Click to prove you're human

When selecting a Computer Science Engineering college in Mumbai, key factors to consider include: - Accreditations, rankings, and reputation of the college - Quality of faculty, infrastructure, and research facilities - Placement records, average salaries, and top recruiters - Specializations, electives, and industry collaborations - Campus life, extracurricular activities, and student support services - Tuition fees, scholarships, and financial aid options PopularityRatingHighest FeesLowest Fees7/10 (28 Reviews)7.5/10 (19 Reviews)8.4/10 (11 Reviews)6.8/10 (9 Reviews) 26,000 - 12,50,000 Fees UGC Accredition26.6 Lacs Avg Package CBSE 12th Exams...+6 GATE , NMIMS NPAT , XAT , MHT-CET , NMAT , NEET Narsee Monjee Institute of Management Studies was established in 1981 and has since grown to become a globally renowned institution. The Shri Vile Parle Kelavani Mandal (SVKM), recognised for its social concern, decided to meet India's growing demand for management institutes. The University Grants Commission and the Ministry of Education have authorised the institute, and it is accredited by the NAAC and NBA. The management college is AACSB certified, while the Bengaluru and Hyderabad programmes are AMBA accredited. The Mumbai University was the first to recognise the institute. NMIMS currently offers 17 specialised schools and 16 fields. Management, business, commerce, and economics, pharmaceutical sciences, engineering, and technology management are among the programmes offered.Shortlisted by 16154+ students From where did you get the data? Weâ€™ve collected cut-offs of few colleges from their websites but there were many colleges putting cut-off list just offline, for which weâ€™ve personally visited all the colleges to collect the data. Cut-off marks represents which list? Displayed cut-offs are the least of all the rounds. For example, A college has 90% in 1st Merit list, 88% in 2nd Merit list and 88.5% in the 3rd one, we took 88% as a closing cut-off. How many merit lists are expected? There is no limit in number of merit list for the case of degree college. For some college, admission gets over in just two merit list and in some, the list goes till seven or eight. Are BMS and BMM open for all the streams for taking admission? Yes, these are the two most popular courses where students from all the streams like commerce, science or arts apply to get the admission. Cut-off list of all these streams are separate and is displayed on our website as well in the form of drop down. There are just five categories displayed! What about the other categories? We have data of all the categories, if you wish to get it, please fill the query form and weâ€™ll revert you as soon as possible. What is the official website to apply for online admissions in Mumbai University? Here are the official portals - Mumbai University Website - Admission portal - When are the HSC results generally gets announced? Generally, it gets announced in the last week of May. In 2019, HSC results were announced on May 28. What is the website to check HSC results online? HSC results can be checked online with this link â€“ mahresult.nic.in When will the Degree college admission procedure start of Mumbai University? Generally, the procedure gets started from the next day of the announcement of HSC results and lasts for 2 weeks to fill the admission form. What is Pre-admission registration form? Pre-admission registration form is to be filled by the students as soon as the HSC results gets announced in which a candidate needs to fill their basic details and have to upload photograph and signature online. After that, they need to apply to the colleges with specific course online. When will the merit lists will start displaying? Usually, Merit lists for first year admission in Mumbai University will start after 2 weeks of HSC result declaration. In 2019, It was started on 13th of June. How many students are appearing for HSC exam 2019? Around 15 Lakh students from Maharashtra are appearing for HSC examination out of which 3.3 lakh students are from Mumbai alone. How many seats are there for first year in degree colleges of Mumbai University? As per the data of 2018, total 58,232 seats in Arts, 1,66,977 in Commerce and 68,219 seats in science are there in first year degree colleges of Mumbai University. Enjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. Your generated images will be more polished than ever.See What's NewExplore how consumers want to see climate stories told today, and what that means for your visuals.Download Our Latest VisualGPS ReportData-backed trends. Generative AI demos. Answers to your usage rights questions. Our original video podcast covers it all—now on demand.Watch NowEnjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. Your generated images will be more polished than ever.See What's NewExplore how consumers want to see climate stories told today, and what that means for your visuals.Download Our Latest VisualGPS ReportData-backed trends. Generative AI demos. Answers to your usage rights questions. Our original video podcast covers it all—now on demand.Watch NowEnjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. Your generated images will be more polished than ever.See What's NewExplore how consumers want to see climate stories told today, and what that means for your visuals.Download Our Latest VisualGPS ReportData-backed trends. Generative AI demos. Answers to your usage rights questions. Our original video podcast covers it all—now on demand.Watch Now CD RankCollegesCourse FeesPlacementUser ReviewsRanking#1₹ 2,36,000BE/B.Tech- 1st Year FeesCompare Fees 4.4 / 5 Based on 397 UserReviewsBest in Social Life#1th/500 in India 2025+ 10 More #2₹ 85,551BE/B.Tech- 1st Year FeesCompare Fees₹ 13,00,000Average Package₹ 57,00,000Highest PackageCompare Placement 4 / 5 Based on 205 UserReviewsBest in Placements#93th/500 in India 2025+ 1 More #3₹ 2,10,000BE/B.Tech- 1st Year Fees₹ 15,14,000Average Package₹ 61,55,000Highest Package 4 / 5 Based on 62 UserReviewsBest in Placements#130th/500 in India 2025+ 1 More #4₹ 2,21,125BE/B.Tech- 1st Year FeesCompare Fees₹ 9,21,000Average Package₹ 34,00,000Highest PackageCompare Placement 4.1 / 5 Based on 93 UserReviewsBest in Placements#11th/175 in India 2025+ 4 More CD RankCollegesCourse FeesPlacementUser ReviewsRanking#5₹ 5,02,000BE/B.Tech- 1st Year Fees₹ 9,28,000Average Package₹ 22,24,000Highest Package 4.1 / 5 Based on 95 UserReviewsBest in Infrastructure#171th/500 in India 2025+ 4 More #6₹ 5,49,525BE/B.Tech- 1st Year FeesCompare Fees₹ 9,45,000Average Package₹ 58,00,000Highest PackageCompare Placement 4 / 5 Based on 687 UserReviewsBest in Infrastructure#18th/175 in India 2025+ 5 More #7₹ 6,04,000BE/B.Tech- Total Fees₹ 14,50,000Highest Package 4 / 5 Based on 148 UserReviewsBest in Academics#46th/175 in India 2025+ 3 More #8₹ 7,60,000BE/B.Tech- Total Fees₹ 5,70,000Average Package₹ 13,50,000Highest Package 4 / 5 Based on 179 UserReviewsBest in Academics#399th/500 in India 2025+ 2 More CD RankCollegesCourse FeesPlacementUser ReviewsRanking#9₹ 8,04,000BE/B.Tech- Total FeesCompare Fees₹ 24,13,000Highest PackageCompare Placement 3.7 / 5 Based on 173 UserReviewsBest in Social Life#41th/175 in India 2025+ 2 More #10₹ 6,18,000BE/B.Tech- Total FeesCompare Fees 4 / 5 Based on 254 UserReviewsBest in Infrastructure#49th/175 in India 2025More #11₹ 7,04,000BE/B.Tech- Total Fees₹ 37,50,000Highest Package 4.2 / 5 Based on 274 UserReviewsBest in Infrastructure--#12₹ 2,31,000ME/M.Tech- Total FeesCompare Fees₹ 8,02,000Average Package₹ 17,00,000Highest PackageCompare Placement 4 / 5 Based on 48 UserReviewsBest in Academics#43th/175 in India 2025More CD RankCollegesCourse FeesPlacementUser ReviewsRanking#13₹ 6,24,000BE/B.Tech- Total FeesCompare Fees₹ 3,00,000Average Package₹ 4,08,000Highest PackageCompare Placement 3.7 / 5 Based on 32 UserReviewsBest in Faculty#49th/175 in India 2025#14₹ 1,38,000BE/B.Tech- 1st Year Fees₹ 6,50,000Average Package₹ 32,00,000Highest Package 4.1 / 5 Based on 192 UserReviewsBest in Social Life--#15₹ 1,48,234BE/B.Tech- 1st Year Fees₹ 5,00,000Average Package₹ 25,00,000Highest Package 4.1 / 5 Based on 112 UserReviewsBest in Social Life#251th/300 in India 2021More #16₹ 3,62,000BE/B.Tech- 1st Year FeesCompare Fees₹ 3,50,000Average Package₹ 15,00,000Highest PackageCompare Placement 4.1 / 5 Based on 99 UserReviewsBest in Social Life#58th/175 in India 2025+ 4 More CD RankCollegesCourse FeesPlacementUser ReviewsRanking#17₹ 1,31,000BE/B.Tech- 1st Year Fees-- 3.6 / 5 Based on 90 UserReviewsBest in Academics--#18₹ 6,12,000BE/B.Tech- Total FeesCompare Fees₹ 5,00,000Average Package₹ 13,00,000Highest PackageCompare Placement 3.7 / 5 Based on 67 UserReviewsBest in Academics--#19₹ 2,86,000BE/B.Tech- Total Fees-- 3.7 / 5 Based on 12 UserReviewsBest in Infrastructure--#20₹ 4,24,000BE/B.Tech- Total FeesCompare Fees-- 4 / 5 Based on 115 UserReviewsBest in Social Life#52th/175 in India 2025More CD RankCollegesCourse FeesPlacementUser ReviewsRanking#21₹ 1,30,000BE/B.Tech- 1st Year Fees₹ 4,46,000Average Package₹ 13,50,000Highest Package 3.7 / 5 Based on 80 UserReviewsBest in Academics#54th/175 in India 2024#22₹ 1,46,205BE/B.Tech- 1st Year Fees₹ 4,25,000Average Package₹ 27,00,000Highest Package 3.6 / 5 Based on 83 UserReviewsBest in Social Life#171th/173 in India 2024More #23₹ 1,60,429BE/B.Tech- 1st Year FeesCompare Fees₹ 4,68,000Average Package₹ 16,00,000Highest PackageCompare Placement 3.6 / 5 Based on 96 UserReviewsBest in Faculty#46th/175 in India 2025+ 1 More #24₹ 1,16,618BE/B.Tech- 1st Year Fees₹ 12,00,000Highest Package 3.9 / 5 Based on 179 UserReviewsBest in Academics#131th/173 in India 2024CD RankCollegesCourse FeesPlacementUser ReviewsRanking#25₹ 6,12,000BE/B.Tech- Total Fees₹ 5,00,000Average Package₹ 12,00,000Highest Package 3.3 / 5 Based on 136 UserReviewsBest in Academics#97th/162 in India 2020#26₹ 1,17,061BE/B.Tech- 1st Year Fees₹ 32,76,000Highest Package 3.8 / 5 Based on 89 UserReviewsBest in Social Life--#27₹ 6,80,000BE/B.Tech- Total Fees-- 3 / 5 Based on 25 UserReviewsBest in Social Life--#28₹ 3,44,000BE/B.Tech- Total Fees-- 5 / 5 Based on 1 UserReviewsBest in Placements-- Whether you are advancing your tech career or transitioning into the tech sector, online computer science classes provide you with the education you need. Many courses have little to no cost and allow you to study at your own pace. Online classes like the ones here provide you with theoretical and practical computer science knowledge and skills in a more convenient and accessible way than a full-blown bachelor's in computer science program. Why take an online computer science class?Learning about how computer software and hardware work gives you the tools to work in the world of information technology. Online computer science classes offer both personal and professional rewards. Many online courses in computer science are massive online open courses (MOOCs) that come from top universities worldwide through websites like Coursera and edX.Courses may be part of certificates in areas — such as software engineering and computer security and networks — that you can add to your resume.They allow you to pursue personal interests while growing your career.You can study at your own pace.Online computer science courses range from introductory to advanced.You can learn computer programming languages like Python, C++, and Java.Computer science courses online train you in computational thinking, how coding works, software design, and game development.Free computer science classes: Our picksOur list of online computer science courses starts with introductory classes and move into intermediate and advanced topics. Many of the latter require knowledge of computer science or prerequisite coursework and are ideal for individuals working in technology. Across the board, each online computer science class includes quality information presented at no cost. Online intro to computer scienceComputer Science 101Offered by: Stanford University via edXCertificate? No; free to audit, pay to verifyLength and format of course: The six-week course allows for self-paced study and includes lab and video lecture components.Who will benefit from this course? This course introduces you to computer software and hardware fundamentals, computer security, and how the Internet works. It is designed for individuals with no experience in computer science. What you'll learn: You learn computer jargon, how software and hardware function, and the ins and outs of computer coding. Additional information about structured data, digital media, and big ideas accompany multiple-choice assessments and lab activities to build coding skills.CS50's Introduction to Computer ScienceOffered by: Harvard University via edXCertificate? Yes; free to audit, pay to upgradeLength and format of course: The course lasts 6-12 weeks, depending on your self-study pace. Videos accompany assessment presented as problems sets.Who will benefit from this course? As an introductory course on the fundamentals of computer science and programming, individuals with little or no previous experience benefit from the course. You receive the same content as students enrolled in Harvard's identical on-campus offering. What you'll learn: With an emphasis on topics like algorithms, data structures, software engineering, and web development, the class also teaches you programming languages. By using Python, HTML, JavaScript, and others, you gain the ability to develop and present a final programming project.Intro to Theoretical Computer ScienceOffered by: UdacityCertificate? No, freeLength and format of course: The self-paced course lasts roughly two months. Taught by industry professionals, the format includes videos and interactive quizzes.Who will benefit from this course? This course teaches you basic concepts of computer science theory. It is designed for individuals with little or no previous knowledge and experience.What you'll learn: Course topics build problem-solving and analytical skills to identify, understand, and reconcile problems that can be solved using soundness and completeness. You learn about tools and techniques to solve theoretically impossible problems, accepting randomness and approximations while recognizing the limits of computers to solve