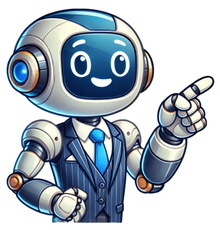
I'm not a robot



Being a freelancer can be extremely advantageous and is probably a dream for many designers and developers who are tired of the cubicle lifestyle. Not only do you get to choose only the jobs you are interested in, but you also have total flexibility in terms of time, whom you want to work with, and where you want to work.The problem now is where you can go to find work that will help you sustain your freelance lifestyle. To help you with this, we have listed the best 50 freelancing job sites to help you in your project search. If you a company or individual looking to outsource or hire a freelancer, these sites will be able to serve that purpose as well. 30 Best Sites to Get Paid For Writing & Blogging FiverrWant to test the waters of freelancing? Give Fiverr a shot. Projects go for between $5 and $10, and this is a great place to gain some experience to add to your portfolio.UpworkThe average budget size of a job here is around $5,000! Its no wonder this online marketplace is a great asset for service providers and employers.CrowdSPRINGWhat makes crowdSPRING different is that instead of outbidding and competing with someone with a larger portfolio, how you approach a project and your level of creativity is what gets you that project.Gun.ioGun.io has successfully delivered freelancers for companies like Amazon.com, Zappos, and LonelyPlanet. To apply as a freelancer in Gun.io, you would need a GitHub account filled with great codes and repositories to be qualified.ToptalToptal is a hiring marketplace for developers of (almost) all programming languages; it provides A-level developers who are truly skillful in their fields. You can apply as a freelance developer with the possibility of working with top tech companies or a cool startup.99designs99Designs is where companies go to get their logos, banners, and websites designed. Designers are awarded a pre-determined amount of money if their design is chosen.Envato StudioA house for creatives and developers of many fields to find freelance gigs worldwide. Apply as a service provider and once you are accepted, you can name your price for your service.StackOverflow CareersStackOverflow is not only a solution-churning site; it also provides job listings of tech companies from all over the world. To apply for the job, you will need a Stack Career Account (youll need to be invited first).DribbbleSign up for a Dribbble Pro account and show the Hire me button on your profile page or scour the job board for companies looking for freelancers.Behance JobProductivity and creativity go hand in hand at the job list section of this site. This exclusive site is known to convert creativity into lucrative services or products to promote unique ideas.WordPressThis is the official WordPress job board. Herein you can find some jobs surrounding the WordPress ecosystem, such as plugin development, theme customization, or WordPress site optimization.LinkedInA site for every professional. Once you sign up for LinkedIn, you can start looking for freelance jobs of your interest in the LinkedIn job board.Smashing JobsA nice job portal to find programming and designing jobs, among many other job opportunities.GuruHeres another spot to find the industrys offering of professionals worldwide. The Escrow payment gives this site an edge over many other freelancing sites.KropKrop is a job board and career resource website for creative professionals. Whether youre looking for a job, or hunting top-notch talent, Krops simple and powerful tools are geared toward connecting the worlds brightest minds with the best companies.CoroflotCoroflot is an employment site for creative professionals: design firms post job openings and designers post portfolios Coroflot makes the connection.Problogger JobsBlogging enthusiasts and professional bloggers who wish to explore the income potential of this fun-filled hobby of blogging, will like this site. The job section of this blog can land you with a few blogging jobs.DiceDice is a job search engine dedicated to only finding technology jobs. It offers a targeted niche space for finding the exact technology position you might be looking for.WPHiredWordPress developers can find big opportunities in WPHired for a WordPress-related project, as a freelance, an intern or a full-time position.WeWorkRemotelyAs the name suggests, this is a site where you can find jobs which you can do from the comforts of your home, or wherever you like. Jobs range from design to programming and development to executive positions.LocalSolo(LocalSolo has been discontinued.)LocalSolo is a site to find local freelancers in many countries from a wide range of expertise including design, engineering, copywriting, photography, and even analyst. You can sign-up as a freelancer or an employer for free.OnSiteOnSite is a place where designers, developers, and copywriters can find many opportunities for freelance jobs. Applicants are carefully curated. Once accepted, freelancers can show off their portfolios, set the price rate, and manage their availability.YunoJunoAnother great site to find freelance gigs, YunoJuno connects freelancers with employers, and also provides tools for generating contracts and invoicing.CrowdsiteOn top of the design contests to try out, if you are an established designer or developer, you can also negotiate for a private project with clients on Crowdsite.Lorem(Lorem has been discontinued.)Quickly emerging as a powerful platform to get well-paying short-term freelance jobs related to designing, building and fixing websites. The payment ranges between $25 and $250 for freelance projects, however, you do go through a strict selection process in order to get accepted.SologigBridging the gap between experienced employees and qualified employers, this site is known to have the best talent in varied industries. You can seek both part-time and full-time contracts as well as consulting opportunities.Authentic JobsCreative and web professionals can seek reputable full-time and freelance opportunities here and get associated with well-known names in major industries like Sony BMG, HBO, HP, Facebook and many more.People per hourBased on the simple bidding system, you can hire efficient freelancers here and enjoy the on-demand flexibility while saving money at the same time. Marketing, legal, accounting, writing, programming are some of the most common industry types covered by this site.DesignCrowdDesignCrowd is a graphic design marketplace that gives creative people opportunities. Businesses can post requirements or request quotes for logo design, business card design, advertising artwork and website design.Simply HiredThis online job portal allows you to find all kinds of jobs, whether freelance or full-time, based on your location, skills and experience in the field.TheShelfTheShelf is a site where bloggers and freelance writers, covering fashion, lifestyle, food, and travel, connect and collaborate with brands to reach the right audience.Working NomadsWorking nomads are freelancers who travel from city to city, coutnry to country, and still working their jobs as they travel. They find remote jobs on site like this. Job categories include Design, Development, and even Management.Barkbark is a marketplace for almost any kind of work field from painter to photographer to party caterer. A great site for regular people to find local professionals. If you are a Pro, sign up.AirPairAirPair is a community site where developers meet other developers to seek advice and mentorship by sharing their experiences. It isnt a freelancing job site but having a good network may help you land a job or possibly a career down the road.SolidGigsSolidGigs takes the hassle out of project searching for freelancers. Out of thousands of job ops, it filters out the ones that go best with your profile. You get a weekly gig list with only the very best of all jobs available so you can focus on your productivity instead of looking for quality work.What I like most about SolidGigs is that you can have access to an enormous resource library with courses, interviews, templates, scripts, and other tools to help you land more freelance projects, negotiate your rates, pitch quality clients, and grow your freelance business.Cloud PeepsFor the freelancers who have gained considerable experience in their field and are looking for high profile clients, then CloudPeeps may be for you. Due to the exclusive nature of the platform, it gets a bit hard to join but once you do, there is an array of quality projects waiting for you.IndeedIndeed is an intuitive platform that curates all the jobs on the interwebs that you can search on the basis of keyword or location. The platform is particularly famous for searching remote jobs. Best of all, its free!College RecruiterCollege Recruiter is a job site created for students and recent graduates. You can enter your degree, majors, or any other keywords and the region in which you want to search the job and you get a list of different freelance or part-time jobs on the beginner level to help you gain experience and contacts for future work.ServiceScapeServiceScape offers a global platform for freelancers that gives them access to more than 86,000 clients and numerous projects. You can find freelance jobs on a range of subjects with an emphasis on graphic design, writing, editing, and translating.NexxtA unique job search website that offers you to search freelance gigs on the basis of career, locality, diversity (a more inclusive work environment for everyone), and globalism. This system of categorization allows you to try different freelance jobs and see which one would suit your career path.HireableA platform to find freelance jobs outside the USA and Europe, Hireable lists equal opportunity employments for its users. With a simple interface, the site sends you job alerts and recommendations. You can also see your saved jobs and all the jobs you applied for.FreeeUpFreeeUp is a platform for high-quality remote freelancers to connect with equality high-quality clientele. In order to get on their panel, you have to go through an extensive vetting process. The site focuses mainly on freelance jobs from the field of e-commerce, digital marketing, and virtual assistance, etc.Angel ListIf you want to work for a budding start-up as a freelance designer, then Angel List would work wonderfully for you. Different start-ups from all over the globe look for talented individuals on this platform so you can also get picked depending on your design talents.Art WantedIf you want your artistic skills to be noticed and paid for, then try out Art Wanted. You can put up your graphic or illustrated masterpieces on the website where people can browse and buy them or you can connect with potential clients.Working Not WorkingA high-quality marketplace for freelancers, Working Not Working accepts only the most talented freelancers but once you do get accepted you get very promising projects. The platform is created by two world-renowned former freelancers and caters to famous companies like Apple, Facebook, Google, and more.10x Management10x Management offers projects for tech experts from freelance web developers to cybersecurity gurus. This is a great place to start if you have a niche tech specialty, or you have an interest and want to see the possibilities.GigsterA great platform for web designers, web designers, even app developers. Gister takes up freelancers who are best at their jobs and accepts them through strong selection criteria. But once selected, they use AI to match freelancers