

However exciting the more comprehensive topics might be, their scientific investigations have to include precise utterances about game playing experience.

[6] One of the involved issues is that when reading a book the reader's imagination substitutes for the missing visual appearance of actors and locations filling in an unforeseeable amount of details. Digital games implementations have to provide a large amount of visualization uniformly to all players. At a first glance, it seems that the need for visualization compared to the imaginations caused by written descriptions is a disadvantage of digital games. But a closer look reveals that it might be also a big advantage–think of the cute NPC actors in the The Settlers games.

5.1 Elementary Formal Language Levels

For every digital game, one may specify the considered set of elementary human player actions as well as the corresponding set of computer actions. Although this seems to be clear at a first glance, it usually turns out that there may be a variety of conceptual difficulties. What are, for instance, the elementary steps a game's simulation engine does perform?

It has to be clear from the very beginning that even such a fundamental act of conceptualization unavoidably involves abstractions. Details are left out consciously and unconsciously. Whether or not our decisions are right can hardly be seen a priori. If the choice of the basic languages allows for interesting results, this justifies the initial decisions are posteriori. Nevertheless, even in the presence of satisfying results, we must be aware of the fact that, firstly, the results depend on the chosen conceptualization and, secondly, another conceptualization might possibly lead to other results.

Assume any digital game G. Any decision as discussed leads to an alphabet $\mathcal{A}$ of actions. We call elementary actions *moves*. Playing a game to the end is seen as a finite sequence π of moves. $\mathcal{A}^*$ is the set of all those sequences.

It sometimes makes sense to talk about some sequence of successive moves at once. For this purpose, the concatenation of moves $\circ$ is introduced. $[\mathcal{A}^*,\circ,\varepsilon]$ is a monoid with the standard neutral element ε named the empty move.

Because digital games are IT systems, they may be always seen as being in some particular game state. The set of all game states is $\mathcal{S}$. Moves may be seen as operators on $\mathcal{S}$. Without loss of generality, one may assume a single initial state $s_0 \in \mathcal{S}$.

It is extremely rare that any two different sequences π_1 and π_2 lead to different game states[7]. Consequently, there are usually different sequences $\pi_1, \pi_2 \in \mathcal{A}^*$ being equivalent in the sense that both drive the game system into the same state. Equivalence is denoted by $\pi_1 \sim \pi_2$.

In the extreme case that the algebra $[\mathcal{A}^*,\circ,\varepsilon]$ is free, $\mathcal{S}$ and $\mathcal{A}^*$ are isomorphic and, thus, $\sim$ coincides with the identity of sequences. This case is not of interest.

According to the concatenation $\circ$ of sequences, there is a substring relation $\preceq$. π' is a subsequence or substring of π denoted by $\pi' \preceq \pi$, if there are sequences $\pi_1, \pi_2 \in \mathcal{A}^*$ satisfying $\pi_1 \circ \pi' \circ \pi_2 = \pi$. It is convenient to drop the symbol $\circ$ to write $\pi_1 \pi' \pi_2 = \pi$ as usual.

In dependence of the aim of investigation, one may ignore particular moves. They may be considered irrelevant such as, e.g., moving leaves of virtual plants or waves of virtual water. Another reason may be that they are unrecognizable such a certain steps of a simulation engine.

Ignoring moves may be seen as an abstraction from $\mathcal{A}$ to some $\tilde{\mathcal{A}}$ with $\tilde{\mathcal{A}} \subset \mathcal{A}$.

[7]This, by the way, is an issue of fun in game playing. We refrain from a detailled discussion.

5.2 Elementary Mappings between Languages

Abstraction is an important approach to simplify expressions. Among the many different variants of abstraction, ignorance is the simplest one. It may be seen as a particular mapping ι from $\mathcal{A}^*$ to $\tilde{\mathcal{A}}^*$ which maps some letters or words[8] to the empty words in $\tilde{\mathcal{A}}^*$. Those letters or words are ignored subsequently.

To keep the whole treatment as simple as possible, all mappings under consideration are assumed to be homomorphisms. Whenever we study a mapping μ from any set of strings $\mathcal{B}^*$ to any set of strings $\mathcal{C}^*$, for arbitrary strings $\pi_1, \pi_2 \in \mathcal{B}^*$ it holds $\mu(\pi_1\pi_2) = \mu(\pi_1)\mu(\pi_2)$.