problems.Introduction to Computer Science and Programming Using PythonOffered by: Massachusetts Institute of Technology via edXCertificate? No; free to audit, pay to upgradeLength and format of course: As the first of a two-course sequence, the class lasts roughly nine weeks of an instructor-led course schedule. Who will benefit from this course? If you want to know more about using Python 3.5 to solve real-world analytical problems, this class prepares you to do just that. This first course of a two-part sequence prepares you to continue onto a class in computational thinking and data science. You should have some high school mathematics aptitude and some background in programming. What you'll learn: The class covers computational notions, the Python programming language, and how to use Python to solve algorithms. You progress from simple algorithms to algorithmic complexity while learning about testing, debugging, and data structures. Introduction to HTML and CSSOffered by: AlisonCertificate? Yes, freeLength and format of course: The class lasts between 1.5 and 3 hours, with four individual modules offered in a self-paced format.Who will benefit from this course? This class is ideal for beginners who want to learn Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS), two applications used to create web pages.What you'll learn: While learning HTML and CSS, you gain insight into setting up a webpage. The course explains HTML formatting and tags, defines CSS and style properties, and trains you to model and manipulate the placement of elements to create the look and feel of a website.Introduction to PythonOffered by: AlisonCertificate? Yes, freeLength and format of course: Self-paced and exclusively focused on Python, this course lasts between three and four hours.Who will benefit from this course? If you need or want to learn Python's syntax and functions, this course trains you through coding lessons, demonstrations, and exercises. What you'll learn: Three modules explore Python, the first of which focuses on Python and basic data types. The second module explores functions, variables, and errors of Python, while the third module emphasizes keywords, statements, and loops. You'll have a comprehensive understanding of Python by the end of the course.Intermediate and advanced comp-sci classesAlgorithms, Part IOffered by: Princeton University via Coursera via Class CentralCertificate? No, free to auditLength and format of course: The class includes six weeks of material, with video content. Numerous languages are available as subtitles. Programming assignments accompany the videos.Who will benefit from this course? Practicing programmers learn about algorithms and data structures to gain information about applications and scientific performance analysis of Java implementations. What you'll learn: The class covers data structures, sorting, and searching algorithms. You learn to analyze algorithms and about stacking, queuing, and symbol tables. The course moves toward a focus on graph- and string-processing algorithms. CS50's Web Programming with Python and JavaScriptOffered by: Harvard University via edX)Certificate? Yes; free to audit, pay to upgradeLength and format of course: Self-paced with video content, the class lasts 12 weeks. Who will benefit from this course? Designed to follow Harvard's introductory course in computer science, this class requires prior programming experience in any language. What you'll learn: The class uses hands-on projects to train you to write and use application programming interfaces, create user interfaces, and leverage cloud services. You'll study database design, scalability, and security while using languages such as HTML, Python, and JavaScript.Machine LearningOffered by: Harvard University via Coursera via Class CentralCertificate? Yes; free to audit, pay to upgradeLength and format of course: Through 11 weeks of content, you watch videos, complete readings, and take assessment quizzes.Who will benefit from this course? Researchers, programmers, and computer science professionals learn essential aspects of machine learning and progress toward human-level artificial intelligence.What you'll learn: The goal of machine learning is to get computers to perform without being programmed. The class explores the concepts of supervised and unsupervised learning while teaching you about data mining and statistical pattern recognition. You learn to apply algorithms to smart robots, text understanding, and medical informatics.Mathematical Thinking in Computer ScienceOffered by: University of California San Diego via CourseraCertificate? Yes; free trial optionLength and format of course: The class includes roughly 40 hours of video content. You will solve interactive puzzles as you apply ideas and concepts. Readings and quizzes supplement these features.Who will benefit from this course? Designed for individuals who want to apply discrete mathematics to computer science, the course includes prerequisites in basic math and basic programming knowledge, specifically Python.What you'll learn: The class emphasizes making and identifying arguments using mathematical thinking. Tools and techniques of discrete mathematics, like recursion, induction, and mathematical logic language and rules, train you to write readable and precise code. This article was reviewed by Monali Mirel Chuatico In 2019, Monali Mirel Chuatico graduated with her bachelor's in computer science, which gave her the foundation that she needed to excel in roles such as data engineer, front-end developer, UX designer, and computer science instructor.Monali is currently a data engineer at Mission Lane. As a data analytics captain at a nonprofit called COOP Careers, Monali helps new grads and young professionals overcome underemployment by teaching them data analytics tools and mentoring them on their professional development journey.Monali is passionate about implementing creative solutions, building community, advocating for mental health, empowering women, and educating youth. Monali's goal is to gain more experience in her field, expand her skill set, and do meaningful work that will positively impact the world.Monali Mirel Chuatico is a paid member of the Red Ventures Education freelance review network. Last reviewed on February 11, 2022. Looking to pursue a career in computer science in Mumbai? Explore the top options available in the city with a diverse range of programs and opportunities. Whether you are interested in software development, artificial intelligence, or cybersecurity, Mumbai has a variety of colleges that can cater to your interests and goals.From prestigious institutions to specialized programs, Mumbai offers a wealth of choices for students looking to further their education in computer science. Compare the 16 Best Colleges for Computer Science in Mumbai below to find the perfect fit for your academic and career aspirations.Internship opportunities with leading tech companiesState-of-the-art facilities and laboratoriesExperienced faculty members with industry expertiseStrong network of alumni for career supportMumbai is a hub for education, with several top-tier colleges offering programs in computer science. From renowned institutions to cutting-edge universities, students have a plethora of options to choose from. Explore the map below to discover the locations of all the colleges for computer science in Mumbai.In Mumbai, there are several renowned colleges for computer science that offer quality education and modern facilities. Some of the top colleges in Mumbai for computer science include Indian Institute of Technology (IIT) Bombay, Veermata Jijabai Technological Institute (VJTI), University of Mumbai, Ramrao Adik Institute of Technology (RAIT), and KJ Somaiya College of Engineering. These colleges are known for their strong computer science programs and successful placements for graduates.Students aspiring to pursue a career in computer science can consider these colleges for their academic excellence, industry connections, and overall learning experience. The faculties at these colleges are highly experienced, and the curriculum is designed to meet the current demands of the IT industry.What are the eligibility criteria for admissions to computer science colleges in Mumbai?Eligibility criteria for admissions to computer science colleges in Mumbai may vary from college to college. However, common requirements typically include completion of higher secondary education with a strong background in physics, chemistry, and mathematics. Some colleges may also consider performance in entrance exams such as JEE Main, MHT CET, or GATE for postgraduate programs.It is important for prospective students to check the specific eligibility criteria of the colleges they are interested in and ensure that they meet the academic requirements before applying. Additionally, some colleges may have reserved seats for certain categories, so applicants should be aware of any specific quotas that may apply.What are the career opportunities after completing a computer science degree in Mumbai?Completing a computer science degree from a college in Mumbai opens up a wide range of career opportunities in the IT industry. Graduates can pursue roles such as software developer, data analyst, IT consultant, systems analyst, network engineer, cybersecurity specialist, web developer, and more.With the increasing demand for tech professionals in Mumbai and across the globe, computer science graduates have the advantage of a versatile skill set that is highly sought after by employers. Many colleges in Mumbai also have strong industry connections that facilitate internships and placements for students, further enhancing their career prospects.Are there any scholarship options available for students in computer science colleges in Mumbai?Several colleges in Mumbai offer scholarship options for students pursuing a degree in computer science. These scholarships may be based on academic merit, financial need, or specific categories such as sports or arts excellence. Students can inquire with the college's scholarship office or financial aid department to learn more about available scholarship opportunities.In addition to college-specific scholarships, there are also external scholarship programs and government schemes that students can explore to support their education in computer science. It is advisable for students to research and apply for scholarships early in the admissions process to maximize their chances of receiving financial assistance. The 20 Best A-Level Schools in Mumbai The 20 Best Computer Classes in Mumbai The 16 Best Arts Colleges in Mumbai The 20 Best Air Hostess Training Institutes in Mumbai The 20 Best Photography Institutes in Mumbai The 16 Best Cyber Security Institutes in Mumbai CD RankCollegesCourse FeesPlacementUser ReviewsRanking#1₹ 6,965B.Sc- 1st Year Fees-- 3.9 / 5 Based on 73 UserReviewsBest in Infrastructure#15th/50 in India 2020#2₹ 65,000M.Sc- 1st Year FeesCompare Fees₹ 12,88,000Highest PackageCompare Placement 4.1 / 5 Based on 516 UserReviewsBest in Social Life#19th/211 in India 2024+ 1 More #3₹ 58,062B.Sc- 1st Year FeesCompare Fees-- 4 / 5 Based on 100 UserReviewsBest in Social Life#36th/88 in India 2024+ 1 More #4₹ 34,845B.Sc- 1st Year FeesCompare Fees-- 4.1 / 5 Based on 113 UserReviewsBest in Social Life#24th/211 in India 2024+ 1 More CD RankCollegesCourse FeesPlacementUser ReviewsRanking#5₹ 72,000M.Sc- 1st Year FeesCompare Fees 4.4 / 5 Based on 397 UserReviewsBest in Social Life#401th/801 in India 2020+ 10 More #6₹ 36,535B.Sc- 1st Year FeesCompare Fees₹ 4,50,000Average Package₹ 8,00,000Highest PackageCompare Placement 3.8 / 5 Based on 95 UserReviewsBest in Faculty--#7₹ 1,18,162M.Sc- Total Fees-- 3.9 / 5 Based on 145 UserReviewsBest in Academics--#8₹ 29,485B.Sc- 1st Year FeesCompare Fees-- 4.1 / 5 Based on 76 UserReviewsBest in Faculty#60th/211 in India 2024More CD RankCollegesCourse FeesPlacementUser ReviewsRanking#9₹ 46,020M.Sc- 1st Year FeesCompare Fees-- 3.8 / 5 Based on 554 UserReviewsBest in Academics--#10₹ 7,31,360M.Sc- Total FeesCompare Fees₹ 3,20,000Average Package₹ 5,50,000Highest PackageCompare Placement 3.8 / 5 Based on 12581 UserReviewsBest in Academics#801th/801 in India 2020+ 2 More #11₹ 78,952B.Sc- 1st Year Fees₹ 4,20,000Average Package₹ 9,60,000Highest Package 4 / 5 Based on 222 UserReviewsBest in Infrastructure--#12--B.Sc-- 4.3 / 5 Based on 2 UserReviews-- Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Skip to content Computer Science Asia India Maharashtra Mumbai Updated: March 02, 2025 EduRank ZDNET , the free encyclopedia that anyone can edit. 110,331 active editors 7,022,970 articles in English School in Sketty, Swansea, photographed in 1854 The period between 1701 and 1870 saw an expansion in access to formal education in Wales, though schooling was not yet universal. Several philanthropic efforts were made to provide education to the poor during the 18th century. In the early to mid-19th century, charitable schools were established to provide a basic education. Private schools aimed at the working classes also existed. State funding was introduced to schools from 1833. Some use of the Welsh language was made in 18th-century philanthropic education, at a time when most agricultural workers in Wales spoke only Welsh, and public opinion was keen for children to learn English. Many schools punished children for speaking Welsh, despite government studies that found such methods ineffective. The government did little to promote bilingual education. Grammar schools experienced difficulties and, by the end of the period, secondary education was limited. Dissenter academies and theological colleges offered higher education. (Full article...) Recently featured: White dwarf Battle of Groix Scott Carpenter Archive By email More featured articles About Sae Kitamura ... that Sae Kitamura (pictured) has had her university students contribute to the Japanese Wikipedia as part of their coursework? ... that the lead actress of The Grub-Stake brought her personal menagerie—which included bears and wolves—to the set for use as extras? ... that James Patrick Shea thought that an invitation to meet with Pope Benedict XVI at the White House was a hoax? ... that Robby Krieger was unable to record his guitar solo for "You're Lost Little Girl" until he got stoned on hashish? ... that all three podium finishers at the 2024 Tour de France were members of cycling's Big Four? ... that the directors of Final Destination Bloodlines "debated the ethics" of a character being killed by an MRI machine? ... that one newspaper described the mansions of Riverside Drive as "glitter[ing] like a wedding cake"? ... that Galidor has been described as Lego's biggest failure? ... that the first review of Ellen, Countess of Castle Howel complained that its marriage plot focused too much on love? Archive Start a new article Nominate an article Vera Rubin Observatory The Vera C. Rubin Observatory (pictured) in Chile releases the first light images from its new 8.4-meter (28 ft) telescope. In basketball, the Oklahoma City Thunder defeat the Indiana Pacers to win the NBA Finals. An attack on a Greek Orthodox church in Damascus, Syria, kills at least 25 people. The United States conducts military strikes on three nuclear facilities in Iran. In rugby union, the Crusaders defeat the Chiefs to win the Super Rugby Pacific final. Ongoing: Gaza war Iran–Israel war Russian invasion of Ukraine timeline Sudanese civil war timeline Recent deaths: Lucien Nedzi Anne Burrell Frederick W. Smith Ron Taylor Mohammad Kazemi Marita Camacho Quirós Nominate an article June 25 Original rainbow flag 1658 – Anglo-Spanish War: The largest battle ever fought on Jamaica, the three-day Battle of Rio Nuevo, began. 