with projects, which is really cool.Talent Cupboard(Talent Cupboard has been discontinued.)Talent Cupboard offers a useful platform for improving your digital resume and finding the right clients for your freelance career.CodeableCodeable is a great platform for freelance WordPress developers and experts. You can offer services in any category of WordPress development including, e-commerce development, plug-in development, custom APIs and integration, and WordPress theme development, among many other areas.TaskRabbitsFor people looking for non-digital or offline freelance jobs, TaskRabbits offers freelance jobs related to housework. From furniture assembling to moving, packing, or plumbing, you can find an array of jobs at the site. Where we source our data Lets get real. Job information online can often be overly optimistic conveniently glossing over the raw bits. But when youre making decisions about your future, you need all the facts. Thats why we anonymously surveyed graphic designers about their job, with hopes of getting an honest insight into what its really like. While we did our best to ensure respondents were Australians and verified their job titles with proof of employment, we cant guarantee complete accuracy or that your experiences in the field will reflect theirs. So, we suggest that you take these insights as a guide only and try to talk to people in the field before making an important decision. Graphic designers design creative assets. Assets can be print publications like books, reports, brochures, product packaging, or posters. You may also make digital design assets like icons, social media graphics, and website design elements (some graphic design positions may incorporate web design too). Youll also be involved in visual branding, designing assets like organisation logos and letterheads. Youll most likely be using design software like Adobe Photoshop, Adobe InDesign, Adobe Illustrator, and similar. Youll either work in-house for an organisation, for a graphic design firm, or can strike out on your own as a self-employed, freelance graphic designer. The job mixes creative thinking with pragmatism. Youll come up with fresh, unique ideas for your designs while also delivering designs that meet a clients brief. Youll also handle contracts, timesheets, and client relationships. What do graphic designers do? Key tasks and responsibilities include: Talking to clients to understand what they want from a graphic designer Agreeing upon graphic design briefs Creating job quotes that estimates the time and costs required for contracted design work Advising clients on different design approaches you can take Formulating ideas and concepts for a design Presenting different design options to clients and listening to their feedback Using design software to make fresh designs that meet the brief Although no specific formal education is required to work as a graphic designer, it is common to hold a tertiary degree in graphic design or a related area. During your study there may be hands-on work experience or internship opportunities. When applying for graphic design jobs, potential employers will want to see what youve designed in the past so they can get a sense of your abilities and style as a professional graphic designer. You can build your portfolio through study, making logo designs on a volunteer basis for other organisations, or simply by creating your own briefs and designs. Qualifications that are relevant to future graphic designers are available throughout Australia. Relevant courses may be available for online learners or delivered in-person, or a mix. Courses cost different amounts depending on the area of study and whether you are eligible for Commonwealth government support. In this course youll learn all about design generally, including graphic design. Youll learn about design elements and principles, typography and logotype design, branding, creative processes, critical thinking, using design software, digital media and multimedia, and work health and safety practices. Youll also have opportunities to build a strong portfolio. The course takes six months of full-time study (or part-time equivalent) to complete. Read More This course will give you the fundamentals of graphic design theory and practice. Youll work to develop designs to briefs to build your portfolio. Youll also learn about the history and theory of visual communication, 2D and 3D graphic design, and more. The qualification takes 12 months of full-time study (or part-time equivalent) to complete. Read More If youre interested in graphic design, you may also like to explore: The #1 email marketing and automations platform* that recommends ways to get more opens, clicks, and sales. Our course navigator helps refine thousands of courses into a personalised list that suits you. Click to answer each question, so we can provide you with the best possible courses, tailored to your preferences. Choose your learning goal to get a personalised course list in under 30 seconds Art of creating moving images using computersIt has been suggested that this article be split into articles titled 3D computer animation and 2D computer animation. (Discuss) (June 2019)An example of computer animation which is produced from the "motion capture" techniqueComputer animation is the process used for digitally generating moving images. The more general term computer-generated imagery (CGI) encompasses both still images and moving images, while computer animation only refers to moving images. Modern computer animation usually uses 3D computer graphics. Computer animation is a digital successor to stop motion and traditional animation. Instead of a physical model or illustration, a digital equivalent is manipulated frame-by-frame. Also, computer-generated animations allow a single graphic artist to produce such content without using actors, expensive set pieces, or props. To create the illusion of movement, an image is displayed on the computer monitor and repeatedly replaced by a new similar image but advanced slightly in time (usually at a rate of 24, 25, or 30 frames/second). This technique is identical to how the illusion of movement is achieved with television and motion pictures.To trick the visual system into seeing a smoothly moving object, the pictures should be drawn at around 12 frames per second or faster (a frame is one complete image).[1] With rates above 75 to 120 frames per second, no improvement in realism or smoothness is perceivable due to the way the eye and the brain both process images. At rates below 12 frames per second, most people can detect jerkiness associated with the drawing of new images that detracts from the illusion of realistic movement.[2] Conventional hand-drawn cartoon animation often uses 15 frames per second in order to save on the number of drawings needed, but this is usually accepted because of the stylized nature of cartoons. To produce more realistic imagery, computer animation demands higher frame rates.Films seen in theaters in the United States run at 24 frames per second, which is sufficient to create the appearance of continuous movement.Computer-generated animation is an umbrella term for three-dimensional (3D) animation, and 2D computer animation. These also include subcategories like asset driven, hybrid, and digital drawn animation. Creators animate using code or software instead of pencil-to-paper drawings. There are many techniques and disciplines in computer generated animation, some of which are digital representations of traditional animation - such as key frame animation - and some of which are only possible with a computer - such fluid simulation.'CG' Animators can break physical laws by using mathematical algorithms to cheat mass, force and gravity, and more. Fundamentally, computer-generated animation is a powerful tool which can improve the quality of animation by using the power of computing to unleash the animator's imagination. This is because Computer Generated Animation allows for things like onion skinning which allows 2D animators to see the flow of their work all at once, and interpolation which allows 3D animators to automate the process of inbetweening.Examples of computer-generated animation in moviesMovieType of Computer Generated AnimationImpactToy Story 2Stylized 3D computer animation[3]Pixar developed cutting-edge technology for fully 3D animation. 'Toy Story' is considered a turning point for 3D animation in general.[4]Godzilla Minus OneDigital VFX, photorealistic[5]Toho studios won an Oscar for its ground breaking VFX on a small budget relative to most box-office movies.[6]The Breadwinner2D computer animation[7]Was praised for its 2D animated style, showing the possibilities of what the format could portray.InterstellarHyper photorealistic CGI following scientific principles[8]The VFX artists working on Interstellar published a paper about the science and mathematics that were used to create the famous 'Gargantua' black hole.[8]KlausHybrid 3D and 2D computer animation[9]The use of 3D lighting for 2D animation in this movie opened up a door to many new animation styles for 2D animators.A frame of animation before and after renderingFor 3D computer animations, objects (models) are built on the computer monitor (modeled) and 3D figures are rigged with a virtual skeleton. Then the limbs, eyes, mouth, clothes, etc. of the figure are moved by the animator on key frames. Normally, the differences between key frames are drawn in a process known as tweening. However, in 3D computer animation, this is done automatically, and is called interpolation. Finally, the animation is rendered and composited.Before becoming a final product, 3D computer animations only exist as a series of moving shapes and systems within 3d software, and must be rendered. This can happen as a separate process for animations developed for movies and short films, or it can be done in real-time when animated for videogames. After an animation is rendered, it can be composited into a final product.For 3D models, attributes can describe any characteristic of the object that can be animated. This includes transformation (movement from one point to another), scaling, rotation, and more complex attributes like blend shape progression (morphing from one shape to another). Each attribute gets a channel on which keyframes can be set. These keyframes can be used in more complex ways such as animating in layers (combining multiple sets of key frame data), or keying control objects to deform or control other objects. For instance, a character's arms can have a skeleton applied, and the joints can have transformation and rotation keyframes set. The movement of the arm joints will then cause the arm shape to deform.3D animation software interpolates between keyframes by generating a spline between keys plotted on a graph which represents the animation. Additionally, these splines can follow Bzier curves to control how the spline curves relative to the keyframes. Using interpolation allows 3D animators to dynamically change animations without having to redo all the in-between animation. This also allows the creation of complex movements such as ellipses with only a few keyframes. Lastly, interpolation allows the animator to change the framerate, timing, and even scale of the movements at any point in the animation process.Another way to automate 3D animation is to use procedural tools such as 4D noise. Noise is any algorithm that plots pseudo-random values within a dimensional space.