GAME ANM

VIDEO GAME ANIMATION EXPLAINED

2ND EDITION

JONATHAN COOPER

Game Anim

Game Anim
Video Game Animation Explained

2nd edition

Jonathan Cooper

For Clara and Jade,
whose adventures in real life
inspire me in the virtual.

Contents

Contents

Contents

Contents

Preface

This second edition of *Game Anim: Video Game Animation Explained* has been something a labor of love for me as I researched the medium's origins with an all-new chapter on "2D and Pixel Art Animation." After all, I myself began animating with what's now known as "pixel art" as a kid in the early-1990s, painstakingly recreating Street Fighter II characters' poses from screenshots in fighting-game tips books, and mocking up level art tile-sets in Deluxe Paint III and IV on my Commodore Amiga. Toward the end of high school I was incredibly fortunate to be invited to my local game studio back in Scotland, (DMA Design, the original creators of Grand Theft Auto) after sending in a portfolio on floppy disk, but upon visiting was utterly devastated to be informed that games were moving away from pixels, instead adopting the blocky characters and stretched textures of early video game 3D. Every trick and technique I'd spent years learning was all for naught. Soon after, I sold my computer and gave up on games.

Instead, I went to art college and discovered traditional animation, making crude animations on everything from zoetropes and phenakistiscopes, to cels and stop-motion. I never even considered making video games for several years, until the day I discovered the fluid motion capture of the Tekken series and fell in love all over again. Characters were finally moving as fluidly as they did at the pinnacle of 2D arcade games. Luckily for me, my school had just opened a lab of cutting-edge (for the time) silicon graphics machines which no one else was using, and so I came to love animating 3D video games.

All this to say: I just hit my 20th year animating games professionally and I'm more excited now about the current state and future of video game animation than ever. This is because of the breadth of experiences available to players now, enabling a wide variety of creative opportunities for game animators. Beautiful 2D and pixel art animation has seen a resurgence in smaller indie titles, and has become something of a touchstone for video games across the greater cultural landscape due to association with what are now classic games, and the ease with which aspiring animators can create and share their work.

This new Chapter 14, "2D and Pixel Art Animation," reflects my strong belief that now is the time to capture and codify the work practices of decades of 2D game artists and animators, to which end I've enlisted the knowledge and expertise of some of the best 2D and pixel animators working in games today. There's just something so satisfying about the meticulous placement of pixels on the screen and the liberation that comes with being able to bring to life anything you can imagine without the need for modeling or rigging. This freedom is further enhanced by the simplicity and ease of use of 2D animation software, (not to mention the affordable price compared to 3D), all lending itself to the minimalist, almost impressionistic aesthetic of

the 2D games of today, especially when juxtaposed with the biggest AAA blockbusters on which I've spent most of my career.

But video game animation has never been about looking backward, so there's also a whole new section in Chapter 11, "Our Project: Motion Capture," covering the developing technique of motion matching. Now that motion matching has shipped in several games, this is practical experience laid out in an example shot list, as well as an attempt to dispel some misunderstandings about the technology formed back when it was purely theoretical. This is, of course, in addition to everything present in the first edition—essentially rounding out this book's contents into an even more complete explanation of all areas of video game animation.

As ever, I really do hope you find this book useful and can't wait to see what the aspiring animators of tomorrow will create. It's never been easier to begin making video game animation—an exciting medium entertaining more people around the world now than ever.

Jonathan Cooper
August 2020

Acknowledgments

Thanks once more to everyone that contributed toward image licensing for the first and second editions, especially to Angella Austin for tolerating my months of email hustling. Importantly, the new content would have been impossible without extensive conversations with the following experts in the field: Nick Wozniak, Kay Yu, Ben Fiquet, Cyrille Lagarigue, Mariel Cartwright, Adrián Miguel, Roger Mendoza, Nicolas Leger, Maksym Zhuravlov, and Kristjan Zadziuk. Special mention also to Brian Gatewood for the fantastic AZRI pixel animation, Matthew Bachnick for her new weapons, and of course Sol Brennan for their continued rework of the free AZRI Rig.