Homomorphisms may be simply defined on the finite alphabet sets because $\mu : \mathcal{B} \rightarrow \mathcal{C}$ may be easily extended to words by means of $\mu(\pi_1\pi_2) = \mu(\pi_1)\mu(\pi_2)$. Every string from $\mathcal{B}^*$ is mapped "letterwise" to $\mathcal{C}^*$.

Another elementary type of mappings is generalization by abstracting from details and mapping different symbols from $\mathcal{B}$ to the same symbol in $\mathcal{C}$.

The author tries to avoid interrupts of the introduction of concepts in the present chapter by wordy discussions. However, readers not very frequently working with a terminology like one in use here shall be supported by a brief motivation illustrating the concepts of abstraction and generalization in practice.

For this purpose, we choose the point & click educational development game GENIUS Task Force Biologie as a case. [Jan 2006b] contains a comprehensive discussion and a large number of screenshots from this game.

Figure 8: Two screenshots from the game GENIUS Task Force Biologie

The left screenshot shows four places where helicopters are bringing building material for erecting accommodations for virtual workers. Each building activity has been caused by three subsequent player moves: one clicking, one dragging and one clicking again. Just a moment before the left screenshot was taken, the player performed a sequence involving 9 different moves $c_{bm}d_1c_1c_{bm}d_2c_2c_{bm}d_3c_3c_{bm}d_4c_4$.

[8] This distinction is not necessary, because only homomorphisms are taken into account. The definition of a mapping on any word, therefore, may be uniquely reduced to the mapping's definition on the word's atomic constituents.

To be honest, this is already a slightly abstracted description. In fact, the player's click c_{bm} on some button for building machinery is answered by a computer move attaching some object to the player's mouse cursor. With his move d_n, the player is dragging this object to some place in the virtual world. Clicking to this place is named c_n above. Here, in fact, another computer move has been dropped in the initial presentation. The computer releases the object from the mouse cursor and the object disappears from the screen.

To sum up, a closer look reveals that there has been the sequence of moves $c_{bm}[a_{bm}]d_1c_1[r_{bm}]c_{bm}[a_{bm}]d_2c_2[r_{bm}]c_{bm}[a_{bm}]d_3c_3[r_{bm}]c_{bm}[a_{bm}]d_4c_4[r_{bm}]$, where all the computer's moves are indicated by brackets.

But even this is not the complete truth. In fact, there is a simulation engine running in the background and changing the game's state. A larger number of further computer moves have to inserted in the sequence above to give a more accurate impression of what happens when playing this game.

So, in fact, the beginning of the sequence of moves above $c_{bm}[a_{bm}]d_1c_1[r_{bm}]c_{bm}$ had to be rewritten to a form where a larger number of computer moves occurs: $c_{bm}[\ldots]\ldots[\ldots][a_{bm}][\ldots]\ldots[\ldots]d_1[\ldots]\ldots[\ldots]c_1[\ldots]\ldots[\ldots][r_{bm}][\ldots]\ldots[\ldots]c_{bm}$

There are dots in the brackets of the computer's moves not to become involved in details of the simulation process. The dots between brackets point to the difficulty of finding out how many simulation steps happen between two user moves or between a user move and the game's direct response move.

It is an obvious step of *abstraction* to leave out the moves of the simulation engine. However, it should be clear that the ignorance of the simulation in the background prevents us from understanding several important phenomena of the game play and, in the very end, must lead to inappropriate descriptions.

A second step of abstraction is to ignore responses of the game system such as the attachment of an object to the mouse cursor. In formal terms, the mapping is $\mu([a_{bm}])=\varepsilon$. Analogously, $\mu([r_{bm}])=\varepsilon$ means ignorance of the other move of the computer allowing the object at the mouse cursor to disappear. This abstraction applied to $c_{bm}[a_{bm}]d_1c_1[r_{bm}]c_{bm}[a_{bm}]d_2c_2[r_{bm}]c_{bm}[a_{bm}]d_3c_3[r_{bm}]c_{bm}[a_{bm}]d_4c_4[r_{bm}]$ yields $c_{bm}d_1c_1c_{bm}d_2c_2c_{bm}d_3c_3c_{bm}d_4c_4$.

On the one hand, every move that occurs during a game playing experience might be of interest. The lowest level of description has to be available, at least, potentially.

On the other hand, the sample strings discussed above illustrate quite well that too much detail in a game experience description may lead to unreadable and, therefore, useless descriptions.

Next to abstraction comes *generalization* that maps different moves to one and the same image meaning that from a certain perspective different moves are considered to be the same.

