IGDA Curriculum Framework

The Study of Games and Game Development

version 3.2 beta

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Foreword

The IGDA Education Special Interest Group (EdSIG) has worked collaboratively to create this newest version of the Curriculum Framework. Working with many voices, ideas and areas of practice is never an easy endeavor. This version of the Framework is the result of many workshops, panels at conferences, and discussions. The curriculum committee has met over constant emails and multiple revisions throughout the year. Although there are undoubtedly bits and pieces missing and voices we have failed to capture, we have tried to provide ample opportunity for comment by opening the document for international peer and industry review.

The EdSIG feels that no single curriculum can apply to every school, or even departments within a school. The Curriculum Framework, therefore, presents a modular approach, rather than a single detailed curriculum. The Framework describes knowledge areas and practical skills required to make and study games, in a format that can be adapted to the resources and curriculum offerings of a range of educational institutions.

As a practical document, the Framework is designed to assist educators and students, from the creation of individual courses to the development of full degree programs. It is also a guide for students creating individualized courses of study at institutions without game-related majors. It is our hope that the Framework presents some fundamental ideas in relation to teamwork, writing, presentation, and cross-discipline experiences for students. We feel that students should be involved in these soft skills throughout their educational exploration. These fundamental proficiencies are often absent in graduates, and require special attention.

Special thanks go to Tracy Fullerton who led the overall curriculum effort, Magy Seif-El Nasr for leading the knowledge base construction phase, Yusuf Pisan for leading the exhaustive document revision phase, and Darius Kazemi and Darren Torpey for their extraordinary work in building Wiki and coordinating activities. Tremendous gratitude goes to my Advisory Board: Rob Catto, Doug Church, Robin Hunicke, Katherine Isbister, Katie Salen, Warren Spector, and Eric Zimmerman; their support has made embarking on such a large wide-scale project possible. A very big thank you goes to IGDA's tireless Executive Director Jason Della Rocca for his commitment to an open and transparent working environment as well as constant encouragement, advice, and support.

Please use the Framework document as a guide and know that the EdSIG listserv is there for support to answer questions and provide advice. The EdSIG wiki will serve as a database of syllabi. Please feel free to use those syllabi and post the courses you develop to share with the community. All of these documents are free to use under Creative Commons.

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1 Introduction

Digital games, a curiosity a forty years ago, are now one of the most popular forms of entertainment and a pervasive component of global culture. The ubiquity and growth of digital games require that we understand them not just as commercial products, but that we appreciate them from many points of view. Games are aesthetic objects, learning contexts, technical constructs, and cultural phenomena—among many other things.

For gaming and the study of gaming to reach their full potential, industry and academia must cultivate a deeper understanding of the ideas that drive games, the experiences games can offer, and the implications of those ideas and experiences on the social and cultural significance of this young medium. This kind of progress will only come about when academia and industry work together.

This cooperation has already begun. Developers, spurred by increasing risk and skyrocketing development costs, turn with greater frequency to academics for conceptual and technical inspiration. Similarly, as academics begin to recognize the cultural importance and technical challenges of games, they are enriching their research and studies through dialogue with developers. As universities begin to create programs for scientific and scholarly research on games, many institutions are including industry voices to help shape their curricula.

The mission of the International Game Developers Association (IGDA) is *to advance the careers and enhance the lives of game developers by connecting members with their peers, promoting professional development, and advocating on issues that affect the developer community.*

As one of the Association's special interest groups, IGDA Education Committee's goal is *to help foster interaction between developers and educators, to facilitate the development of educational programs, and contribute to the evolution of games.* Interaction between industry and the academy has many benefits: facilitating the transition of new technologies from research labs into products; enriching education by bringing industry experience into the classroom; engendering more critical approaches among game creators; enhancing understanding of contemporary media culture; and fostering a deeper exchange between academics and game developers.

1.1 Purpose of This Report

The curriculum framework we present in this document is a conceptual guide for game-related educational programs.

Though the field of scientific game research and game studies is young, the number and variety of game-related educational institutions is already vast. No single curriculum can apply to them all. Therefore, this document presents a modular curriculum framework, not a single detailed curriculum. We have described knowledge areas and practical skills required to make and study games, in a format that can be adapted to the resources and curriculum offerings of a range of institutions worldwide.

We have not suggested specific courses, appropriate credit hours, or specific degree program requirements. Nor is this framework an attempt to tell developers what areas of knowledge should be important to them. Instead, this framework proposes a set of Core Topics—a list of general

areas relevant to the construction of a game-related curriculum. We intend for you to mix and match the Core Topics according to your needs, to include and exclude as you see fit. Rather than a menu of necessary ingredients, this document lists possible ways to grow or focus your program.

In such a complex field, there is no “silver bullet” approach. It is our hope that individual teachers, administrators, and students can adapt appropriate aspects of this framework to their particular educational needs and institutional contexts.

We have created this report to explain the character of the various games programs, and to serve a broad and varied audience. We think it can be helpful to:

- Educators and administrators who are developing curricula for games related programs at their institutions;
- Games companies wishing to know or influence what they can expect from new graduates seeking jobs;
- Students who are trying to determine which area of games suits their interests, goals and skills;
- Professionals who are considering how to continue their education in a rapidly-changing field;
- Public education organizations, government officials, accreditation bodies, and others who seek a deeper understanding of the games area; and
- Anyone who is trying to make a sense of the wide range of games-related programs that are now available.

1.2 Scope of This Report

There are many types of games related programs. Some have obvious names, such as *game design* or *game programming*, while others are embedded as specialisations within a larger program. Over the last ten years, there has been a dramatic increase in the number and type of programs related to games. It is beyond our goal and capacity to catalogue or categorize them. As part of the curriculum framework, we attempt to describe the current landscape of games education. The list of core topics in Section 3 attempts to capture all major areas that are related to games education. While we do not expect any program or any institution to cover all the core topics, the core topics do provide a framework for thinking about the different areas of games education.

The meaning and value of accreditation is vastly different in different contexts and in different countries. Currently, there is no accreditation for undergraduate university degrees in games in the United States, although some states do approve and accredit community colleges and private training institutions. In the UK, Skillset (http://www.skillset.org) is the industry body responsible for liaison with the Audio Visual Industries and has accredited four games courses to date.

Since the study of games is a highly interdisciplinary area, it is not clear what type of accreditation would be most appropriate and beneficial. Although games degrees designed and offered by

computer science departments look very different from games degrees designed and offered by film schools, the graduates from both programs are valuable contributors to the games industry. We leave aside the discussion of whether it is too early for accreditation or whether games itself is not a distinct discipline, and attempt to describe the landscape of the field. As different countries and organisations start accrediting games programs, we will add the appropriate pointers to this document for reference.

1.3 Background and History

The IGDA Special Interest Group on Game Education was formed in 2000 with an unprecedented cooperative effort between game industry and academia. At that time, only a few pioneering educators viewed games as a sophisticated medium of expression – a cultural and economic force that deserved study and attracted increasing numbers of students. Similarly, only a handful of game developers saw the value in forging relationships with academia, jumpstarting valuable research programs, creating a common language, and building a shared knowledge base for discussing games.

In 2000, the Education Committee was created to improve collaboration and communication between industry and academia. Reinforcing the goals of the IGDA charter, the Committee began building bridges between game developers and academics from a variety of fields.

