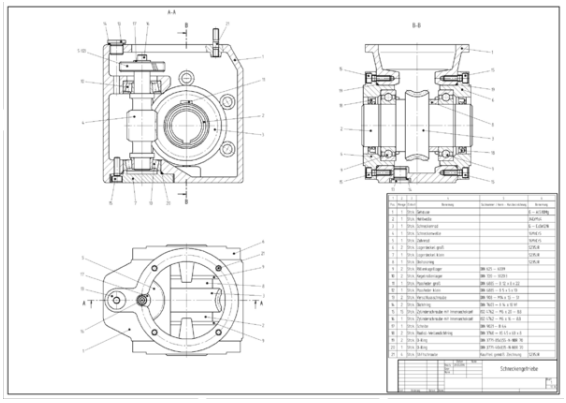
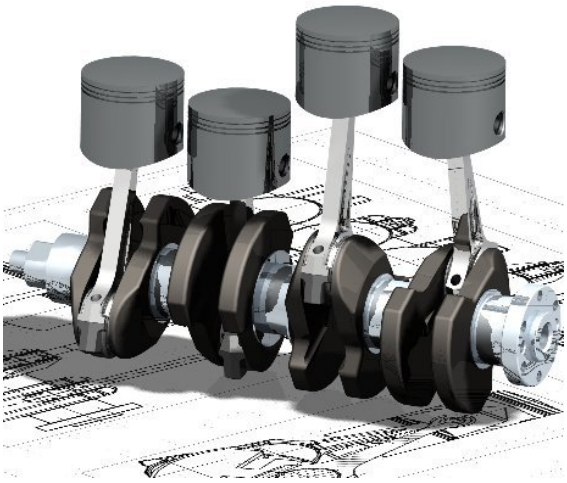
Computer-aided design

"CAD" and "CADD" redirect here. For other uses, see CAD (disambiguation) and CADD (disambiguation).

Computer-aided design (**CAD**) is the use of computer



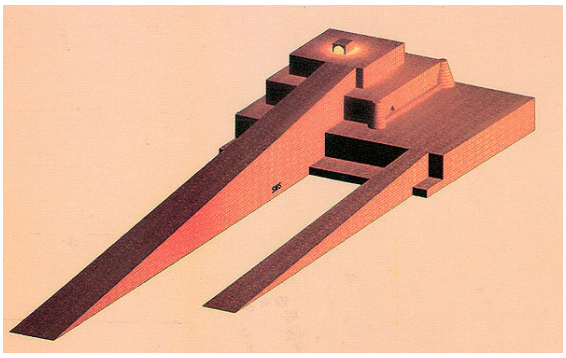
Example: 2D CAD drawing



Example: 3D CAD model

systems to aid in the creation, modification, analysis, or optimization of a design.[1] CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing.[2] CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term **CADD** (for *Computer Aided Design and Drafting*) is also used.[3]

Its use in designing electronic systems is known as electronic design automation, or **EDA**. In mechanical design it is known as mechanical design automation (**MDA**)



CAD rendering of Sialk ziggurat based on archeological evidence

or **computer-aided drafting** (**CAD**), which includes the process of creating a technical drawing with the use of computer software.[4]

CAD software for mechanical design uses either vector-based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects. However, it involves more than just shapes. As in the manual drafting of technical and engineering drawings, the output of CAD must convey information, such as materials, processes, dimensions, and tolerances, according to application-specific conventions.

CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space.[5]

CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals, often called DCC digital content creation. The modern ubiquity and power of computers means that even perfume bottles and shampoo dispensers are designed using techniques unheard of by engineers of the 1960s. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry, computer graphics (both hardware and software), and discrete differential geometry.[6]

The design of geometric models for object shapes, in particular, is occasionally called *computer-aided geometric design* (*CAGD*).[7]