1910 – The United States Congress passed the Mann Act, which prohibited the interstate transport of females for "immoral purposes". 1944 – World War II: U.S. Navy and Royal Navy ships bombarded Cherbourg, France, to support U.S. Army units engaged in the Battle of Cherbourg. 1978 – The rainbow flag (original version pictured) representing gay pride was first flown at the San Francisco Gay Freedom Day parade. 2009 – Singer Michael Jackson died as a result of the combination of drugs in his body. Giovanni Battista Riccioli (d. 1671)Eloísa Díaz (b. 1866)George Michael (b. 1963)Farrah Fawcett (d. 2009) More anniversaries: June 24 June 25 June 26 Archive By email List of days of the year About 1795 Turban Head eagle with original reverse 1797 Turban Head eagle with heraldic eagle reverse The Turban Head eagle was a ten-dollar gold piece, or eagle, struck by the United States Mint from 1795 to 1804. The piece was designed by Robert Scot, and was the first in the eagle series, which continued until the Mint ceased striking gold coins for circulation in 1933. The common name is a misnomer; Liberty does not wear a turban but a cap, believed by some to be a pileus or Liberty cap: her hair twisting around the headgear makes it appear to be a turban. The number of stars on the obverse was initially intended to be equal to the number of states in the Union, but with the number at 16, that idea was abandoned in favor of using 13 stars in honor of the original states. The initial reverse, featuring an eagle with a wreath in its mouth, proved unpopular and was replaced by a heraldic eagle. Increases in the price of gold made it profitable for the coins to be melted down, and in 1804, President Thomas Jefferson ended coinage of eagles; the denomination was not struck again for circulation for more than 30 years. These Turban Head eagles are in the National Numismatic Collection at the National Museum of American History. Coin design credit: United States Mint; photographed by Jaclyn Nash Recently featured: Springbok Geraldine Ulmar Shah Mosque (Isfahan) Archive More featured pictures Community portal – The central hub for editors, with resources, links, tasks, and announcements. Village pump – Forum for discussions about Wikipedia itself, including policies and technical issues. Site news – Sources of news about Wikipedia and the broader Wikimedia movement. Teahouse – Ask basic questions about using or editing Wikipedia. Help desk – Ask questions about using or editing Wikipedia. Reference desk – Ask research questions about encyclopedic topics. Content portals – A unique way to navigate the encyclopedia. Wikipedia is written by volunteer editors and hosted by the Wikimedia Foundation, a non-profit organization that also hosts a range of other volunteer projects: CommonsFree media repository MediaWikiWiki software development Meta-WikiWikimedia project coordination WikibooksFree textbooks and manuals WikidataFree knowledge base WikinewsFree-content news WikiquoteCollection of quotations WikisourceFree-content library WikispeciesDirectory of species WikiversityFree learning tools WikivoyageFree travel guide WiktionaryDictionary and thesaurus This Wikipedia is written in English. Many other Wikipedias are available; some of the largest are listed below. 1,000,000+ articles العربية Deutsch Español فارسی Français Italiano Nederlands 日本語 Polski Português Русский Svenska Українська Tiếng Việt 中文 250,000+ articles Bahasa Indonesia Bahasa Melayu Bân-lâm-gú Български Català Čeština Dansk Eesti Ελληνικά Esperanto Euskara עברית Հայերեն Magyar Norsk bokmål Română Simple English Slovenčina Srpski Srpskohrvatski Suomi Türkçe Oʻzbekcha 50,000+ articles Asturianu Azərbaycanca ᨅᨔᨘᨕᨘᨁᨗᨔᨕᨁᨗᨔᨕᨁᨗᨔᨕ

Portugal and Philippines to Spain. 1529: Imam Ahmad Gurey defeats the Ethiopian Emperor Dawit II in the Battle of Shimbra Kure, the opening clash of the Ethiopian–Adal War. Main article: 1530s Spanish conquistadors with their Tlaxcallan allies fighting against the Otomies of Metztitlan in present-day Mexico, a 16th-century codex 1531–1532: The Church of England breaks away from the Catholic Church and recognizes King Henry VIII as the head of the Church. 1531: The Inca Civil War is fought between the two brothers, Atahualpa and Huáscar. 1532: Francisco Pizarro leads the Spanish conquest of the Inca Empire. 1532: Foundation of São Vicente, the first permanent Portuguese settlement in the Americas. 1533: Anne Boleyn becomes Queen of England. 1533: Elizabeth Tudor is born. 1534: Jacques Cartier claims Canada for France. 1534: The Ottomans capture Baghdad from the Safavids. 1534: Affair of the Placards, where King Francis I becomes more active in repression of French Protestants. 1535: The Münster Rebellion, an attempt of radical, millennialist, Anabaptists to establish a theocracy, ends in bloodshed. 1535: The Portuguese in Ternate depose Sultan Tabariji (or Tabarija) and send him to Portuguese Goa where he converts to Christianity and bequeaths his Portuguese godfather Jordao de Freitas the island of Ambon.[12] Hairun becomes the next sultan. 1536: Catherine of Aragon dies in Kimbolton Castle, in England.Territorial expansion of the Ottoman Empire under Suleiman (in red and orange) 1536: In England, Anne Boleyn is beheaded for adultery and treason. 1536: Establishment of the Inquisition in Portugal. 1536: Foundation of Buenos Aires (in present-day Argentina) by Pedro de Mendoza. 1537: The Portuguese establish Recife in Pernambuco, north-east of Brazil. 1537: William Tyndale's partial translation of the Bible into English is published, which would eventually be incorporated into the King James Bible. 1538: Gonzalo Jiménez de Quesada founds Bogotá. 1538: Spanish–Venetian fleet is defeated by the Ottoman Turks at the Battle of Preveza. 1539: Hernando de Soto explores inland North America. Main article: 1540s Nicolaus Copernicus 1540: The Society of Jesus, or the Jesuits, is founded by Ignatius of Loyola and six companions with the approval of Pope Paul III. 1540: Sher Shah Suri founds the Suri dynasty in South Asia, an ethnic Pashtun (Pathan) of the house of Sur, who supplanted the Mughal dynasty as rulers of North India during the reign of the relatively ineffectual second Mughal emperor Humayun. Sher Shah Suri decisively defeats Humayun in the Battle of Bilgram (May 17, 1540). 1541: Pedro de Valdivia founds Santiago in Chile. 1541: An Algerian military campaign by Charles V of Spain (Habsburg) is unsuccessful. 1541: Amazon River is encountered and explored by Francisco de Orellana. 1541: Capture of Buda and the absorption of the major part of Hungary by the Ottoman Empire. 1541: Sahib I Giray of Crimea invades Russia. 1542: The Italian War of 1542–1546 War resumes between Francis I of France and Emperor Charles V. This time Henry VIII is allied with the Emperor, while James V of Scotland and Sultan Suleiman I are allied with the French. 1542: Akbar The Great is born in the Rajput Umarkot Fort 1542: Spanish explorer Ruy López de Villalobos named the island of Samar and Leyte Las Islas Filipinas honoring Philip II of Spain and became the official name of the archipelago. 1543: Ethiopian/Portuguese troops defeat the Adal army led by Imam Ahmad Gurey at the Battle of Wayna Daga; Imam Ahmad Gurey is killed at this battle. 1543: Copernicus publishes his theory that the Earth and the other planets revolve around the Sun 1543: The Nanban trade period begins after Portuguese traders make contact with Japan. 1544: The French defeat an Imperial–Spanish army at the Battle of Ceresole.Scenes of everyday life in Ming China, by Qiu Ying 1544: Battle of the Shirts in Scotland. The Frasers and Macdonalds of Clan Ranald fight over a disputed chiefship; reportedly, 5 Frasers and 8 Macdonalds survive. 1545: Songhai forces sack the Malian capital of Niani 1545: The Council of Trent meets for the first time in Trent (in northern Italy). 1546: Michelangelo Buonarroti is made chief architect of St. Peter's Basilica. 1546: Francis Xavier works among the peoples of Ambon, Ternate and Morotai (Moro) laying the foundations for a permanent mission. (to 1547) 1547: Henry VIII dies in the Palace of Whitehall on 28 January at the age of 55. 1547: Francis I dies in the Château de Rambouillet on 31 March at the age of 52. 1547: Edward VI becomes King of England and Ireland on 28 January and is crowned on 20 February at the age of 9. 1547: Emperor Charles V decisively dismantles the Schmalkaldic League at the Battle of Mühlberg. 1547: Grand Prince Ivan the Terrible is crowned tsar of (All) Russia, thenceforth becoming the first Russian tsar. 1548: Battle of Uedahara: Firearms are used for the first time on the battlefield in Japan, and Takeda Shingen is defeated by Murakami Yoshikiyo. 1548: Askia Daoud, who reigned from 1548 to 1583, establishes public libraries in Timbuktu (in present-day Mali). 1548: The Ming dynasty government of China issues a decree banning all foreign trade and closes down all seaports along the coast; these Hai jin laws came during the Wokou wars with Japanese pirates. 1549: Tomé de Sousa establishes Salvador in Bahia, north-east of Brazil. 1549: Arya Penangsang with the support of his teacher, Sunan Kudus, avenges the death of Raden Kikin by sending an envoy named Rangkud to kill Sunan Prawoto by Keris Kyai Satan Kober (in present-day Indonesia). Main article: 1550s The Islamic gunpowder empires: Mughal Army artillerymen during the reign of Jalaluddin Akbar 1550: The architect Mimar Sinan builds the Süleymaniye Mosque in Istanbul. 1550: Mongols led by Altan Khan invade China and besiege Beijing. 1550–1551: Valladolid debate concerning the human rights of the Indigenous people of the Americas. 1551: Fifth outbreak of sweating sickness in England. John Caius of Shrewsbury writes the first full contemporary account of the symptoms of the disease. 1551: North African pirates enslave the entire population of the Maltese island Gozo, between 5,000 and 6,000, sending them to Libya. 1552: Russia conquers the Khanate of Kazan in central Asia. 1552: Jesuit China Mission, Francis Xavier dies. 1553: Mary Tudor becomes the first queen regnant of England and restores the Church of England under Papal authority. 1553: The Portuguese found a settlement at Macau. 1554: Missionaries José de Anchieta and Manuel da Nóbrega establishes São Paulo, southeast Brazil. 1554: Princess Elizabeth is imprisoned in the Tower of London upon the orders of Mary I for suspicion of being involved in the Wyatt rebellion. 1555: The Muscovy Company is the first major English joint stock trading company. 1556: Publication in Venice of Delle Navigiationi et Viaggi (terzo volume) by Giovanni Battista Ramusio, secretary of Council of Ten, with plan La Terra de Hochelaga, an illustration of the Hochelaga.[13] 1556: The Shaanxi earthquake in China is history's deadliest known earthquake during the Ming dynasty. 1556: Georgius Agricola, the "Father of Mineralogy", publishes his De re metallica. 1556: Akbar defeats Hemu at the Second battle of Panipat. 1556: Russia conquers the Astrakhan Khanate. 1556–1605: During his reign, Akbar expands the Mughal Empire in a series of conquests (in the Indian subcontinent).Political map of the world in 1556 1556: Mir Chakar Khan Rind captures Delhi with Humayun. 1556: Pomponio Algerio, radical theologian, is executed by boiling in oil as part of the Roman Inquisition. 1557: Habsburg Spain declares bankruptcy. Philip II of Spain had to declare four state bankruptcies in 1557, 1560, 1575 and 1596. 1557: The Portuguese settle in Macau (on the western side of the Pearl River Delta across from present-day Hong Kong). 1557: The Ottomans capture Massawa, all but isolating Ethiopia from the rest of the world. 1558: Elizabeth Tudor becomes Queen Elizabeth I at age 25. 1558–1603: The Elizabethan era is considered the height of the English Renaissance. 1558–1583: Livonian War between Poland, Grand Principality of Lithuania, Sweden, Denmark and Russia. 1558: After 200 years, the Kingdom of England loses Calais to France. 1559: With the Peace of Cateau Cambrésis, the Italian Wars conclude. 1559: Sultan Hairun of Ternate (in present-day Indonesia) protests the Portuguese's Christianisation activities in his lands. Hostilities between Ternate and the Portuguese. Main article: 1560s The Mughal Emperor Akbar shoots the Rajput warrior Jaimal during the Siege of Chittorgarh in 1567 1560: Ottoman navy defeats the Spanish fleet at the Battle of Djerba. 1560: Elizabeth Bathory is born in Nyirbator, Hungary. 1560: By winning the Battle of Okehazama, Oda Nobunaga becomes one of the pre-eminent warlords of Japan. 1560: Jeanne d'Albret declares Calvinism the official religion of Navarre. 1560: Lazarus Church, Macau 1561: Sir Francis Bacon is born in London. 1561: The fourth battle of Kawanakajima between the Uesugi and Takeda at Hachimanbara takes place. 