In 2003, the Education Committee put together the first version of the curriculum framework titled *IGDA Framework: The Study of Games and Game Development* version 2.3 beta[1]. The document was never intended to be a finished product. It captured ongoing practices, presenting snapshot in time.

Since 2003, many more universities and private institutions have begun offering games courses. The computer games industry has continued to grow, and by all indications it will keep growing, making it even more crucial to have a strong relationship between the games industry and academia.

The *Curriculum Framework 2008* document builds on *Curriculum Framework 2003* . In putting together this document, we went through a two-phase effort. In phase one, we collected course outlines at the IGDA wiki (http://igda.org/wiki/index.php/Category:Courses) and developed a knowledge base for educators to use as a reference. We structured the knowledge base so that courses could be classified and easily browsed. The knowledge base continues to grow and has already proven to be a valuable resource[2]. In phase two, we revised the 2003 framework with new insights gained from the knowledge base and incorporated feedback from game developers. We sought additional comments from the larger community by making the draft document available on IGDA's web site, through posting it on mailing lists, and through workshops and panels at conferences.

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[1] The first topics IGDA Curriculum Framework released in 2003 was given the version number 2.3 beta. It was beta because it was not a finished product. We expect this document to continue to evolve and always remain in "beta". As to why it was version 2.3 rather than version 1 remains a mystery. One hypothesis is that it was labeled as version 2.003 reflecting the year the document was released and then shortened to 2.3. The current document is labeled as version 2.008 beta to reflect the year it is presented at the Game Developers Conference (GDC).

[2] IGDA Curriculum Knowledge Base can be found at http://igda.org/wiki/index.php/Curriculum_Knowledge_Base

The document is the result of a community effort and continues to be work in progress.

1.4 Guiding Principles

The principles that guided the development of the curriculum framework are as follows:

1. Shared Identity. The dramatic growth in the number of games-related educational programs and their collective impact requires that games education articulate a shared identity. Games have a significant impact on society. The impact is not limited to entertainment, as games are often used in education, training, recruitment, advertising, simulation, decision-making, and many other areas. Games represent a significant part of today's culture. Given the importance of games to society, educators have a responsibility to help society understand what we do. The goal of this report is to articulate a shared identity and common understanding of this emergent field.

2. Fields of Study. The curriculum framework does not dictate a specific program, but outlines fields of study that make up a games education. We are creating, defining, and exploring the knowledge required to contribute to the current games industry as well as to produce the next generation of games. Our goal is to paint a useful picture that transcends disciplinary boundaries and is accessible to a broad audience.

3. Collaboration and Shared Vocabulary. As game industry and academic programs continue to evolve, the curriculum framework should also evolve to reflect what both industry and academia have learned from each other and to establish a common vocabulary to enable developers, academics and students to talk to each other with shared understanding of the field. Academic programs can support the industry through educating students with relevant skills and research into new areas of game design and development. Best practices established in industry can be fed back into educational programs to improve education.

4. Theory and Practice. The curriculum can help create guidelines on how to bring together theory and practice, encouraging a critical approach to development. This works in reverse, too—theoretical studies of games in the social sciences and the humanities should also be more aware of the nature of the development and business of games.

5. Living Document. The curriculum framework is a talking point for future work and encourages innovation and free thinking in game design education This is not a final draft, but a living document. The more people who read it and comment on its contents (both the good and the bad), the stronger this document will become in future revisions.

The IGDA Education SIG web page at http://igda.org/education/ and the IGDA wiki at http://igda.org/wiki/index.php/Game_Education_SIG provide further resources on relevant mailing lists, web sites, and books, as well as large collection of course outlines and sample degree programs.

2 Games Discipline

Defining games as a field of study is extremely difficult. It has a unique cultural identity, utilizes distinctive theoretical and conceptual principles, and requires an interdisciplinary perspective to understand and appreciate its various elements. Currently, journals and periodicals define much of the discipline's special interests, and a full articulation of the field is often debated. This

curriculum framework attempts to identify what is considered a common denominator within our collective knowledge, with recommendations on breadth of concept, detail of knowledge, and general studies within the area referred to as games. While our focus is on digital games, we recognize that digital games are an extension of non-electronic games and "play". The study of games should incorporate all stages of production (management, design, programming, audio, graphic design, writing, testing, QA) and provide a context of videogame culture (marketing, sociology, theory and criticism). This document outlines the areas that make up the games field. Since it would not be possible for any one program to incorporate all of these areas, we expect each institution to balance the depth and breadth of their programs based on their specific context.

2.1 What are Games

This document thinks of games in the broadest possible sense and any one definition would be limiting, giving preference to one discipline or perspective. Common to most definitions is the notion that games are systems that involve a player who makes choices that change the state of the system, leading to an outcome.

For the sake of having a working definition that is "good enough," we offer the following definition:

A *game* is an **activity** with **rules**. It is a form of **play** often but not always involving **conflict**, either with other players, with the game system itself, or with randomness/fate/luck.

Most games have **goals**, but not all (e.g. The Sims, SimCity). Most games have **defined start and end points**, but not all (e.g. World of Warcraft, Dungeons & Dragons). Most games involve **decision-making** on the part of the players, but not all (e.g. Candyland, Chutes & Ladders).

A *videogame* is a **game** (as defined above) that uses a **digital video screen** of some kind, in some way.

The definition above is not meant to exclude any type of game, but is included as a "working definition." Readers should refer to the reference materials for additional definitions and perspectives on what constitutes a game.

Studying games involves understanding the many factors that impact the workings of this complex system. The three overlapping areas in studying games are:

- **Game Design** – concerned primarily with interaction and interface design

  Game design is the process of crafting a system of play in which players' actions have meaning in the context of the game environment [Salen and Zimmerman, Rules of Play, 2004]. Game design encompasses the set of principles, concepts, and practices that lead to the development of high-quality product. Implicit in the process of game design is the consideration of design trade-offs to allow the implementation of a game in some human playable interactive environment.

- **Game Development** – concerned primarily with the production of games, especially technologies used in creating a game

  Game development is a process that involves the interdisciplinary cooperation of technical disciplines like software engineering and creative disciplines like art and music to implement a game design in a playable real-world format [Rabin, Introduction to Game Development, 2005]. Game development often involves implementing and incrementally testing potential game elements without knowing in advance which will succeed and which will fail. Game development also requires knowledge of project management to ensure that a game is completed with the available resources and within acceptable time constraints.

- **Game Studies** – concerned primarily with examining games as cultural artifacts, as pieces of media and exploring theories of play

  Game studies deals with the conceptual basis and vocabulary used to study and analyze games. Related to game audiences, game history and videogame history, technology/platform history, game criticism, games for educational and instructional purposes.

The definitions given above are intended as guidelines for reading this document; they are not meant to be final, definitive, or universally accepted. For each area, multiple definitions can be found in literature, and there are of course many different ways of dividing and studying games. While each of the core topics described in the next section can be attached to multiple areas, it is conceptually helpful to think of a core topic belonging mostly to one area.

3 Core Topics

Games are interdisciplinary on many levels. To create games requires collaboration among diverse existing fields, from audio and visual design to programming and project management. At the same time, digital gaming has given rise to new kinds of hybrid disciplines, such as game design and interactive storytelling. When considered as cultural artifact, a full critical understanding of games requires that we appreciate them in all of their social, psychological, historical, and aesthetic complexity.

For this reason, we strongly advocate a cross-disciplinary approach to game-related education. For us this means an educational approach that both respects what established fields bring to games and pays attention to new realms of study that games make possible.

