4—Type Design

In this chapter, the design issues pertaining to Arabic type will be tackled in comparison to Latin type for a number of reasons. First, the same issues of visual perception apply to both scripts regardless of their visual differences. Second, the tools used to create them are nowadays exactly the same. Third, the majority of people reading and writing languages that use the Arabic script also use Latin as a complementary script for their bilingual visual communication. Fourth, most type designers who design Arabic fonts are also proficient in designing Latin fonts, and therefore the comparison of both scripts might prove to be a pragmatic and informative approach.

All design activity starts with defining the purpose of the design application and the context in which the design has to perform its intended goal. The brief also contains a listing of the design constraints. With these elements a benchmark is created by which the effectiveness and functionality of the end result may be measured. This also counts for type design. The purpose of a typeface design, the scope of work, and the time invested in its completion, are constraints that vary from one typeface design to another.

Before going deeper into the description of the current spectrum of type design, a clear distinction between the various methods of text production needs to be drawn. In the professional field, often the production of text is divided into three categories: writing, lettering, and typography. The first, writing, is described as the free-flowing and uncorrected manual production of text. The second, lettering, is considered a meticulous method of producing carefully drawn letters, which allows for corrections during the text production process. The third, typography, is considered the industrialised method of text production—whether on the level of type design, or on the level of applying existing type to design applications.
In this respect, calligraphy can be seen to exist halfway between writing and lettering. This distinction may be useful in explaining why Arabic typography has never developed an independent and purely typographic form. All efforts to produce Arabic type remained culturally tied to the superficial conservation of formal values found during the golden age of Arabic calligraphic developments. The refusal to cross the threshold into modern times often drove Arabic type production to the outer edge of technology.

This categorisation of the various kinds of type production is no longer of much relevance to the visual appearance of type, nor to the way it is produced. Even for the Latin script, the shape of the characters used today has preceded the invention of movable type. The invention of the English knolz Akgun of a faster writing style known as the Carolingian Minuscule, has had a lasting impact in shaping all Latin type. Similarly, Ibn Muqla's thorougly thought-out mathematical system for all Arabic cursive scripts, has left its imprint on Arabic typefaces. Ibn Muqla's system which was based on the circle and the dot as measuring units (related to the thickness of the letter-stem), can be considered as perfectly suitable for the computer screen.

The difference between the various ways that type can be produced is not very relevant to the purpose nor function of the design. The distinction disappears with the overall digitisation process, since all text ends up on the computer screen at some stage or other. Nowadays, many type designers design typefaces with a specific purpose: for titles of books or logos of organisations. 'Real' one-off unique original artwork on paper hardly exists. Even our handwriting can be easily transferred into a font, and a font can be programmed to have random formal variations producing letters that mimic the imperfections of handwritten text. Fonts can be given a general style at a later stage, depending on the content of the text or the user's mood. The possibilities are vast and the limits are only the designers' creativity.

The scope of the final purpose of the work undertaken by the type designer is far more important as a professional discussion worth engaging in. The scope of type design can vary immensely. On one hand a font is often easily accessible and changed, and on the other hand the underlying technology can be relatively complex. Type designers can choose a niche in this wide professional field that best matches their interest.

The graphic industry and type manufacturing have undergone a considerable change. Typefoundries used to have a controlled monopoly over the production of type. The development of new typefaces was closely linked to their core business, of manufacturing typesetting machines. Eventually these machines became obsolete and were replaced by widely available computers. This resulted in the disappearance of many typefoundries, and the few remaining have either merged or been bought by other companies. Typefoundries still commission type designers on a project basis and may even employ some as in-house staff.

The major new players in the font-making business revolve around the computer industry; they are the manufacturers of hardware and software (especially graphic software). Companies like Apple and Adobe have commissioned many type designers and developed in-house type designs, creating extensive font libraries. Microsoft has also become interested of late in the visual aspects of type. The so-called osx (original equipment manufacturers), involved in the creation of machines that render and print type, are important commissioners for type designers and typefoundries. They commission designs that are heavily involved in modern computer technology. Text processing is at a stage where font technology is a primary concern.

Type design became an enterprise in its own right. TFC (the International Typeface Corporation) crept type design from its link to proprietary hardware when it started marketing typefaces by independent type designers, and developing them for the photo-typesetting technology in the early 1970s. Then companies like Bitstream in the 1980s, and later Adobe, began developing new fonts and revivals of classical typefaces for digital technology. Many individual designers, and typefoundries today are the result of this development. On the 'stylish' end of font production, serving the ever-fake human need for novelty, new typefaces are entering the market at an alarming rate. It is hard to have a clear idea anymore of the number of typefaces around. Many fonts are offered on the Internet for free, with some websites offering a new (free) font every day! Even the 'respectable' typefoundries offer CD-ROMs out of their collections, with thousands of fonts that one can buy at once, mindboggling figures, and perhaps a bit overwhelming. On the face of it, designing fonts for this part of the market can hardly be a lucrative part of the type design business. In the expectation of questionable profit, designers are often forced to use the benefits of modern technology in a quick and sometimes superficial way.
On average, a more rewarding part of the type design business is linked to organisations that like to have exclusivity of one or more proprietary typefaces for business purposes. For instance, publishers of newspapers or magazines might feel the need to develop a special typeface for their products as an additional marketing tool. Publishers of scientific works might need special extended fonts. Manufacturers that make use of ‘Graphical User Interfaces’ are often in need of carefully designed typefaces to enhance the quality of their products. A lot of products incorporate users interfaces nowadays. Governmental bodies involved in highway signage or public lettering can feel the need to develop special typefaces. Often this kind of work is limited to the design category of ‘lettering’ — the design of logos for product names, special headings or issues.