[10] 4D noise can be used to do things like move a swarm of bees around; the first three dimensions correspond to the position of the bees in space, and the fourth is used to change the bee's position over time. Noise can also be used as a cheap replacement for simulation. For example, smoke and clouds can be animated using noise.Node-based animation is useful for animating organic and chaotic shapes. By using nodes, an animator can build up a complex set of animation rules that can be applied either to many objects at once, or one very complex object. A good example of this would be setting the movement of particles to match the beat of a song.There are many different disciplines of 3D animation, some of which include entirely separate artforms. For example, hair simulation for computer animated characters in and of itself is a career path which involves separate workflows,[11] and different software and tools. The combination of all or some 3D computer animation disciplines is commonly referred to within the animation industry as the 3D animation pipeline.[12]Examples of disciplines within the 3D animation pipelineDisciplineExplanationToolsExamplesFace RiggingA facial rig is a rig that includes muscles, deformation, mesh displacement, and other techniques to enable the animation of facial expressions, and phonemes for lip syncing.Autodesk Maya, BlenderIn 'Avatar, Way of Water', WETA workshops meticulously designed the digital muscles in the faces of their characters so that their emotional range could be comparable to that of a human.[13]Facial AnimationThis is the process of animating facial animations, lip-syncing, and animating phoneme blend-shapes (shapes that the face morphs into)Autodesk Maya, Blender, Autodesk 3DS MaxIn Pixar's 'Turning Red', animators took influence from anime style facial expressions to inform their animation.[14]Character AnimationSpecifically the animation of characters. 3D character animation is its own specialty do to the complexity required to animated dancing, running, fighting, or high fidelity motion such as playing basketball.Autodesk Maya, BlenderPixar's 'Incredibles' won the 2004 Visual Effects Society Award for Outstanding Animated Character in an Animated FeatureCloth SimulationCloth simulation is a subset of simulation but specifically for things like clothes. In modern 3D computer animation, cloth simulation is becoming more and more advanced and widely used.Houdini, BlenderPixar's 'Coco' advanced the use of high fidelity clothes by designing new tools to combine cloth simulation with character animation.[15]2D computer graphics are still used for stylistic, low bandwidth, and faster real-time renderings.Computer animation is essentially a digital successor to stop motion techniques, but using 3D models, and traditional animation techniques using frame-by-frame animation of 2D illustrations.For 2D figure animations, separate objects (illustrations) and separate transparent layers are used with or without that virtual skeleton.In 2D computer animation, moving objects are often referred to as "sprites." A sprite is an image that has a location associated with it. The location of the sprite is changed slightly, between each displayed frame, to make the sprite appear to move.[16] The following pseudocode makes a sprite move from left to right:var int x:= 0, y:= screenHeight / 2;while x < screenWidthdrawBackground()drawSpriteAtXY (x, y) // draw on top of the backgroundx:= x + 5 // move to the rightComputer-assisted animation is usually classed as two-dimensional (2D) animation and is also known as digital ink and paint. Drawings are either hand drawn (pencil to paper) or interactively drawn (on the computer) using different assisting appliances and are positioned into specific software packages. Within the software package, the creator places drawings into different key frames which fundamentally create an outline of the most important movements.[17] The computer then fills in the "in-between frames", a process commonly known as Tweening.[18] Computer-assisted animation employs new technologies to produce content faster than is possible with traditional animation, while still retaining the stylistic elements of traditionally drawn characters or objects.[19]Examples of films produced using computer-assisted animation are the rainbow sequence at the end of The Little Mermaid (the rest of the films listed use digital ink and paint in their entirety), The Rescuers Down Under, Beauty and the Beast, Aladdin, The Lion King, Pocahontas, The Hunchback of Notre Dame, Hercules, Mulan, Tarzan, We're Back! A Dinosaur's Story, Balto, Anastasia, Titan A.E., The Prince of Egypt, The Road to El Dorado, Spirit: Stallion of the Cimarron and Sinbad: Legend of the Seven Seas.This section is an excerpt from Text-to-video model.[edit]A video generated using OpenAI's Sora text-to-video model, using the prompt: A stylish woman walks down a Tokyo street filled with warm glowing neon and animated city signage. She wears a black leather jacket, a long red dress, and black boots, and carries a black purse. She wears sunglasses and red lipstick. She walks confidently and casually. The street is damp and reflective, creating a mirror effect of the colorful lights. Many pedestrians walk about.A text-to-video model is a machine learning model that uses a natural language description as input to produce a video relevant to the input text.[20] Advancements during the 2020s in the generation of high-quality, text-conditioned videos have largely been driven by the development of video diffusion models.[21]Main article: History of computer animationFor a chronological guide, see Timeline of computer animation.See also: Video game graphicsEarly digital computer animation was developed at Bell Telephone Laboratories in the 1960s by Edward E. Zajac, Frank W. Sinden, Kenneth C. Knowlton, and A. Michael Noll.[22] Other digital animation was also practiced at the Lawrence Livermore National Laboratory.[23]In 1967, a computer animation named "Hummingbird" was created by Charles Csuri and James Shaffer.[24] In 1968, a computer animation called "Kitty" was created with BESM-4 by Nikolai Konstantinov, depicting a cat moving around.[25] In 1971, a computer animation called "Metadata" was created, showing various shapes.[26]An early step in the history of computer animation was the sequel to the 1973 film Westworld, a science-fiction film about a society in which robots live and work among humans.[27] The sequel, Futureworld (1976), used the 3D wire-frame imagery, which featured a computer-animated hand and face both created by University of Utah graduates Edwin Catmull and Fred Parke.[28] This imagery originally appeared in their student film A Computer Animated Hand, which they completed in 1972.[29][30]Developments in CGI technologies are reported each year at SIGGRAPH,[31] an annual conference on computer graphics and interactive techniques that is attended by thousands of computer professionals each year.[32] Developers of computer games and 3D video cards strive to achieve the same visual quality on personal computers in real-time as is possible for CGI films and animation. With the rapid advancement of real-time rendering quality, artists began to use game engines to render non-interactive movies, which led to the art form Machinima."Spring", a 3D animated short film made using BlenderCGI short films have been produced as independent animation since 1976.[33] Early examples of feature films incorporating CGI animation include the live-action films Star Trek II: The Wrath of Khan and Tron (both 1982),[34] and the Japanese anime film Golgo 13: The Professional (1983).[35] VeggieTales is the first American fully 3D computer-animated series sold directly (made in 1993); its success inspired other animation series, such as ReBoot (1994) and Transformers: Beast Wars (1996) to adopt a fully computer-generated style.The first full-length computer-animated television series was ReBoot,[36] which debuted in September 1994; the series followed the adventures of characters who lived inside a computer.[37] The first feature-length computer-animated film is Toy Story (1995), which was made by Disney and Pixar:[38][39][40] following an adventure centered around anthropomorphic toys and their owners, this groundbreaking film was also the first of many fully computer-animated movies.[39]The popularity of computer animation (especially in the field of special effects) skyrocketed during the modern era of U.S. animation.[41] Films like Avatar (2009) and The Jungle Book (2016) use CGI for the majority of the movie runtime, but still incorporate human actors into the mix.[42] Computer animation in this era has achieved photorealism, to the point that computer-animated films such as The Lion King (2019) are able to be marketed as if they were live-action.[43][44]3D game character animated using skeletal animationIn this .gif of a 2D Flash animation, each 'stick' of the figure is keyframed over time to create motion.In most 3D computer animation systems, an animator creates a simplified representation of a character's anatomy, which is analogous to a skeleton or stick figure.[45] They are arranged into a default position known as a bind pose, or T-Pose. The position of each segment of the skeletal model is defined by animation variables, or Avars for short. In human and animal characters, many parts of the skeletal model correspond to the actual bones, but skeletal animation is also used to animate other things, with facial features (though other methods for facial animation exist).[46] The character "Woody" in Toy Story, for example, uses 712 Avars (212 in the face alone). The computer does not usually render the skeletal model directly (it is invisible), but it does use the skeletal model to compute the exact position and orientation of that certain character, which is eventually rendered into an image. Thus by changing the values of Avars over time, the animator creates motion by making the character move from frame to frame.There are several methods for generating the Avar values to obtain realistic motion. Traditionally, animators manipulate the Avars directly.[47] Rather than set Avars for every frame, they usually set Avars at strategic points (frames) in time and let the computer interpolate or tween between them in a process called keyframing. Keyframing puts control in the hands of the animator and has roots in hand-drawn traditional animation.[48]In contrast, a newer method called motion capture makes use of live action footage.[49] When computer animation is driven by motion capture, a real performer acts out the scene as if they were the character to be animated.[50] Their motion is recorded to a computer using video cameras and markers and that performance is then applied to the animated character.[51]Each method has its advantages and as of 2007, games and films are using either or both of these methods in productions. Keyframe animation can produce motions that would be difficult or impossible to act out, while motion capture can reproduce the subtleties of a particular actor.