One of the criticisms from the games industry has been that some graduates know a little bit of each part of game design and development, but do not have in-depth knowledge of any particular area. Each institution needs to carefully balance the breadth and the depth of the programs they offer based on their target students and specific circumstances.

The set of Core Topics we propose below reflects this approach. Some of the Core Topics are derived directly from existing disciplines like computer science. Others combine disciplines or synthesize new ones. We acknowledge that there are other ways to organize these overlapping fields of knowledge. However, we feel that the set of Core Topics listed below intuitively addresses the unique practical and theoretical concerns of games. As a whole, the Core Topics

provide a bird's-eye view of the immense landscape of games-related education. These Core Topics are:

1. Critical Game Studies
2. Games and Society
3. Game Design
4. Game Programming
5. Visual Design
6. Audio Design
7. Interactive Storytelling
8. Game Production
9. Business of Gaming

It should be noted that there is a consistent overlap in this list, so that some subtopics may be part of more than core topic. This also means that there are some issues that can be tackled from different disciplines (e.g. play-testing as part of design, or as part of software development, or as part of focus testing in marketing).

At this point in time, there is no agreement on a small set of core topics that all games programs should cover or even what all students who are doing an arts-heavy (versus a programming-, design-, or business-heavy) games course should cover. In fact, we expect that while the essential topics for a game programmer and a 3D game artist would have some overlap, they would also have many differences. If/when a small set of core topics emerges, we will update the document to reflect that shift.

For each core topic, we provide links to relevant IGDA resources when possible; however, as these resources grow and change over time, interested readers are encouraged to search IGDA http://igda.org/ pages directly for additional resources.

Below is a general description of each of these topics.

3.1 Critical Game Studies

Criticism, Analysis & History of electronic and non-electronic games.

This interdisciplinary Core Topic combines approaches from history, literature, media studies, and design. A key goal of *critical game studies* is to develop and refine a critical vocabulary for articulating the aesthetics of games. This includes both the distinctive features unique to games and those they share with other forms of media and culture. Critical game studies, for example, offers insight into the textual analysis of game play, whereas established work on other media, such as literature, film, television, theatre, and interactive arts can provide rich critical frameworks. Also included here are: the history of computers and digital games and toys; the construction and critique of a canon of significant and influential games; and game criticism and journalism.

3.1.1 Game Criticism

Game studies

- Ludology – studying game and play activities
- Critical theory and research
- Critical vocabulary for discussing games and play, including the evaluation of game mechanics, game play, game flow and game design and forms of gameplay experience that influence game design
- Establishing and critiquing the canon of influential and/or important games

Experience-centered criticism (Player-centered approach)

- Study of interactivity, human-interaction technologies
- Function and uses of exploration in virtual worlds
- Encouraging and supporting player “agency”
- Creating and sustaining player immersion
- Supporting the suspension of disbelief
- Study of human virtual social interactions

Consumer-oriented criticism

- Analysing and understanding the function and current state of the gaming press
- The function and current state of game reviews
- Tools, techniques and standards of print and media journalism
- Legislative and judicial impact on the game industry
- Game advertising

Genre analysis

- What genres exist?
- How are game genres defined?
- History of game genres (genres that have come and gone)
- Are genres useful? How does the application of genre analysis differ when applied to games as opposed to other media?

Auteur studies

- Given the collaborative nature of game development, who actually creates a game?
- Does the concept of authorship apply to individual games?
- Does the concept of authorship apply to an individual’s body of work as a whole?
- “Branding” of games as being the work of one author

Analysis of Game Design

- Gameplay
- Narrative / Game writing
- Story and Plot
- Character Development
- Art design
- Sound design
- Interaction design (How do new interaction devices influence forms of play?)
- Simulation Methodologies

3.1.2 Media Studies

Non-game media, such as literature, radio, film, television, art, theatre, graphic novels, architecture, Internet

Media Research Methods

- Data collection methods
- Ethnography
  - Qualitative
  - Quantitative
- Technology survey (study and comparison of different technologies, their performance and their potential)
- Experimental technologies (building new gaming technologies, particularly hardware)
- Introduction to mass media/pop culture research
- General media effects research
- Game-specific research
- Player-focused research

Core Experiences

- Write a game review
- Read game criticism
- Write game criticism

3.2 Games and Society

Understanding how games reflect and construct individuals and groups, as well as how games reflect and are constructed by individuals and groups.

In this Core Topic, sociology, anthropology, cultural studies and psychology offer important insights into worldwide gaming culture. *Games and society* includes scholarly work on online

economies and community building, fan cultures and their creative modifications of game content, the role of play in human culture, and the relationship between online and offline identity. Also found here are issues of representation, ideology, and rhetoric as they relate to gaming. This Core Topic covers the psychological facets of games including studies of media effects and the ongoing debate about the psychological impact of games on individuals and groups.

This core topic also examines how individuals and groups construct games. It explores how values, identities, and cultural images shape game production. Finally, this core topic examines how technologies, legal institutions, government policies, and corporations mold the production of video games. Placing games in a broader social, political, and economic context can provide insight into how a game came to be.

Players and Effects

Gaming demographics

- Gender and diversity of players
- Childhood, education and child development
- Understanding the choices and patterns of buyers and players
- Information sources, game related organizations

The “Cultures” of Gaming

- Pop Culture: Games as icons and cultural artifacts
- Fan Culture: Game communities and their members
    - Why communities form
    - How to encourage the creation of fan communities and how to support them
    - Game merchandizing
    - Fan communities from related media
    - Online communities: design and dynamics
- Mass Culture: Cultural dialogue about games
    - Games in other media (film, television, books, etc)
    - Games in the larger perspective of cultural impact of computers

History

- Famous designers, people and events that have defined the field
- Electronic games / Non-electronic games / Online Games
- Computers / Platform studies
- Preservation of Digital Technologies
- Games from other countries

Experience of Play

Historical aspects of the experience of play

- History of play
- Cross-cultural anthropology of play
- Commonalities and differences of games across national boundaries
- Role of the economy in history of play (leisure time, spare money for toys…)

Social aspects

- Social games, online and massively multiplayer games
- How games create “safe spaces” for play: experimentation
- How they are used in social settings
- How they support and break traditional social roles
- Effects of cheating (during the game vs while practicing/learning, using built in cheats)
- Stereotypes in games (characters, settings)
- Ethical and social issues in games

Psychological aspects

- How emotional responses are triggered and manipulated by games
- Cognitive theory
    - Mental Models
    - Problem-solving
- Theories of intelligence
- Applicability of developmental models
- Reactions to games by others (like reactions to comics and rock music, political legislation, law suits)
- How games rely upon and affect our understanding of ourselves and others
- Research into the relationship between games and violence
- Research into games and addiction

Economic aspects

- Push for larger sales – more sequels of successful products, more licensed products)
- The role of game quality and supply in the crash of the 80s
- Changing demographics, new opportunities

Human/machine interaction

- Usability issues (e.g. making game interfaces easy to learn and easy to use)
- Accessibility issues (e.g. dealing with users having special needs)

The Construction of Games and Game Technologies

Historical aspects of the technologies and institutions that frame the game industry.

- History of game technologies
- History of game companies
- History of video game litigation and patents

Anthropology of the Game Industry

- Political and Economic Context of the Game Industry
- Practice of Game Development
- Cultural Context of Game Development
- Game Developer "Culture"
- The Intersection of Gamer Culture and Game Producer Culture
- The Transnational Production of Games and Game Technologies

3.3 Game Design

Principles and methodologies behind the rules and play of games.