Commissioning type design is not strictly restricted to organisations involved in text production. Most large organisations make serious efforts to maintain a corporate visual style. A proprietary corporate typeface is an integral part of that visual identity. One typeface can be carefully specified and incorporated in all the organisation’s office machines that produce text, thus creating an effective corporate face. Even a special typeface can be developed for that purpose, or an existing typeface can be extended with special characters for signage or other special glyphs the organisation needs. Creating consistency in text production is a very effective tool in maintaining a consistent corporate identity.

The ‘high end’ of the type design business revolves around computer software. Typefaces and fonts produced for this category are among the most technologically advanced. They carry extensive sets of instructions that make these fonts suitable for all kinds of environments. Computers can perform many exciting tricks with the shapes of characters and the stream of ‘raw data’ of text input. The development of this technology started with phototypesetting. It triggered the creation of ‘kerning tables’. Photo-type technology had a short shelf-life. The following technology, laserisation of text introduced the problem of optimal grid-fitting of individual characters. Hintering tables were later added to the fonts in order to take care of this job, while keeping the kerning tables.

The digitisation of type generated a wealth of possibilities for type manipulation. This process is still in progress with technologies like the Multiple Master Technology (MMT), and the Penrose classification system. Both provide in different ways the possibility of creating glyphs ‘on the fly’ with the help of smart software and carefully composed algorithms. This is most likely to be the future of sophisticated type design, with reading from screens steadily gaining preference over reading from print.

The establishment of ‘Open type’ and ‘Unicode’ will create software and graphic user interfaces that are fluent in handling numerous languages simultaneously. This technology is most likely to become the standard in the near future. It facilitated the task of incorporating more than one language and writing system within a typeface’s repertoire, thus resulting in fonts with huge character sets. Designing a font family for Arabic will almost inevitably imply an accompanying Latin character set. The majority of Arabic type users will need both character sets in compatible form.

Type designers who are willing to delve deep into computer technology will discover a bottomless world without boundaries. Dreaming away easy in that environment, like characters that are animated or that can change slowly over time in shape or colour on the screen, or fonts that can be customised slightly by the readers (for instance to best serve their eyesight). Text can be given a voice or be displayed in a different writing system. However, it is good to return to the surface from time to time after exploring the dark depths of modern computer technology. On the return to the surface, one might discover that designing type remains strongly linked to handwriting. It appears to be the most ‘natural source’ to create a family of type. Experiments on this level remain useful. Both worlds are essential in the professional business of type design today.
4.1. The influence of production tools on the visual aspects of type. Production tools exert a considerable influence on the way type is produced. These tools are a combination of those devices that are used to draw or write a specific symbol on a specific material support. The combination of both support and tools contributes to the ultimate form aspect of the letters. Any tool requires a certain specific drawing process that is inherent in its nature and in the way it is held and manipulated by the human hand and perceived by the human eye. Since the beginning of known human civilisations, tools have been influenced by the physical environment of a civilisation and its living conditions. They have often been shaped out of the natural matter readily available and abundant within that environment.

Sometimes certain cultural and economic values and status have been attributed to their owners, and certain power or magic has been attached to the material of which they were shaped. As we move forward in time, and with the advancements in human civilisation and their ingenuity at overpowering and controlling their environment, more sophisticated inventions lead to more complex techniques and machines. By retracing the history and development of writing and later typographic tools—from their first inception as concrete objects to their later existence as immaterial digital codes—we can retrace the formal developments of letterforms.

The effect of production tools on the visual aspects of writing, lettering, or typography is highly visible throughout the historical development of written language. The working method and skill of the crafts person in developing the most efficient tools influences the visual appearance of the resulting text, consequently creating a particular style representative of a specific period. The development of tools and technologies is irrevocably attached to desirable economic conditions. The need for their replacement only takes place when new tools are invented that are more suitable to the production demands and more profitable—either by being available at lower prices, and/or by improving the speed and quality of production and products.

The mark of production tools on the shape of letters is one factor, yet another essential factor is the human desire for the preservation of traditional values and aesthetics. The traces of old production tools are still detectable in the shapes of letterforms to this day. They become conventional forms that tampering with, would hinder letter recognition and reading in general. They are often nostalgically romanticised and collectively cherished for their charm and aesthetics.

It is important to trace the reasons underpinning the invention and development of the writing tools in order to achieve a deeper understanding of the origins of letterforms. Since the beginning of the 20th century and especially in the last 30 years of the second millennium, technological advancements have accelerated at a speed previously unimaginable. The knowledge and expertise for type production has been decentralised from the hands of a few members of a guild and spread over a range of technical and design disciplines. Like much of today’s knowledge, type design and production has become collective knowledge, no longer gathered in one spot and in need of a variety of expertise to properly produce and reproduce it.

Below is a concise overview of the inventions and developments of tools and techniques, and how they have come to influence the formal aspects of Latin and Arabic scripts.