1 Overview of CAD Software

Starting around the mid 1970s, as computer aided design systems began to provide more capability than just an ability to reproduce manual drafting with electronic drafting, the cost benefit for companies to switch to CAD became apparent. The benefit of CAD systems over manual drafting are the capabilities one often takes for granted from computer systems today; automated generation of Bill of Material, auto layout in integrated circuits, interference checking, and many others. Eventually CAD provided the designer with the ability to perform engineering calculations. During this transition, calculations were still performed either by hand or by those individuals who could run computer programs. CAD was a revolutionary change in the engineering industry, where draftsmen, designers and engineering roles begin to merge. It did not eliminate departments, as much as it merged departments and empowered draftsman, designers and engineers. CAD is just another example of the pervasive effect computers were beginning to have on industry. Current computer-aided design software packages range from 2D vector-based drafting systems to 3D solid and surface modelers. Modern CAD packages can also frequently allow rotations in three dimensions, allowing viewing of a designed object from any desired angle, even from the inside looking out. Some CAD software is capable of dynamic mathematical modeling, in which case it may be marketed as CAD.

CAD technology is used in the design of tools and machinery and in the drafting and design of all types of buildings, from small residential types (houses) to the largest commercial and industrial structures (hospitals and factories).[8]

CAD is mainly used for detailed engineering of 3D models and/or 2D drawings of physical components, but it is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies to definition of manufacturing methods of components. It can also be used to design objects. Furthermore, many CAD applications now offer advanced rendering and animation capabilities so engineers can better visualize their product designs. 4D BIM is a type of virtual construction engineering simulation incorporating time or schedule related information for project management.

CAD has become an especially important technology within the scope of computer-aided technologies, with benefits such as lower product development costs and a greatly shortened design cycle. CAD enables designers to layout and develop work on screen, print it out and save it for future editing, saving time on their drawings.

2 Uses

Computer-aided design is one of the many tools used by engineers and designers and is used in many ways depending on the profession of the user and the type of software in question.

CAD is one part of the whole Digital Product Development (DPD) activity within the Product Lifecycle Management (PLM) processes, and as such is used together with other tools, which are either integrated modules or stand-alone products, such as:

- Computer-aided engineering (CAE) and Finite element analysis (FEA)
- Computer-aided manufacturing (CAM) including instructions to Computer Numerical Control (CNC) machines
- Photorealistic rendering and Motion Simulation.
- Document management and revision control using Product Data Management (PDM).

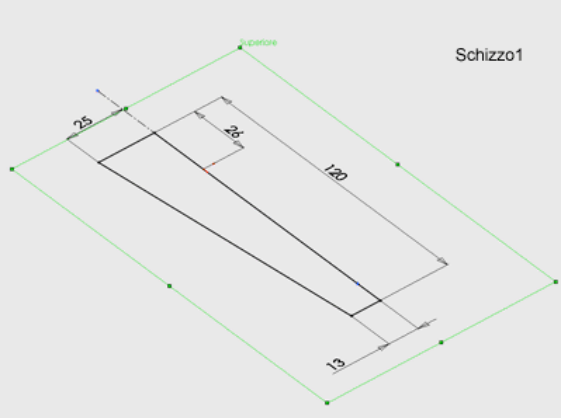
CAD is also used for the accurate creation of photo simulations that are often required in the preparation of Environmental Impact Reports, in which computer-aided designs of intended buildings are superimposed into photographs of existing environments to represent what that locale will be like, where the proposed facilities are allowed to be built. Potential blockage of view corridors and shadow studies are also frequently analyzed through the use of CAD.

CAD has been proven to be useful to engineers as well. Using four properties which are history, features, parameterization, and high level constraints. The construction history can be used to look back into the model's personal features and work on the single area rather than the whole model. Parameters and constraints can be used to determine the size, shape, and other properties of the different modeling elements. The features in the CAD system can be used for the variety of tools for measurement such as tensile strength, yield strength, electrical or electro-magnetic properties. Also its stress, strain, timing or how the element gets affected in certain temperatures, etc.

3 Types

See also: Comparison of computer-aided design editors

There are several different types of CAD,[9] each requiring the operator to think differently about how to use them and design their virtual components in a different manner for each.



A simple procedure

There are many producers of the lower-end 2D systems, including a number of free and open source programs. These provide an approach to the drawing process without all the fuss over scale and placement on the drawing sheet that accompanied hand drafting, since these can be adjusted as required during the creation of the final draft.