[52] For example, in the 2006 film Pirates of the Caribbean: Dead Man's Chest, Bill Nighy provided the performance for the character Davy Jones. Even though Nighy does not appear in the movie himself, the movie benefited from his performance by recording the nuances of his body language, posture, facial expressions, etc. Thus motion capture is appropriate in situations where believable, realistic behavior and action is required, but the types of characters required exceed what can be done throughout the conventional costuming.3D computer animation combines 3D models of objects and programmed or hand "keyframed" movement. These models are constructed out of geometrical vertices, faces, and edges in a 3D coordinate system. Objects are sculpted much like real clay or plaster, working from general forms to specific details with various sculpting tools. Unless a 3D model is intended to be a solid color, it must be painted with "textures" for realism. A bone/joint animation system is set up to deform the CGI model (e.g., to make a humanoid model walk). In a process known as rigging, the virtual marionette is given various controllers and handles for controlling movement.[53][54] Animation data can be created using motion capture, or keyframing by a human animator, or a combination of the two.[55]3D models rigged for animation may contain thousands of control points for example, "Woody" from Toy Story uses 700 specialized animation controllers. Rhythm and Hues Studios labored for two years to create Aslan in the movie The Chronicles of Narnia: The Lion, the Witch and the Wardrobe, which had about 1,851 controllers (742 in the face alone). In the 2004 film The Day After Tomorrow, designers had to design forces of extreme weather with the help of video references and accurate meteorological facts. For the 2005 remake of King Kong, actor Andy Serkis was used to help designers pinpoint the gorilla's prime location in the shots and used his expressions to model "human" characteristics onto the creature. Serkis had earlier provided the voice and performance for Gollum in Peter Jackson's The Lord of the Rings trilogy.A ray-traced 3-D model of a jack inside a cube, and the jack alone belowComputer animation can be created with a computer and an animation software. Some impressive animation can be achieved even with basic programs; however, the rendering can require much time on an ordinary home computer.[56] Professional animators of movies, television and video games could make photorealistic animation with high detail. This level of quality for movie animation would take hundreds of years to create on a home computer. Instead, many powerful workstation computers are used;[57] Silicon Graphics said in 1989 that the animation industry's needs typically caused graphical innovations in workstations.[58] Graphics workstation computers use two to four processors, and they are a lot more powerful than an actual home computer and are specialized for rendering. Many workstations (known as a "render farm") are networked together to effectively act as a giant computer,[59] resulting in a computer-animated movie that can be completed in about one to five years (however, this process is not composed solely of rendering). A workstation typically costs $2,000 to $16,000 with the more expensive stations being able to render much faster due to the more technologically advanced hardware that they contain. Professionals also use digital movie cameras, motion/performance capture, bluescreens, film editing software, props, and other tools used for movie animation. Programs like Blender allow for people who can not afford expensive animation and rendering software to be able to work in a similar manner to those who use the commercial grade equipment.[60]Main article: Computer facial animationThe realistic modeling of human facial features is both one of the most challenging and sought after elements in computer-generated imagery. Computer facial animation is a highly complex field where models typically include a very large number of animation variables.[61] Historically speaking, the first SIGGRAPH tutorials on State of the art in Facial Animation in 1989 and 1990 proved to be a turning point in the field by bringing together and consolidating multiple research elements and sparked interest among a number of researchers.[62]The Facial Action Coding System (with 46 "action units", "lip bite" or "squint"), which had been developed in 1976, became a popular basis for many systems.[63] As early as 2001, MPEG-4 included 68 Face Animation Parameters (FAPs) for lips, jaws, etc., and the field has made significant progress since then and the use of facial microexpression has increased.[63][64]In some cases, an affective space, the PAD emotional state model, can be used to assign specific emotions to the faces of avatars.[65] In this approach, the PAD model is used as a high level emotional space and the lower level space is the MPEG-4 Facial Animation Parameters (FAP). A mid-level Partial Expression Parameters (PEP) space is then used to in a two-level structure the PAD-PEP mapping and the PEP-FAP translation model.[66]Joy & Heron a typical example of realistic animationRealism in computer animation can mean making each frame look photorealistic, in the sense that the scene is rendered to resemble a photograph or make the characters' animation believable and lifelike.[67] Computer animation can also be realistic with or without the photorealistic rendering.[68]One trend in computer animation has been the effort to create human characters that look and move with the highest degree of realism. A possible outcome when attempting to make pleasing, realistic human characters is the uncanny valley, the concept where the human audience (up to a point) tends to have an increasingly negative, emotional response as a human replica looks and acts more and more human. Films that have attempted photorealistic human characters, such as The Polar Express,[69][70][71] Beowulf,[72] and A Christmas Carol[73][74]have been criticized as "disconcerting" and "creepy".The goal of computer animation is not always to emulate live action as closely as possible, so many animated films instead feature characters who are anthropomorphic animals, legendary creatures and characters, superheroes, or otherwise have non-realistic, cartoon-like proportions.[75] Computer animation can also be tailored to mimic or substitute for other kinds of animation, like traditional stop-motion animation (as shown in Flushed Away or The Peanuts Movie). Some of the long-standing basic principles of animation, like squash and stretch, call for movement that is not strictly realistic, and such principles still see widespread application in computer animation.[76]The popularity of websites that allow members to upload their own movies for others to view has created a growing community of independent and amateur computer animators.[77] With utilities and programs often included free with modern operating systems, many users can make their own animated movies and shorts. Several free and open-source animation software applications exist as well. The ease at which these animations can be distributed has attracted professional animation talent also. Companies such as PowToon and Vyond attempt to bridge the gap by giving amateurs access to professional animations as clip art.The oldest (most backward compatible) web-based animations are in the animated GIF format, which can be uploaded and seen on the web easily.[78] However, the raster graphics format of GIF animations slows the download and frame rate, especially with larger screen sizes. The growing demand for higher quality web-based animations was met by a vector graphics alternative that relied on the use of a plugin. For decades, Flash animations were a common format, until the web development community abandoned support for the Flash Player plugin. Web browsers on mobile devices and mobile operating systems never fully supported the Flash plugin.By this time, internet bandwidth and download speeds increased, making raster graphic animations more convenient. Some of the more complex vector graphic animations had a slower frame rate due to complex rendering compared to some of the raster graphic alternatives. Many of the GIF and Flash animations were already converted to digital video formats, which were compatible with mobile devices and reduced file sizes via video compression technology. However, compatibility was still problematic as some of the video formats such as Apple's QuickTime and Microsoft Silverlight required plugins. YouTube was also relying on the Flash plugin to deliver digital video in the Flash Video format.The latest alternatives are HTML5 compatible animations. Technologies such as JavaScript and CSS animations made sequencing the movement of images in HTML5 web pages more convenient. SVG animations offered a vector graphic alternative to the original Flash graphic format, SmartSketch. YouTube offers an HTML5 alternative for digital video. APNG (Animated PNG) offered a raster graphic alternative to animated GIF files that enables multi-level transparency not available in GIFs.See also: Comparison of HTML5 and FlashComputer animation uses different techniques to produce animations. Most frequently, sophisticated mathematics is used to manipulate complex three-dimensional polygons, apply "textures", lighting and other effects to the polygons and finally rendering the complete image. A sophisticated graphical user interface may be used to create the animation and arrange its choreography. Another technique called constructive solid geometry defines objects by conducting Boolean operations on regular shapes, and has the advantage that animations may be accurately produced at any resolution.Main article: List of animation studiosThe examples and perspective in this section deal primarily with the United States and do not represent a worldwide view of the subject. You may improve this section, discuss the issue on the talk page, or create a new section, as appropriate. (May 2018) (Learn how and when to remove this message)Some notable producers of computer-animated feature films include:Animal Logic Films include Happy Feet (2006), Legend of the Guardians: The Owls of Ga'Hoole (2010), Walking with Dinosaurs (2013), and The Lego Movie (2014)Aardman Animations Films include Flushed Away (2006) and Arthur Christmas (2011)Angel Studios Films include The King of Kings (2025)nima Estudios Films include Monster Island (2017), Ana and Bruno (2018), and Cranston Academy: Monster Zone (2020)Annapurna Pictures Films include Sausage Party (2016), and Nimona (2023)Assemblage Entertainment Films include Blinky Bill the Movie (2015), Norm of the North (2016), and Arctic Dogs (2019)Big Idea Entertainment Jonah: A VeggieTales Movie (2002) and The Pirates Who Don't Do Anything: A VeggieTales Movie (2008)Bron Animation Films include The Addams Family (2019) and The Willoughbys (2020)Blue Sky Studios Films include Ice Age (2002), Robots (2005), Horton Hears a Who! (2008), Rio (2011), Epic (2013), and The Peanuts Movie (2015), and Spies in Disguise (2019)DNA Productions Films include Jimmy Neutron: Boy Genius (2001), Santa vs. the Snowman 3D (2002), and The Ant Bully (2006)DreamWorks Animation Films include Shrek (2001), Shark Tale (2004), Madagascar (2005), Over the Hedge (2006), Bee Movie (2007), Kung Fu Panda (2008), Monsters vs. Aliens (2009), How to Train Your Dragon (2010), Rise of the Guardians (2012), The Croods (2013), Turbo (2013), Home (2015), Trolls (2016), The Boss Baby (2017), Captain Underpants: The First Epic Movie (2017), Abominable (2019), The Bad Guys (2022), Ruby Gillman, Teenage Kraken (2023), Orion and the Dark (2024), The Wild Robot (2024), and Dog Man (2025)Flying Bark Productions Films include 100% Wolf (2020)Framestore - Films include The Tale of Despereaux (2008)Huayi Brothers Films include Rock Dog (2016), Extinct (2021), and Paws of Fury: The Legend of Hank (2022)ImageMovers Films include The Polar Express (2004), Monster House (2006), Beowulf (2007), A Christmas Carol (2009), and Mars Needs Moms (2011)Imagi Animation