4.1.1. Tools for manual production

![Image of a stylus](image-url)

The oldest writing tool found in Mesopotamia around 3000 BCE, was the Stylus. It is a three-sided sharpened stick used to impress marks into wet clay tablets that were left to dry in the sun. They remain the oldest written records of human civilisations. Lying in a fertile plain between two rivers, the Mesopotamian choice of clay as a material support for written documents was due to the availability and abundance of this material in the immediate surroundings. The marks made out of the combination of the stylus, the wet clay and the human hand resulted in triangular wedged shapes that came to be known as cuneiforms. These same wedged grooves are still adopted when cutting Roman letterforms in stone.
Around the same period, the Egyptians also developed a faster type of script by employing more flexible tools and support. They invented the principle of writing sheets, which they produced from dried papyrus leaves, a sedge that grew along the Nile river. This material was easy to write on with ink; consequently, (from the same vegetation) the reed brushes were produced and employed for writing. The script was originally highly pictorial (hence the name Hieroglyphs)—a feature only made possible with the employed tool and support. The Egyptian script eventually developed into the more abstract and cursive Hieratic and Demotic scripts.

It took some thousand years for a new writing system to be developed. It was the Phoenician people—a small civilization of traders squeezed between two giant empires, the Mesopotamian and the Egyptians—who built on the knowledge of their neighbours in producing pragmatic writing tools and support, and stemming from the need for simple commercial communication with foreign nations, invented the most pragmatic and ingenious system, the alphabet. It consisted of a system that dissociated the written representation of language from meaning, creating 22 autonomous symbols each representing a simple sound. The Phoenicians used the same tools and support as the Egyptians and even traded in papyrus sheets thus becoming middlemen between the Egyptians and the Greeks.

The Greeks eventually invented their own writing support produced out of animal skin, known as parchment. It was a thinner and more flexible material that could be folded and stored away efficiently. It had a smoother surface that was easier to write on. The Greeks also invented the split-reed pen to go with their parchment support. This tool allowed for more precision and was more comfortable to handle. The effect of the reed pen was to create more fluid, elegant letterforms, and its impact on the Roman scripts is still quite visible in calligraphic type styles to this day. Parchment and the calligraphic pen were used in Europe up until the 18th century, when the Arabs introduced the Chinese papermaking invention through their Western colonies in Spain and Sicily.

As the Romans were actively building up their empire after the 6th century BC, their conquests brought them in contact with the neighbouring Greek nation. From the Greeks they gained aesthetic and intellectual knowledge that helped them raise their cultural standards. Among the borrowed art practices was beautiful lettering, termed calligraphy by the Greeks. The development of the serif on Roman capital letters—the clean and beautiful ending of letterforms—and the modulated thick to thin strokes were a standard in Greek lettering technique. This technique developed further as the Roman Empire expanded; its administration getting more complex and needing strict
organisation, and Roman monumental inscriptions on stone
becoming a standardised signposting representation of imperial
power and authority. Since the script represented the visual
identity of the imperial state, the letterforms had to be standard-
ised, abiding by strict formal rules. The production of Roman
stone inscriptions was made consistent by using stencils of the
letterforms for positioning the text and tracing the image with
white chalk directly on the stone. This stencil image was then
drawn over with a flat brush and carved out of the stone with a
chisel. This technique remained in use for hundreds of years,
ensuring the unchanged visual representation of Roman imperi-
al inscriptions over a remarkable expanse of time and geographi-
cal locations.

With the decay of the Roman Empire and the emergence of the
French Empire under the reign of Charlemagne, new and more
complex administrative needs emerged. By then a few handwrit-
ten scripts were developed during the Middle Ages in Europe
based on the Roman capitals, such as the Square Capitals and the
Roman Semi-Cursives (4th century AD); the Rustica Capitals (2nd
to 4th century AD); the Latin Uncial (5th to 8th century AD); and
the Irish-Anglo-Saxon Uncial (8th century AD) where the first
forms of some lower case letters can be detected. These scripts
were employed by professional scribes for use in religious and
beautifully illuminated manuscripts. With Charlemagne’s ambi-
tion to spread literacy and liberate knowledge from the hands of
the clerical elite, the English monk Alcuin of York was compro-
missioned in the 8th century AD to develop a new standard script
that was easier to read and write. This script became known as
the Carolingian Minuscule (named after Charlemagne). It con-
stisted of small type with connected letters, and com-
bined lowercase and capital letters. This script is the origin of all
today’s Latin typefaces. It was written with ink and goose-
quill pens, firstly on parchment and later (13th century AD) on
paper. This production technique remained in use for centuries
and produced a wide variety of writing styles based on the
Carolingian Minuscule. The two main divisions were clearly vis-
able: in the northern Germanic part of Europe where the
Blackletter (Gothic) or the Rotunda (Round Gothic) scripts were
commonly used; and the southern Roman part of Europe where
the Humanistic Minuscule and Cancelleresca scripts were de-
veloped. Both styles prevailed and flourished in book-letters until
the invention of printing with movable type in the 15th century.
Arabic script is a late bloomer compared to its Latin counterpart.
It originated from older Semitic scripts and developed in its own
right in the 7th century AD. It took a few hundred years and the
establishment and flourish of an Arab Islamic empire for the
script to mature and become standardised. It never however
reached the same strict level of normalisation as that applied
under the Roman Empire. Artistic freedom and styles prevailed.
It was not until the 16th century AD that all cursive Arabic cali-
graphic styles were categorised, and the letter proportions and
scriptorial rules standardised by the vizier Abu Ali Ibn Muqlah.
The same tools of pen, ink and paper were used and further
developed. Arabic script remained for the major part manually
reproduced by professional calligraphers, until the introduction
of printing into the Middle East in the 18th century.