3D wireframe is basically an extension of 2D drafting (not often used today). Each line has to be manually inserted into the drawing. The final product has no mass properties associated with it and cannot have features directly added to it, such as holes. The operator approaches these in a similar fashion to the 2D systems, although many 3D systems allow using the wireframe model to make the final engineering drawing views.

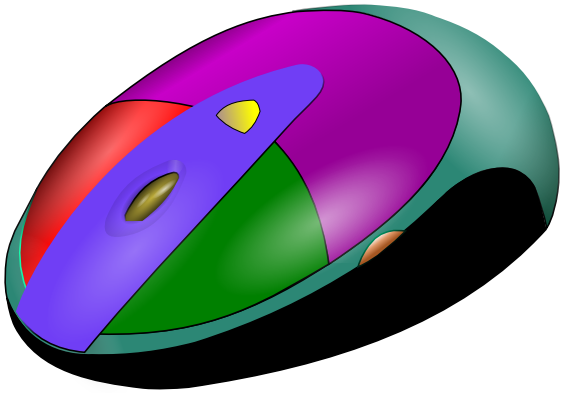
3D "dumb" solids are created in a way analogous to manipulations of real world objects (not often used today). Basic three-dimensional geometric forms (prisms, cylinders, spheres, and so on) have solid volumes added or subtracted from them, as if assembling or cutting real-world objects. Two-dimensional projected views can easily be generated from the models. Basic 3D solids don't usually include tools to easily allow motion of components, set limits to their motion, or identify interference between components.

There are two types of *3D Solid Modeling*

1. *Parametric modeling* allows the operator to use what is referred to as "design intent". The objects and features created are modifiable. Any future modifications can be made by changing how the original part was created. If a feature was intended to be located from the center of the part, the operator should locate it from the center of the model. The feature could be located using any geometric object already available in the part, but this random placement would defeat the design intent. If the operator designs the part as it functions the parametric modeler is able to make changes to the part while maintaining geometric and functional relationships.
2. *Direct or Explicit modeling* provide the ability to edit geometry without a history tree. With direct modeling once a sketch is used to create geometry the sketch is incorporated into the new geometry and the designer just modifies the geometry without needing the original sketch. As with parametric modeling, direct modeling has the ability to include relationships between selected geometry (e.g., tangency, concentricity).

Top end systems offer the capabilities to incorporate more organic, aesthetics and ergonomic features into designs. Freeform surface modeling is often combined with solids to allow the designer to create products that fit the human form and visual requirements as well as they interface with the machine.

4 Technology



A CAD model of a computer mouse.

Originally software for Computer-Aided Design systems was developed with computer languages such as Fortran, ALGOL but with the advancement of object-oriented programming methods this has radically changed. Typical modern parametric feature based modeler and freeform surface systems are built around a number of key C modules with their own APIs. A CAD system can be seen as built up from the interaction of a graphical user interface (GUI) with NURBS geometry and/or boundary representation (B-rep) data via a geometric modeling kernel. A geometry constraint engine may also be employed to manage the associative relationships between geometry, such as wireframe geometry in a sketch or components in an assembly.

Unexpected capabilities of these associative relationships have led to a new form of prototyping called digital prototyping. In contrast to physical prototypes, which entail manufacturing time in the design. That said, CAD models can be generated by a computer after the physical prototype has been scanned using an industrial CT scanning machine. Depending on the nature of the business, digital or physical prototypes can be initially chosen according to specific needs.

Today, CAD systems exist for all the major platforms (Windows, Linux, UNIX and Mac OS X); some packages even support multiple platforms.

Right now, no special hardware is required for most CAD software. However, some CAD systems can do graphically and computationally intensive tasks, so a modern graphics card, high speed (and possibly multiple) CPUs and large amounts of RAM may be recommended.

The human-machine interface is generally via a computer mouse but can also be via a pen and digitizing graphics tablet. Manipulation of the view of the model on the screen is also sometimes done with the use of a Spacemouse/SpaceBall. Some systems also support stereoscopic glasses for viewing the 3D model.Technologies which in the past were limited to larger installations or specialist applications have become available to a wide group of users.These include the CAVE or HMD`s and interactive devices like motion-sensing technology

5 Software

CAD software enables engineers and architects to design, inspect and manage engineering projects within an integrated graphical user interface (GUI) on a personal computer system. Most applications support solid modeling with boundary representation (B-Rep) and NURBS geometry, and enable the same to be published in a variety of formats. A geometric modeling kernel is a software component that provides solid modeling and surface modeling features to CAD applications.