1561: Guido de Bres draws up the Belgic Confession of Protestant faith. 1562: Mughal emperor Akbar reconciles the Muslim and Hindu factions by marrying into the powerful Rajput Hindu caste. 1562–1598: French Wars of Religion between Catholics and Huguenots. 1562: Massacre of Wassy and Battle of Dreux in the French Wars of Religion. 1562: Portuguese Dominican priests build a palm-trunk fortress which Javanese Muslims burned down the following year. The fort was rebuilt from more durable materials and the Dominicans commenced the Christianisation of the local population.[12] 1563: Plague outbreak claimed 80,000 people in Elizabethan England. In London alone, over 20,000 people died of the disease. 1564: Galileo Galilei born on February 15 1564: William Shakespeare baptized 26 April 1565: Deccan sultanates defeat the Vijayanagara Empire at the Battle of Talikota. 1565: Mir Chakar Khan Rind dies at aged 97. 1565: Estácio de Sá establishes Rio de Janeiro in Brazil. 1565: The Hospitallers, a Crusading Order, defeat the Ottoman Empire at the siege of Malta (1565). 1565: Miguel López de Legazpi establishes in Cebu the first Spanish settlement in the Philippines starting a period of Spanish colonization that would last over three hundred years. 1565: Spanish navigator Andres de Urdaneta discovers the maritime route from Asia to the Americas across the Pacific Ocean, also known as the tornaviaje. 1565: Royal Exchange is founded by Thomas Gresham. 1566: Suleiman the Magnificent, ruler of the Ottoman Empire, dies on September 7, during the battle of Szigetvar.Siege of Valenciennes during the Dutch War of Independence in 1567 1566–1648: Eighty Years' War between Spain and the Netherlands. 1566: Da le Balle Contrade d'Oriente, composed by Cipriano de Rore. 1567: After 45 years' reign, Jiajing Emperor died in the Forbidden City, Longqing Emperor ascended the throne of Ming dynasty. 1567: Mary, Queen of Scots, is imprisoned by Elizabeth I. 1568: The Transylvanian Diet, under the patronage of the prince John Sigismund Zápolya, the former king of Hungary, inspired by the teachings of Ferenc Dávid, the founder of the Unitarian Church of Transylvania, promulgates the Edict of Torda, the first law of freedom of religion and of conscience in the World. 1568–1571: Morisco Revolt in Spain. 1568–1600: The Azuchi-Momoyama period in Japan. 1568: Hadiwijaya sent his adopted son and son in-law Sutawijaya, who would later become the first ruler of the Mataram dynasty of Indonesia, to kill Arya Penangsang. 1569: Rising of the North in England. 1569: Mercator 1569 world map published by Gerardus Mercator. 1569: The Polish–Lithuanian Commonwealth is created with the Union of Lublin which lasts until 1795. 1569: Peace treaty signed by Sultan Hairun of Ternate and Governor Lopez De Mesquita of Portugal. Main article: 1570s The Battle of Lepanto 1570: Ivan the Terrible, tsar of Russia, orders the massacre of inhabitants of Novgorod. 1570: Pope Pius V issues Regnans in Excelsis, a papal bull excommunicating all who obeyed Elizabeth I and calling on all Catholics to rebel against her. 1570: Sultan Hairun of Ternate (in present-day Indonesia) is killed by the Portuguese.[12] Babullah becomes the next Sultan. 1570: 20,000 inhabitants of Nicosia in Cyprus were massacred and every church, public building, and palace was looted. Cyprus fell to the Ottoman Turks the following year. 1571: Pope Pius V completes the Holy League as a united front against the Ottoman Turks, responding to the fall of Cyprus to the Ottomans. 1571: The Spanish-led Holy League navy destroys the Ottoman Empire navy at the Battle of Lepanto. 1571: Crimean Tatars attack and sack Moscow, burning everything but the Kremlin. 1571: American Indians kill Spanish missionaries in what would later be Jamestown, Virginia. 1571: Spanish conquistador Miguel López de Legazpi establishes Manila, Philippines as the capital of the Spanish East Indies. 1572: Brielle is taken from Habsburg Spain by Protestant Watergeuzen in the Capture of Brielle, in the Eighty Years' War. 1572: Spanish conquistadores apprehend the last Inca leader Tupak Amaru at Vilcabamba, Peru, and execute him in Cuzco. 1572: Jeanne d'Albret dies aged 43 and is succeeded by Henry of Navarre. 1572: Catherine de' Medici instigates the St. Bartholomew's Day massacre which takes the lives of Protestant leader Gaspard de Coligny and thousands of Huguenots. The violence spreads from Paris to other cities and the countryside. 1572: First edition of the epic The Lusiads of Luís Vaz de Camões, three years after the author returned from the East.[14] 1572: The 9 years old Taizi, Zhu Yijun ascended the throne of Ming dynasty, known as Wanli Emperor. 1573: After heavy losses on both sides the siege of Haarlem ends in a Spanish victory.St. Bartholomew's Day massacre of French Protestants 1574: in the Eighty Years' War the capital of Zeeland, Middelburg declares for the Protestants. 1574: After a siege of 4 months the siege of Leiden ends in a comprehensive Dutch rebel victory. 1575: Oda Nobunaga finally captures Nagashima fortress. 1575: Following a five-year war, the Ternateans under Sultan Babullah defeated the Portuguese. 1576: Tahmasp I, Safavid shah, dies. 1576: The Battle of Haldighati is fought between the ruler of Mewar, Maharana Pratap and the Mughal Empire's forces under Emperor Akbar led by Raja Man Singh. 1576: Sack of Antwerp by badly paid Spanish soldiers. 1577–1580: Francis Drake circles the world. 1577: Ki Ageng Pemanahan built his palace in Pasargede or Kotagede. 1578: King Sebastian of Portugal is killed at the Battle of Alcazarquivir. 1578: The Portuguese establish a fort on Tidore but the main centre for Portuguese activities in Maluku becomes Ambon.[12] 1578: Sonam Gyatso is conferred the title of Dalai Lama by Tumed Mongol ruler, Altan Khan. Recognised as the reincarnation of two previous Lamas, Sonam Gyatso becomes the third Dalai Lama in the lineage.[15] 1578: Governor-General Francisco de Sande officially declared war against Brunei in 1578, starting the Castilian War of 1578. 1579: The Union of Utrecht unifies the northern Netherlands, a foundation for the later Dutch Republic. 1579: The Union of Arras unifies the southern Netherlands, a foundation for the later states of the Spanish Netherlands, the Austrian Netherlands and Belgium.The Irish Gaelic chieftain's feast, from The Image of Ireland 1579: The British navigator Sir Francis Drake passes through Maluku and transit in Ternate on his circumnavigation of the world. The Portuguese establish a fort on Tidore but the main centre for Portuguese activities in Maluku becomes Ambon.[16] Main article: 1580s The fall of Spanish Armada 1580: Drake's royal reception after his attacks on Spanish possessions influences Philip II of Spain to build up the Spanish Armada. English ships in Spanish harbours are impounded. 1580: Spain unifies with Portugal under Philip II. The struggle for the throne of Portugal ends the Portuguese Empire. The Spanish and Portuguese crowns are united for 60 years, i.e. until 1640. 1580–1587: Nagasaki comes under control of the Jesuits. 1581: Dutch Act of Abjuration, declaring abjuring allegiance to Philip II of Spain. 1581: Bayinnaung dies at the age of 65. 1582: Oda Nobunaga commits seppuku during the Honnō-ji Incident coup by his general, Akechi Mitsuhide. 1582: Pope Gregory XIII issues the Gregorian calendar. The last day of the Julian calendar was Thursday, 4 October 1582 and this was followed by the first day of the Gregorian calendar, Friday, 15 October 1582 1582: Yermak Timofeyevich conquers the Siberia Khanate on behalf of the Stroganovs. 1583: Denmark builds the world's first theme park, Bakken. 1583: Death of Sultan Babullah of Ternate. 1584–1585: After the siege of Antwerp, many of its merchants flee to Amsterdam. According to Luc-Normand Tellier, "At its peak, between 1510 and 1557, Antwerp concentrated about 40% of the world trade...It is estimated that the port of Antwerp was earning the Spanish crown seven times more revenues than the Americas."[17] 1584: Ki Ageng Pemanahan died. Sultan Pajang raised Sutawijaya, son of Ki Ageng Pemanahan as the new ruler in Mataram, titled "Loring Ngabehi Market" (because of his home in the north of the market). 1585: Akbar annexes Kashmir and adds it to the Kabul SubahPortuguese fusta in India from a book by Jan Huygen van Linschoten 1585: Colony at Roanoke founded in North America. 1585–1604: The Anglo-Spanish War is fought on both sides of the Atlantic. 1587: Mary, Queen of Scots is executed by Elizabeth I. 1587: The reign of Abbas I marks the zenith of the Safavid dynasty. 1587: Troops that would invade Pajang Mataram Sultanate storm ravaged the eruption of Mount Merapi. Sutawijaya and his men survived. 1588: Mataram into the kingdom with Sutawijaya as Sultan, titled "Senapati Ingalaga Sayidin Panatagama" means the warlord and cleric Manager Religious Life. 1588: England repulses the Spanish Armada. 1589: Spain repulses the English Armada. 1589: Catherine de' Medici dies at aged 69. Main articles: 1590s and 1600s Abu'l-Fazl ibn Mubarak presenting Akbarnama to Mughal Azam Akbar, Mughal miniature 1590: Siege of Odawara: the Go-Hojo clan surrender to Toyotomi Hideyoshi, and Japan is unified. 1591: Gazi Giray leads a huge Tatar expedition against Moscow. 1591: In Mali, Moroccan forces of the Sultan Ahmad al-Mansur led by Judar Pasha defeat the Songhai Empire at the Battle of Tondibi. 1592–1593: John Stow reports 10,675 plague deaths in London, a city of approximately 200,000 people. 1592–1598: Korea, with the help of Ming dynasty China, repels two Japanese invasions. 1593–1606: The Long War between the Habsburg monarchy and the Ottoman Turks. 1594: St. Paul's College, Macau, founded by Alessandro Valignano. 1595: First Dutch expedition to Indonesia sets sail for the East Indies with two hundred and forty-nine men and sixty-four cannons led by Cornelis de Houtman.[18] 1596: Birth of René Descartes. 1596: June, de Houtman's expedition reaches Banten the main pepper port of West Java where they clash with both the Portuguese and Indonesians. It then sails east along the north coast of Java losing twelve crew to a Javanese attack at Sidayu and killing a local ruler in Madura.[18] 1597: Romeo and Juliet is published. 1597: Cornelis de Houtman's expedition returns to the Netherlands with enough spices to make a considerable profit.[18] 1598: The Edict of Nantes ends the French Wars of Religion. 1598: Abbas I moves Safavids capital from Qazvin to Isfahan in 1598. 1598–1613: Russia descends into anarchy during the Time of Troubles. 1598: The Portuguese require an armada of 90 ships to put down a Solorese uprising.[12] (to 1599) 1598: More Dutch fleets leave for Indonesia and most are profitable.[18]Edo period screen depicting the Battle of Sekigahara 1598: The province of Santa Fe de Nuevo México is established in Northern New Spain. The region would later become a territory of Mexico, the New Mexico Territory in the United States, and the US State of New Mexico. 1598: Death of Toyotomi Hideyoshi, known as the unifier of Japan. 1599: The Mali Empire is defeated at the Battle of Jenné. 1599: The van Neck expedition returns to Europe. The expedition makes a 400 per cent profit.[18] (to 1600) 1599: March, Leaving Europe the previous year, a fleet of eight ships under Jacob van Neck was the first Dutch fleet to reach the 'Spice Islands' of Maluku.[18] 1600: Giordano Bruno is burned at the stake for heresy in Rome.Siege of Fiľakovo castle during the Long Turkish War 1600: Battle of Sekigahara in Japan. End of the Warring States period and beginning of the Edo period. 1600: The Portuguese win a major naval battle in the bay of Ambon.[19] Later in the year, the Dutch join forces with the local Hituese in an anti-Portuguese alliance, in return for which the Dutch would have the sole right to purchase spices from Hitu.[19] 1600: Elizabeth I grants a charter to the British East India Company beginning the English advance in Asia. 1600: Michael the Brave unifies the three principalities: Wallachia, Moldavia and Transylvania after the Battle of Şelimbăr from 1599. For later events, see Timeline of the 17th century. Polybius' The Histories translated into Italian, English, German and French.[20] Mississippian culture disappears. Medallion rug, variant Star Ushak style, Anatolia (modern Turkey), is made. It is now kept at the Saint Louis Art Museum. Hernan Cortes (1485–1547) Henry VIII, (1491–1547) King of England and Ireland Don Fernando Álvarez de Toledo (1507–1582) Suleiman the Magnificent, Sultan of the Ottoman Empire (1520–1566) Ivan IV the Terrible (1530–1584) Oda Nobunaga (1534–1582) Sir Francis Drake (c. 1540 – 1596) Alberico Gentili, (1552–1608) the Father of international law Philip II of Spain, King of Spain (1556–1598) Akbar the Great, Mughal emperor (1556–1605) Related article: List of 16th century inventions. The Columbian Exchange introduces many plants, animals and diseases to the Old and New Worlds. Introduction of the spinning wheel revolutionizes textile production in Europe. The letter J is introduced into the English alphabet. 1500: First portable watch is created by Peter Henlein of Germany.The Iberian Union in 1598, under Philip II, King of Spain and Portugal 1513: Juan Ponce de León sights Florida and Vasco Núñez de Balboa sights the eastern edge of the Pacific Ocean. 1519–1522: Ferdinand Magellan and Juan Sebastián Elcano lead the first circumnavigation of the world. 1519–1540: In America, Hernando de Soto expeditions map the Gulf of Mexico coastline and bays. 1525: Modern square root symbol (√) 1540: Francisco Vásquez de Coronado sights the Grand Canyon. 1541–42: Francisco de Orellana sails the length of the Amazon River. 1542–43: Firearms are introduced into Japan by the Portuguese. 1543: Copernicus publishes his theory that the Earth and the other planets revolve around the Sun 1545: Theory of complex numbers is first developed by Gerolamo Cardano of Italy. 1558: Camera obscura is first used in Europe by Giambattista della Porta of Italy. 1559–1562: Spanish settlements in Alabama/Florida and Georgia confirm dangers of hurricanes and local native warring tribes. 1565: Spanish settlers outside New Spain (Mexico) colonize Florida's coastline at St. Augustine. 