4.2.1. Tools for handmade and handset type

In the late 14th and early 15th centuries, the spirit of the times
was adventurous, attempting to shake off the oppressive Medi-
eval social values. Society was growing more complex and liberal
and the need to spread knowledge to a wider audience became
more urgent with the growth of literacy. The need to create mul-
tiple copies of original texts grew. Woodblock and engraved
metal plate printing were employed for this end—a technique
invented in China some hundreds of years earlier and brought
into Europe by the Arabs. The printed book was born and print-
ing techniques developed along a more economically viable and logical direction. This development eventually led to the invention of movable type by Johannes Gutenberg of Mainz in 1450. The first book to be printed with movable lead type by Gutenberg was of course the Bible. (The Chinese had also been using movable printing types some hundreds of years earlier, but instead of lead they used clay for their type, which was brittle and therefore a less durable material.) After Gutenberg, the printing and book publishing industry moved to Italy (mainly Venice and Rome), and was sponsored by the Roman Catholic Church for propagating its political and economic power. The first Arabic book to be printed with Arabic movable type was also a liturgical Christian book for the Melkite Eastern Church. It was printed in Venice by Gregorio de Gregoriis in 1514. The calligraphic nature of the Arabic script proved to be a costly challenge and it took several decades for it to be resolved by the French type designer, Robert Granjon.

After Gutenberg, the production of type moved from the hands of printers to more specialised craftsmen, the punchcutters. These were originally metalsmiths who got more skilled at cutting punches for the typefoundries that produced the lead fonts for the printers. The shape of the letters developed along the specific limitations of the metalworking and printing production methods. And the influence and skill of punchcutters—the first type designers—grew while that of calligraphers diminished and eventually disappeared from the process of book production. Producing punches and movable type was a laborious task that required time and a considerable investment. Therefore, most skilled punchcutters/type designers were found in countries with the most wealth, namely in 16th century Italy where Nicolas Jenson revived the Carolingian Minuscule in movable type; Francesco Griffo cut the first italic types for the printer and book publisher, Aldus Manutius and Robert Granjon brought type design to an unprecedented aesthetic level, cutting numerous types in a range of Latin and non-Latin scripts.
In the 17th century, France emerged as a typographic centre under the auspices of King Louis XIV, who commissioned the chief engraver of the Royal Academy of Medals and Inscriptions, Philippe Grandjean, to cut an official royal book typeface, that was named Romain du Roi. In the same period and at the peak of its Golden Age, The Netherlands became the typographic centre of Protestant Europe. A range of Latin and non-Latin printing types were produced in conjunction with the printers affiliated with universities in Leiden and Amsterdam, and abroad in England and Germany.

4.1.3. Tools for mechanical production and typesetting

The Industrial Revolution of the 19th century modernised the printing industry by mechanising a major part of type production, typesetting and printing techniques. Complex machines were developed that mechanised the production and setting of type in a faster and more economic way, boosting the number and amount of publishing of daily papers and other publications. The German company Linotype invented in 1896 a mechanism using Klett typesetting machine that set and cast whole lines of type, the metal slug-casting Linotype. Shortly afterwards in 1899, the English company Monotype invented a new typesetting machine — the Monotype Typesetter — that was revolutionary in its invention and intricate mechanical construction. The advantage of the Monotype Typesetter was that it could set individual characters. This allowed for typographic refinements most needed for setting Italic and Arabic typefaces. Since the Linotype slug-casting machine was confined to casting whole lines of text and was limited in its possibilities to allow for intricate kerning, which was needed for setting Italic, a mechanical simulation of Italic was invented to compensate for this lack. It was a slanted version of the upright Roman fonts known as Oblique or Slanted fonts. For the first time, the keyboard (or input device) was totally separated from the lead type (or output device). Typing on a keyboard replaced the function of hand picking lead type from the wooden cases; yet the layout of the keyboard was modelled according to that of the type cases it replaced. Influenced by the invention of the typewriter, most keyboards became simpler and more compact, taking into account the human hands and the layout most suitable for typing. This speeded up the work of keyboard operators and optimised text production.

Industrialisation always initiates two types of related and contradictory developments: first it initiates the invention of complex technologies or machines that perform more efficiently the work done by manual labour often used for high-end manufacturing, then in turn these same complex machines generate a
The mechanical production of type gave birth to standardised complex type metrics. These played an important role in the design of new typefaces that were originally copied from earlier metal styles and rectified to work best on the new machines. No pretense was made to originality, the main goal of manufacturers of typesetting machines was to reproduce as accurately as possible the existing designs of movable metal types. In the early phase of industrialisation, type metrics was an important design constraint. Type was created of tangible pieces of metal that had to be assembled to form lines and columns of text. This called for the creation of the 'one point' module as the smallest unit of the type metrics measurement system. The exact measurement of this point module varied from one country to another (the French metric Didot point and the English Pica point had slightly different values). It is remarkable to note that the non-metric point is still in use today; the common computer screen has a resolution of 72 pixels per inch, with a pixel being roughly the same size as one point. When the input or the keyboard device was separated from the output or typesetting device, as in the Monotype Typewriter, the need for a more complex type metrics structure arose; a grid based on 18 units was invented to help in making calculations easily applicable to all sizes of a single typeface.