Additional Legal Notices

The cover "AZRI" character is property of Matthew Bachnick and is used under license, and can not be used for commercial purposes.

The Last Guardian: © 2016 Sony Interactive Entertainment Inc.

For Assassin's Creed pictures: "© 2007–2017 Ubisoft Entertainment. All Rights Reserved. Assassin's Creed, Ubisoft, and the Ubisoft logo are trademarks of Ubisoft Entertainment in the US and/or other countries."

For Prince of Persia's pictures : "© 2003 Ubisoft Entertainment. Based on Prince of Persia® created by Jordan Mechner. Prince of Persia is a trademark of Waterwheel Licensing LLC in the US and/or other countries used under license."

For Watch Dogs pictures : "© 2014 Ubisoft Entertainment. All Rights Reserved. Watch Dogs, Ubisoft and the Ubisoft logo are registered or unregistered trademarks of Ubisoft Entertainment in the U.S. and/or other countries."

Author

Jonathan Cooper is a video game animator from Scotland who has been bringing virtual characters to life since 2000. He has led teams on large projects such as the Assassin's Creed and Mass Effect series, with a focus on memorable stories and characters and cutting-edge video game animation. He has since been focusing on interactive cinematics in the latest chapters of the DICE and Annie award-winning series Uncharted and The Last of Us.

In 2008, Jonathan started the BioWare Montreal studio, leading a team to deliver the majority of cinematic cutscenes for the 2011 British Academy of Film and Television Award (BAFTA) Best Game, Mass Effect 2, and in 2013 he directed the in-game team that won the Academy of Interactive Arts and Sciences (AIAS/DICE) award for Outstanding Achievement in Animation on Assassin's Creed III.

Jonathan has presented at the Game Developers Conference (GDC) in San Francisco and at other conferences across Canada and the United Kingdom, and holds a Bachelor of Design honors degree in animation.

You can follow him online at his website, www.gameanim.com, and on Twitter at @GameAnim.

The Video Game Animator

What It Means to Be a Video Game Animator

So you want to be a video game animator, but what exactly does that entail? And what, if any, are the differences between a video game animator and those in the more traditional linear mediums of film and television? While there are certainly a lot of overlap and shared skills required to bring a character to life in any medium, there are many unique technical limitations, and opportunities, in the interactive artform.

Artistry and Creativity

To begin with, having a keen eye for the observation of movement in the world around you (and a desire to replicate and enhance it for your own creative ends) is the first step to becoming a great game animator. The willingness to not only recreate these motions but to envision how this movement might be controlled by yourself and others, allowing players to embody the characters you create, is a key factor in separating game animators from the non-interactive animators of linear mediums.

Understanding key fundamentals of weight, balance, mass, and momentum to ensure your characters are not only pleasing to the eye but meet with the player's understanding of the physics of the worlds they will inhabit are equally essential. A desire to push the envelope of visual and interaction fidelity within your explorable worlds, which can afford players new stories and experiences they could never have in the real world, with believable characters that are as real to them as any created in another medium, is a driving force in pushing this still-young medium forward.

The ultimate goal is immersion—where players forget they are in front of a screen (or wearing a virtual/augmented-reality headset), escaping their own physical limitations and instead being transported into our virtual world, assuming their character's identity such that it is "they themselves" (and no longer their avatar) who are in the game.

Technical Ability

Beautiful animations are only the first challenge. Getting them to work in the game and play with each other seamlessly in character movement systems is the real challenge. The best game animators get their hands dirty with the technical side of seeing their animations through every step of the way into the game. A good game animation team will balance animators with complementary levels of technical and artistic abilities, but strength in both areas is only ever a good thing.