Studios Films include TMNT (2007) and Astro Boy (2009)Ilion Animation Studios Films include Planet 51 (2009), Mortadelo and Filemon: Mission Implausible (2014), and Wonder Park (2019)Illumination Films include Despicable Me (2010), The Lorax (2012), Minions (2015), The Secret Life of Pets (2016), Sing (2016), The Grinch (2018), The Secret Life of Pets 2 (2019) and The Super Mario Bros. Movie (2023), and Migration (2023)Industrial Light & Magic Films include Rango (2011) and Strange Magic (2015)Lightbox Entertainment Films include Tad, The Lost Explorer (2012), and Capture the Flag (2015)Locksmith Animation- Films include Ron's Gone Wrong (2021) and That Christmas (2024)Monsta Studios Films include BoBoiBoy: The Movie (2016), and Mechamato Movie (2022)Netflix Animation Films include Back to the Outback (2021), The Sea Beast (2022), The Magician's Elephant (2023), The Monkey King (2023), Leo (2023), Thelma the Unicorn (2024), and Ultraman: Rising (2024)Nickelodeon Movies Films include Paw Patrol: The Movie (2021)nWave Studios Films include Fly Me to the Moon (2008), A Turtle's Tale: Sammy's Adventures (2010), The House of Magic (2013), Robinson Crusoe (2016), The Son of Bigfoot (2017), The Queen's Corgi (2019), and Chickenhare and the Hamster of Darkness (2022)Omation Animation Studios Films include Barnyard (2006)Pacific Data Images Films include Antz (1998), Shrek (2001), Shrek 2 (2004), Madagascar (2005), Megamind (2010), and Mr. Peabody and Sherman (2014)Paramount Animation Films include The SpongeBob Movie: Sponge Out of Water (2015), Monster Trucks (2017), Sherlock Gnomes (2018), Wonder Park (2019), The SpongeBob Movie: Sponge on the Run (2020), Under the Boardwalk (2023), The Tiger's Apprentice (2024), and Transformers One (2024)Pixar Animation Studios Films include Toy Story (1995), Monsters, Inc. (2001), Finding Nemo (2003), The Incredibles (2004), Cars (2006), Ratatouille (2007), WALL-E (2008), Up (2009), Brave (2012), Inside Out (2015), The Good Dinosaur (2015), Coco (2017), Onward (2020), Soul (2020) Luca (2021), Turning Red (2022), and Elemental (2023)Rainmaker Studios Films include Escape from Planet Earth (2013) and Ratchet & Clank (2016)Reel FX Animation Studios Films include Free Birds (2013), The Book of Life (2014), and Rumble (2021)Wizart Animation Films include The Snow Queen (2012) and Sheep and Wolves (2016)Shirogumi Films include Friends: Mononoke Shima no Naki (2011), Stand by Me Doraemon (2014), and Dragon Quest: Your Story (2019)Skydance Animation Films include Luck (2022) and Spellbound (2024)Square Pictures- Films include Final Fantasy: The Spirits Within (2001)Sony Pictures Animation Films include Open Season (2006), Surf's Up (2007), Cloudy with a Chance of Meatballs (2009), Hotel Transylvania (2012), The Emoji Movie (2017), The Star (2017), Spider-Man: Into the Spider-Verse (2018), The Mitchells vs. the Machines (2021), Wish Dragon (2021), and Vivo (2021)Sony Pictures Imageworks Films include The Angry Birds Movie (2016) and Over the Moon (2020)TA

motion and puppetry over cel animation. Japanese anime TV series became very successful internationally since the 1960s, and European producers looking for affordable cel animators relatively often started co-productions with Japanese studios, resulting in hit series such as Barbapapa (The Netherlands/Japan/France 19731977), Wickie und die starken Mnner/ (Vicky the Viking) (Austria/Germany/Japan 1974), Maya the Honey Bee (Japan/Germany 1975) and The Jungle Book (Italy/Japan 1989).[citation needed]Main article: History of computer animationComputer animation was gradually developed since the 1940s. 3D wireframe animation started popping up in the mainstream in the 1970s, with an early (short) appearance in the sci-fi thriller Futureworld (1976).[17]The Rescuers Down Under was the first feature film to be completely created digitally without a camera.[18] It was produced using the Computer Animation Production System (CAPS), developed by Pixar in collaboration with The Walt Disney Company in the late 1980s, in a style similar to traditional cel animation.[19][20][21]The so-called 3D style, more often associated with computer animation, became the dominant technique following the success of Pixar's Toy Story (1995), the first computer-animated feature in this style.[22]Most of the cel animation studios switched to producing mostly computer-animated films around the 1990s, as it proved cheaper and more profitable. Not only the very popular 3D animation style was generated with computers, but also most of the films and series with a more traditional hand-crafted appearance, in which the charming characteristics of cel animation could be emulated with software, while new digital tools helped developing new styles and effects.[23][24][25][26][27][28]In 2010, the animation market was estimated to be worth circa US$80 billion.[29] By 2021, the value had increased to an estimated US$370 billion.[30] Animated feature-length films returned the highest gross margins (around 52%) of all film genres between 2004 and 2013.[31] Animation as an art and industry continues to thrive as of the early 2020s.[32][33][34]The clarity of animation makes it a powerful tool for instruction, while its total malleability also allows exaggeration that can be employed to convey strong emotions and to thwart reality. It has therefore been widely used for other purposes than mere entertainment.[35]During World War II, animation was widely exploited for propaganda. Many American studios, including Warner Bros. and Disney, lent their talents and their cartoon characters to convey to the public certain war values. These efforts extended to other countries well into the Cold War era, particularly as it pertained to "combatting" communism. For example, the English 1954 adaptation of George Orwell's Animal Farm (the nation's first feature-length animated film) is speculated to have had its production funded by the CIA.[36][37]Animation has been very popular in television commercials, both due to its graphic appeal, and the humour it can provide. Some animated characters in commercials have survived for decades, such as Snap, Crackle and Pop in advertisements for Kellogg's cereals.[38] Tex Avery was the producer of the first Raid "Kills Bugs Dead" commercials in 1966, which were very successful for the company.[39]Apart from their success in movie theaters and television series, many cartoon characters would also prove lucrative when licensed for all kinds of merchandise and for other media.Animation has traditionally been very closely related to comic books. While many comic book characters found their way to the screen (which is often the case in Japan, where many manga are adapted into anime), original animated characters also commonly appear in comic books and magazines. Somewhat similarly, characters and plots for video games (an interactive form of animation that became its own medium) have been derived from films and vice versa.[40]Some of the original content produced for the screen can be used and marketed in other media. Stories and images can easily be adapted into children's books and other printed media. Songs and music have appeared on records and as streaming media.[citation needed]While very many animation companies commercially exploit their creations outside moving image media, The Walt Disney Company is the best known and most extreme example. Since first being licensed for a children's writing tablet in 1929, their Mickey Mouse mascot has been depicted on an enormous amount of products, as have many other Disney characters. This may have influenced some pejorative use of Mickey's name, but licensed Disney products sell well, and the so-called Disneyana has many avid collectors, and even a dedicated Disneyana Fan Club (since 1984). [41]Disneyland opened in 1955 and features many attractions that were based on Disney's cartoon characters. Its enormous success spawned several other Disney theme parks and resorts. Disney's earnings from the theme parks have relatively often been higher than those from their movies.Main article: List of animation awardsAs with any other form of media, animation has instituted awards for excellence in the field. Many are part of general or regional film award programs, like the China's Golden Rooster Award for Best Animation (since 1981). Awards programs dedicated to animation, with many categories, include ASIFA-Hollywood's Annie Awards, the Emile Awards in Europe and the Anima Mundi awards in Brazil.[42][43][44]Main article: List of animated feature films nominated for Academy AwardsApart from Academy Awards for Best Animated Short Film (since 1932) and Best Animated Feature (since 2002), animated movies have been nominated and rewarded in other categories, relatively often for Best Original Song and Best Original Score.Beauty and the Beast was the first animated film nominated for Best Picture, in 1991. Up (2009) and Toy Story 3 (2010) also received Best Picture nominations, after the academy expanded the number of nominees from five to ten.[45]Joy & HeronThe creation of non-trivial animation works (i.e., longer than a few seconds) has developed as a form of filmmaking, with certain unique aspects.[46] Traits common to both live-action and animated feature films are labor intensity and high production costs.[47]The most important difference is that once a film is in the production phase, the marginal cost of one more shot is higher for animated films than live-action films.[48] It is relatively easy for a director to ask for one more take during principal photography of a live-action film, but every take on an animated film must be manually rendered by animators (although the task of rendering slightly different takes has been made less tedious by modern computer animation).[49] It is pointless for a studio to pay the salaries of dozens of animators to spend weeks creating a visually dazzling five-minute scene if that scene fails to effectively advance the plot of the film.[50] Thus, animation studios starting with Disney began the practice in the 1930s of maintaining story departments where storyboard artists develop every single scene through storyboards, then handing the film over to the animators only after the production team is satisfied that all the scenes make sense as a whole.[51] While live-action films are now also storyboarded, they enjoy more latitude to depart from storyboards (i.e., real-time improvisation).[citation needed][52]Another problem unique to animation is the requirement to maintain a film's consistency from start to finish, even as films have grown longer and teams have grown larger. Animators, like all artists, necessarily have individual styles, but must subordinate their individuality in a consistent way to whatever style is employed on a particular film.[53][54] Since the early 1980s, teams of about 500 to 600 people, of whom 50 to 70 are animators, typically have created feature-length animated films. It is relatively easy for two or three artists to match their styles; synchronizing those of dozens of artists is more difficult.[55]This problem is usually solved by having a separate group of visual development artists develop an overall look and palette for each film before the animation begins.[53] While animators must "sacrifice their personal drawing styles so that the work of many hands appears to be that of one", visual development artists are allowed to "create new worlds, new characters, and new entertainment possibilities in their own individualistic graphic styles".