Based on market statistics, commercial software from Autodesk, Dassault Systems, Siemens PLM Software and PTC dominate the CAD industry.[10][11] The following is a list of major CAD applications, grouped by usage statistics.[12]

Commercial

- ASCON KOMPAS-3D
- Autodesk AutoCAD
- Autodesk Inventor
- Dassault CATIA
- Dassault SolidWorks
- Kubotek KeyCreator
- Siemens NX
- Siemens Solid Edge
- PTC Pro/ENGINEER (now renamed Creo)
- TurboCAD
- IronCAD
- MEDUSA
- ProgeCAD
- SpaceClaim
- Rhinoceros 3D
- VariCAD
- VectorWorks
- Cobalt

Freeware and open source

- 123D
- LibreCAD
- FreeCAD
- BRL-CAD
- OpenSCAD
- NanoCAD
- QCad

CAD Kernels

- Parasolid by Siemens
- ACIS by Spatial
- ShapeManager by Autodesk
- Open CASCADE
- C3D by C3D Labs
- K3 by Center GeoS

6 History

Designers have long used computers for their calculations.[13][14][15][16] Digital computers were used in power system analysis or optimization as early as proto-"Whirlwind" in 1949. Circuit[17] design theory, or power network methodology would be algebraic, symbolic, and often vector-based. Examples of problems being solved in the mid-1940s to 50s include, Servo motors controlled by generated pulse (1949), The digital computer with built-in compute operations to automatically co-ordinate transforms to compute radar related vectors (1951) and the essentially graphic mathematical process of forming a shape with a digital machine tool (1952).[18] These were accomplished with the use of computer software. The man credited with coining the

term CAD.[19] Douglas T. Ross stated "As soon as I saw the interactive display equipment, [being used by radar operators 1953]. The designers of these very early computers built utility programs so that programmers could debug programs using flow charts on a display scope with logical switches that could be opened and closed during the debugging session. They found that they could create electronic symbols and geometric figures to be used to create simple circuit diagrams and flow charts.[20] They made the pleasant discovery that an object once drawn could be reproduced at will, its orientation, Linkage [flux, mechanical, lexical scoping] or scale changed. This suggested numerous possibilities to them. It took ten years of interdisciplinary development[21] work before SKETCHPAD sitting on evolving math libraries emerged from MIT`s labs. Additional developments were carried out in the 1960s within the aircraft, automotive, industrial control and electronics industries in the area of 3D surface construction, NC programming and design analysis, most of it independent of one another and often not publicly published until much later. Some of the mathematical description work on curves was developed in the early 1940s by Robert Issac Newton from Pawtucket, Rhode Island. Robert A. Heinlein in his 1957 novel *The Door into Summer* suggested the possibility of a robotic *Drafting Dan*. However, probably the most important work on polynomial curves and sculptured surface was done by Pierre Bézier, Paul de Casteljau (Citroen), Steven Anson Coons (MIT, Ford), James Ferguson (Boeing), Carl de Boor (GM), Birkhoff (GM) and Garibedian (GM) in the 1960s and W. Gordon (GM) and R. Riesenfeld in the 1970s.

The invention of the 3D CAD/CAM is attributed to a French engineer, Pierre Bezier (Arts et Métiers ParisTech, Renault). After his mathematical work concerning surfaces, he developed UNISURF, between 1966 and 1968, to ease the design of parts and tools for the automotive industry. Then, UNISURF became the working base for the following generations of CAD software.