Only in thoroughly understanding tools, processes, and existing animation systems will new creative opportunities open up to animators willing to
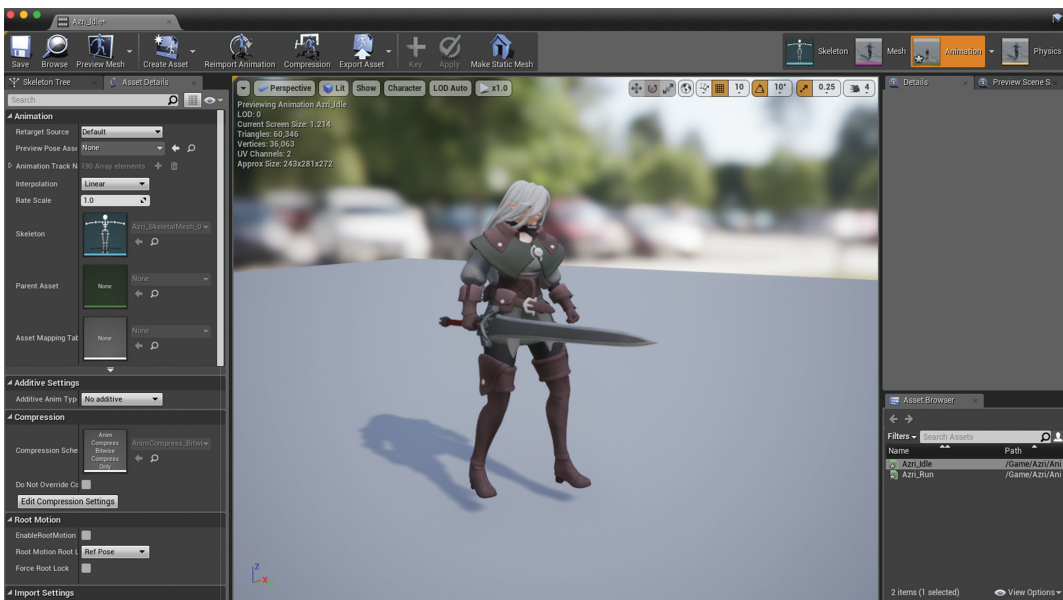
Animation inside a game engine.

experiment and discover new techniques and methods that might make animation creation more efficient or increase quality.

Teamwork

Beyond simply making motions look clean and fluid, it is a game animator's responsibility to balance multiple (sometimes conflicting) desires to make a video game. A finished game is always more than the sum of its parts, and when all of a development team's disciplines pull in the same direction in unison this when we delight and surprise players the most.

Animators must work in concert with designers, programmers, artists, audio technicians, and more to bring their creations to life, so those harboring a desire to sit with headphones on and the door closed, focusing solely on their own area, will be quickly left behind in the race to create the best possible experiences.

A game animator can only truly succeed with a good awareness of the other disciplines in game development and the ability to speak their language, empathize with their needs, and know at least a little of all areas of game development.

Design Sense

Game animations do not exist in a bubble and are not simply created to look good, but must serve a purpose for the greater game. Animators handling player character animation, especially, must balance a game's "feel" with visual fidelity (though the two are not mutually exclusive).

Designers touting conventional wisdom will often fall back on the tenet of quicker animations equaling better and more reactive characters, but go too fast without the appropriate visual feedback and the characters will simply not exist believably in the world, destroying the illusion of life and hurting the tactile gameplay "feel" in the opposing direction. Ultimately, it is a game animator's responsibility to create consistency in the game world, with everything displaying a relative weight and physics, with gravity being a constant throughout.

In game development, we might hope that "everyone is a designer," but the best game designers are the keepers of the game's goals with an idea of how to reach them. It is the game animators' role to know enough of design to ensure their creations do not hurt but serve the design goals while maintaining visual fidelity as much as possible.

Accepting the Nature of the Medium

It goes without saying that a great game animator must be passionate about their chosen field, but they must also understand that this chosen field is not just animation but game development as a whole.

Those wishing for the more easily scheduled approach of traditional linear animation production will likely grow frustrated with the fluid nature of game development. You cannot plan how many iterations it will take a new mechanic to be fun, so it follows that you must always be open to schedules in a state of flux.

Avoid being precious about your work because it *will* change or be thrown away, but, similarly, don't be dissuaded, because you will always improve and refine your animation as the game progresses, no matter how many times you might rework it.