[53] Character designers on the visual development team draw model sheets to show how each character should look like with different facial expressions, posed in different positions, and viewed from different angles.[56][57] On traditionally animated projects, maquettes were often sculpted to further help the animators see how characters would look from different angles.[56][58]Unlike live-action films, animated films were traditionally developed beyond the synopsis stage through the storyboard format; the storyboard artists would then receive credit for writing the film.[59][60] The traditional approach worked for several decades because prior to the 1960s, no one except Disney was attempting to regularly produce feature-length animated films. [60] All other animation studios, with occasional exceptions, were producing short films only a few minutes in length.[60] For short films, it was enough for the storyboard artists to work up a few visual gags and then string them together to form a crude plot.[60]In 1960, Hanna-Barbera pioneered the longer animated sitcom format for television with The Flintstones.[60] Hanna-Barbera and the other early television animation studios soon discovered that storyboarding was far too inefficient to fill up a half-hour episode on the extremely tight budgets typical of television.[60] During the 1960s, these studios experimented with a more efficient method for developing story material: a screenwriter is hired to draft a written screenplay which is approved and handed over to the storyboard artists for storyboarding.[60] This method creates significant tension between screenwriters and storyboard artists, in that some artists feel that people who cannot draw should not be writing for animation, while some writers feel that artists do not understand how to write.[60] Despite that tension, it has become and remains the dominant method by which animation studios develop both feature-length films and television shows.[60] Ironically, the Disney studio was relatively slow to adopt this method. The first Disney feature animated film to have a complete screenplay written and approved before storyboarding was One Hundred and One Dalmatians (1961).[61] However, 101 Dalmatians was "a short-lived experiment"; the next Disney film to follow this method was The Great Mouse Detective (1986).[61]Finally, another key difference is that actors traditionally record vocal tracks for animated films in separate individual sessions.[62] Actors usually schedule sessions in the recording studio around their live-action work.[62] In live-action filmmaking, it is very common for actors to drop out of projects due to scheduling conflicts, while in animation, recording actors separately makes it possible to "get a lot more stars into one movie than" would be possible if those actors needed to be physically present on the same set at the same time.[62]Main article: Traditional animationAn example of traditional animation, a horse animated by rotoscoping from Eadweard Muybridge's 19th-century photosTraditional animation (also called cel animation or hand-drawn animation) is the process that was used for most animated films of the 20th century.[63] The individual frames of a traditionally animated film are photographs of drawings, first drawn on paper.[64] To create the illusion of movement, each drawing differs slightly from the one before it. The animators' drawings are traced or photocopied onto transparent acetate sheets called cels,[65] which are filled in with paints in assigned colors or tones on the side opposite the line drawings.[66] The completed character cels are photographed one-by-one against a painted background by a rostrum camera onto motion picture film.[67]The traditional cel animation process became obsolete by the beginning of the 21st century. In modern traditionally animated films, animators' drawings and the backgrounds are either scanned into or drawn directly into a computer system.[1][68] Various software programs are used to color the drawings and simulate camera movement and effects.[69] The final animated piece is output to one of several delivery media, including traditional 35 mm film and newer media with digital video.[1][70] The "look" of traditional cel animation is still preserved, and the character animators' work has remained essentially the same over the past 90 years.[58] Some animation producers have used the term "tradigital" (a play on the words "traditional" and "digital") to describe cel animation that uses significant computer technology.Examples of traditionally animated feature films include Pinocchio (United States, 1940),[71] Animal Farm (United Kingdom, 1954), Lucky and Zorba (Italy, 1998), and The Illusionist (British-French, 2010). Traditionally animated films produced with the aid of computer technology include The Lion King (US, 1994), Anastasia (US, 1997), The Prince of Egypt (US, 1998), Akira (Japan, 1988),[72] Spirited Away (Japan, 2001), The Triplets of Belleville (France, 2003), and The Secret of Kells (Irish-French-Belgian, 2009).Full animation is the process of producing high-quality traditionally animated films that regularly use detailed drawings and plausible movement,[73] having a smooth animation.[74] Fully animated films can be made in a variety of styles, from more realistically animated works like those produced by the Walt Disney studio (The Little Mermaid, Beauty and the Beast, Aladdin, The Lion King) to the more 'cartoon' styles of the Warner Bros. animation studio. Many of the Disney animated features are examples of full animation, as are non-Disney works, The Secret of NIMH (US, 1982), The Iron Giant (US, 1999), and Nocturna (Spain, 2007). Fully animated films are often animated on "twos", sometimes on "ones", which means that 12 to 24 drawings are required for a single second of film.[75]Main article: Limited animationLimited animation involves the use of less detailed or more stylized drawings and methods of movement usually a choppy or "skippy" movement animation.[76] Limited animation uses fewer drawings per second, thereby limiting the fluidity of the animation. This is a more economic technique. Pioneered by the artists at the American studio United Productions of America,[77] limited animation can be used as a method of stylized artistic expression, as in Gerald McBoing-Boing (US, 1951), Yellow Submarine (UK, 1968), and certain anime produced in Japan.[78] Its primary use, however, has been in producing cost-effective animated content for media for television (the work of Hanna-Barbera,[79] Filmation,[80] and other TV animation studios[81]) and later the Internet (web cartoons).Main article: RotoscopingRotoscoping is a technique patented by Max Fleischer in 1917 where animators trace live-action movement, frame by frame.[82] The source film can be directly copied from actors' outlines into animated drawings,[83] as in The Lord of the Rings (US, 1978), or used in a stylized and expressive manner, as in Waking Life (US, 2001) and A Scanner Darkly (US, 2006). Some other examples are Fire and Ice (US, 1983), Heavy Metal (1981), and Aku no Hana (Japan, 2013).[citation needed]Main article: Films with live action and animationLive-action/animation is a technique combining hand-drawn characters into live action shots or live-action actors into animated shots.[84] One of the earlier uses was in Koko the Clown when Koko was drawn over live-action footage.[85] Walt Disney and Ub Iwerks created a series of Alice Comedies (19231927), in which a live-action girl enters an animated world. Other examples include Allegro Non Troppo (Italy, 1976), Who Framed Roger Rabbit (US, 1988), Volere volare (Italy 1991), Space Jam (US, 1996) and Osmosis Jones (US, 2001).[citation needed]Main article: Stop motionStop motion is used to describe animation created by physically manipulating real-world objects and photographing them one frame of film at a time to create the illusion of movement.[86] There are many different types of stop-motion animation, usually named after the materials used to create the animation.[87] Computer software is widely available to create this type of animation; traditional stop-motion animation is usually less expensive but more time-consuming to produce than current computer animation.[87]Stop motionTypically involves stop-motion puppet figures interacting in a constructed environment, in contrast to real-world interaction in model animation.[88] The puppets generally have an armature inside of them to keep them still and steady to constrain their motion to particular joints.[89] Examples include The Tale of the Fox (France, 1937), The Nightmare Before Christmas (US, 1993), Corpse Bride (US, 2005), Coraline (US, 2009), the films of Ji Trnka and the adult animated sketch-comedy television series Robot Chicken (US, 2005present).PuppetoonsCreated using techniques developed by George Pal,[90] are puppet-animated films that typically use a different version of a puppet for different frames, rather than manipulating one existing puppet.[91]A clay animation scene from a Finnish television commercialClay animation or Plasticine animation(Often called claymation, which, however, is a trademarked name). It uses figures made of clay or a similar malleable material to create stop-motion animation.[86][92] The figures may have an armature or wire frame inside, similar to the related puppet animation (below), that can be manipulated to pose the figures.[93] Alternatively, the figures may be made entirely of clay, in the films of Bruce Bickford, where clay creatures morph into a variety of different shapes. Examples of clay-animated works include The Gumby Show (US, 19571967), Mio Mao (Italy, 19742005), Morph shorts (UK, 19772000), Wallace & Gromit shorts (UK, as of 1989), Jan vankmajer's Dimensions of Dialogue (Czechoslovakia, 1982), The Trap Door (UK, 1984). Films include Wallace & Gromit: The Curse of the Were-Rabbit, Chicken Run and The Adventures of Mark Twain.[94]Strata-cut animationMost commonly a form of clay animation in which a long bread-like "loaf" of clay, internally packed tight and loaded with varying imagery, is sliced into thin sheets, with the animation camera taking a frame of the end of the loaf for each cut, eventually revealing the movement of the internal images within.[95]Cutout animationA type of stop-motion animation produced by moving two-dimensional pieces of material paper or cloth.[96] Examples include Terry Gilliam's animated sequences from Monty Python's Flying Circus (UK, 19691974); Fantastic Planet (France/Czechoslovakia, 1973); Tale of Tales (Russia, 1979), Matt Stone and Trey Parker the first cutout animation South Park (1992), the pilot episode of the adult television sitcom series (and sometimes in episodes) of South Park (US, 1997) and the music video Live for the moment, from Verona Riots band (produced by Alberto Serrano and Nvola Uy, Spain 2014).Silhouette animationA variant of cutout animation in which the characters are backlit and only visible as silhouettes.[97] Examples include The Adventures of Prince Achmed (Weimar Republic, 1926) and Princes et Princesses (France, 2000).Model animationStop-motion animation created to interact with and exist as a part of a live-action world.[98] Intercutting, matte effects and split screens are often employed to blend stop-motion characters or objects with live actors and settings.[99] Examples include the work of Ray Harryhausen, as seen in films, Jason and the Argonauts (1963),[100] and the work of Willis H. O'Brien on films, King Kong (1933).Go motionA variant of model animation that uses various techniques to create motion blur between frames of film, which is not present in traditional stop motion.