1565: Invention of the graphite pencil (in a wooden holder) by Conrad Gesner. Modernized in 1812. 1568: Gerardus Mercator creates the first Mercator projection map. 1572: Supernova SN 1572 is observed by Tycho Brahe in the Milky Way. 1582: Gregorian calendar is introduced in Europe by Pope Gregory XIII and adopted by Catholic countries. c. 1583: Galileo Galilei of Pisa, Italy identifies the constant swing of a pendulum, leading to development of reliable timekeepers. 1585: earliest known reference to the 'sailing carriage' in China. 1589: William Lee invents the stocking frame. 1591: First flush toilet is introduced by Sir John Harrington of England, the design published under the title 'The Metamorphosis of Ajax'. 1593: Galileo Galilei invents a thermometer. 1596: William Barents discovers Spitsbergen. 1597: Opera in Florence by Jacopo Peri. Entertainment in the 16th century ^ a b Modern reference works on the period tend to follow the introduction of the Gregorian calendar for the sake of clarity; thus NASA's lunar eclipse catalogue states "The Gregorian calendar is used for all dates from 1582 Oct 15 onwards. Before that date, the Julian calendar is used." For dates after 15 October 1582, care must be taken to avoid confusion of the two styles. ^ de Vries, Jan (14 September 2009). "The limits of globalization in the early modern world". The Economic History Review. 63 (3): 710–733. CiteSeerX 10.1.1.186.2862. doi:10.1111/j.1468-0289.2009.00497.x. JSTOR 40929823. S2CID 219969360. SSRN 1635517. ^ Singh, Sarina; Lindsay Brown; Paul Clammer; Rodney Cocks; John Mock (2008). Pakistan & the Karakoram Highway. Vol. 7, illustrated. Lonely Planet. p. 137. ISBN 978-1-74104-542-0. Retrieved 23 August 2010. ^ Babur (2006). Babur Nama. Penguin Books. p. vii. ISBN 978-0-14-400149-1. ^ "16th Century Timeline (1501 to 1600)". fsmitha.com. Archived from the original on February 3, 2009. ^ "History of Smallpox – Smallpox Through the Ages" Archived 2019-09-24 at the Wayback Machine. Texas Department of State Health Services. ^ Ricklefs (1991), p.23 ^ "A LIST OF NATIONAL EPIDEMICS OF PLAGUE IN ENGLAND 1348–1665". Archived from the original on 2009-05-08. Retrieved 2009-04-25. ^ a b Ricklefs (1991), page 24 ^ The Sweating Sickness. Story of London.. Accessed 2009-04-25. Archived 2009-05-03. ^ Sandra Arlinghaus. "Life Span of Suleiman the Magnificent 1494–1566". Personal.umich.edu. Retrieved 2013-05-05. ^ a b c d e Ricklefs (1991), page 25 ^ "La Terra De Hochelaga – Jaques Cartier a Hochelaga". jacquescarter.org. Archived from the original on December 23, 2008. ^ "The Lusiads". World Digital Library. 1800–1882. Retrieved 2013-08-31. ^ Schwieger, Peter (2014). The Dalai Lama and the Emperor of China: a political history of the Tibetan institution of reincarnation. New York: Columbia University Press. ISBN 9780231538602. OCLC 905914446. ^ Miller, George, ed. (1996). To The Spice Islands and Beyond: Travels in Eastern Indonesia. New York: Oxford University Press. pp. xv. ISBN 967-65-3099-9. ^ Luc-Normand Tellier (2009). "Urban world history: an economic and geographical perspective". PUQ. p.308. ISBN 2-7605-1588-5 ^ a b c d e f Ricklefs (1991), page 27 ^ a b Ricklefs (1991), page 28 ^ Polybius: The Rise Of The Roman Empire, Page 36, Penguin, 1979. Langer, William. An Encyclopedia of World History (5th ed. 1973); highly detailed outline of events online free Media related to 16th century at Wikimedia Commons Timelines of 16th century events, science, culture and persons Retrieved from " 4 The following pages link to 16th century External tools (link count transclusion count sorted list) · See help page for transcluding these entries Showing 50 items. View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Bagpipes (links | edit) List of decades, centuries, and millennia (links | edit) Fashion (links | edit) Giovanni Boccaccio (links | edit) History of Mali (links | edit) History of Mauritius (links | edit) Post office (links | edit) Snare drum (links | edit) Republican Party (United States) (links | edit) 20th century (links | edit) 15th century (links | edit) 17th century (links | edit) 18th century (links | edit) 1624 (links | edit) 1626 (links | edit) 1642 (links | edit) 1661 (links | edit) 1608 (links | edit) 1492 (links | edit) 14th century (links | edit) 1st century (links | edit) 13th century (links | edit) 4th century (links | edit) 12th century (links | edit) 11th century (links | edit) 1564 (links | edit) 1648 (links | edit) 1572 (links | edit) 1623 (links | edit) 1662 (links | edit) 1490s (links | edit) 1640s (links | edit) 1597 (links | edit) 1690 (links | edit) 1688 (links | edit) 7th century (links | edit) 10th century (links | edit) 9th century (links | edit) 8th century (links | edit) 6th century (links | edit) 5th century (links | edit) 3rd century (links | edit) 2nd century (links | edit) 1573 (links | edit) 1570s (links | edit) 1574 (links | edit) 1436 (links | edit) 1476 (links | edit) 1542 (links | edit) 1540s (links | edit) View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500) Retrieved from " WhatLinksHere/16th_century" Read moreThere are about 80+ B Tech Computer Science colleges in Mumbai. Of these, 70 colleges are privately owned and 3 colleges are owned by the government. JEE Main and MHT CET are top entrance exams for admission to top BTech in CSE colleges in Mumbai. IIT Bombay, K J Somaiya Institute of Technology, Sardar Patel Institute of Technology, Don Bosco Institute of Technology, Vidyalankar Institute of Technology, etc. are some of the best B Tech Computer Science colleges in Mumbai. Best BTech Computer Science Colleges in Mumbai (All): Highlights 2025 BTech in Computer Science Engineering is the most preferred course by candidates seeking a career in engineering after Class 12. BTech in Computer Science Engineering is a 4-year duration course having 8 semesters (2 semesters per year). The job roles offered by these companies to a BTech in Computer Science Engineering graduate are Software Engineer, Developer, System Analyst, Computer Network Architect, etc. The table below mentions key highlights of the Computer Science BTech colleges in Mumbai: Parameters Statistics No. of Colleges 80+ Annual Fees Less than INR 1 lakh: 1 college INR 1-2 lakh: 4 colleges INR 2-3 lakh: 15+ colleges INR 3-5 lakh: 25+ colleges INR > 5 lakh: 25+ colleges Top BTech CSE Colleges IIT Bombay, K J Somaiya Institute of Technology, Sardar Patel Institute of Technology, Don Bosco Institute of Technology, Vidyalankar Institute of Technology, etc. Top Specialisation Computer Science Engineering Admission Process JEE Main, MHT CET, etc. Disclaimer: This information is sourced from the official website and may vary. Predict your chances here: Engineering Cutoff 2024 Predictor BTech in Computer Science Colleges in Mumbai (All): NIRF Ranking 2024 NIRF ranking is provided to the colleges based on different parameters like teaching, research, and teaching resources. Here is the list of best colleges in Mumbai for BTech in Computer Science as per NIRF ranking 2022 to 2024: Disclaimer: This information is sourced from the official website of the ranking body listed and may vary. READ MORE: Career after BTech Best BTech Computer Science Colleges in Mumbai: Admissions 2024 The basic eligibility requirement to pursue a Computer Science Engineering course at 5the UG and PG levels in B Tech CSE colleges in Mumbai: Eligibility requirements for BTech in CSE: Aspirants should have passed the Class 12 exam from a recognised board with Physics, Chemistry, and Mathematics as core subjects. Besides, the candidates should also have secured a minimum aggregate mark of 60% in the above subjects combined. For admissions, candidates must take standard entrance exams, such as JEE Main and MHT CET, in addition to their Class 12 results. Are you preparing for JEE Main? The links below can be helpful: Read more about NCERT solutions: BTech in Computer Science Colleges in Mumbai (All): Exam Schedules 2025 Admissions to BTech programs take place through national-level/state-level/institute-level engineering entrance examinations. Listed below are some of the main accepted entrance exams in the best colleges in Mumbai for BTech in Computer Science. JEE Main: The Joint Entrance Examination (Main), popularly called JEE Main, is the exam conducted for admission to BTech, BArch and BPlan courses at NITs, IIITs, other Centrally Funded Technical Institutions (CFTIs), Institutions/Universities funded/recognised by participating State Governments. The JEE Main exam is also an eligibility test for JEE Advanced, conducted for admission to IITs. MHT CET: Maharashtra Common Entrance Test, also known as MHT CET, is a state-level entrance test to select candidates for admission to undergraduate engineering and pharmacy programs at various colleges throughout Maharashtra. The exam is conducted every year by the Maharashtra State Common Entrance Test Cell. The difficulty level of the MHT CET exam will be similar to JEE Mains. The table below shows the entrance exams accepted in the best CSE colleges in Mumbai along with their schedules: Exams Dates Schedule JEE Main 2025 Exam Over for '25 JEE Main Schedule MHT CET 2025 PCM Exam Over for '25 Exams Dates Schedule What are the entrance exams accepted by Computer Science Engineering Colleges in Mumbai? The popular BTech exams whose scorecard is accepted by the Computer Science Engineering colleges in Mumbai are JEE Main, MHT CET, NMIMS CET, SAT India, JEE Advanced, etc. Refer to the table below for a detailed overview of Engineering entrance exams accepted by colleges in Mumbai: The table below shows the popular entrance exams accepted by various best Engineering colleges in Mumbai for Computer Science: READ MORE: Computer Science Engineering Top Exams Best Private BTech in Computer Science Colleges in Mumbai (All) Here is a list of the best private colleges in Mumbai for BTech Computer Science along with their total tuition fee and entrance exams/eligibility criteria: Disclaimer: This information is sourced from the official website/ sanctioning body and may vary. READ MORE: Computer Science Engineering Career Scope Best Government BTech in Computer Science Colleges in Mumbai (All) Here is a list of government bTech CSE colleges Mumbai along with their total tuition fee/seat intake and entrance exams/eligibility criteria: Disclaimer: This information is sourced from the official website/ sanctioning body and may vary. READ MORE: BTech Admission 2025 Read more about BTech in Computer Science Engineering colleges in other locations: ROI, also known as Return on Investment is an indicator to evaluate the colleges in terms of value for money. While pursuing a course, a student invests a sum as a course fee and expects placement in return. ROI is the comparison between the course fee and the average placement package offered by a college. See the table below with the best colleges in Mumbai for B Tech CSE with the total tuition fee and the annual average package: Disclaimer: The above statistics are based on the latest available data. Highest Placement Offered by B Tech CSE Colleges in Mumbai (All) Below is the list of a few top companies in India that recruit graduates from best colleges in Mumbai for B Tech CSE along with their average placement package: College Name Average Placement Package Top Recruiters IIT Bombay Placements INR 18 LPA – INR 19 LPA Google India, Apple, Microsoft India, etc. Sardar Patel Institute of Technology Placements INR 12 LPA Morgan Stanley, Microsoft, Deloitte, KPMG, etc. K J Somaiya Institute of Technology Placements INR 5 LPA IDFC First Bank, Reliance Jio, TCS Digital, Deloitte, etc. Disclaimer: This information is sourced from official website/ media reports/ NIRF website and may vary. READ MORE: Computer Science Engineering Courses Low-cost BTech Computer Science Colleges in Mumbai (All) Pursuing top B Tech Computer Science colleges in Mumbai is moderately expensive as most of the colleges have a total tuition fee between INR 3-5 lakh. Listed below are some of the affordable colleges having tuition fees of less than INR 1 lakh and between INR 1-2 lakh: READ MORE: BTech Courses BTech CSE Colleges in Mumbai (All): Comparison To check the comparison between the B Tech Computer Science colleges in Mumbai, click the link below: Aneena Aley Abraham06-11-2025 17:40Get personalised college recommendationsRegistering gives you the benefit to browse variety of colleges based on your preferencesRegister Computer science is a field that is immensely broad and important in everyday life, and it is becoming more so by the day. The field is popular among overseas students in the United States because of job security, starting pay, a wide range of work opportunities, and the fact that it is demanding—with endless possibility for growth and creativity. In the last decade, the expansion of information technology (IT) has caused more change in human society than the previous century combined. It's also feasible that the globe will change more in the next 10-15 years than it has in the entire history of humanity. Professionals in computer science are in high demand in practically every industry and country on the planet. There are many reasons to study computer science at US University, including job options, high earning potential, and the chance to improve the world. A computer science degree will provide you with the skills and knowledge necessary to enter an interesting and rapidly evolving field. Application of computer is everywhere regardless of the size of business, there is always a need of computer devices and its applications such as portable devices. Computer and its applications lead students to focus on the study which teaches various field requirements, which is the main reason why study computer science in USA. Most of the Information technology organization's looking for students who acquired knowledge in fields of computer science. MS computer science in USA provides better information about fundamentals of computation and algorithms in the basis of storing and functioning the information. Studying abroad allows you to learn about another country and culture while also improving your language skills. If you choose to study in the United States, you will receive a globally recognized education