This Core Topic addresses the fundamental ideas behind the design of electronic and non-electronic games. *Game design* includes gameplay, storytelling, challenges, and basic interactive design, including interface design, information design, and world interaction. Perhaps most important for *game design* is a detailed study of how games function to construct experiences, including rule design, play mechanics, game balancing, social game interaction, and the integration of visual, audio, tactile and textual elements into the total game experience. More practical aspects of *game design*, such as game design documentation and playtesting are also covered. This is the Core Topic most intrinsic to games themselves and is therefore in some ways the heart of the curriculum framework we outline here. On the other hand, because it is the least understood, trained instructors and quality reference materials are sorely lacking, making it among the most challenging Core Topics to teach.

Conceptual Game Design

Understanding the atomic parts of games

- Game objects (tokens) and game setting
- Rules
- Dynamics
- Play mechanics
- Goal(s)
- Conflict
- Theme/Color

Play Mechanics

- What are game "rules"?
    - How should they be structured?
    - How do you create the right balance of obstacles/aids, penalties/rewards?
    - The nature of ‘world’ and interaction.
- Core mechanics: What are they? How do they shape gameplay?
    - Types of play mechanics: discrete/continuous input, deterministic/random outcome, etc.
    - Information flow as a key component of systems design
        - Player input
        - System output
        - Information feedback loops
        - The importance of maintaining a tight information feedback loop
- Game theory: two-player games and strategies, payoff matrices, Nash equilibrium, …
- How are play mechanics shaped or influenced by the game genre or platform?
- When are games too hard, too easy? Why?
    - How does difficulty influence gameplay?
    - What are the consequences of a game being too hard or too easy?
- What sorts of play mechanics work best for what sorts of people?
- The study of strategic decision-making in competitive and cooperative situations (Prisoner’s Dilemna, etc.)
- The role of balance in game design
    - Situational Balancing techniques (Area vs. Point effects, Resist Gear vs. Combat Gear)
    - Equivalency Balancing (Damage per Second, accuracy vs. power, etc.)
- Transitive versus Intransitive mechanics
- Modelling Methods

Approaches to Game Design

- Thinking about design algorithmically
    - Bottom-up versus top-down design
- Player experience approach – design for the moment
- World design – building gameplay from within a story and setting
- How are play mechanics shaped or influenced by the game genre or platform?
- What sorts of play mechanics work best for what sorts of people?

Boardgame and Roleplaying design

- Wargames

- Role Playing Games
- Collectable Card games
- The role of chance and probability
- Narrative and flavor versus mechanics

Ideas

- Generating new ideas
    - Individual and group brainstorming
    - Seeing the systems in the world around you
- Turning ideas into game concepts
- Evaluating game concepts using design documents and game prototypes

Fun

- What does “fun” mean?
- Different kinds of fun: exploration, character advancement/growth, social experience, challenge, etc.
- Does a game have to be “fun”?
- Why people play

Abstract design elements

- Positive and Negative feedback systems
    - Game balancing tools
    - Player rewards and punishments
    - Challenge and “flow”
- Emergent complexity
    - Interactions among systems that lead to unique player experience
    - Controlling emergent complexity to keep it from breaking the game
    - Player intent, and making systems clear enough that the player can understand, predict and control them
- Simulation & Emulation
    - Using systems that allow flexible response versus specific behaviors for preconceived situations
- Communication systems
    - How much information does the player need?
    - What’s the best way to get information to the player?
    - Layered communication
    - Subconscious communication

Psychological design considerations

- Operant conditioning
- Flow states
- Addiction in gaming
- Rewards and penalties
- Difficulty curve
- Creating diverse social systems
- Keeping the players in the game / bringing them back over time
- Fostering variety of gameplay styles

Interface design

- Interface design theory / Computer UI theory
- Human-Computer Interaction
    - Novel or specialized interfaces
- Information visualization
- User task modeling
- Balancing player control schemes -- simplicity versus expressiveness.
- The impact of specific hardware constraints – controllers, keyboards, headsets, etc.

Iterative nature of game design: create, test, change, and repeat

Serious Game Design

Uses of games in medical, training, therapeutic and other non-entertainment applications

Education

Training

Therapeutic uses

Simulation

Use of games for political statements

Use of games as an artistic medium

Working with content experts

Instructional Design

Assessment – Evaluation of the game as an educational or training tool.

Practical Game Design

Spatial design

- Gameplay spaces
    - Representational spaces
    - Abstract spaces
    - Space and pacing
    - Space and narrative
- Creating densely interactive, highly responsive worlds
- Goal communication through spatial design

Task design

- Action and interaction
    - World/geometry interaction
    - Character interaction
    - Puzzles
- Providing adequate feedback to players

Design integration

- Melding space and task
- Integrating art and gameplay
- Design implications of platform choice

Control schemes

- Direct/Indirect Manipulation
- Movement and Navigation
- Items and item manipulation
- Inventories
- Natural controller mappings

Custom Tool Use

- Getting Design Concepts into a Game's Underlying System

Training

- Teaching your players how to play the game / what can be done in the game; integrating tutorials within the game
- Supporting learning with consistent challenges and appropriate feedback.
- Communicating with the player regarding challenges, actions and abilities within the game world

- Keeping track of what the player has done in the game / giving feedback about remaining goals

Game tuning

- Understanding games as dynamic systems
- What makes a balanced game
- Applying game-tuning strategies in light of feedback from actual play
- Balancing player advancement with challenge advancement

Game player analysis

- Understanding who your audience is
- Designing for diverse populations
- What criteria to use to measure success with a given audience
- Working with Quality Assurance
    - Bug tracking, bug assignment
    - Understanding how to write feedback to others

Play testing (used much more in production, but can also be used in design phase as well)

- Ethical considerations in human subjects testing
- Think-aloud protocols
- Differences and similarities between usability testing and play testing
- Interviews/Questionnaires
- Observation
- Beta testing
- Testing under different constraints: testing by yourself, testing with your close friends/colleagues, supervising a test with complete strangers, blindtesting

Prototyping

- Paper prototyping
- Rapid, light-weight computer-based prototyping
- Creating physical prototypes for turn-based videogames
- Creating physical prototypes for realtime videogames
- Creating digital prototypes of individual systems or mechanics

Game Design Documentation

- Writing and maintaining a game design document
- Writing concepts, proposals, rules documents and design documentation

- Communicating design ideas clearly to the team
    - Appropriate level of detail
    - Making design requirements understandable to artists and programmers
- Change tracking

Content design

- Level design

3.4 Game Programming

Aspects of traditional computer science and software engineering – modified to address the technical aspects of gaming.

This Core Topic includes physics, mathematics, programming techniques, algorithm design, game-specific programming and the technical aspects of game testing. Much of the material in this area could be taught under the auspices of a traditional computer science or software engineering curriculum. However, games do present a very specific set of programming challenges, such as optimization of mainstream algorithms such as path-finding and sorting, and real-time 3D rendering, that are addressed here.