It is argued that a turning point was the development of the SKETCHPAD system at MIT[22][23] by Ivan Sutherland (who later created a graphics technology company with Dr. David Evans). The distinctive feature of SKETCHPAD was that it allowed the designer to interact with his computer graphically: the design can be fed into the computer by drawing on a CRT monitor with a light pen. Effectively, it was a prototype of graphical user interface, an indispensable feature of modern CAD. Sutherland presented his paper Sketchpad: A Man-Machine Graphical Communication System in 1963 at a Joint Computer Conference having worked on it as his PhD thesis paper for a few years. Quoting,"For drawings where motion of the drawing, or analysis of a drawn problem is of value to the user, Sketchpad excels. For highly repetitive drawings or drawings where accuracy is required, Sketchpad is sufficiently faster than conventional techniques to be worthwhile. For drawings which merely communicate with shops, it is probably better to use conventional paper and pencil." Over time efforts would be directed toward the goal of having the designers drawings communicate not just with shops but with the shop tool itself. This goal would be a long time arriving.

The first commercial applications of CAD were in large companies in the automotive and aerospace industries, as well as in electronics. Only large corporations could afford the computers capable of performing the calculations. Notable company projects were, a joint project of GM (Dr. Patrick J.Hanratty) and IBM (Sam Matsa, Doug Ross`s MIT APT research assistant) to develop a prototype system for design engineers DAC-1 (Design Augmented by Computer) 1964; Lockheed projects; Bell GRAPHIC 1 and Renault.

One of the most influential events in the development of CAD was the founding of MCS (Manufacturing and Consulting Services Inc.) in 1971 by Dr. P. J. Hanratty,[24] who wrote the system ADAM (Automated Drafting And Machining) but more importantly supplied code to companies such as McDonnell Douglas (Unigraphics), Computervision (CADDS), Calma, Gerber, Autotrol and Control Data.

As computers became more affordable, the application areas have gradually expanded. The development of CAD software for personal desktop computers was the impetus for almost universal application in all areas of construction.

Other key points in the 1960s and 1970s would be the foundation of CAD systems United Computing, Intergraph, IBM, Intergraph IGDS in 1974 (which led to Bentley Systems MicroStation in 1984).

CAD implementations have evolved dramatically since then. Initially, with 3D in the 1970s, it was typically limited to producing drawings similar to hand-drafted drawings. Advances in programming and computer hardware,[25][26] notably solid modeling in the 1980s, have allowed more versatile applications of computers in design activities.

Key products for 1981 were the solid modelling packages - Romulus (ShapeData) and Uni-Solid (Unigraphics) based on PADL-2 and the release of the surface modeler CATIA (Dassault Systemes). Autodesk was founded 1982 by John Walker, which led to the 2D system AutoCAD. The next milestone was the release of Pro/ENGINEER in 1987, which heralded greater usage of feature-based modeling methods and parametric linking of the parameters of features. Also of importance to the development of CAD was the development of the B-rep solid modeling kernels (engines for manipulating geometrically and topologically consistent 3D objects) Parasolid (ShapeData) and ACIS (Spatial Technology Inc.) at the end of the 1980s and beginning of the 1990s, both inspired by the work of Ian Braid. This led to the release of mid-range packages such as SolidWorks

and TriSpective (later known as IRONCAD) in 1995, Solid Edge (then Intergraph) in 1996 and Autodesk Inventor in 1999. An independent geometric modeling kernel has been evolving in Russia since the 1990s.[27] Nikolay Golovanov joined ASCON Company in 1994 from the Kolomna Engineering Design Bureau and began development of C3D – the geometric kernel of the Russian popular CAD system, KOMPAS-3D.[28] Nowadays, C3D (C3D Labs) is the most valued Russian CAD product in the category of "components", i.e. products designed for integration in the end-user CAD systems of Russian and global vendors.[29]

7 See also

- 3D computer graphics software
- 3D modeling
- 3D printing
- Additive Manufacturing File Format
- CAD standards
- Coarse space (numerical analysis)
- Comparison of 3D computer graphics software
- Comparison of computer-aided design editors
- Comparison of Free EDA software (Electronic Design Automation)
- Computer-aided industrial design
- Digital architecture
- Electronic design automation
- Engineering optimization
- Finite element method
- Integrating functionality
- ISO 128
- ISO 10303 STEP
- Model based definition
- Molecular design software
- Open hardware
- Rapid prototyping
- Space mapping
- Surrogate model
- Virtual prototyping
- Virtual reality