The Industrial Revolution gave birth to a new professional discipline, type design. Although the cost of design and production of type was reduced with industrialisation, it was still a considerable investment. The manufacturers of typesetting machines replaced the independent foundries, providing fonts with their machines. The punch cutters disappeared and with them a whole craft of creating type based on manual skills. With the invention of the Pantograph in 1844, type design and production were further mechanised. Punches were no longer cut and designed individually for each type size. The Pantograph and engraving machines were employed to trace large-sized letterforms and engrave their exact shape in far smaller sizes. This effective design and production process did not necessarily improve the aesthetic quality of fonts by mechanically instead of optically reducing type sizes, it did however speed up the work.
4.1.4. Tools for photographic production and typesetting

The offset printing technology based on the hydrophobic quality of fatty inks, became the favoured printing technology, eventually replacing letterpress printing for most mainstream printed matter. The advancements in photographic technology was behind this technique of printing from a flat photosensitive plate. Typesetting machines had followed suit in employing the photographic process for the production of type. The cost of design and production of new typefaces was dramatically reduced with this new typesetting technology. Only one set of matrices was required to make all type sizes; using a partially transparent matrix, a strong light source, a set of lenses, and a mechanical transportation system for the photosensitive paper or film to be exposed.

Type production became partially immaterial; the letters could be composed out of parts that are superimposed by simply manipulating the exposure and transportation distance of the photosensitive film/paper. Leading and wordspacing became more flexible and easily modifiable by the typesetter. Type designers took into consideration the tendency of photographic technology to clutter up small spaces, and designed fonts with optical corrections and more open counterforms in order to keep the type sharp and clear, especially in small sizes. During this same period research was carried out for composing traditional calligraphic Arabic cursive scripts using the composite letter systems that phototypesetting allowed for, in order to create fluid letter connections.

The environment of type production was transformed from the noisy, smelly environment of the metal type casting machines to the laboratory-like new environment, occupied by new quiet white boxes in sealed dust-free rooms, smelling of photo-chemicals. This new technology boosted the development of new designs, and previously unheard-of quantities of fonts formed the collections of typefoundries. The first such mega type collection was released by the German typefoundry Berthold. Phototypesetting became an independent profession with specialisation staff that provided their services to design studios and printers. The effect of this technology was immense in widening the creative and formal possibilities of type design.

Within ten years of the introduction of photographic processes, phototypesetters became the standard for setting type. The text input process into these new typesetting machines changed from a mechanical to an electronic one, by supplying the machine with text on a floppy disk then adding a set of coded instructions to create the right designed text output. The generic text was provided by the client and the design instructions by the professional typesetter. Still the font matrices were tangible and the mechanical part of the machine was essential for ensuring the quality of the end result.

In 1966, the German company Holl developed a new CRT (Cathode Ray Tube) exposure system for photographic paper. This invention was the important step in the direction of the new digital era. It marked the beginning of storing type as digitised data called bitmaps. The preparation of this new storage procedure was to take the analogue drawings, scan them, and by doing so transform them into bitmaps. The bitmaps were then edited to achieve the closest representation of the actual letterforms. With this technology, type manipulation was made possible 'on-the-fly', by adding instructions to an existing font. Typefaces and images could be incorporated in the same exposure of the film since both became rasterized (halftone) images. Originally, the position of characters within a font had always been regulated by the parameters of a set grid. However, this grid was applicable to the space a letter could occupy within a line of text, but the shape of the letter itself was free within its set framing boundaries. With the latest CRT technology, even the shapes of each letter were set on the rasterisation grid to which they were mapped and confined. This invention marked the end of mechanical supremacy and the beginning of digital production and reproduction of type.
4.2.5 Tools for digital production and typesetting

The Digital Revolution marked the beginning of a new era in visual communication and production technologies. The tools became invisible electrical signals and the whole physical aspect of typographic material totally evaporated; the tool, the support, and the type itself merged into one and the same digital medium. The computer technology not only changed the means of production and made manufacturing more efficient, it reduced all processes to digital data. It has an unprecedented capacity at storing information and instructions that can be carried out at various stages of the production process. The Monotype typesetter could also store instructions which were produced as punched holes on a roll of paper that was later read by the machine that set the actual lines of metal type, but the storage capacity of such mechanical tools was rather limited to very specific functions.

In our present-day digital age, machines and tools are no longer operated by hand but electronically instructed with a set of numerical binary codes. The development of tools has always been basically an extension of human skills, with mechanical tools it was an extension of muscle power, but with the advent of digital technology, the essence of particular skills became the product itself, which could be reproduced indefinitely. The world of craft was to be transformed from manipulating atoms to manipulating invisible bits. It took some considerable amount of time, and skilled labour of specialists to make these various machines compatible, resulting in an explosion of widely available cheap production equipment.

Office machines were changing dramatically in terms of their function and the range of tasks they could perform. Even the typewriter became equipped with a small digital memory and could deliver more complex typographic layouts in a variety of typefaces. The gap between professional and office equipment was narrowing, and the level of text quality was getting closer. The American company IBM put a ‘desktop computer’ on the market as a sideline of their production of ‘mainframe’ computers. IBM underestimated the impact of this low-end product while signing their licensing deals with the young Microsoft software company that was responsible for creating the operating system of this ‘desktop computer’. Though these new computers did replace the typewriters in most offices, their keyboard was essentially very similar to that of the typewriter with some additional keys that could input extra instructions into the computer.
The most important feature of the new computers was that their viewing screens showed precisely and instantaneously the result of the typed text and its layout, which allowed for changes and adjustments to be made before any instruction is given to actually print the text.

instructions into a computer, they created simple little illustrations calling them 'icons' on the screen, and a hand pointer device called a 'mouse', with which one could navigate over the screen virtually picking icons and clicking on them to initiate specific instructions related to each respective icon. Also the screen became what you see is what you get, which means that the image on the screen was a close representation of the printed end result. This system combining GUI or icons, the mouse and the what you see is what you get, was an invaluable improvement to working with computers.