[101] The technique was invented by Industrial Light & Magic and Phil Tippett to create special effect scenes for the film Star Wars: Episode V The Empire Strikes Back (1980).[102] Another example is the dragon named "Vermithrax" from the 1981 film Dragonslayer.[103]Object animationThe use of regular inanimate objects in stop-motion animation, as opposed to specially created items.[104]Graphic animationUses non-drawn flat visual graphic material (photographs, newspaper clippings, magazines, etc.), which are sometimes manipulated frame by frame to create movement.[105] At other times, the graphics remain stationary, while the stop-motion camera is moved to create on-screen action.BrickfilmA subgenre of object animation involving using Lego or other similar brick toys to make an animation.[106][107] These have had a recent boost in popularity with the advent of video sharing sites, YouTube and the availability of cheap cameras and animation software.[108]PixilationInvolves the use of live humans as stop-motion characters.[109] This allows for a number of surreal effects, including disappearances and reappearances, allowing people to appear to slide across the ground, and other effects.[109] Examples of pixilation include The Secret Adventures of Tom Thumb and Angry Kid shorts, and the Academy Award-winning Neighbours by Norman McLaren.Main article: Computer animationComputer animation encompasses a variety of techniques, the unifying factor being that the animation is created digitally on a computer.[69][110] 2D animation techniques tend to focus on image manipulation while 3D techniques usually build virtual worlds in which characters and objects move and interact.[111] 3D animation can create images that seem real to the viewer.[112]Main article: 2D computer graphicsA 2D animation of two circles joined by a chain2D animation figures are created or edited on the computer using 2D bitmap graphics and 2D vector graphics.[113] This includes automated computerized versions of traditional animation techniques, interpolated morphing,[114] onion skinning[115] and interpolated rotoscoping. 2D animation has many applications, including After Effects Animation, analog computer animation, Flash animation, and PowerPoint animation. Cinemagraphs are still photographs in the form of an animated GIF file of which part is animated.[116]Final line advection animation is a technique used in 2D animation,[117] to give artists and animators more influence and control over the final product as everything is done within the same department.[118] Speaking about using this approach in Paperman, John Kahrs said that "Our animators can change things, actually erase away the CG underlayer if they want, and change the profile of the arm."[119]When working with game animations, skeletal 2D animations are commonly created using tools like Spine, DragonBones, Blender COA Tools, Rive, and the built-in Unity editor. The primary benefit of this approach is the ability to reuse images, which reduces the amount of graphics stored in RAM. This principle of maximizing resource efficiency means that by reusing existing elements, you can enhance the visual appeal of animations without needing to create additional graphics.[120]Main articles: Computer animation and 3D computer graphicsCaminandes | Llama Drama3D animation is digitally modeled and manipulated by an animator. The 3D model maker usually starts by creating a 3D polygon mesh for the animator to manipulate.[121] A mesh typically includes many vertices that are connected by edges and faces, which give the visual appearance of form to a 3D object or 3D environment.[121] Sometimes, the mesh is given an internal digital skeletal structure called an armature that can be used to control the mesh by weighting the vertices.[122][123] This process is called rigging and can be used in conjunction with key frames to create movement.[124]Other techniques can be applied, mathematical functions (e.g., gravity, particle simulations), simulated fur or hair, and effects, fire and water simulations.[125] These techniques fall under the category of 3D dynamics.[126]Cel shading is used to mimic traditional animation using computer software.[127] The shading looks stark, with less blending of colors. Examples include Skyland (2007, France), The Iron Giant (1999, U.S.), Futurama (1999, U.S.) Appleseed Ex Machina (2007, Japan), The Legend of Zelda: The Wind Waker (2002, Japan), The Legend of Zelda: Breath of the Wild (2017, Japan)Machinima Films created by screen capturing in video games and virtual worlds. The term originated from the software introduction in the 1980s demoscene, as well as the 1990s recordings of the first-person shooter video game Quake.Motion capture is used when live-action actors wear special suits that allow computers to copy their movements into CG characters.[128][129] Examples include Polar Express (2004, US), Beowulf (2007, US), A Christmas Carol (2009, US), The Adventures of Tintin (2011, US) kochadiiyan (2014, India)Computer animation is used primarily for animation that attempts to resemble real life while having a stylized cartoonish appearance, using advanced rendering that mimics in detail skin, plants, water, fire, clouds, etc.[130] Examples include Up (2009, US), How to Train Your Dragon (2010, US)Physically based animation is animation using computer simulations.[131]Animatronics is the use of mechatronics to create machines that seem animate rather than robotic.Audio-Animatronics is a form of robotics animation, combined with 3-D animation, created by Walt Disney Imagineering for shows and attractions at Disney theme parks move and make noise (generally a recorded speech or song).[132] They are fixed to whatever supports them. They can sit and stand, and they cannot walk. An Audio-Animatron is different from an android-type robot in that it uses prerecorded movements and sounds, rather than responding to external stimuli. In 2009, Disney created an interactive version of the technology called Autonomatronics.[133]Linear Animation Generator is a form of animation by using static picture frames installed in a tunnel or a shaft. The animation illusion is created by putting the viewer in a linear motion, parallel to the installed picture frames.[134]Chuckimation is a type of animation created by the makers of the television series Action League Now! in which characters/props are thrown, or chucked from off camera or wiggled around to simulate talking by unseen hands.[135]The magic lantern used mechanical slides to project moving images. Christiaan Huygens was thought to have invented the magic lantern in the mid-1600s.[136]World of Color hydrotechnics at Disney California Adventure creates the illusion of motion using 1,200 fountains with high-definition projections on mist screens.Musical fountain: a hydrautechnical show that includes water and lights, nowadays often combined with lasers and high-definition projections on mist screens.[137]Drawn-on-film animation: a technique where footage is produced by creating the images directly on film stock; for example, by Norman McLaren,[138] Len Lye and Stan Brakhage.Paint-on-glass animation: a technique for making animated films by manipulating slow drying oil paints on sheets of glass,[139] for example by Aleksandr Petrov.[140]Erasure animation: a technique using traditional 2D media, photographed over time as the artist manipulates the image. For example, William Kentridge is famous for his charcoal erasure films,[141] and Piotr Dumaa for his auteur technique of animating scratches on plaster.[142]Pinscreen animation: makes use of a screen filled with movable pins that can be moved in or out by pressing an object onto the screen.[143] The screen is lit from the side so that the pins cast shadows. The technique has been used to create animated films with a range of textural effects difficult to achieve with traditional cel animation. [144]Sand animation: sand is moved around on a back- or front-lighted piece of glass to create each frame for an animated film.[145] This creates an interesting effect when animated because of the light contrast.[146]Flip book: a flip book (sometimes, especially in British English, called a flick book) is a book with a series of pictures that vary gradually from one page to the next, so that when the pages are turned rapidly, the pictures appear to animate by simulating motion or some other change.[147][148] Flip books are often illustrated books for children,[149] they also are geared towards adults and employ a series of photographs rather than drawings. Flip books are not always separate books, they appear as an added feature in ordinary books or magazines, often in the page corners.[147] Software packages and websites are also available that convert digital video files into custom-made flip books.[150]Character animationMulti-sketch animationSpecial effects animation2.5D Animation: A mix of 2D and 3D animation elements that emphasize the illusion of depth utilizing the pseudo-3D effect.[151] During the 1970s, the term "2.5D" started to gain recognition.[152] But its background comes from anime and manga during the 1920s where theatrical stage productions were popular.[153] Stage adaptations of well-liked anime series featured live performances by voice actors called 2.5D.[152]Animation portalAnimated war filmAnimation departmentAnimated seriesAnimeArchitectural animationAvarIndependent animationInternational Animation DayInternational Animated Film AssociationInternational Tourne of AnimationList of film-related topicsMotion graphic designSociety for Animation StudiesTwelve basic principles of animationWire-frame model^ a b c Buchan 2013.^ "The definition of animation on dictionary.com".^ "How Modern Animation Originated from Live and Stage Performances - studio9". studio9.ie. 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Unsourced material may be challenged and removed.Find sources:"3D computer graphics"news newspapers books scholar JSTOR (April 2017) (Learn how and when to remove this message)Three-dimensional (3D)computer graphicsFundamentalsModelingScanningRenderingPrintingPrimary uses3D modelsComputer-aided designGraphic designVideo gamesVisual effectsVisualizationVirtual engineeringVirtual realityVirtual cinematographyRelated topicsComputer-generated imagery (CGI)Animationcomputerskeletal3D displayWire-frame modelTexture mappingMotion captureCrowd simulationGlobal illuminationVolume renderingvte3D computer graphics, sometimes called CGI, 3D-CGI or three-dimensional computer graphics, are graphics that use a three-dimensional representation of geometric data (often Cartesian) that is stored in the computer for the purposes of performing calculations and rendering digital images, usually 2D images but sometimes 3D images. The resulting images may be stored for viewing later (possibly as an animation) or displayed in real time.[1]3D computer graphics, contrary to what the name suggests, are most often displayed on two-dimensional displays. Unlike 3D film and similar techniques, the result is two-dimensional, without visual depth. More often, 3D graphics are being displayed on 3D displays, like in virtual reality systems.3D graphics stand in contrast to 2D computer graphics which typically use completely different methods and formats for creation and rendering.3D computer graphics rely on many of the same algorithms as 2D computer vector graphics in the wire-frame model and 2D computer raster graphics in the final rendered display. In computer graphics software, 2D applications may use 3D techniques to achieve effects such as lighting, and similarly, 3D may use some 2D rendering techniques.