8 References

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9 External links

- Learning materials related to Computer-aided Geometric Design at Wikiversity
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Quinn, PopUpPirate, Andrewpmk, Kurt Shaped Box, Spangineer, Snowolf, Wtmitchell, Ronark, Wtshymanski, Kernoz, Bsadowski1, Kusma, TVBZ28, TheCoffee, Tm1000, Forderud, Saxifrage, Oleg Alexandrov, Tom.k, Bushytails, Poppafuze, RHaworth, Rocastelo, Miaow Miaow, Chris Mason, WadeSimMiser, Bluemoose, CharlesC, Waldir, Hughcharlesparker, Palica, Allen3, Graham87, BD2412, Kbdank71, Reisio, Ketiltrout, Rogerd, Ctdunstan, JoshuacUK, Bruce1ee, Tawker, Bhadani, FuelWagon, FlaBot, Winhunter, Nihiltres, Bky1701, RexNL, Ewlyahoocom, DuLithgow, BjKa, Viznut, Alphachimp, M7bot, Eric.dane~enwiki, Chobot, Visor, PKM, Bornhj, DVdm, Bgwhite, Martin Hinks, YurikBot, MMuzammils, RussBot, Fabartus, Makana, Stephenb, Shell Kinney, Gaius Cornelius, Pseudomonas, Wimt, Tong~enwiki, Welsh, Valhallia, Malcolma, Anetode, Cholmes75, Raven4x4x, Moe Epsilon, Emersoni, Dbfirs, SFC9394, Bota47, Elkman, Wknight94, FF2010, Zzuuzz, StuRat, Ninly, Freeformer, Juanscott, Arthur Rubin, Eric Jack Nash, Dspradau, Sean Whitton, GraemeL, Cadtech, Kevin, Daleh, Ybbor, Honeyman, Ásgeir IV.~enwiki, Some guy, Rwwww, GrinBot~enwiki, DVD R W, Veinor, SmackBot, Dweller, Xkoalax, Reedy, Vald, Jacek Kendysz, Brossow, Srnec, Yamaguchi??, Gilliam, Ohnoitsjamie, Corneliusagain, Bluebot, PDD, NickBall, Grade7b, JMSwtlk, NCurse, MalafayaBot, LaggedOnUser, Jerome Charles Potts, Octahedron80, Baa, DHN-bot~enwiki, Cassivs, FLabordeC, Scwlong, Bsilverthorn, Patleahy, Can't sleep, clown will eat me, Anthonyling, Paddyohale, JonHarder, Rrburke, LouScheffer, Addshore, Aldaron, Nakon, Shadow1, Dreadstar, ShaunES, David G. Smith, James084, Omvegan, DMacks, Le baron, Chaney44145, DDima, ChaChaFut, Gurklurk, Kukini, Dogears, Hmoul, Rory096, Moojoe, CaptainVindaloo, Wickethewok, Onna, Llamadog903, 16@r, SQGibbon, Childzy, Ehheh, Dicklyon, Ryulong, Kkkkat, Dodo bird, Hu12, Quaeler, Wizard191, Edykstra, Newone, Twingy, Gregmilliken, Blehfu, Courcelles, Tawkerbot2, Ryt, JForget, Brutzman, Ale jrb, Jrneumann, Blue-Haired Lawyer, Victoriagirl, Marioestrada, Randalllin, Dgw, GargoyleMT, WeggeBot, Jmswisher, Myasuda, Dschwa, Inzy, Cydebot, Gogo Dodo, Biggreenbooks, Jon Stockton, Daniel J. Leivick, Dancter, Tawkerbot4, Christian75, DumbBOT, Chrislk02, Sharonlees, Kozuch, Toolingu, Omicronpersei8, UberScienceNerd, Tortillovsky, Saintrain, Thijs!bot, Epbr123, Kubanczyk, Kablammo, DavidPedia, Mojo Hand, Kevin kaior, Marek69, Dalahäst, Nezzadar, RickinBaltimore, E. Ripley, Rick0289, SusanLesch, Dawnseeker2000, CTZMSC3, Adminmoderator, Visik, PulpDood, Henri8888, Mentifisto, Administrator