Math and Science techniques

- Basic Newtonian physics
- Computational mechanics
- Probability and statistics
- Geometry, discrete math and linear algebra
    - Vectors and Matrices
    - Coordinate spaces and transformations
    - Collision Detection
- Computational geometry
- Basic calculus and differential equations

Style & design principles

- Coherency
- Object oriented programming paradigms
- Design patterns
    - Game design patterns

Information design

- Data structures – data architecture, file formats, data organization, data compression
- Asset pipelining

- Computational geometry
- Environmental models, spatial data structures
- Database
- Machine Architecture
- Optimization (CPU and GPU)
- Embedded System Development
- Configuration Control and Source Control Systems
- Software Architecture
- Software Engineering

Game Engine Design

- Purpose and importance
- Architecture and design
- Data Pipelines
- Methodologies and practices to create stand-alone gaming applications,
    - Limitations of implementing cross-platform technology
- Generic and universal issues in programming for 3D engines
    - Graphics libraries and 3D hardware issues
    - Programming object and camera motions
    - Collision detection and collision response
    - Performance analysis
    - Special effects

Prototyping

- Tools and skills for fast, iterative development
- Building flexible systems, configurable by others

Programming teams -- structure and working relationships

- Working in interdisciplinary teams
- Talking with programmers/artists/designers/producers/etc.
- Team programming processes and methodologies

Design/Technology synthesis

- Supporting player goals and actions
- Building intelligent, coherent, consistent, reactive game environments
- Platform issues

System architecture for real time game environments and simulations

- Concurrent programming techniques
- Integration of sub systems (Physics, Collision detection, AI, Input, Render, Scripting)
- Incorporating and extending third party systems in a game engine.
- Resource budgeting (CPU, GPU, memory)

Computer Architecture

- Structure of a CPU with implications to program design (eg, avoiding branching)
- The memory hierarchy with implications to program design (eg, alignment of data structures in memory, locality of reference)
- Algorithm design considerations for CPU versus GPU implementation

Tools construction

- "Tool Development"
- GUI creation
- Tools for multimedia content creation, modification and management
- Custom design tools
- Building flexible systems for non-programmers to use

Graphics Programming

- Rendering
    - Transforms, lighting, texturing
    - Clipping, occlusions, transparency
    - Level of detail considerations
    - Using data structures to optimise rendering time
- Animation
    - Forward and inverse kinematics
    - Transform representations
    - Interpolation techniques
    - Camera animation
- Graphics System Design
- Procedural content generation (Textures, Models, etc.)

Sound / Audio Programming

- Physics of sound and human hearing
- Programming 3D positional sound
- Utilizing Audio Channels
- Audio Prioritization

Artificial intelligence

- Difference in goals between Game AI and traditional AI
- Path planning, search algorithms
- Agent architectures
- Decision-making systems
- State machine design
- Statistical machine learning

Networks

- Networking and Server design
- Performance metrics
- Topologies
- Protocols – TCP/IP, UDP, …
- Security
- Game Servers
- Game Protocol Development
- Available Network Libraries
- Open Source Network Game Case Studies

Game logic

- Compilers
- Scripting languages

Play analysis

- Play testing to monitor player frustration, progress and enjoyment
- Monitoring player state -- gameplay data logging
- Player metrics

3.5 Visual Design

Designing, creating and analyzing the visual components of games.

This topic includes visual design fundamentals, both on and off the computer, across a broad range of media. Content areas include: history, analysis and production in traditional art media such as painting, drawing and sculpture; communication fields like illustration, typography and graphic design; other design disciplines such as architecture and industrial design; and time-based media like animation and filmmaking. Special emphasis is placed on how visual aesthetics play a role in the game experience. Use of 2D and 3D graphics programs can be an important part of a *visual design* curriculum. However, our emphasis is on fundamental visual design principles rather than on specific software packages.

Basic Visual Design

- Art history & theory
- Visual design fundamentals
    - Composition
    - Lighting and color
    - Graphic design and typography
- Fundamentals of drawing
- Painting techniques
- Sculpting
- Anatomy and life drawing
- Physiology and kinesiology

Non-narrative graphics/Abstraction as expressive tool

Visual design in an interactive context

Visual narratives: painting, comics, photography, film

Motion Graphics

- Animation
- Cinematography
- Camera angles and framing
- Visual narrative / storyboarding
- Filmmaking: framing, types of shots and camera movement, editing
- Kinematics

Visual asset generation

- 2d graphics
    - Pixel Art
- 3d modelling
- Textures
- Interface design
- Character design
    - Conceptual design
    - Character modelling
    - Character animation

World Design

- Environmental modeling

Architecture

- Fundamental principles of architecture
- History of architecture
- Fundamental principles of architecture
- Real-world spaces vs. game spaces
- Space design
- Navigation
- Materials

Working with 3D Hardware

- Procedural shading
- Lighting
- Effects

Game Art (digital based art with game content)

- Custom tool use – getting game art into a game's engine

Information Visualization

Procedural content

3.6 Audio Design

Designing and creating sound and sound environments.

This core topic includes a range of theoretical and practical audio-related areas, such as: music theory and history; music composition; aesthetic analysis of music; recording studio skills; and electronic sound generation. Audio relating specifically to digital game technologies, such as 3D sound processing and generative audio structures, is also included. Throughout, special emphasis is placed on the role of audio experience within the larger context of a game. As with visual design, the emphasis is on design fundamentals rather than on specific technical knowledge.

Audio history & theory

Basic technical skills

Basic studio skills

- Familiarity with hardware and software (e.g., microphones, mixers, outboard gear)

- Recording, mixing and mastering.
- Studio organization

Audio Programming

Audio Assets

Audio Tools

Audio Design Fundamentals

- Setting mood, managing tension and resolution
- Processing, mixing and controlling sound for aesthetic effect
- General workflow for game creation
- Audio engine terminology and functionality

Introduction to Interactive Audio

- Designing sound for interactivity
- Sound effects
- Music
- Voice recording

Sound Effects

- Simulation of sound environments
- Ambience versus musicality in soundtracks

Music

- Composition
- Interactive scoring

3d Audio

- Fundamentals of 3D and multi-channel sound.
- Modeling for effects, echo, room size simulation

3.7 Interactive Storytelling

Traditional storytelling and the challenges of interactive narrative.

Writers and designers of interactive works need a solid understanding of traditional narrative theory, character development, plot, dialogue, back-story, and world creation, as well as experimental approaches to storytelling in literature, theatre, and film with relevance to games. In addition, interactive storytelling requires familiarity with new tools and techniques, including the technical aspects of writing for this new medium, algorithmic storytelling, and collaborative story construction. In this Core Topic, these approaches are applied to the unique context of interactive storytelling in games.