[2]The objects in 3D computer graphics are often referred to as 3D models. Unlike the rendered image, a model's data is contained within a graphical data file. A 3D model is a mathematical representation of any three-dimensional object; a model is not technically a graphic until it is displayed. A model can be displayed visually as a two-dimensional image through a process called 3D rendering, or it can be used in non-graphical computer simulations and calculations. With 3D printing, models are rendered into an actual 3D physical representation of themselves, with some limitations as to how accurately the physical model can match the virtual model.[3]Main article: History of computer animationWilliam Fetter was credited with coining the term computer graphics in 1961[4][5] to describe his work at Boeing. An early example of interactive 3-D computer graphics was explored in 1963 by the Sketchpad program at Massachusetts Institute of Technology's Lincoln Laboratory.[6] One of the first displays of computer animation was Futureworld (1976), which included an animation of a human face and a hand that had originally appeared in the 1971 experimental short A Computer Animated Hand, created by University of Utah students Edwin Catmull and Fred Parke.[7]3-D computer graphics software began appearing for home computers in the late 1970s. The earliest known example is 3D Art Graphics, a set of 3-D computer graphics effects, written by Kazumasa Mitazawa and released in June 1978 for the Apple II.[8][9]Virtual Reality 3D is a version of 3D computer graphics.[10] With the first headset coming out in the late 1950s, the popularity of VR didn't take off until the 2000s. In 2012 the Oculus was released and since then, the 3D VR headset world has expanded.[11]3D computer graphics production workflow falls into three basic phases: 3D modeling the process of forming a computer model of an object's shapeLayout and CGI animation the placement and movement of objects (models, lights etc.) within a scene3D rendering the computer calculations that, based on light placement, surface types, and other qualities, generate (rasterize the scene into) an imageMain article: 3D modelingThe modeling describes the process of forming the shape of an object. The two most common sources of 3D models are those that an artist or engineer originates on the computer with some kind of 3D modeling tool, and models scanned into a computer from real-world objects (Polygonal Modeling, Patch Modeling and NURBS Modeling are some popular tools used in 3D modeling). Models can also be produced procedurally or via physical simulation. Basically, a 3D model is formed from points called vertices that define the shape and form polygons. A polygon is an area formed from at least three vertices (a triangle). A polygon of n points is an n-gon.[12] The overall integrity of the model and its suitability to use in animation depend on the structure of the polygons.Main article: Computer animationBefore rendering into an image, objects must be laid out in a 3D scene. This defines spatial relationships between objects, including location and size. Animation refers to the temporal description of an object (i.e., how it moves and deforms over time. Popular methods include keyframing, inverse kinematics, and motion-capture). These techniques are often used in combination. As with animation, physical simulation also specifies motion.Stop Motion has multiple categories within such as Claymation, Cutout, Silhouette, Lego, Puppets, and Pixelation. [13]Claymation is the use of models made of clay used for an animation. Some examples are Clay Fighter and Clay Jam.[13]Lego animation is one of the more common types of stop motion. Lego stop motion is the use of the figures themselves moving around. Some examples of this are Lego Island and Lego Harry Potter.[13]Materials and textures are properties that the render engine uses to render the model. One can give the model materials to tell the render engine how to treat light when it hits the surface. Textures are used to give the material color using a color or albedo map, or give the surface features using a bump map or normal map. It can be also used to deform the model itself using a displacement map.Main article: 3D renderingRendering converts a model into an image either by simulating light transport to get photo-realistic images, or by applying an art style as in non-photorealistic rendering. The two basic operations in realistic rendering are transport (how much light gets from one place to another) and scattering (how surfaces interact with light). This step is usually performed using 3-D computer graphics software or a 3-D graphics API. Altering the scene into a suitable form for rendering also involves 3D projection, which displays a three-dimensional image in two dimensions. Although 3-D modeling and CAD software may perform 3-D rendering as well (e.g., Autodesk 3ds Max or Blender), exclusive 3-D rendering software also exists (e.g., OTOY's Octane Rendering Engine, Maxon's Redshift) Examples of 3-D renderingA 3-D rendering with ray tracing and ambient occlusion using Blender and YafaRayA 3-D model of a Dunkerque-class battleship rendered with flat shadingDuring the 3-D rendering step, the number of reflections "light rays" can take, as well as various other attributes, can be tailored to achieve a desired visual effect. Rendered with Cobalt.A 3-D rendering of a penthouse3-D computer graphics software produces computer-generated imagery (CGI) through 3D modeling and 3D rendering or produces 3-D models for analytical, scientific and industrial purposes.Main article: List of file formatsThere are many varieties of files supporting 3-D graphics, for example, Wavefront .obj files and .x DirectX files. Each file type generally tends to have its own unique data structure.Each file format can be accessed through their respective applications, such as DirectX files, and Quake. Alternatively, files can be accessed through third-party standalone programs, or via manual decompilation.Main article: 3D modeling3-D modeling software is a class of 3-D computer graphics software used to produce 3-D models. Individual programs of this class are called modeling applications or modelers.3-D modeling starts by describing 3 display models: Drawing Points, Drawing Lines and Drawing triangles and other Polygonal patches.[14]3-D modelers allow users to create and alter models via their 3-D mesh. Users can add, subtract, stretch and otherwise change the mesh to their desire. Models can be viewed from a variety of angles, usually simultaneously. Models can be rotated and the view can be zoomed in and out.3-D modelers can export their models to files, which can then be imported into other applications as long as the metadata are compatible. Many modelers allow importers and exporters to be plugged-in, so they can read and write data in the native formats of other applications.Most 3-D modelers contain a number of related features, such as ray tracers and other rendering alternatives and texture mapping facilities. Some also contain features that support or allow animation of models. Some may be able to generate full-motion video of a series of rendered scenes (i.e. animation).Main article: Computer-aided designComputer aided design software may employ the same fundamental 3-D modeling techniques that 3-D modeling software use but their goal differs. They are used in computer-aided engineering, computer-aided manufacturing, Finite element analysis, product lifecycle management, 3D printing and computer-aided architectural design.After producing a video, studios then edit or composite the video using programs such as Adobe Premiere Pro or Final Cut Pro at the mid-level, or Autodesk Combustion, Digital Fusion, Shake at the high-end. Match moving software is commonly used to match live video with computer-generated video, keeping the two in sync as the camera moves.Use of real-time computer graphics engines to create a cinematic production is called machinima.[15]This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (September 2023) (Learn how and when to remove this message)See also: Still life 21st centuryNot all computer graphics that appear 3D are based on a wireframe model. 2D computer graphics with 3D photorealistic effects are often achieved without wire-frame modeling and are sometimes indistinguishable in the final form. Some graphic art software includes filters that can be applied to 2D vector graphics or 2D raster graphics on transparent layers. Visual artists may also copy or visualize 3D effects and manually render photo-realistic effects without the use of filters.[16]Main article: 2.5DSome video games use 2.5D graphics, involving restricted projections of three-dimensional environments, such as isometric graphics or virtual cameras with fixed angles, either as a way to improve performance of the game engine or for stylistic and gameplay concerns. By contrast, games using 3D computer graphics without such restrictions are said[by whom?] to use true 3D.Cutout is the use of flat materials such as paper. Everything is cut out of paper including the environment, characters, and even some props. An example of this is Paper Mario.[17] Silhouette is similar to cutouts except they are one solid color, black. Limbo is an example of this.[17] Puppets are dolls and different puppets used in the game. An example of this would be Yoshi's Wooly World.[17] Pixelation is when the entire game appears pixelated, this includes the characters and the environment around them. One example of this is seen in Shovel Knight. 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Retrieved 2024-08-22.Retrieved from " 4The following pages link to 3D computer graphics External tools(link counttransclusion countsorted list) See help page for transcluding these entriesShowing 50 items.View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Animation (links | edit)Anime (links | edit)ASCII art (links | edit)Alpha compositing (links | edit)Lists of animated television series (links | edit)Atari ST (links | edit)Sid Meier's Alpha Centauri (links | edit)Accelerated Graphics Port (links | edit)AMD (links | edit)AutoCAD (links | edit)Alexey Pajitnov (links | edit)Video game (links | edit)Rendering (computer graphics) (links | edit)Chrono Trigger (links | edit)Computer animation (links | edit)Computer music (links | edit)Computer mouse (links | edit)List of games based on Dune (links | edit)Doraemon (links | edit)Doom (1993 video game) (links | edit)Digital compositing (links | edit)EverQuest (links | edit)Film crew (links | edit)Final Fantasy (links | edit)File manager (links | edit)Game Boy Advance (links | edit)Global illumination (links | edit)"Hello, World!" program (links | edit)Hierarchy (links | edit)Handheld game console (links | edit)Id Software (links | edit)Judge Dredd (links | edit)Key frame (links | edit)Katsuhiro Otomo (links | edit)Machinima (links | edit)Maniac Mansion (links | edit)Motherboard (links | edit)MIPS architecture (links | edit)Mecha (links | edit)MacOS (links | edit)Maxis (links | edit)Nights into Dreams (links | edit)NetHack (links | edit)Ninja Tune (links | edit)Neo Geo (links | edit)OpenGL (links | edit)Pixel (links | edit)PlayStation (console) (links | edit)Pong (links | edit)Quine (computing) (links | edit)View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Retrieved from " WhatLinksHere/3D_computer_graphics"

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