with English classes. Every year, more than 100,000 international students opt to study in USA. As a life skill, problem solving is the most important aspect of computer science. Students will learn how to design, develop, and test software and hardware that may be used to solve problems in a variety of business, scientific, and social situations. Computer science has a significant human component since computers solve problems to assist humans. The main reason for studying computer science in USA is to widen and strengthen one's grasp of the subject, as well as to select specialties that can lead to a job. Universities in the United States offer good job chances due to their affiliation with a variety of businesses. This would be a once-in-a-lifetime chance for students to gain in-depth knowledge of the most cutting-edge computer science subjects. Universities in the United States offer concentrations in Artificial Intelligence, Robotics, Cyber security, and Management Information Systems. The following is a list of the top reasons to study computer science in USA.Computer science is the study of how we interact with information and the use of computers in our daily life. As a computer scientist, you can contribute to the development of technology that benefits society. Here are a few examples of how you can make a difference.Computer science can lead to a variety of intriguing job prospects in a variety of fields. Here are a few examples of jobs you could pursue:Studying in the United States can make a major difference in a student's life, with globally ranked universities and some of the top recruiters based there. For overseas students interested in computer science programmes, the following are the top universities in USA that offer the degree, according to QS rankings (2021):Computer science is the most common course with better opportunities around the world. Best course needs a best institution to grasp knowledge in the field. The value of the course depends on the place where it's completed. Computer science has variety of course options to begin a career with one's life. USA is known for its top ranked universities which offer great career options in both bachelors and master degrees. Over 100 universities in USA lend variety of computer science courses which assure career development. Computer science in USA leads the world by its range of applications from basic electronics to advanced technology, which makes it as an essential field of study. The study of computer science in USA is extensive and graduates could be a senior engineer, software coordinator and network development engineer. Universities in USA for MS in computer science are ideal in terms of curriculum, internship and practical training opportunities which makes you to expertise in your field of study. Not only theoretical knowledge but also you would be trained with real time application knowledge. The top universities in USA offers computer science, from diploma course to PhD programs, which brings computer science in USA to global attention, makes international students are attracted

private memory, and information can be exchanged to achieve common goals.[68] Main article: Computer network This branch of computer science aims studies the construction and behavior of computer networks. It addresses their performance, resilience, security, scalability, and cost-effectiveness, along with the variety of services they can provide.[69] Main articles: Computer security and Cryptography Computer security is a branch of computer technology with the objective of protecting information from unauthorized access, disruption, or modification while maintaining the accessibility and usability of the system for its intended users. Historical cryptography is the art of writing and deciphering secret messages. Modern cryptography is the scientific study of problems relating to distributed computations that can be attacked.[70] Technologies studied in modern cryptography include symmetric and asymmetric encryption, digital signatures, cryptographic hash functions, key-agreement protocols, blockchain, zero-knowledge proofs, and garbled circuits. Main articles: Database and Data mining A database is intended to organize, store, and retrieve large amounts of data easily. Digital databases are managed using database management systems to store, create, maintain, and search data, through database models and query languages. Data mining is a process of discovering patterns in large data sets. The philosopher of computing Bill Rapaport noted three Great Insights of Computer Science:[71] Gottfried Wilhelm Leibniz's, George Boole's, Alan Turing's, Claude Shannon's, and Samuel Morse's insight: there are only two objects that a computer has to deal with in order to represent "anything".[note 4] All the information about any computable problem can be represented using only 0 and 1 (or any other bistable pair that can flip-flop between two easily distinguishable states, such as "on/off", "magnetized/de-magnetized", "high-voltage/low-voltage", etc.). See also: Digital physics Alan Turing's insight: there are only five actions that a computer has to perform in order to do "anything". Every algorithm can be expressed in a language for a computer consisting of only five basic instructions:[72] move left one location; move right one location; read symbol at current location; print 0 at current location; print 1 at current location. See also: Turing machine Corrado Böhm and Giuseppe Jacopini's insight: there are only three ways of combining these actions (into more complex ones) that are needed in order for a computer to do "anything".[73] Only three rules are needed to combine any set of basic instructions into more complex ones: sequence: first do this, then do that; selection: IF such-and-such is the case, THEN do this, ELSE do that; repetition: WHILE such-and-such is the case, DO this. The three rules of Boehm's and Jacopini's insight can be further simplified with the use of goto (which means it is more elementary than structured programming). See also: Structured program theorem Main article: Programming paradigm Programming languages can be used to accomplish different tasks in different ways. Common programming paradigms include: Functional programming, a style of building the structure and elements of computer programs that treats computation as the evaluation of mathematical functions and avoids state and mutable data. It is a declarative programming paradigm, which means programming is done with expressions or declarations instead of statements.[74] Imperative programming, a programming paradigm that uses statements that change a program's state.[75] In much the same way that the imperative mood in natural languages expresses commands, an imperative program consists of commands for the computer to perform. Imperative programming focuses on describing how a program operates. Object-oriented programming, a programming paradigm based on the concept of "objects", which may contain data, in the form of fields, often known as attributes; and code, in the form of procedures, often known as methods. A feature of objects is that an object's procedures can access and often modify the data fields of the object with which they are associated. Thus object-oriented computer programs are made out of objects that interact with one another.[76] Service-oriented programming, a programming paradigm that uses "services" as the unit of computer work, to design and implement integrated business applications and mission critical software programs. Many languages offer support for multiple paradigms, making the distinction more a matter of style than of technical capabilities.[77] Further information: List of computer science conferences and Category:Computer science journals Conferences are important events for computer science research. During these conferences, researchers from the public and private sectors present their recent work and meet. Unlike in most other academic fields, in computer science, the prestige of conference papers is greater than that of journal publications.[78][79] One proposed explanation for this is the quick development of this relatively new field requires rapid review and distribution of results, a task better handled by conferences than by journals.[80] Computer science education Glossary of computer science List of computer scientists List of computer science awards List of pioneers in computer science Outline of computer science ^ In 1851 ^ "The introduction of punched cards into the new engine was important not only as a more convenient form of control than the drums, or because programs could now be of unlimited extent, and could be stored and repeated without the danger of introducing errors in setting the machine by hand; it was important also because it served to crystallize Babbage's feeling that he had invented something really new, something much more than a sophisticated calculating machine." Bruce Collier, 1970 ^ See the entry "Computer science" on Wikiquote for the history of this quotation. ^ The word "anything" is written in quotation marks because there are things that computers cannot do. One example is: to answer the question if an arbitrary given computer program will eventually finish or run forever (the Halting problem). ^ "What is Computer Science?". Department of Computer Science, University of York. Archived from the original on June 11, 2020. Retrieved June 11, 2020. ^ a b What Can Be Automated? Computer Science and Engineering Research Study. Computer Science Series. MIT Press. 1980. ISBN 978-0262010603. Archived from the original on January 9, 2021. ^ a b c Denning, P.J.; Comer, D.E.; Gries, D.; Mulder, M.C.; Tucker, A.; Turner, A.J.; Young, P.R. (February 1989). "Computing as a discipline". Computer. 22 (2): 63–70. doi:10.1109/2.19833. ISSN 1558-0814. Archived from the original on March 3, 2022. Retrieved March 3, 2022. The discipline of computing is the systematic study of algorithmic processes that describe and transform information, their theory, analysis, design, efficiency, implementation, and application. The fundamental question underlying all of computing is, 'What can be (efficiently) automated?' ^ "WordNet Search—3.1". WordNet Search. Wordnetweb.princeton.edu. Archived from the original on October 18, 2017. Retrieved May 14, 2012. ^ "Definition of computer science | Dictionary.com". www.dictionary.com. Archived from the original on June 11, 2020. Retrieved June 11, 2020. ^ "What is Computer Science? | Undergraduate Computer Science at UMD". undergrad.cs.umd.edu. Archived from the original on November 27, 2020. Retrieved July 15, 2022. ^ Harel, David (2014). Algorithmics The Spirit of Computing. Springer Berlin. ISBN 978-3-642-44135-6. OCLC 876384882. Archived from the original on June 17, 2020. Retrieved June 17, 2020. ^ Patton, Richard D.; Patton, Peter C. (2009), Nof, Shimon Y. (ed.), "What Can be Automated? What Cannot be Automated?", Springer Handbook of Automation, Springer Handbooks, Berlin, Heidelberg: Springer, pp. 305–313, doi:10.1007/978-3-540-78831-7_18, ISBN 978-3-540-78831-7, archived from the original on January 11, 2023, retrieved March 3, 2022 ^ Forsythe, George (August 5–10, 1969). "Computer Science and Education". Proceedings of IFIP Congress 1968. The question 'What can be automated?' is one of the most inspiring philosophical and practical questions of contemporary civilization. ^ Knuth, Donald E. (August 1, 1972). "George Forsythe and the development of computer science". Communications of the ACM. 15 (8): 721–726. doi:10.1145/361532.361538. ISSN 0001-0782. S2CID 12512057. ^ Hanson, Vicki L. (January 23, 2017). "Celebrating 50 years of the Turing award". Communications of the ACM. 60 (2): 5. doi:10.1145/3033604. ISSN 0001-0782. S2CID 29984960. ^ Scott, Eric; Martins, Marcella Scoczynski Ribeiro; Yafrani, Mohamed El; Volz, Vanessa; Wilson, Dennis G (June 5, 2018). "ACM marks 50 years of the ACM A.M. turing award and computing's greatest achievements". ACM SIGEVOlution. 10 (3): 9–11. doi:10.1145/3231560.3231563. ISSN 1931-8499. S2CID 47021559. ^ "2021: 375th birthday of Leibniz, father of computer science". people.idsia.ch. Archived from the original on September 21, 2022. Retrieved February 4, 2023. ^ "Charles Babbage Institute: Who Was Charles Babbage?". cbi.umn.edu. Archived from the original on January 9, 2007. Retrieved December 28, 2016. ^ "Ada Lovelace | Babbage Engine | Computer History Museum". www.computerhistory.org. Archived from the original on December 25, 2018. Retrieved December 28, 2016. ^ "History of Computer Science". cs.uwaterloo.ca. Archived from the original on July 29, 2017. Retrieved July 15, 2022. ^ "Wilhelm Schickard – Ein Computerpionier" (PDF) (in German). Archived from the original (PDF) on September 19, 2020. Retrieved December 4, 2016. ^ Keates, Fiona (June 25, 2012). "A Brief History of Computing". The Repository. The Royal Society. Archived from the original on June 29, 2012. Retrieved January 19, 2014. ^ "Science Museum, Babbage's Analytical Engine, 1834–1871 (Trial model)". Archived from the original on August 30, 2019. Retrieved May 11, 2020. ^ a b Hyman, Anthony (1982). Charles Babbage: Pioneer of the Computer. Oxford University Press. ISBN 978-0691083032. ^ "A Selection and Adaptation From Ada's Notes found in Ada, The Enchantress of Numbers," by Betty Alexandra Toole Ed.D. Strawberry Press, Mill Valley, CA". Archived from the original on February 10, 2006. Retrieved May 4, 2006. ^ "The John Gabriel Byrne Computer Science Collection" (PDF). Archived from the original on April 16, 2019. Retrieved August 8, 2019. ^ Torres Quevedo, L. (1914). "Ensayos sobre Automática – Su definicion. Extension teórica de sus aplicaciones". Revista de la Academia de Ciencias Exacta, 12, pp. 391–418. ^ Torres Quevedo, Leonardo. Automática: Complemento de la Teoría de las Máquinas, (pdf), pp. 575–583, Revista de Obras Públicas, 19 November 1914. ^ Ronald T. Kneusel. Numbers and Computers, Springer, pp. 84–85, 2017. ISBN 978-3319505084 ^ Randell, Brian. Digital Computers, History of Origins, (pdf), p. 545, Digital Computers: Origins, Encyclopedia of Computer Science, January 2003. ^ Randell 1982, p. 6, 11–13. ^ "In this sense Aiken needed IBM, whose technology included the use of punched cards, the accumulation of numerical data, and the transfer of numerical data from one register to another", Bernard Cohen, p.44 (2000) ^ Brian Randell, p. 187, 1975 ^ The Association for Computing Machinery (ACM) was founded in 1947. ^ "IBM Archives: 1945". Ibm.com. January 23, 2003. Archived from the original on January 5, 2019. Retrieved March 19, 2019. ^ "IBM100 – The Origins of Computer Science". Ibm.com. September 15, 1995. Archived from the original on January 5, 2019. Retrieved March 19, 2019. ^ a b c Denning, P.J.; Comer, D.E.; Gries, D.; Mulder, M.C.; Tucker, A.; Turner, A.J.; Young, P.R. (February 1989). "Computing as a discipline". Computer. 