Life Experience

The best game animators love playing games and can find something to learn from every work, but they also go beyond simply referencing other games or movies. If we wish to truly improve our artistic works (and gaming as a whole), we must escape the echo chamber of comparing with and copying our peers and instead bring as much of our own varied life experience into our work as possible.

The blandest games are those that only reference their competition, and the most pedestrian animation choices are inspired only by other animations. Be passionate about games, but also be passionate about life and the world around you, and get away from the screen outside of work as much as possible.

Different Areas of Game Animation

While game animators in larger teams typically specialize, those at smaller studios may wear the many hats listed below. Regardless, even when specializing, it is incredibly valuable to understand other areas of game animation to open up opportunities for creativity across disciplines—often, the best results occur when lines are blurred such that an animator might excel in all moving aspects of a game.

Player Character Animation

The primary and easily the most challenging aspect of game animation is the motion of characters under the player's control. This occurs in all but the most abstract of games and therefore is an important skill to focus on and for any game animator to have under his or her belt.

Character animation style and quality can vary greatly across different game types (and studios), depending upon their unique goals, but one thing is becoming more apparent as the medium progresses—bad character animation is unacceptable these days. Bringing up the baseline standard is one of the main goals of this book.

The Assassin is an excellent example of player character movement. (Copyright 2007–2017 Ubisoft Entertainment. All Rights Reserved. Assassin's Creed, Ubisoft, and the Ubisoft logo are trademarks of Ubisoft Entertainment in the US and/or other countries.)

Facial Animation

Facial animation is a relatively recent requirement, due to advances in the quality of characters. When we bring the cameras in close enough (especially on more realistic faces) even the most undiscerning player will be able to instinctively critique the facial motion due to experience with other humans.
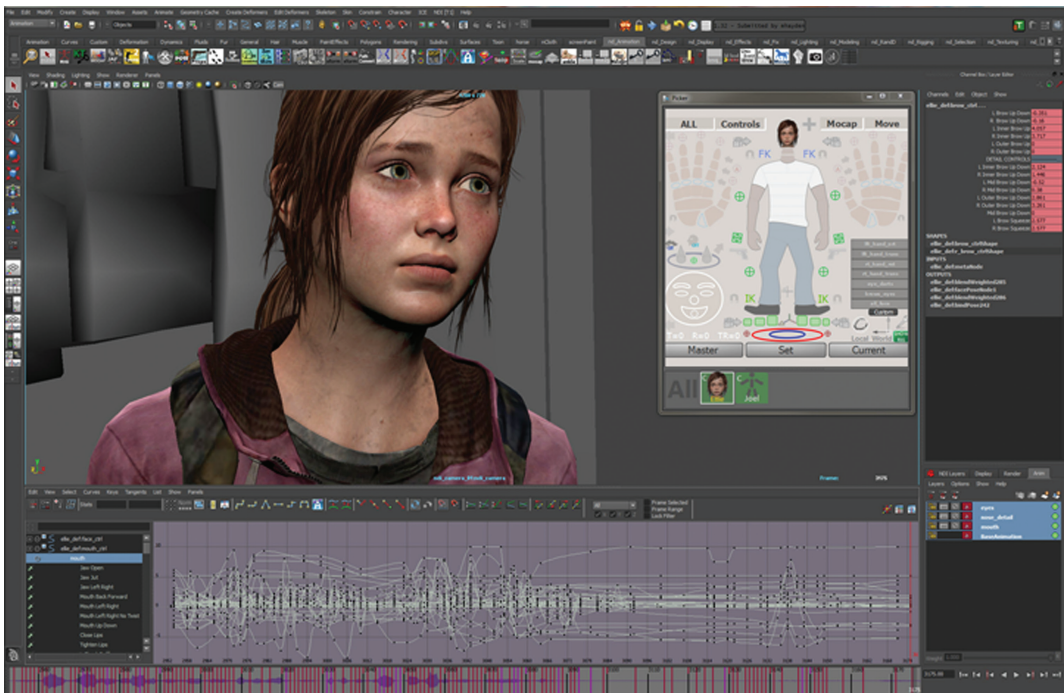
Great facial animation is a crucial element of story-based games like The Last of Us. (Courtesy of Sony Interactive Entertainment.)