Story in Non-Interactive Media

- Literary Theory & Narratology
    - Traditional narrative “act” structure
    - Thinking abstractly and concretely about “story”
    - Traditional Narratives (folktales)
    - Structuralism/Narratology
    - Post-structuralism (Barthes, Baudrillard, etc.)
    - Post-modern literature
- Theatre
    - Performance Theory
    - Theorists: Aristotle, Brecht, Artaud, Boal, etc.
- Story creation
    - Setting: time, place
    - Character: Actions, motivations, dialogue
    - Events
- Discourse
    - Style
    - Voice and Point of View
    - Event Structure
- Characterization in fiction, film and theatre
- Introduction to film and literary theory
- Theories of game and narrative
- Context-setting versus traditional storytelling
- Back-story and fictional setting design
- Creating compelling characters

Narrative in Interactive Media

- Theoretical issues
    - Agency, immersion
    - Interactivity vs. narrative
    - Cybertext
    - Algorithmic storytelling and process intensity
    - Cohesion and “well-formed” narrative
- Interactive story in non-computer-based media
    - Role-playing games
    - Oral storytelling
    - Literary examples – Oulipo, Nabakov’s Pale Fire, etc.
    - Theatre examples – Forum theatre, theatre of the oppressed, etc.
- Alternating fixed story with interactive game
    - Visual Novels (Japanese genre)
- Exploratory narratives
    - Hypertext
- Branching trees: branching narrative, branching dialogue
- Emergent narrative approaches
    - Story generators
- Interactive fiction
- Collaborative storytelling
    - Web-based collaborative stories
    - Alternative reality games
    - MUDs, MMOGs

Writing for other media

- Fiction-writing
- Dramatic writing
    - Screenwriting
    - Playwriting
    - Writing for the radio

Abstract audiovisual narrative

- Semiotics and symbology
- Creating mood and drama with music and sound

3.8 Game Production

Practical challenges of managing the development of games.

Games are among of the most complex forms of software to create, and game development and publishing are complex, collaborative efforts. Along with all the technical challenges of software development, issues of design documentation, content creation, team roles, group dynamics, risk analysis, people management, and process management are addressed in this Core Topic. Although there is growing literature on *game production*, there are also rich traditions in software engineering and project management from which to draw for this Core Topic.

People management and collaborative development

Budgeting a development project

Where to find industry standard info, industry info – trades, trades from different parts of the industry, other media trades

Typical budgets and budget categories

Team make-up

- Job descriptions
- Recruiting, training
- Balancing talent, experience, budget

The Game Development Lifecycle

- Pre-production / Production / Testing
- Shipping and maintaining customer loyalty
- Different approaches to production process
    - Waterfall, spiral, v-shaped, evolutionary, Scrum/Agile, iterative/incremental development, rapid prototyping, etc.
    - Wtrengths and weaknesses
    - Issues specific to game development

Workflow

- Knowing which tools to use and when
- Evaluating and using computer-supported collaborative work tools
    - Bug-tracking systems
    - Wikis
    - Spreadsheets
    - Message boards/forums
    - Databases
    - Version-control

- Problem evaluation and investing appropriate resources
- Task breakdown
    - Creating a backlog
    - Dropping features

Group dynamics

- Team building
- Establishing clear roles and clear goals
- Realities of development teams
- Building effective teams
    - Working as a team to realize a unified gameplay vision
    - Leadership, delegation and responsibility
    - Defining the interfaces between team members

Design and development documentation

- Why document?
- What should you document?
- How much documentation is enough/too much?
- Who is the audience for the documentation?
- To storyboard or not to storyboard?
- Non-text based documentation: using prototypes, physical models, pictures, …
- Design and Development Documents
    - Concept Document/Proposal
    - Game Specifications
    - Design Document
    - Story Bible
    - Script
    - Art Bible
    - Storyboards
    - Technical Design Document
    - Schedules and Business/Marketing Documents
    - Test Plan

Testing

- Code review and test harnesses
- Designing tests and incorporating feedback from Quality Assurance
- Bug fixing, bug databases, creating stable code bases

Scheduling and Time Management

- Creating a schedule
- Goals of a schedule -- milestones
- Balancing quality and reality
- Working with a schedule, using it to help you ship
- Typical schedules
- Crunch time issues
- Quality of life issues

Communication skills

- Rhetoric
- Communicating with peers, supervisors and subordinates
    - Communicating clearly in print and in speech
    - Collaboration skills - speaking the same language
    - Collaboration skills – speaking across disciplinary divides (you wont always have a "same language." (bridging "language" gaps)

Coordinating the efforts of development, quality assurance, sales, marketing, public relations and finance

Localization issues, processes and skills

- Writing “around” the game
    - Packaging
    - Player manuals, websites, etc.

Product post-mortems

- Evaluating decisions, after the fact
    - Design decisions
    - Process decisions
    - Business decisions

Quality Assurance

- Planning and QA Plans

Defect Tracking

Technical Reviews and Inspections

Architecture

- Software Testing
    - Beta Testing

    - System Testing
    - Code review and test harnesses
    - Designing tests and incorporating feedback from Quality Assurance
    - Bug fixing, bug databases, creating stable code bases
- Game Testing

Working with marketing

- Marketing plans and schedules
- Marketing asset needs

3.9 Business of Gaming

Economic, legal and policy aspects of games.

The economics of the game industry – how games are funded, marketed and sold, and the relationships among publishers, developers, distributors, marketers, retailers, and other kinds of companies are addressed here. Market and industry trends, licensing management, the dynamics of company and product value, and business differences between major game platforms are all important aspects of the *business of gaming*. In addition, legal issues that affect games, developers and players, such as intellectual property and contract law, are part of this Core Topic. Lastly, social and governmental forces that impact the legislation and regulation of game content are included here.

Game industry economics

- Retailers, shelf-space, digital distribution: How audiences currently reach the games
- Platform choices – the tradeoffs of developing for consoles, PCs and handheld and mobile devices
- Internationalization / globalization of development
    - Offshoring / Outsourcing
    - Changing barriers-to-entry (knowledge, technology, manpower)
    - Challenges of cultures, distance, time-zones
- Distribution channels
- Microtransactions, one-time payment, software as a service with monthly payments, free to play with some features available to paying members, etc.
- Real money transactions in virtual worlds and MMOs
- Different delivery method and revenue streams s (MS Arcade, PS Home, …)
- Independent vs Publisher/Developer game development
- Piracy

Audience

- Marketing and sales: How games currently reach an audience

- Understanding audiences for different game genres
- How to reach and keep given audiences
- Consumer behavior and psychology (what do consumers of various sorts and various populations want?)

Publisher/Developer Relationships

- The deal
    - What it covers
    - How it gets done
    - What it is likely to say
    - Greenlighting process
- Day-to-day: Once signed up, what interactions and processes occur
- Milestone review

Intellectual property

- Technology and Copyright
    - Key Cases
    - Major players
- Content
- Licenses
    - Acquisition of licenses
    - Use of licenses
    - Working with licensors
- Piracy

Patents and the game industry

Contracts

- Publisher/developer
- Employer/employee
- Contractors

Content Regulation

- Game Ratings and Classification
    - ESRB (North America)
    - PEGI (Europe)
    - CERO (Japan)

- Government regulation
  - North America
  - Europe / Oceania
  - Asia

4 Degree programs and expectations of graduates

For most students, getting an education in games is a step towards a career in games. However, many students (and some academics) are not aware of the full scope of games industry positions. Although games education will never be attached to a specific industry position, it is important to understand the types jobs that are available for games graduates.

The industry positions below are based on the annual Gamasutra survey of people working in the games industry. A more comprehensive list of job titles has been compiled by the IGDA Credits and Awards Committee and can be found at
http://www.igda.org/wiki/I_%E2%80%93_IGDA_STANDARDIZED_ROLES

1. Programming
2. Art & Animation
3. Game Design
4. Game writing
5. Production
6. Quality Assurance
7. Audio
8. Business & Legal
9. Marketing
10. Consumer support
11. Community support

We will try to expand this section to include expected duties, responsibilities and education for each of these job titles.

5 Institutional Considerations

Games programs differ significantly from each other due to differences in institutional size, whether the program is part of an undergraduate/graduate/specialized degree, which department initiated the games program, whether the program incorporates industry experts, and how students are admitted to the program. Although a few courses or a cluster of courses can produce well-rounded students with a broad world view, fully-fledged, games-specific programs can produce passionate students who are well-prepared for their first jobs in the game industry.