22 (2): 63–70. doi:10.1109/2.19833. ISSN 1558-0814. Archived from the original on March 3, 2022. Retrieved March 3, 2022. ^ "Some EDSAC statistics". University of Cambridge. Archived from the original on September 3, 2007. Retrieved November 19, 2011. ^ "Computer science pioneer Samuel D. Conte dies at 85". Purdue Computer Science. July 1, 2002. Archived from the original on October 6, 2014. Retrieved December 12, 2014. ^ a b Tedre, Matti (2014). The Science of Computing: Shaping a Discipline. Taylor and Francis / CRC Press. ^ a b Louis Fine (1960). "The Role of the University in Computers, Data Processing, and Related Fields". Communications of the ACM. 2 (9): 7–14. doi:10.1145/368424.368427. S2CID 6740821. ^ "Stanford University Oral History". Stanford Libraries. Stanford University. Archived from the original on April 4, 2017. Retrieved May 30, 2013. ^ Donald Knuth (1972). "George Forsythe and the Development of Computer Science". Comms. ACM. Archived October 20, 2013, at the Wayback Machine ^ Matti Tedre (2006). "The Development of Computer Science: A Sociocultural Perspective" (PDF). p. 260. Archived (PDF) from the original on October 9, 2022. Retrieved December 12, 2014. ^ Peter Naur (1966). "The science of datalogy". Communications of the ACM. 9 (7): 485. doi:10.1145/365719.366510. S2CID 47558402. ^ Weiss, E.A.; Corley, Henry P.T. "Letters to the editor". Communications of the ACM. 1 (4): 6. doi:10.1145/368796.368802. S2CID 5379449. ^ Communications of the ACM 2(1):p.4 ^ IEEE Computer 28(12): p.136 ^ P. Mounier-Kuhn, L'Informatique en France, de la seconde guerre mondiale au Plan Calcul. L'émergence d'une science, Paris, PUPS, 2010, ch. 3 & 4. ^ Groth, Dennis P. (February 2010). "Why an Informatics Degree?". Communications of the ACM. Cacm.acm.org. Archived from the original on January 11, 2023. Retrieved June 14, 2016. ^ Tedre, M. (2011). "Computing as a Science: A Survey of Competing Viewpoints". Minds and Machines. 21 (3): 361–387. doi:10.1007/s11023-011-9240-4. S2CID 14263916. ^ Parnas, D.L. (1998). "Software engineering programmes are not computer science programmes". Annals of Software Engineering. 6: 19–37. doi:10.1023/A:1018949113292. S2CID 35786237., p. 19: "Rather than treat software engineering as a subfield of computer science, I treat it as an element of the set, Civil Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, [...]" ^ Luk, R.W.P. (2020). "Insight in how computer science can be a science". Science & Philosophy. 8 (2): 17–47. doi:10.23756/sp.v8i2.531. ^ Knuth, D.E. (1974). "Computer science and its relation to mathematics". The American Mathematical Monthly. 81 (4): 323–343. doi:10.2307/2318994. JSTOR 2318994. ^ a b c d e f g "The Philosophy of Computer Science". The Philosophy of Computer Science (Stanford Encyclopedia of Philosophy). Metaphysics Research Lab, Stanford University. 2021. Archived from the original on September 16, 2021. Retrieved September 16, 2021. ^ Wegner, P. (October 13–15, 1976). Research paradigms in computer science—Proceedings of the 2nd international Conference on Software Engineering. San Francisco, California, United States: IEEE Computer Society Press, Los Alamitos, CA. ^ Denning, Peter J. (2007). "Computing is a natural science". Communications of the ACM. 50 (7): 13–18. doi:10.1145/1272516.1272529. S2CID 20045303. ^ Eden, A.H. (2007). "Three Paradigms of Computer Science" (PDF). Minds and Machines. 17 (2): 135–167. CiteSeerX 10.1.1.304.7763. doi:10.1007/s11023-007-9060-8. S2CID 3023076. Archived from the original (PDF) on February 15, 2016. ^ Turner, Raymond; Angius, Nicola (2019). "The Philosophy of Computer Science". In Zalta, Edward N. (ed.). The Stanford Encyclopedia of Philosophy. Archived from the original on October 14, 2019. Retrieved October 14, 2019. ^ a b "Computer Science as a Profession". Computing Sciences Accreditation Board. May 28, 1997. Archived from the original on June 17, 2008. Retrieved May 23, 2010. ^ Committee on the Fundamentals of Computer Science: Challenges and Opportunities, National Research Council (2004). Computer Science: Reflections on the Field, Reflections from the Field. National Academies Press. ISBN 978-0-309-09301-9. Archived from the original on February 18, 2011. Retrieved August 31, 2008. ^ "CSAB Leading Computer Education". CSAB. August 3, 2011. Archived from the original on January 20, 2019. Retrieved November 19, 2011. ^ Clay Mathematics Institute P = NP Archived October 14, 2013, at the Wayback Machine ^ P. Collins, Graham (October 14, 2002). "Claude E. Shannon: Founder of Information Theory". Scientific American. Archived from the original on January 16, 2014. Retrieved December 12, 2014. ^ Van-Nam Huynh; Vladik Kreinovich; Songsak Sriboonchitta; 2012. Uncertainty Analysis in Econometrics with Applications. Springer Science & Business Media. p. 63. ISBN 978-3-642-35443-4. ^ Phillip A. Laplante, (2010). Encyclopedia of Software Engineering Three-Volume Set (Print). CRC Press. p. 309. ISBN 978-1-351-24926-3. ^ Muhammad H. Rashid, (2016). SPICE for Power Electronics and Electric Power. CRC Press. p. 6. ISBN 978-1-4398-6047-2. ^ "What is an integrated circuit (IC)? A vital component of modern electronics". WhatIs.com. Archived from the original on November 15, 2021. Retrieved November 15, 2021. ^ A. Thisted, Ronald (April 7, 1997). "Computer Architecture" (PDF). The University of Chicago. Archived (PDF) from the original on October 9, 2022. ^ Jiacun Wang, (2017). Real-Time Embedded Systems. Wiley. p. 12. ISBN 978-1-119-42070-5. ^ Gordana Dodig-Crnkovic; Raffaela Giovagnoli, (2013). Computing Nature: Turing Centenary Perspective. Springer Science & Business Media. p. 247. ISBN 978-3-642-37225-4. ^ Simon Elias Bibri (2018). Smart Sustainable Cities of the Future: The Untapped Potential of Big Data Analytics and Context-Aware Computing for Advancing Sustainability. Springer. p. 74. ISBN 978-3-319-73981-6. ^ Peterson, Larry; Davie, Bruce (2000). Computer Networks: A Systems Approach. Singapore: Harcourt Asia. ISBN 9789814066433. Retrieved May 24, 2025. ^ Katz, Jonathan (2008). Introduction to modern cryptography. Yehuda Lindell. Boca Raton: Chapman & Hall/CRC. ISBN 978-1-58488-551-1. OCLC 137325053. Archived from the original on May 6, 2022. Retrieved November 17, 2021. ^ Rapaport, William J. (September 20, 2013). "What Is Computation?". State University of New York at Buffalo. Archived from the original on February 14, 2001. Retrieved August 31, 2013. ^ B. Jack Copeland, (2012). Alan Turing's Electronic Brain: The Struggle to Build the ACE, the World's Fastest Computer. OUP Oxford. p. 107. ISBN 978-0-19-960915-4. ^ Charles W. Herbert, (2010). An Introduction to Programming Using Alice 2.2. Cengage Learning. p. 122. ISBN 0-538-47866-7. ^ Md. Rezaul Karim; Sridhar Alla, (2017). Scala and Spark for Big Data Analytics: Explore the concepts of functional programming, data streaming, and machine learning. Packt Publishing Ltd. p. 87. ISBN 978-1-78355-050-0. ^ Lex Sheehan, (2017). Learning Functional Programming in Go: Change the way you approach your applications using functional programming in Go. Packt Publishing Ltd. p. 16. ISBN 978-1-78728-604-7. ^ Evelio Padilla, (2015). Substation Automation Systems: Design and Implementation. Wiley. p. 245. ISBN 978-1-118-98730-8. ^ "Multi-Paradigm Programming Language". MDN Web Docs. Mozilla Foundation. Archived from the original on August 21, 2013. ^ Meyer, Bertrand (April 2009). "Viewpoint: Research evaluation for computer science". Communications of the ACM. 25 (4): 31–34. doi:10.1145/1498765.1498780. S2CID 8625066. ^ Patterson, David (August 1999). "Evaluating Computer Scientists and Engineers For Promotion and Tenure". Computing Research Association. Archived from the original on July 22, 2015. Retrieved July 19, 2015. ^ Fortnow, Lance (August 2009). "Viewpoint: Time for Computer Science to Grow Up". Communications of the ACM. 52 (8): 33–35. doi:10.1145/1536616.1536631. Tucker, Allen B. (2004). Computer Science Handbook (2nd ed.). Chapman and Hall/CRC. ISBN 978-1-58488-360-9. Ralston, Anthony; Reilly, Edwin D.; Hemmendinger, David (2000). Encyclopedia of Computer Science (4th ed.). Grove's Dictionaries. ISBN 978-1-56159-248-7. Archived from the original on June 8, 2020. Retrieved February 6, 2011. Edwin D. Reilly (2003). Milestones in Computer Science and Information Technology. Greenwood Publishing Group. ISBN 978-1-57356-521-9. Knuth, Donald E. (1996). Selected Papers on Computer Science. CSLI Publications, Cambridge University Press. Collier, Bruce (1990). The little engine that could've: The calculating machines of Charles Babbage. Garland Publishing Inc. ISBN 978-0-8240-0043-1. Archived from the original on January 20, 2007. Retrieved May 4, 2013. Cohen, Bernard (2000). Howard Aiken, Portrait of a computer pioneer. The MIT press. ISBN 978-0-262-53179-5. Tedre, Matti (2014). The Science of Computing: Shaping a Discipline. CRC Press, Taylor & Francis. Randell, Brian (1973). The origins of Digital computers, Selected Papers. Springer-Verlag. ISBN 978-3-540-06169-4. Randell, Brian (October–December 1982). "From Analytical Engine to Electronic Digital Computer: The Contributions of Ludgate, Torres, and Bush" (PDF). IEEE Annals of the History of Computing. 4 (4): 327–341. doi:10.1109/mahc.1982.10042. S2CID 1737953. Archived from the original (PDF) on September 21, 2013. Peter J. Denning. Is computer science science?, Communications of the ACM, April 2005. Peter J. Denning, Great principles in computing curricula, Technical Symposium on Computer Science Education, 2004. Wikibooks has a book on the topic of: Informatics Practices for Class XI (CBSE) Computer science at Wikipedia's sister projects Definitions from WiktionaryMedia from CommonsQuotations from WikiquoteTextbooks from WikibooksResources from Wikiversity Library resources about Computer science Resources in your library Resources in other libraries DBLP Computer Science Bibliography Association for Computing Machinery Institute of Electrical and Electronics Engineers Retrieved from " 2Computer-based generation of digital images This article has multiple issues. Please help improve it or discuss these issues on the talk page. (Learn how and when to remove these messages) This article needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.Find sources: "2D computer graphics" – news · newspapers · books · scholar · JSTOR (December 2009) (Learn how and when to remove this message) This article possibly contains original research. Please improve it by verifying the claims made and adding inline citations. Statements consisting only of original research should be removed. (July 2019) (Learn how and when to remove this message) (Learn how and when to remove this message) 2D computer graphics is the computer-based generation of digital images—mostly from two-dimensional models (such as 2D geometric models, text, and digital images) and by techniques specific to them. It may refer to the branch of computer science that comprises such techniques or to the models themselves. Raster graphic sprites (left) and masks 2D computer graphics are mainly used in applications that were originally developed upon traditional printing and drawing technologies, such as typography, cartography, technical drawing, advertising, etc. In those applications, the two-dimensional image is not just a representation of a real-world object, but an independent artifact with added semantic value; two-dimensional models are therefore preferred, because they give more direct control of the image than 3D computer graphics (whose approach is more akin to photography than to typography). In many domains, such as desktop publishing, engineering, and business, a description of a document based on 2D computer graphics techniques can be much smaller than the corresponding digital image—often by a factor of 1/1000 or more. This representation is also more flexible since it can be rendered at different resolutions to suit different output devices. For these reasons, documents and illustrations are often stored or transmitted as 2D graphic files. 2D computer graphics started in the 1950s, based on vector graphics devices. These were largely supplanted by raster-based devices in the following decades. The PostScript language and the X Window System protocol were landmark developments in the field. 2D graphics models may combine geometric models (also called vector graphics), digital images (also called raster graphics), text to be typeset (defined by content, font style and size, color, position, and orientation), mathematical functions and equations, and more. These components can be modified and manipulated by two-dimensional geometric transformations such as translation, rotation, and scaling. In object-oriented graphics, the image is described indirectly by an object endowed with a self-rendering method—a procedure that assigns colors to the image pixels by an arbitrary algorithm. Complex models can be built by combining simpler objects, in the paradigms of object-oriented programming. This section duplicates the scope of other articles, specifically Translation (geometry) and Rotation (geometry). Please discuss this issue and help introduce a summary style to the section by replacing the section with a link and a summary or by splitting the content into a new article. (May 2022) Further information: Rotations and reflections in two dimensions A translation moves every point of a figure or a space by the same amount in a given direction. In Euclidean geometry, a translation (geometry) moves every point a constant distance in a specified direction. A translation can be described as a rigid motion: other rigid motions include rotations and reflections. A translation can also be interpreted as the addition of a constant vector to every point, or as shifting the origin of the coordinate system. A translation operator is an operator T δ {\displaystyle T_{\mathbf {\delta } }} such that T δ f (v) = f (v + δ) . {\displaystyle T_{\mathbf {\delta } }f(\mathbf {v})=f(\mathbf {v} +\mathbf {\delta }).