How do we avoid these pitfalls when aiming to create believable characters that serve our storytelling aspirations? There are many decisions throughout a project's development that must work in concert to bring characters to life that are not just believable, but appealing.

Cinematics and Cutscenes

A mainstay of games with even the slightest degree of storytelling, cinematic cutscenes give developers the rare opportunity to author scenes of a game enough so that they play out exactly as they envision. A double-edged sword, when used sparingly and done well, they can bring us much closer to empathizing with characters, but used too much and they divorce us from not just our protagonists but the story and experience as a whole.

A well-rounded game animator should have a working knowledge of cinematography, staging, and acting to tell stories in as unobtrusive and economical a manner as possible.

Technical Animation

Nothing in games exists without some degree of technical wrangling to get it working, and game creation never ceases to surprise in all the ways the game can break. A game animator should have at least a basic knowledge of the finer details of character creation, rigging, skinning, and implementation into the game—even more so if on a small team where the animator typically assumes much of this responsibility alone.

A game animator's job only truly begins when the animation makes it into the game—at which point the systems behind various blends, transitions, and physical simulations can make or break the feel and fluidity of the character as a whole.
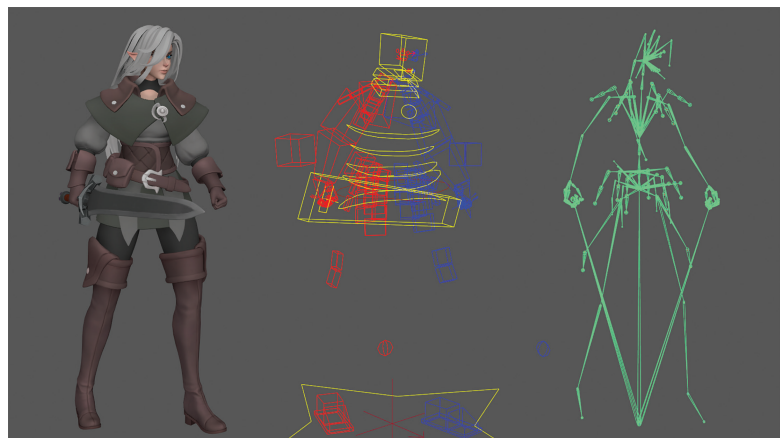
The character mesh, rig, and export skeleton.

Nonplayer Characters

While generally aesthetically similar, the demands of player animations differ greatly from those of nonplayer characters. Depending on the goals and

design requirements of the game, they bring their own challenges, primarily with supporting artificial intelligence (AI), such as decision-making and moving through the world. Failing to realize NPCs to a convincing degree of quality can leave the player confused as to their virtual comrades' and enemies' intentions and believability.

Cameras

The camera is the window through which the game world is viewed. Primarily concerning player character animation in 3D games, a bad camera can undermine the most fluidly animated character. A good game animator, while perhaps not directly controlling the implementation, should take a healthy interest in the various aspects of camera design: how it reacts to the environment (colliding with walls, etc.), the rotation speed and general rigidity with which it follows player input, and the arc it takes as it pivots around the character in 3D games. It's no wonder a whole new input (joypad right-stick) was added in the last decade just to support the newly required ability to look around 3D environments.
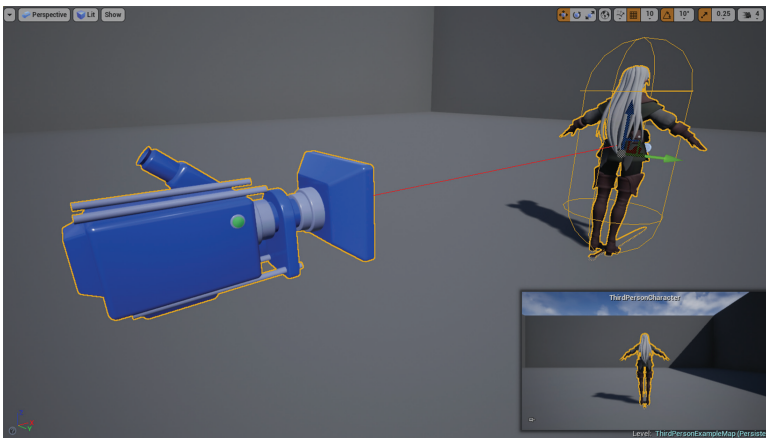
Gameplay camera setup.