The mapping with the two properties $\mu(d_1)=\mu(d_2)=\mu(d_3)=\mu(d_4)=d$ and $\mu(c_1)=\mu(c_2)=\mu(c_3)=\mu(c_4)=c$ maps the string $c_{bm}d_1c_1c_{bm}d_2c_2c_{bm}d_3c_3c_{bm}d_4c_4$ to $c_{bm}dcc_{bm}dcc_{bm}dcc_{bm}dc$. Those mappings are essential to find patterns in playing.

5.3 Higher Level Languages

In the case study above, which shall not be discussed here in much more detail, the sequence of moves $c_{bm}dc$ has a *meaning*. It means to build accommodation.

When $\ll$building accommodation$\gg$ is seen as a move on some higher level, it belongs to the higher level alphabet $\mathcal{A}_i$ where it plays the role of a letter. Vice versa, $c_{bm}dc$ is seen as an implementation of $\ll$building accommodation$\gg$.

To keep our overall approach sound, the original alphabet $\mathcal{A}$ is indexed by 0, i.e. $\mathcal{A} = \mathcal{A}_0$.

A mapping μ which assigns meaning to some language expressions on the level $\mathcal{A}_i$ is mapping strings over $\mathcal{A}_i$ to strings over some $\mathcal{A}_j$. More formally and clearly, $\mu : \mathcal{A}_i^* \rightarrow \mathcal{A}_j^*$. In the case study, we have $\mu(c_{bm}dc) = \ll$building accommodation$\gg$.

Whatever occurs on a higher level $\mathcal{A}_j$ must have an implementation[9] on a lower level. In contrast, not all low level strings have a meaning on a higher level.

Homomorphisms may be concatenated, i.e. executed one after the other. In other terms, one may summarize a sequence of moves on a first level by a more compact expression on a second level and, again, expressions on this second level may be represented on a third level.

5.4 Relations in a Language Lattice

It is assumed that the description languages form a hierarchy, because mappings that abstract, generalize, or assign meaning always map from a certain language of expression to another one which may be seen to be "higher". Higher level languages represent less detail. The descriptions in higher level languages are more compact.

For the following discussion, we assume some particular digital game G and some family of alphabets $\{\mathcal{A}_i\}_{i \in I}$ over some index set I as introduced.

When some mapping μ is in use to assign meaning to some sequence of moves $\pi \in \mathcal{A}_i^*$ by means of the terminology $\mathcal{A}_j$, i.e. $\mu(\pi) \in \mathcal{A}_j^*$, the terminology of $\mathcal{A}_j$ is considered to be higher than the one of $\mathcal{A}_i$. The corresponding notation is $\mathcal{A}_i \prec \mathcal{A}_j$. It always holds $\mathcal{A}_0 \prec \mathcal{A}_j$ (for $0 \neq i$).

The family $\{\mathcal{A}_i\}_{i \in I}$ of alphabets is partially ordered containing its infimum $\mathcal{A}_0$. It may be always completed to form a lattice. Instead of using the terminology of universal algebra, we circumscribe the essentials. When there are two languages determined by their alphabets $\mathcal{A}_i$ and $\mathcal{A}_j$, there is a highest level alphabet $\mathcal{A}_k$ for implementation of both. Similarly, given two alphabets $\mathcal{A}_i$ and $\mathcal{A}_j$, one may ponder higher level meanings of what is expressed over the one or the other alphabet. Those expressions need a higher level alphabet $\mathcal{A}_l$ ($\mathcal{A}_i \prec \mathcal{A}_l$, $\mathcal{A}_j \prec \mathcal{A}_l$).

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[9]If there is no implementation of some higher level of digital game playing experience description, that means that this does never occur when the game is played. In such a case, the particular expression may be removed from the alphabet. As an effect, whatever occurs on a higher level surely has an implementation on the lower level.

5.5 Multi-Layer Language Expressions

As mentioned earlier in this report, substantial motivation for the present work derives from systematic film analysis.

There are fascinating investigations galore. The one chosen here and illustrated in figure 9 is adopted from the film DON'T LOOK NOW (the German unnecessarily baroque film title is WENN DIE GONDELN TRAUER TRAGEN), Nicolas Roeg, 1973, perfs. Julie Christie and Donald Sutherland. This film is based on the book of the same title by Daphne du Maurier[10], 1971.

This film has a single erotic seen of a bit more than 200 seconds in length and a bit more than 70 cuts (see the corresponding discussion and other film examples in section 3 above). Here are the alternating cuts $c_1 c_2 c_3 \ldots c_9 c_{10}$ on display.