} If v is a fixed vector, then the translation Tv will work as Tv(p) = p + v. If T is a translation, then the image of a subset A under the function T is the translation of A by T. The translation of A by Tv is often written A + v. In a Euclidean space, any translation is an isometry. The set of all translations forms the translation group T, which is isomorphic to the space itself, and a normal subgroup of Euclidean group E(n). The quotient group of E(n) by T is isomorphic to the orthogonal group O(n): E(n) / T ≅ O(n). Since a translation is an affine transformation but not a linear transformation, homogeneous coordinates are normally used to represent the translation operator by a matrix and thus to make it linear. Thus we write the 3-dimensional vector w = (wx, wy, wz) using 4 homogeneous coordinates as w = (wx, wy, wz, 1).[1] To translate an object by a vector v, each homogeneous vector p (written in homogeneous coordinates) would need to be multiplied by this translation matrix: T v = [1 0 0 v x 0 1 0 v y 0 0 1 v z 0 0 0 1] {\displaystyle T_{\mathbf {v} }={\begin{bmatrix}1&0&0&v_{x}\\0&1&0&v_{y}\\0&0&1&v_{z}\\0&0&0&1\end{bmatrix}}} As shown below, the multiplication will give the expected result: T v p = [1 0 0 v x 0 1 0 v y 0 0 1 v z 0 0 0 1] [p x p y p z 1] = [p x + v x p y + v y p z + v z 1] = p + v {\displaystyle T_{\mathbf {v} }\mathbf {p} ={\begin{bmatrix}1&0&0&v_{x}\\0&1&0&v_{y}\\0&0&1&v_{z}\\0&0&0&1\end{bmatrix}}{\begin{bmatrix}p_{x}\\p_{y}\\p_{z}\\1\end{bmatrix}}={\begin{bmatrix}p_{x}+v_{x}\\p_{y}+v_{y}\\p_{z}+v_{z}\\1\end{bmatrix}}=\mathbf {p} +\mathbf {v} } The inverse of a translation matrix can be obtained by reversing the direction of the vector: T v − 1 = T − v . {\displaystyle T_{\mathbf {v} }^{-1}=T_{-\mathbf {v} }.\!} Similarly, the product of translation matrices is given by adding the vectors: T u T v = T u + v . {\displaystyle T_{\mathbf {u} }T_{\mathbf {v} }=T_{\mathbf {u} +\mathbf {v} }.\!} Because addition of vectors is commutative, multiplication of translation matrices is therefore also commutative (unlike multiplication of arbitrary matrices). In linear algebra, a rotation matrix is a matrix that is used to perform a rotation in Euclidean space. R = [cos θ − sin θ sin θ cos θ] {\displaystyle R={\begin{bmatrix}\cos \theta &-\sin \theta \\\sin \theta &\cos \theta \\\end{bmatrix}}} rotates points in the xy-Cartesian plane counterclockwise through an angle θ about the origin of the Cartesian coordinate system. To perform the rotation using a rotation matrix R, the position of each point must be represented by a column vector v, containing the coordinates of the point. A rotated vector is obtained by using the matrix multiplication Rv. Since matrix multiplication has no effect on the zero vector (i.e., on the coordinates of the origin), rotation matrices can only be used to describe rotations about the origin of the coordinate system. Rotation matrices provide a simple algebraic description of such rotations, and are used extensively for computations in geometry, physics, and computer graphics. In 2-dimensional space, a rotation can be simply described by an angle θ of rotation, but it can be also represented by the 4 entries of a rotation matrix with 2 rows and 2 columns. In 3-dimensional space, every rotation can be interpreted as a rotation by a given angle about a single fixed axis of rotation (see Euler's rotation theorem), and hence it can be simply described by an angle and a vector with 3 entries. However, it can also be represented by the 9 entries of a rotation matrix with 3 rows and 3 columns. The notion of rotation is not commonly used in dimensions higher than 3; there is a notion of a rotational displacement, which can be represented by a matrix, but no associated single axis or angle. Rotation matrices are square matrices, with real entries. More specifically they can be characterized as orthogonal matrices with determinant 1: R T = R − 1 , det R = 1 {\displaystyle R^{T}=R^{-1},\det R=1\,} . The set of all such matrices of size n forms a group, known as the special orthogonal group SO(n). A counterclockwise rotation of a vector through angle θ. The vector is initially aligned with the x-axis. In two dimensions every rotation matrix has the following form: R (θ) = [cos θ − sin θ sin θ cos θ] {\displaystyle R(\theta)={\begin{bmatrix}\cos \theta &-\sin \theta \\\sin \theta &\cos \theta \\\end{bmatrix}}} . This rotates column vectors by means of the following matrix multiplication: [x ′ y ′] = [cos θ − sin θ sin θ cos θ] [x y] {\displaystyle {\begin{bmatrix}x'\\y'\\\end{bmatrix}}={\begin{bmatrix}\cos \theta &-\sin \theta \\\sin \theta &\cos \theta \\\end{bmatrix}}{\begin{bmatrix}x\\y\\\end{bmatrix}}} . So the coordinates (x',y') of the point (x,y) after rotation are: x ′ = x cos θ − y sin θ {\displaystyle x'=x\cos \theta -y\sin \theta \,} , y ′ = x sin θ + y cos θ {\displaystyle y'=x\sin \theta +y\cos \theta \,} . The direction of vector rotation is counterclockwise if θ is positive (e.g. 90°), and clockwise if θ is negative (e.g. -90°). R (− θ) = [cos θ sin θ − sin θ cos θ] {\displaystyle R(-\theta)={\begin{bmatrix}\cos \theta &\sin \theta \\-\sin \theta &\cos \theta \\\end{bmatrix}}\,} . A rotation through angle θ with non-standard axes If a standard right-handed Cartesian coordinate system is used, with the x axis to the right and the y axis up, the rotation R(θ) is counterclockwise. If a left-handed Cartesian coordinate system is used, with x directed to the right but y directed down, R(θ) is clockwise. Such non-standard orientations are rarely used in mathematics but are common in 2D computer graphics, which often have the origin in the top left corner and the y-axis down the screen or page.[2] See below for other alternative conventions which may change the sense of the rotation produced by a rotation matrix. Particularly useful are the matrices for 90° and 180° rotations: R (90 ∘) = [0 − 1 1 0] {\displaystyle R(90^{\circ })={\begin{bmatrix}0&-1\\[3pt]1&0\\\end{bmatrix}}} (90° counterclockwise rotation) R (180 ∘) = [− 1 0 0 − 1] {\displaystyle R(180^{\circ })={\begin{bmatrix}-1&0\\[3pt]0&-1\\\end{bmatrix}}} (180° rotation in either direction – a half-turn) R (270 ∘) = [0 1 − 1 0] {\displaystyle R(270^{\circ })={\begin{bmatrix}0&1\\[3pt]-1&0\\\end{bmatrix}}} (270° counterclockwise rotation, the same as a 90° clockwise rotation) This article needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.Find sources: "2D computer graphics" – news · newspapers · books · scholar · JSTOR (April 2008) (Learn how and when to remove this message) In Euclidean geometry, uniform scaling (isotropic scaling,[3] homogeneous dilation, homothety) is a linear transformation that enlarges (increases) or shrinks (diminishes) objects by a scale factor that is the same in all directions. The result of uniform scaling is similar (in the geometric sense) to the original. A scale factor of 1 is normally allowed, so that congruent shapes are also classed as similar. (Some school text books specifically exclude this possibility, just as some exclude squares from being rectangles or circles from being ellipses.) More general is scaling with a separate scale factor for each axis direction. Non-uniform scaling (anisotropic scaling, inhomogeneous dilation) is obtained when at least one of the scaling factors is different from the others; a special case is directional scaling or stretching (in one direction). Non-uniform scaling changes the shape of the object; e.g. a square may change into a rectangle, or into a parallelogram if the sides of the square are not parallel to the scaling axes (the angles between lines parallel to the axes are preserved, but not all angles). A scaling can be represented by a scaling matrix. To scale an object by a vector v = (vx, vy, vz), each point p = (px, py, pz) would need to be multiplied with this scaling matrix: S v = [v x 0 0 0 v y 0 0 0 v z] . {\displaystyle S_{v}={\begin{bmatrix}v_{x}&0&0&0\\0&v_{y}&0\\0&0&v_{z}\\\end{bmatrix}}.} As shown below, the multiplication will give the expected result: S v p = [v x 0 0 0 v y 0 0 0 v z] [p x p y p z] = [v x p x v y p y v z p z] . {\displaystyle S_{v}p={\begin{bmatrix}v_{x}&0&0&0\\0&v_{y}&0\\0&0&v_{z}\\\end{bmatrix}}{\begin{bmatrix}p_{x}\\p_{y}\\p_{z}\end{bmatrix}}={\begin{bmatrix}v_{x}p_{x}\\v_{y}p_{y}\\v_{z}p_{z}\end{bmatrix}}.} Such a scaling changes the diameter of an object by a factor between the scale factors, the area by a factor between the smallest and the largest product of two scale factors, and the volume by the product of all three. The scaling is uniform if and only if the scaling factors are equal (vx = vy = vz). If all except one of the scale factors are equal to 1, we have directional scaling. In the case where vx = vy = vz = k, the scaling is also called an enlargement or dilation by a factor k, increasing the area by a factor of k2 and the volume by a factor of k3. Scaling in the most general sense is any affine transformation with a diagonalizable matrix. It includes the case that the three directions of scaling are not perpendicular. It includes also the case that one or more scale factors are equal to zero (projection), and the case of one or more negative scale factors. The latter corresponds to a combination of scaling proper and a kind of reflection: along lines in a particular direction we take the reflection in the point of intersection with a plane that need not be perpendicular; therefore it is more general than ordinary reflection in the plane. In projective geometry, often used in computer graphics, points are represented using homogeneous coordinates. To scale an object by a vector v = (vx, vy, vz), each homogeneous coordinate vector p = (px, py, pz, 1) would need to be multiplied with this projective transformation matrix: S v = [v x 0 0 0 0 v y 0 0 0 0 v z 0 0 0 0 1] . {\displaystyle S_{v}={\begin{bmatrix}v_{x}&0&0&0\\0&v_{y}&0&0\\0&0&v_{z}&0\\0&0&0&1\end{bmatrix}}.} As shown below, the multiplication will give the expected result: S v p = [v x 0 0 0 0 v y 0 0 0 0 v z 0 0 0 0 1] [p x p y p z 1] = [v x p x v y p y v z p z 1] . {\displaystyle S_{v}p={\begin{bmatrix}v_{x}&0&0&0&0\\0&v_{y}&0&0&0\\0&0&v_{z}&0&0\\0&0&0&1&0\end{bmatrix}}{\begin{bmatrix}p_{x}\\p_{y}\\p_{z}\\1\end{bmatrix}}={\begin{bmatrix}v_{x}p_{x}\\v_{y}p_{y}\\v_{z}p_{z}\\1\end{bmatrix}}.} Since the last component of a homogeneous coordinate can be viewed as the denominator of the other three components, a uniform scaling by a common factor s (uniform scaling) can be accomplished by using this scaling matrix: S v = [1 0 0 0 0 1 0 0 0 0 1 0 0 0 0 1 s] . {\displaystyle S_{v}={\begin{bmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&{\frac {1}{s}}\end{bmatrix}}.} For each vector p = (px, py, pz, 1) we would have S v p = [1 0 0 0 0 1 0 0 0 0 1 0 0 0 0 1 s] [p x p y p z 1] = [p x p y p z 1 s] {\displaystyle S_{v}p={\begin{bmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&{\frac {1}{s}}\end{bmatrix}}{\begin{bmatrix}p_{x}\\p_{y}\\p_{z}\\1\end{bmatrix}}={\begin{bmatrix}p_{x}\\p_{y}\\p_{z}\\{\frac {1}{s}}\end{bmatrix}}} which would be homogenized to [s p x s p y s p z 1] . {\displaystyle {\begin{bmatrix}sp_{x}\\sp_{y}\\sp_{z}\\1\end{bmatrix}}.} A convenient way to create a complex image is to start with a blank "canvas" raster map (an array of pixels, also known as a bitmap) filled with some uniform background color and then "draw", "paint" or "paste" simple patches of color onto it, in an appropriate order. In particular the canvas may be the frame buffer for a computer display. Some programs will set the pixel colors directly, but most will rely on some 2D graphics library or the machine's graphics card, which usually implement the following operations: paste a given image at a specified offset onto the canvas; write a string of characters with a specified font, at a given position and angle; paint a simple geometric shape, such as a triangle defined by three corners, or a circle with given center and radius; draw a line segment, arc, or simple curve with a virtual pen of given width. Text, shapes and lines are rendered with a client-specified color. Many libraries and cards provide color gradients, which are handy for the generation of smoothly-varying backgrounds, shadow effects, etc. (See also Gouraud shading). The pixel colors can also be taken from a texture, e.g. a digital image (thus emulating rub-on screentones and the fabled checker paint which used to be available only in cartoons). Painting a pixel with a given color usually replaces its previous color. However, many systems support painting with transparent and translucent colors, which only modify the previous pixel values. The two colors may also be combined in more complex ways, e.g. by computing their bitwise exclusive or. This technique is known as inverting color or color inversion, and is often used in graphical user interfaces for highlighting, rubber-band drawing, and other volatile painting—since re-painting the same shapes with the same color will restore the original pixel values. A 2D animated character composited with 3D backgrounds using layers Main article: Layers (digital image editing) The models used in 2D computer graphics usually do not provide for three-dimensional shapes, or three-dimensional optical phenomena such as lighting, shadows, reflection, refraction, etc. However, they usually can model multiple layers (conceptually of ink, paper, or film; opaque, translucent, or transparent—stacked in a specific order. The ordering is usually defined by a single number (the layer's depth, or distance from the viewer). Layered models are sometimes called "21⁄2-D computer graphics". They make it possible to mimic traditional drafting and printing techniques based on film and paper, such as cutting and pasting; and allow the user to edit any layer without affecting the others. For these reasons, they are used in most graphics editors.