Environmental and Prop Animation

Perhaps less glamorous than character animation, an animated environment can bring soulless locations to life. Moreover, a character's interaction with props and the environment with convincing contact points can place a character in the environment to an unparalleled degree.

Use of weapons, primarily guns and melee types, is a mainstay in games, and the knowledge required to efficiently and convincingly animate and maintain these types of animations is an essential part of most game animation pipelines. While doors, chests, and elevators might not be demo-reel material, they are all essential in the player's discovery of a more interactive world.

Many game characters require weapon props.

Required Software and Equipment

Digital Content Creation (DCC) Software

The primary method of animation content creation for video games has always been via expensive DCC packages such as Autodesk's Maya and Max, but now they are facing competition from free offerings such as Blender that increasingly support game development.

In the future, more and more of the creation aspect of game development is expected to take place within the game engine, but for now we still rely upon the workflow of first creating and then exporting assets into the game.
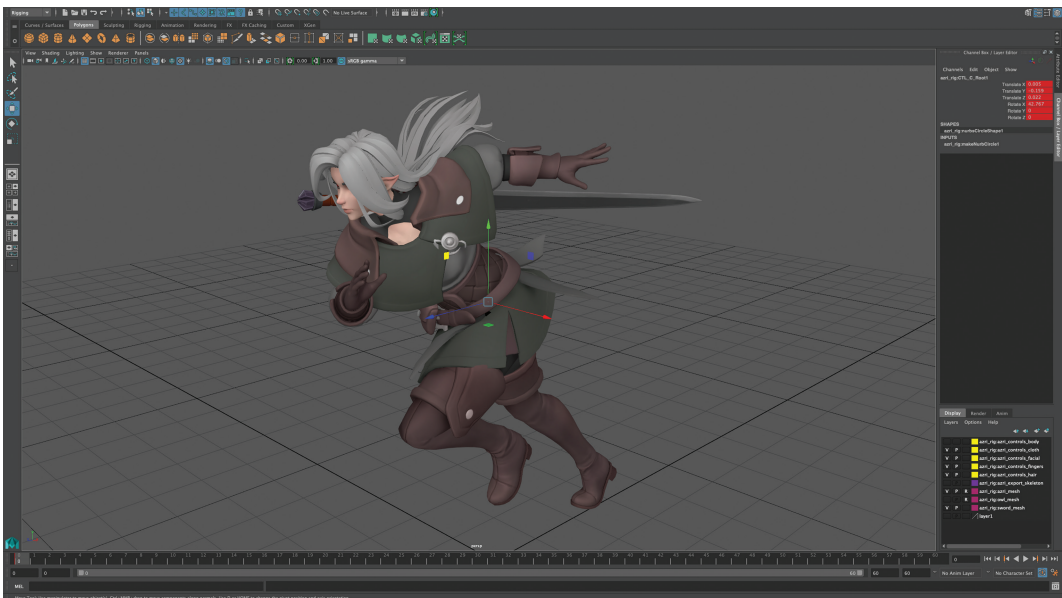
A character animated in Maya.

A good game animator will have at least a basic knowledge of polygon modeling, rigging, and skinning, as well as an intimate knowledge of the animation export process and its various abilities and limitations. A good understanding of the many ways to break an animation on export can save time and increase iteration, making the difference between an acceptable and exceptionally polished animated game.

Game Engines

This is the software that wrangles together all the various game assets and data creation, from animation, art, and audio to level design and more, and spits out a complete video game.