Computer developments came cascading after this, improving the quality of type output until they brought the phototypesetting industry to a full halt. The American company Adobe, invented a new way of storing numerical data in the form of mathematical formulas. This technology was not only applicable to type, but to whole layouts and images. This method occupied less computer memory space and made manipulation of images and data faster and easier. The Adobe software was called PostScript, and became the standard in the graphic industry. Since the PostScript technology was dissociated from raster resolution, the documents created with this software could be used for any output machine, from the cheap low-end office printers (as proof prints) to the high-end ionizing film printers. The coarse dot screen was soon resolved for high-end printers with machines that could expose film with laser beams at 3400 dots per inch, a level of detail by which the human eye can no longer detect the separate dots.

A complete new era was dawning with the arrival of the personal computer on every office desk, replacing the old typewriters at alarming speed. Typing became known as 'word-processing', and typesetting in the form of sophisticated software was termed 'desktop publishing'. Typewriters became known as 'computer operators', only processing type on film, provided on floppy disks and designed by their clients. Typesetting offices were no longer a professional discipline requiring specialist personnel, their skills were replaced by computer software directly in the hands of designers and laypeople alike. During the industrial revolution, production facilities became cheaper than their predecessors but a considerable capital investment was still needed to set up production facilities. With digital equipment, this initial cost was a small fraction of what it used to be; the determining factor for the business success of these machines was determined rather by their efficiency and the range of software applications they could operate.
Following these developments, and within a short period of time, type production underwent a major change. The investment to develop a new typeface was reduced to an investment of design time on the part of the type designer. All other costs of producing matrices, storage and distribution had completely disappeared. A font turned into a collection of numerical instructions and mathematical formulas that can fit on any small computer floppy disk. The font became entirely immaterial and was not confined to a specific typesetting machine. Compared to today’s type production, the efforts of the famous English type designer William Caslon would seem preposterous. It took Caslon 14 years to cut his punches and make with them the matrices for his Caslon font. Today electronic matrices can be produced within a day’s work. This has resulted in the availability of a very extensive range of fonts. The perception of fonts as everyday commonplace commodities has been largely influenced by the fact that every computer owner has tens of fonts imbedded in his machine, and that a wide selection of thousands of fonts (in different styles and scripts) can be ordered from a range of large and small typefoundries in digital formats, on CD, or via the Internet. One can also order custom-made fonts at an affordable price. All traditional European typefoundries have witnessed the obsolescence of their typesetting machines and have rushed to digitise their font collections and make alliances with the American computer industry. In the past 15 years, far more typefaces have been designed and produced than in the entire preceding 500 years of type production.

All the paraphernalia of type production facilities have been stripped away. Type could be entirely designed and produced on the same machine where it would be used. Neither the noisy mechanical nor the laboratory-like environments has survived. Instead, type is being created in environments very similar to any office, on machines not very different from those used by a bank clerk or an office manager. Type designers, working in their own studios behind their personal desktop computer have full control over their fonts from design inception to production and even distribution. This has led to an explosion in the type design field, and with the freedom from technical constraints, formal experimentation has run wild.
calligraphic styles of Arabic Naskh script; or fonts that can incorporate within one font family all the written scripts of the world.
Type manufacturers are busy improving the rendering of their typefaces on a wide variety of output machines by embedding more computer instructions into their fonts. Another contemporary concern is to create a computer system that can incorporate all the world’s writing systems simultaneously within the same environment.

Type, taken away from its printed end result has still far more potential applications than is presently explored. In the digital age, type has lost its final status and is in an unstable state of flux. It is constantly being re-built with every ‘refreshment’ of the computer screen. It can move, change colour or shape instantly, be animated or carry further instructions when activated. Type on a screen communicates differently than in its printed form. In the future, text may lose its supreme status. It has already partially lost its physical existence on tangible support material.

Though originally invented to preserve and document spoken language, type and speech are slowly becoming interchangeable forms of information representation. A text may be read by the computer and listened to by the user, and vice versa; instruction may be spoken by the user and listened to (and carried out) by the computer.
4.2. The repertoire. The repertoire is the name given to the full collection of glyphs within one typeface. The repertoire of a typeface can range in size from a small to a large number of glyphs. This depends on the intended function and scope of the typeface design, the typographic refinement sought, or the writing system or script the type is representing. Moreover, and like all collections, type repertoires have the tendency to grow over time.

In what follows, the emphasis is put on the collection of characters rather than glyphs. But before going any further, a definition of terminologies—a clear distinction between characters and glyphs—is needed to avoid unnecessary confusion.

4.2.1. The distinction between characters and glyphs

Characters are all the different graphic signs that constitute a writing system. In alphabetic writing systems characters are divided into alphabetic characters (the letters of the alphabet) and non-alphabetic characters (the numerals, punctuation marks and symbols). All alphabetic writing systems use a limited number of letters. However, each letter may be represented by more than one character. The Latin script has two characters (upper and lower case) to represent each letter of the alphabet. The Arabic script has four characters (initial, medial, final and free-standing) to represent most letters of the alphabet. In addition to this set of characters for the letters of the alphabet, there exist characters for vocalisation marks. These marks appear sometimes as part of a letter thus creating a new letter, or as separate characters added to letters to enhance the pronunciation of the text (as in the case of vocalisation marks in Arabic texts).
Giving proper names to the representation of characters is not that simple. The information (drawings and related instructions) responsible for the representation of all characters on a computer screen or in print are called glyphs. Each character can be represented by a variety of different glyphs, that are the result of different design or style variations. Characters cover the content part of a repertoire and have names and numbers, whereas glyphs have a face linked to these numbers. Upper and lowercase variations of letters in the Latin script are considered separate distinct characters, but what about ligatures, old-style figures, and swashes? In order to make the distinction between characters and glyphs clearer, it might be useful to introduce the concept of a ‘unique skeleton’. Characters must have a unique and distinct skeleton basic shape, whereas glyphs may vary visually in the way the ‘flesh’ is built around this ‘skeleton’. Glyphs give the basic skeletal shapes of characters distinct contours or silhouettes. This distinction would classify variations in proportions (condensed or extended), in angle (oblique or roman), or in weight (light or bold), not only as style variations but also as glyph variations.