craig, AntiVandalBot, Styletexpro, Abu-Fool Danyal ibn Amir al-Makhiri, Luna Santin, Seaphoto, Prolog, DarkAudit, Bridgeplayer, LibLord, Mbeijers, Credema, AJKool, Glennwells, Sandipjadhav, Perelaar, Myanw, Chrisa11, Toastydeath, Ingolfson, Ioeth, JAnDbot, Ndyguy, DuncanHill, MER-C, Arch dude, Fetchcomms, Michig, Skatterbrain, PhilKnight, Aekbal, Mardavich, AndriesVanRenssen, Bongwarrior, VoABot II, Troy.peterson, AuburnPilot, Lotusv82, Soulbot, Avicennasis, Bubba hotep, MetsBot, Ironkevin, Noodle snacks, 28421u2232nfenfcenc, Allstarecho, Spellmaster, Glen, Edward321, Nicateen, Oicumayberight, Crahul, Gwern, ClubOranje, MartinBot, Mmoneypenny, Jim.henderson, Nikpapag, Heather hope, Anaxial, Mausy5043, J.delanoy, Pharaoh of the Wizards, Trusilver, Zippedpinhead, Fcsuper, Rlsheehan, Shimaspawn, Eduemoni, Uncle Dick, Mully-cron, Noble75, Khullah~enwiki, FactsAndFigures, Jonoridge, Acalamari, Phillipwnd, Frankn12345, Ciaran2506, Hodlipson, Skier Dude, Mentalmouse, SmilesALot, Pivi69, Phirazo, Pradeepdesign, Cometstyles, Brosi, Dannathrik, Ossido, CardinalDan, VolkovBot, Miubot, R05592, Indubitably, JohnBlackburne, Senachie, Wikipowered, Ryan032, Philip Trueman, TXiKiBoT, Vatrex, Mercy, Stephenkirkup, Maximillion Pegasus, Technopat, GDonato, Miranda, Rei-bot, Anonymous Dissident, Qxz, Ccolin2509, Martin451, Leafyplant, Don4of4, Msanford, LeaveSleaves, Raymondwinn, Davidarnoult, Mariddle, Kuczora, BigDunc, Andy Dingley, Finngall, HrqFox, Jmac1962, Wolfrock, CarinaT, Altermike, Enviroboy, Spinningspark, Staceyswt, Brianga, CDC Catia, Swendel, Zabidi8, FlyingLeopard2014, EmxBot, Aqwfyj, SieBot, Euryalus, Cae prince, Vpdvpd, Kivaan, Mwpeters49, Zatchi9, Zacatecnik, Happysailor, Zabidi68, Caddsoft, Normsch, Rickben, JSpung, Prestonmag, Henry Delforn (old), Tombomp, Correogsk, Wuhwuzdat, Homologia, Quinacrine, Rodrigo111, Twistchi, Sandipnj, Parametric66, Escape Orbit, TwinnedChimera, Prashant chan, Schbrownie, Atif.t2, Loren.wilton, Martarius, ClueBot, LAX, Rks22, Alnatour 2000, The Thing That Should Not Be, Wysprgr2005, Nrcjersey, The 888th Avatar, Ridge Runner, Mohafern, Paul Tracey, Excirial, Jusdafax, Jesswah13, Vanisheduser12345, Iner22, Galacticvoyager, Kippi3000, NuclearWarfare, Cenarium, Moolito2893, Razorflame, Quickcad, Inspirtech, IamNotU, La Pianista, C628, Info nutt, Aitias, Achyutwiki, Funnymonk64, Ouzari, Versus22, Vd437, XLinkBot, Stickee, Rror, Skarebo, TFOWR, SilvonenBot, Machiavelli2008, Badgernet, Mm40, HarlandQPitt, Midnight Voice, RyanCross, JonHunwick, HexaChord, Thebestofall007, Erikhansson1, Svea Kollavainen, Addbot, Ramu50, Scottmcv91, Sbikulov, Brianlembr, Archuwtecture, AkhtaBot, Elsendero, Ronhjones, Jncraton, Rayka12345, CanadianLinuxUser, Fluffernutter, Engineer00, MrOllie, LaaknorBot, Chamal