While most studios use their own in-house engines that cater most efficiently to the type of game they make, in recent years a race to democratize game development for everyone has culminated in the two most popular game engines, Unreal and Unity, going free. Offering a suite of tools to create and integrate all aspects of game creation, these professional-grade game engines are now freely available to everyone reading this book!
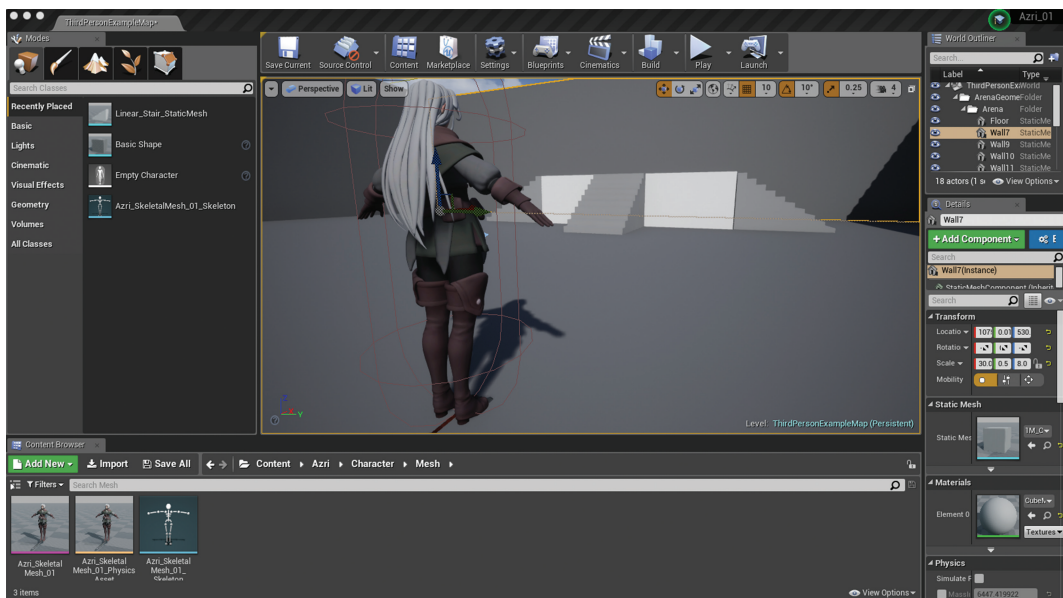
A typical game engine editor.

Reference Camera

Even the best animators work to a video reference (this must be stated, as some juniors mistakenly see it as cheating), and these days every phone contains a video camera good enough to capture any actions you or your friends and colleagues can perform. Animating to a video reference will not

only save time by preventing basic mistakes in motion, but it is also the surest way to raise your animation quality as you better understand the physics and motion of the human body.

While you can source references from the internet, the only way to truly get exactly what you need is to have someone film you acting it out. Get outside if there's no room in the studio and get recording!

Video Playback Software

While these come as standard in your computer's operating system, it is important to use one that allows both scrubbing (easily moving the video forward and backward) and frame-stepping for detailed analysis of your chosen reference video.

While an advanced functionality such as the ability to edit videos or choose a section to play on a loop is ideal, the most robust free video player for scrubbing animation is Apple's Quicktime.

Notepad

Game animators do much more than just think about animation and must take notes on everything from design decisions to workload lists. Keeping a notepad handy helps you visually hash out ideas as you discuss with other team members—it's a visual medium, after all, and an agreed-upon diagram can speak a million more words than an easily misinterpreted idea when it is spoken.

Taking a notepad and pencil/pen to every meeting and creative exchange will make your life so much easier as you often come back to ideas and tasks some time after they have been decided upon.

The Game Development Environment

Finding the Right Fit

We can choose our friends but not our family, and while we can't all choose where we work (at least initially), finding the right team will make a dramatic difference in your experience of game development.

Studio Culture

Just as a church is not the building but the community inside it, a game is not made by a monolithic studio but instead a collection of individuals who come together to create. Team makeup is fluid and will change from project to project, but generally individuals housed within a studio are drawn to a particular style of game or studio ethos. It is the combined values of these individuals that make up a studio culture.