A clear distinction has to be drawn between the basic repertoire of a typeface, the possible extension of this basic repertoire into what is called the ‘expert’ set, and the variations of these characters in a ‘family’ of related glyphs within one typeface. In real-life fonts, these distinctions are not always clearly nor logically organised. The most logical and simple way to make the distinction and categorisation clearer is to say that there are three main constituents—the graphic signs, the characters, and the glyphs. Graphic signs are representations of meaning or sounds. Characters are representations of the graphic signs in their skeletal shape, grouped in coded character sets per language or script, and directly accessible through our keyboard. Glyphs are the outline drawings of the characters, grouped per typeface or font family, and accessible through our menu on the screen.

4.2.3. The historical development of the repertoire

The historical development of the font repertoire starts naturally with the first set of movable printing types. Gutenberg was the first to develop his own repertoire of glyphs. He used the written manuscripts of his time as a source of inspiration for making the selection of his needed glyphs. His set contained many formal variations of characters, and many more ligatures than is generally used today in Latin fonts. Though more extensive than the average basic repertoire of a Latin font, Gutenberg’s repertoire was still limited in quantity. It was available in one size and one weight, resulting in a large set of glyphs for a small font family.

The way he used his font was rather simple. He cast his type with his own matrices, and arranged them in a wooden case. This case was divided into compartments each containing a specific character, and varying in size to provide sufficient space for storing the need amount of types. This amount varied depending on the number of times that a character was likely to appear in a text. The layout of the case was also designed so as to accommodate the efficient hand-picking of individual characters.

Gutenberg’s method of organising and storing movable type remained the same for centuries. However, the average repertoire was growing over time. The average font family was steadily expanding into a wider range of form and size variations. Technological developments have had a great influence on the shapes of existing and additional characters of the Latin script. For Arabic typefaces, technological developments had far less influence on the visual aspects of the script. The complexity of the repertoire did notexpand beyond the conventions of handwritten manuscripts. Robert Granjon was the first to develop a refined and beautiful translation from Arabic calligraphy to movable metal type. It is not known precisely how big was the repertoire of needed glyphs.
With the invention of the typewriter and its implementation in most office spaces around the world, the keyboard dictated entirely the size of the glyph repertoire of these machines. Both the Latin and Arabic scripts used the exact same amount of keys and their glyph repertoire had to be modified and simplified accordingly. The typewriter had 45 keys, which were doubled with the function of the shift key allowing for a maximum of 86 characters. This strict limitation in the size of the repertoire did not cause serious problems for producing legible text in Latin and Arabic scripts.

The technology based on movable type reached its peak during the first wave of the industrial revolution. Some Latin fonts became so extensive, consisting of a huge repertoire of glyphs that accommodated very refined typographic applications. Each type size was cut with great care and consideration. Typesetting became automated replacing the manual handwriting. The keyboard replaced the type case and came to play an important role in font technology. Since keyboards could not be altered for each specific font, repertoires had to be standardised to match the keyboard. Technology was pushed to the edge of its limits in order to produce manuscript-like calligraphic Arabic type.

Monotype built special type casting machines to create a fully vocalised Arabic Naskh font, only available in 24 pt size—written manuscript size.

Phototypesetting freed the repertoire from all the different type sizes that were originally needed. Optical lenses took over, producing from one single set of matrices all the desired type sizes. Still, specialised typesetting machines with their own keyboards were still in use. This last proprietary feature was soon abolished by digital typesetting. The keyboard of office machines became the standard and was used for most typesetting work. It did not differ much from that of the good old typewriter. The number of keys increased slightly from the original 45 to an average of 48. The real difference lies in the computerised processes that start after the initial key stroke. The keys no longer represent specific characters like they did on the original typewriter keyboard. On a computer keyboard, keys only generate numeric codes which can be linked to additional codes. The keys can therefore quadruple the amount of characters accessible through the keyboard, with the help of not only the shift key, but also with the option...
key, and the option-shift key combination. This gave a total of 162 characters directly accessible through the regular computer keyboard. With the additional function of pull-down menus on the computer screen that are accessible with the mouse device, an additional number of characters and glyphs may be obtained. In addition, the fact that keys were no longer physically connected to specific characters on a matrix, electronic mapping through character codes provide the possibility of having more flexible keyboard layouts. This possibility has instigated the creation of a superlative font repertoire. Monotype designed an Unda Nasta'liq font of around 17,000 characters (originally designed for computerised phototypesetting). Latin typefaces, such as the Times font family, have been designed containing over 35,000 glyphs. Multilingual and multiscriptural typefaces following the Unicode standard character set, like the Lucida and the Andale font families, are continuously expanding the size of their repertoire. The use of one keyboard for the production of different typefaces initiated the need for standardisation. Sending typed or 'keyed-in' text directly as digital information over a network instead of sending printed letters, made standardisation of repertoires inevitable. That is to say only a standard structure was needed for the underlying repertoire, the character set. The repertoire has two related aspects, the coded character set and the related family of glyphs. There is a clear separation in the way the computer deals with the characters that are 'keyed-in' and immediately stored, and their final representation on the screen or printed paper. Characters are first queues of character strings, which are endless lines of numeric codes. In this format, text is communicated from one computer to another. At the receiver's end, these codes are rebuilt into visible representations.
of readable text. In such an environment, sharing one standard character code is of course essential to avoid gibberish. The receiver has the possibility of changing the visual representation of these codes easily by choosing a different typeface, or other such form variation. This method can also be used to select totally new characters, for instance, changing Roman letters into italics, or Titling figures into Old Style figures. These characters share the same character code but are represented differently when an ‘expert’ set is selected. The expert set is sometimes a part of the font family. It is in fact a ‘special’ part because it is an extension of the character set. Instead of adding a new character code, it adds a new code at the beginning (and at the end) of the selected text part. In Arabic, expert sets can be used to produce alternative ligatures or (prolonged) representations of the same characters.