While each institution will need to tailor their program based on their resources, existing structure and their specific context, some of the components of a strong program are as follows:

1. Advisory Board (local professionals if available)
2. Focus on portfolio development (graduation requirement, professional/academic judges)
3. Internship network with studios, companies and community organizations including non-profits.
4. Relationship with local IGDA chapter (student memberships)
5. Faculty with industry experience (especially for development-focused programs)
6. Labs and libraries (access to hardware/software/games students don't have)
7. Speaker program (bring current professionals on campus)
8. Mixed classes (courses involving programmers and artists on same project, team-based)
9. Extracurricular projects (student-led mods, projects outside the classroom)

Some general advice to educators starting a new course

1. Be prepared for your colleagues to be skeptical. This is a new field of study and often academic colleagues simply will not be capable of accepting it as an academic field in its own right.
2. Be sure you understand where your program fits within your subject area. Often undergraduate programs are created within an existing department of study. This obviously has a big impact on the nature of the program design, and institutions are well advised to be sure they have capacity within the subject areas before starting a program.
3. Students (and industry) can see very quickly if your program is not being taken seriously. With a large number of programs becoming available, they are very critical of institutions where programs are being set up not because they are academically credible, but because of the potential for recruitment. In our experience, students -- and perhaps more importantly employers –are attuned to this and are quickly able to see through such tactics.
4. Understand that the technologies and tools involved in developing games can be expensive.
5. Play games and encourage your colleagues who want to get involved in the program to play. You do not have to become a hard-core gamer, but first-hand experience with games is essential for anybody teaching or researching the games area.

6 Next Steps

The 2008 Curriculum Framework will be presented at GDC 2008 (Game Developers Conference) at the IGDA Education Summit. The feedback collected at GDC will be incorporated into this document. The next major revision will be in late 2010 or 2011.

7 Further Information

For additional information please refer to

IGDA web site: http://igda.org/

IGDA Game Education SIG: http://igda.org/education/

IGDA Game Education Wiki: http://igda.org/wiki/Game_Education_SIG

IGDA Game Education Listserv: http://seven.pairlist.net/mailman/listinfo/game_edu

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Appendix A

CMU Program

Contributed by: Drew Davidson

The Entertainment Technology Center at Carnegie Mellon University is the premiere professional graduate program for interactive entertainment as it is applied across a variety of fields. The ETC offers a unique two-year Masters in Entertainment Technology degree that is jointly conferred by the School of Computer Science and the College of Fine Arts.

At the ETC, students learn how to work effectively in interdisciplinary teams and create engaging interactive experiences. They are prepared for any environment where technologists and artists work closely on a team; like theme parks, children and science museums, web sites, mobile computing, video games and more.

We have a project-based curriculum with almost no lecture-based coursework. Our only required courses are in the first semester: Building Virtual Worlds, ETC Fundamentals, Improvisational Acting, and Visual Storytelling. In their last three semesters, students take a free elective that can be any course taught at CMU, and the rest of their time is in the project courses.

Project courses consist of a faculty assigned, interdisciplinary team of students who share an office for a semester. Each team has a faculty advisor who guides them toward building an artifact; often a prototype, but sometimes a finished product for installation, and some teams have an external sponsor/client. These semester-long projects originate with external clients, faculty research, or student pitches.

Throughout their semesters, students are provided with in-depth critiques. These critiques are split between process grades and product grades. Process grades focus on their individual accomplishments and challenges, while product grades assess the work the group has done together as a team.

Pittsburgh isn't the center of the interactive entertainment or video game universe (yet!) so we send students to conferences and to visit the industries for which they are preparing themselves. All ETC students are encouraged and supported to do an industry internship during the summer between their two years. And it should also be noted that several successful ETC projects have inspired entrepreneurial ETC alumni to start local spin-off companies that are creating the future of interactive media and video games. There are now 6 spin-off companies operating in Pittsburgh.

Looking forward, the ETC has evolved into ETC Global. This involves campuses world-wide, starting with Adelaide, Australia and California in 2006 and Seoul, Korea, Singapore and Osaka, Japan in 2007. These campuses form parts of a distributed whole; our students will be able to shift from location to location on a semester-by-semester, project-by-project basis to complete their two-year degree. In a rapidly globalizing world, we think this grand experiment will prepare our students for the jobs of the future, where having a team distributed over multiple continents will become commonplace.

The Entertainment Technology Center is simply different. We emphasize leadership, innovation and communication by creating challenging experiences through which students learn how to collaborate, experiment, and iterate solutions. Our students graduate well-prepared to have a positive impact in their fields. The ETC is the place for students interested in taking the lead in the industry.

Full Sail Program

Contributed by: Rob Catto

Full Sail Real World Education, a college outside of Orlando, FL, has been an innovative educational leader for those pursuing a career in the entertainment industry. In 1998, the Associate of Science degree in Game Design and Development was developed to fill the need for academically trained employees. In 2004, the program was converted to a Bachelor of Science degree in Game Development.

Students experience a “real world” education, with a professional class structure of 8 hours per day, and a 24-hour round the clock schedule which earned Full Sail the “Most Innovative Program” Award by the Florida Association of Postsecondary Schools and Colleges.

The Game Development degree is a Software Engineering program with a game development focus. The curriculum is fashioned using the Software Engineering framework provided by the Association for Computing Machinery. Students are scheduled for two courses a week lasting either four or eight weeks. Students attend classes five days a week attending a four hour lecture followed by a four hour lab.

Course curriculum can be broken down by the following major sections and credit hours.

- General Education – 24 credit hours
- Professional Practice – 08 credit hours
- Computing Essentials – 24 credit hours
- Software Engineering – 42 credit hours
- Game Design – 10 credit hours
- Project Development – 26 credit hours

The Project Development courses immerse students in a game development project with heavy emphasis on core teamwork as well as project planning and documentation. Students are also introduced to a Software Quality Assurance cycle with an emphasis on peer review and proper defect reporting mechanisms. Student assignments include creation and maintenance of technical design documentation, implementation of game technology, and design and implementation of a quality assurance cycle, designed to provide a strong foundation for delivering milestones in subsequent courses.

Full Sail’s Game Development degree program has twelve starts each year with the fall months having the highest population.

More information about the Game Development degree program and the other Full Sail degree programs can be found at: http://www.Fullsail.edu.