Different studios have different strengths, weaknesses, and priorities based on this team culture, and this often flows from the original founders (and therefore founding principles) upon which the studio is based. Some studios focus on storytelling, some on graphics and technology, some on fun

gameplay over everything else. While none of these attributes are mutually exclusive, studios and teams within them will generally be stronger in one or a few areas depending on the team composition.

Beyond different discipline strengths, work ethic, attention to detail, perfectionism, production methods, and work/life balance all vary from studio to studio. Again, while not mutually exclusive, it is impossible to balance all different approaches to game development, so it is important to find a studio environment that matches your values to be happy and sustain a long career in game development.

For the ambitious game animator, it is important to find a team that values great characters and the desire to expend effort and resources, bringing them to life. Thankfully, while strong animation skills were for years seen as a benefit or a "nice-to-have," it is all but becoming essential for studios with any kind of narrative ambitions. As such, recent years have seen an explosion of animation teams, whereas just a few years ago the entire workload might have been assumed by a much smaller or single-person department.

Team Strengths

As said above, studios vary depending on the makeup of their team members, mostly depending on their initial founders. Studios and teams with a strong programming pedigree tend to favor technical excellence. Those with artists at the core tend to excel in incredible visuals and world-building. Those with an animation background place a desire to tell stories with memorable characters at the forefront.

All of the strengths above cannot come at the expense of good gameplay, so a strong design sense is essential to any team. While this rightfully falls on the shoulders of the designers, a game will only benefit from everyone, including game animators, knowing as much about game design as possible. Because there is no formula for good game design, due to the youth of the medium, there is no rich history of training to become a great game designer (unlike established avenues like animation, programming, and art). As such, many designers and creative directors come from backgrounds in other fields. This means that even individual game designers will typically approach a project with a bent toward art or programming and so on.

While junior animators are not yet in a position to choose, once established, a game animator seeking employment from various studios should consider if the team strengths match his or her own goals and aspirations.

Game Pillars

From the team strengths generally comes the desire to focus on the "pillars" of a project. Pillars form the basis of any project and allow a team to zero in on what is important and what is not. Every idea that arises throughout the
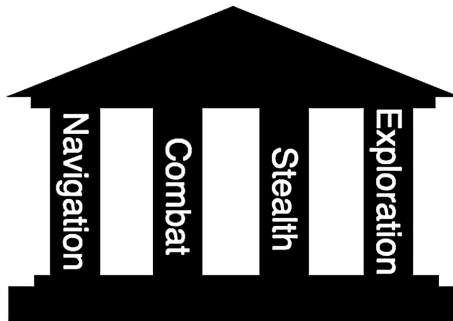
Every game has game design pillars upon which it is built.

development cycle can be held up as either supporting a pillar or not, and so can be endorsed and given priority, or, if not, then dismissed or given less priority.

In a game where animation-heavy melee combat or traversal of the world is a core gameplay pillar, then animation will be more supported than in a project where the core pillars do not depend so much on animation. Similarly, interacting and talking with a variety of high-fidelity characters will also require that facial animation quality become core to the experience, whereas a game about driving cars would naturally focus elsewhere.

Working in a team where animation quality is seen as a necessity is an entirely different experience from working on one that does not. Resources, such as programmer time, hiring a commensurate number of animators for the workload (animation quality often rests on the time allotted), and a willingness to listen to and take on the game animators' ideas and requests, will be much more forthcoming on such a team. Naturally, it is not always possible to start a career in such a studio environment, but this is certainly something worth pursuing as an eventual goal.

While it is rare to be able to pick and choose, it is important when looking for different studios and teams to join that the kinds of games which that studio makes resonate with you. As a game animator, it is highly likely that you prefer to play games with excellent animation quality, so this makes seeking out those teams and studios which produce this a natural fit.

Team Size

The type of team size you aim for should be the one you are comfortable with. Large teams generally afford greater programming support and resources, allowing game animators to push the envelope in terms of visuals and believable characters. However, starting your career in such a team means you will only have access to a small piece of the pie, sometimes leading to being pigeonholed or specializing in one specific area of game animation. As such, it might be hard to gain a grasp of the various areas that make up overall game development—something that can only help you grow as a game developer.