It makes sense to talk on this part of the film on the level of cuts. Preceding phases of the film are most probaly told on a higher level, say $\mathcal{A}_i$. After talking here on level $\mathcal{A}_0$, when continuing the investigation, one pops up to some higher language level $\mathcal{A}_j$.

This does apply to digital games playing experience similarly. It will be usually impossible to tell a longer phase of playing on level $\mathcal{A}_0$, but for particular details such as performing some jump or some other avatar's move, it may be essential to go down to the basic language level.

The simple message of the present section is that we usually need several levels of our layered languages of ludology at the same time.

Which language levels are required depends very much on the aim and purpose of the actual discussion.

Language levels are introduced on demand. The only requirement is that every semantic concept invoked on a higher level has a certain implementation on some lower level, i.e. it really appears when playing the game.

Figure 9: DON'T LOOK NOW

[10]Daphne du Maurier might be even better known by some of her earlier books such as REBECCA, 1938, and THE BIRDS, 1952, adopted by Alfred Hitchcock.

There have been a few attempts to formalize a language of gaming experiences. None has achieved broad acceptance. Whether a widely accepted language is even possible or useful is still an open question. ... I expect this will take some time.
Bruce Philips, September/October 2006

6 Summary and Conclusions

The present approach to *Layered Languages of Ludology* has not been thought up out of thin air. It is based on

- the author's lectures on digital games in Darmstadt, Ilmenau, and Mannheim during the Summer term 2006, in particular,
  - on the conceptual work in preparing the courses and
  - on the numerous feedback from the author's students,
- the author's investigations directed toward scientific publications such as
  - the invited papers [Jan 2006a], [Jan 2006d], [Jan 2006e], [Jan 2006c], (listed in the order of presentation) and
  - the submitted–finally and luckily accepted–topical papers [Jan 2006f], [Jan 2006g], and [Jan 2006h] (listed in the order of appearance),
- the author's work within industrial cooperation projects which are reflected in corresponding teaching activities during the Winter term 2006/07 as follows,
  - a Practice Workshop in cooperation with the developer studio Deck 13,
  - a Research Seminar in cooperation with the producer ML Enterprises,
  - a Research Seminar in cooperation with the publisher TGC,
- a few further miscellaneous activities such as
  - the cooperation of the author's research group at the TU of Ilmenau with Prof. Onnen-Weber at Wismar University of Applied Sciences toward a novel digital game development, and
  - the author's critical analysis of digital games that teach [Jan 2006b].

Surely, a language will rarely be introduced ex cathedra. It has to evolve over time when being in use. However, concepts have to be abstracted from reality and thought, they have to be brought into some terminology, and they need to be proposed to a competent community for application and evaluation. Exactly this is the aim of the present technical report a condensed version of which has been presented at the *First International Workshop on Knowledge Media Science*, Landsberg Castle, Germany, October 2-5, 2006.

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Appendix

Games that are mentioned in this report

Agatha Christie: And Then There Were None
Ankh

Call of Cthulhu: Dark Corners of Earth
Call of Duty
Chess

Die Siedler von Catan

GENIUS Task Force Biologie
Grand Theft Auto

Medal of Honor

Neutron

Physikus

Shogi
Splinter Cell
Super Columbine Massacre RPG

The Da Vinci Code
The Settlers

Zookeeper

Artwork beyond digital games mentioned in this report

And Then There Were None[11], novel, 1939
Call of Cthulhu, novel, 1926

Don't Look Now, novel, 1971
Don't Look Now, film, 1973

Final Fantasy: The Spirits Within, film, 2001

Lolita, film, 1962

Memento, film, 2000

Rebecca, novel, 1938

The Birds, novel, 1952
The Da Vinci Code, film, 2006
The Da Vinci Code, novel, 2004
The Hunt for Red October, novel, 1984
The Wizard of Oz, film, 1939
The Wonderful Wizard of Oz, novel, 1903
Tom Clancy's Splinter Cell, novel, 2005

Wild at Heart, film, 1990

[11] Agatha Christie has published the book under the title Ten little niggers after the children's rhyme 'Ten little niggers', in England earlier also known as 'Ten little indians'. Because this title was considered politically incorrect when making a film after the book in 1945, it was changed to fit the US American market to 'And then there were none'. In the early 80ies of the last century, even the book's title in the U.K. was changed to 'And then there were none'.

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