Northumbria University

Computer Games Software Engineering Degree Programme at Northumbria University, Newcastle, England. Contributed by: Dan Hodgson

BSc (Hons) Computer Games Software Engineering at Northumbria University combines traditional computer science disciplines with modules specifically about games development. In the main the programme is aimed at producing high quality graduates for programmer roles within the industry, backing up the subject-specifics with a broader range of computing disciplines. Introductory games design and asset production are also taught so that graduates would appreciate the jobs of those around them. The programme is delivered over 4 years. Here is an outline of the modules studied:

Year 1

- Programming for games 1 & 2 : starting from scratch in C++ with the principles of programming, working through to development of small 2D games in DirectX
- Maths for Computer Games 1: Trig, complex numbers, matrices, vectors, calculus and particle dynamics
- Computer games Design: principles of good game design, nature of the industry, industry issues & ethics, Creation of a game design document
- Relational Databases: SQL and database design using Oracle
- Web design: HTML, Javascript, PHP etc.
- Computer Systems Fundamentals: basic processor architecture & assembler

Year 2

- Programming for Games 3&4: More 2D programming in DirectX, compiler writing, 3D programming on a GameCube devkits
- Maths for Computer Games 2: Differential Equations, rigid body dynamics, Numerical techniques, 3D representations and affine transformations in 3D
- Game Systems Architecture: Intermediate processor architecture & assembler (pong on 6800)
- Foundations of HCI: Interaction principles, interface design, use of peripherals, presentation of information
- System Design and Architecture: Top-down system design using UML
- Object-oriented game development: bottom-up look at O-O design patterns for game systems using UML
- Project Management and Professional Skills

Year 3 *Industrial Placement*

Year 4

- Games Case Project: Group project creating a significant game demo
- Advanced Architecture for Game Systems: advanced game systems architecture, including GameCube and ARM architecture.
- Advanced Programming issues for games: An advanced module looking at relevant programming techniques for up-to-date game development. At time of writing this focuses on distributed and network programming
- Multimedia assets for computer games: 3D modelling and video production
- AI for computer games
- Level 3 option module

For more information please see http://www.gamesdegree.com

USC Program

Contributed by: Tracy Fullerton tfullerton[at]cinema.usc.edu

The School of Cinematic Arts at the University of Southern California created a Master of Fine Arts in Interactive Media in 2002 and a Bachelor of Arts in Interactive Entertainment in 2005. These programs were endowed by a gift from Electronic Arts and focussed on developing the next generation of creative designers and producers for the games and interactive industries. There is a strong focus in these programs on procedural literacy, innovation in game design, and collaborative creative work.

In 2006, the Viterbi School of Engineering at USC created a Master of Science and Bachelor of Science in Computer Science with an emphasis in Games. These programs, which include integrated curriculum with the core production cycle in place at the School of Cinematic Arts, are focussed on developing game programmers experienced in creative teamwork and collaboration.

In 2007, the Roski School of Fine Arts created two minor programs that also integrated with both the School of Cinematic Arts and the Viterbi courses. In addition to these formal degree programs, the Annenberg School of Communications offers courses in cultural game studies. Also, a University-wide research unit – the Games ORU – was established in 2007 to promote further integration of curriculum, research labs and collaboration among all USC programs addressing games and game design.

The integrated production courses for the M.F.A./M.S./B.A./B.S. students in both the School of Cinematic Arts and the School of Engineering include:

> Game Design Workshop – a beginning game design course focused on the design of innovative game mechanics, prototyping and playtesting in an iterative design process. Intermediate Game Design and Development – an intermediate production class in which teams of two design and develop a small digital game. Emphasis is on digital prototyping, playtesting, and production management.
>
> Advanced Game Projects – a two-semester advanced production course in which teams of 6-10 students produce an innovative game project mentored by industry experts. This course may be taken as either a crew member or project lead.

Project leads and game concepts are selected by a competitive pitch process involving faculty, prior team leads and industry mentors.

In addition to this core production cycle, students in the School of Cinematic Arts take classes in: film and video production, screenwriting, history and theory of interactive media, business of games, sound design, visual design, etc. B.A. students also must fulfill their general education requirements for the four-year degree. M.F.A. students must produce a thesis project and paper, the researching of which should contribute new knowledge to the field. Full course lists for both the M.F.A. and the

Students in the M.S./B.S. program take the core Computer Science curriculum in addition to the integrated production cycle and game-specific computer science topics such as AI, graphic programming, etc. Full course lists can be found at:

B.A. can be found at: http://interactive.usc.edu/about/.
http://www.cs.usc.edu/admissions/graduate/msgames.htm and
http://www.cs.usc.edu/current/undergrad/default.htm

UTS Program

Contributed by: Yusuf Pisan ypisan[at]it.uts.edu.au

University of Technology, Sydney (http://www.uts.edu.au/) started the Bachelor of Science in Games Development in 2006. Australian university degrees are typically three years. For the BSc in Games Development is a four year degree where students study two years in TAFE (similar to community college or training institution) and then study two years at UTS. The first two years is very hands-on where students focus on programming skills, learn to work with game engines and work in teams to produce a series of games. The next two years at UTS is in the Faculty of Information

Technology, aimed at increasing students' depth of knowledge in computer science and computer games.

While at TAFE, students have around 30 hours of class time per week. The classes are run mostly in workshop/studio mode. At UTS, students typically have 8 hours of lectures and around 8 hours of labs and tutorials per week.

At UTS, students take the following game related courses (as well as other CS courses)

Computer Graphics – a traditional graphics course with a slight games orientation

Game Design – focusing on design issues through text based games, 2D games and writing design documents, minimal programming knowledge required

Game Programming – heavy programming course where students build a game engine from scratch. Emphasis on advanced graphics techniques, such as BSP trees, and some simple AI techniques (finite state machines, LUA based scripting and rules)

3D Computer Animation – focusing on character movement and short story. Students create a five minute animation using Maya.

• Computer Graphics Rendering Techniques – student build their own ray tracing engine from scratch • Systems

Development Project – students complete a group project over two semesters. Groups are usually ten to fifteen students requiring large amount of teamwork. • Computer Graphics Project – an independent project where students need to develop an idea from scratch and implement it. TAFE places are limited to 30 and UTS places limited to 20 students each year. Students need to apply and be selected to continue from TAFE to UTS. Student whose applications are not successful receive a Diploma of Games Development from TAFE. At UTS, students typically take 4 courses in each 14-week semester, maximum total of 16 courses for 2 years at UTS.

Official information about UTS course can be found at
http://www.handbook.uts.edu.au/it/ug/c10229.html

WPI Program

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The major in Interactive Media and Game Development (IMGD) (http://www.wpi.edu/Academics/Majors/IMGD/) at Worcester Polytechnic Institute, Worcester, Massachusetts, was begun in the Fall of 2005. It is jointly administered by the Department of Computer Science and the Department of Humanities and Arts. It is a four-year undergraduate program, and leads to a Bachelor of Science degree.

Undergraduate courses at WPI given in a seven week term, with 28 contact hours. There are four terms in the academic year, and students typically take three courses per term. The major offers two tracks, a Technical track, focusing on programming, and an Artistic track, focusing on visual arts, music and writing. Two guiding principles of the program are 1) that all students take some course work in each of the tracks, and 2) Artistic students and Technical students work together in courses and in projects.

Students in the IMGD major are required to take two of the following three core courses:

Critical Studies in IMGD, giving a critical overview of the elements of a game, and establishing a common vocabulary for analyzing games

The Game Development Process. This course discusses the roles of the different contributors to the creation of a game. Students create simple games.

Storytelling in Games.

They also take one of two courses focusing on social and ethical issues: Social Issues in Interactive Media and Games or Philosophy and Ethics of Computer Games.

In addition to these courses, students take courses specialized for their track.

Technical majors take ten courses in Computer Science, focusing on areas of Computer Science relevant to game development, such as Software Engineering and Computer Graphics. They also take two advanced technical IMGD courses, focusing on low-level game programming in the first course, and, in the second course, higher-level topics such as AI and networking in games.

In the Artistic track, students take ten courses in Humanities and Arts, and two advanced artistic IMGD courses, covering the creation of art assets and their integration in game development. The culmination of the major is a Major Qualifying Project, a project three courses in size. Artistic and Technical students work together to design and create a game or other interactive media project.