N, Glane23, Torla42, West.andrew.g, Tide rolls, Krano, Teles, Quantumobserver, Luckas-bot, Yobot, 2D, Senator Palpatine, Legobot II, II MusLiM HyBRiD II, THEN WHO WAS PHONE?, Wonderfl, Jean.julius, Ghosty231, AnomieBOT, Rubinbot, 1exec1, Efa, Piano non troppo, AdjustShift, Crvaught, Materialscientist, IndonesiaCAD, Paranormal Skeptic, KevinPerez, Jimmy Bergmark, Edaitt, PavelSolin, Xqbot, TheAMmollusc, Zad68, Capricorn42, Bihco, Boggiebaojie, P99am, Nmeier23, Stevemc9, Sixequalszero, VitruV07, RibotBOT, Ilovetaipei, Manequinho, Esmu Igors, Shadowjams, Adrignola, SD5, A.amitkumar, Griffinofwales, Bjsmasth, Surv1v4l1st, Coolkid146, Recognizance, Louperibot, Leyton91, M.J. Moore-McGonigal PhD, P.Eng, Pinethicket, I dream of horses, ICEAGE, 10metreh, Calmer Waters, RedBot, Cyon Steve, SpaceFlight89, AshPhi, Reconsider the static, Therealbrendan, Retired user 0001, Vortex42506, Lotje, Collins2009, Tl1378, Dinamik-bot, Vrenator, Aoidh, Mattovbev2k9, Agrasa, Jeffrd10, DDEEVVYYNN, Raykyogrou0, Brian the Editor, DARTH SIDIOUS 2, Mammydippy, WildBot, Galactusmax, Salvio giuliano, DASHBot, Jeweldesign, EmausBot, Gandhu12345, Donnilad93, Dewritech, Randyll13, Simonchalky, Ebe123, RenamedUser01302013, Lambertmt, Solarra, Brayrow, Wikipelli, Dcirovic, K6ka, Hussy007, Theslychi, Josve05a, Nitintyagi89, Scotttsweeney, Suhaas27, Noroargus, Aeonx, Bzlik88-NJITWILL, Tolly4bolly, Thine Antique Pen, Glome4D, Jay-Sebastos, MaGa, Dougertman, Emgeeo, Puffin, Carmichael, Michael Leeman, Capoeirista.muralha, Petrb, ClueBot NG, Funarog, CocuBot, MelbourneStar, IV001-NJITWILL, Maierstrahl, Widr, Mattvilson, PaquitoChocolatero, Khw8201, Helpful Pixie Bot, Mattybmc12345, Calabe1992, Jaymstevens, Wbm1058, Lowercase sigmabot, BG19bot, Dsajga, CityOfSilver, Jake happe (AKA mrmeh), Nospildoh, MusikAnimal, Behrange, Mark Arsten, Tpeiyn, Cncmaster, Writ Keeper, Sir Cumference (usurped), PwilliamQ99, Liambroad97, Klilidiplomus, Achowat, Autodidaktos, Merluza-NJITWILL, Iskander HFC, Web2.0classmru, HotdogPi, Arthurgan, Karen Ggsddu, Enterprisey, TwoTwoHello, Downy78, Lugia2453, P.arashnia, Reatlas, Epicgenius, Wordcraft, RosaMcVey,

CadPerson, Johnbandler, Chris999cs, Oroszegy, Peterpan911man, Ginsuloft, ScotXW, 7Sidz, Maxicar, Mr. Smart LION, Lagoset, Bugzuki, Monkbot, DOS4004, Fratilias, Alpha Monarch, Tjdunn1979, Mattwillmarron, Azeem678, Bulava14, FourViolas, Jfgpulikal, Burakomersaracoglu, ArkadiyKamnev, Pappgab, Barnon321, KasparBot, TancrediV2, StephenJohns00, Meenakshi023, Alopor12138, CAPTAIN RAJU, Naoum mabkhout, Pdpatel1992, Mikediamond1984, Entranced98, Fmadd, Hola IV, Ayylmaopepe420 and Anonymous: 1114

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