Making a selection without changing any character codes in order to change the visual representation of text drastically can be made with built-in instructions in the font itself. These instructions make alterations ‘on-the-fly’. This type of instruction is called ‘context-related character substitution’, and is used in Arabic where characters change ‘automatically’ in shape according to their position within the word. In this case, character codes change their numeric code automatically depending on their neighbouring characters, in order to produce a different representation of the same letter. Meanwhile, in Latin scripts, the upper and lower case representation of the same letter has to be typed in manually.

The possibility of adding to a font general instructions that influence the visual appearance makes the boundaries of the precise repertoire somewhat nebulous. These instructions can be parameters modifiable by the end user. This possibility makes collections in fact limitless.

The standardisation of repertoires by institutions or companies is confined to creating coded standard character sets. These standardised character sets have the advantage of making fonts and text files interchangeable among various computers. Computers would know what to expect, and this is absolutely essential for global communication nowadays. The important standard character sets are the ASCII (which forms the first half of many 8-bit character sets), ISO Latin-1 (after which Adobe’s set was modelled), MacRoman, and Unicode (used by Windows 2000, and MacOS X).
The generation of glyph repertoires has recently taken two forms. The first to enter the stage was Adobe Systems with their development of the ‘Multiple Master’ technology. It used two fonts, the SerifMax and the SansMax, as a method for generating visual representations of any specified font by strictly using its font metrics. The second is a standardised font categorisation or description technology developed by the PANOS font matching system, and now exploited by the company Hewlett Packard. The underlying idea is that fonts could be described by every determining detail. Once this descriptive information is known (and available for all fonts), original outlines would be less needed to make accurate representations of a particular font.

The development of “Open Type” and “Unicode” has led to the creation of software and multilingual graphical user interfaces where many scripts can coexist. This has resulted in tremendous character sets, such as the Arial Unicode MS font provided with MS Office 2000. This font supports all characters in the Unicode 2.0 standard (approximately 40,000 characters).
4.2.3. The functions of characters and glyphs

4.2.3.1. The alphabet

Arabic and Latin are alphabetic writing systems, using separate letters in specific combinations to create words and subsequently sentences. Though they originated from the same Phoenician script, each has developed in a quite different visual direction.

The alphabet provides the essential basic characters of any alphabetic writing system. It consists of individual letters and letters with accents. The Arabic script has 29 individual letters, whereas the Latin script has 26 letters. Letters with accents are used in Latin to accommodate the various languages using the script. These accents combine with existing letters to create new additionally needed letters. Accents are sometimes used as help for the pronunciation of words. The different languages that make use of the Latin script vary considerably in the amount of accents used. The English written language is without any accents, while the French makes extensive use of them. French text in general gives an accurate indication of the proper pronunciation. English text (especially British English) contains some words with unexpected pronunciation. In character sets, accents can appear as separate characters. Using specific key combinations on the keyboard can place these accents above regular letters, thus saving character slots.

In Arabic scripts, two distinct types of diacritics are used. The first type is comparable in function to accents in Latin scripts. These are called 'diacritic dots', and come in configurations of one, two or three dots placed above or underneath existing letters to create complete new letters. This method is also used for making additional letters for non-Arabic languages using the Arabic script. Some languages even use clusters of up to four diacritic dots.

The second kind of diacritics are the 'vocalisation marks' used to mark short vowels and diphthongs. These vocalisation marks are used to facilitate the understanding of the text and clarify the pronunciation of certain words. The amount of marks actually used in Arabic type varies immensely depending on the purpose of the text. For example, vocalisation marks are often absent from text in newspapers where visual simplicity and economy of space are favoured. Vocalisation marks are used as reading and learning aids for children's books, or where it is imperative not to have any misreading or misinterpretation as in the Quran. On the other side of the spectrum, vocalisation marks can also be
very prominent in specially designed words or names. In fact, accents in Arabic can be used to such a detailed extent to demonstrate proper pronunciation, that it starts to resemble the signs used for music notations. Vocalisation marks in Arabic scripts are always separate 'characters' in a character set. These marks can be placed afterwards by positioning the cursor after the letter where a vocalisation mark is wanted, and then typing in the required mark in combination with the shift key. This method of using the so-called 'dead keys' originated with the old typewriters. A few keys on the old typewriter keyboard were used to place accents, and were called dead keys because they did not move the paper sheet automatically sideways after being pressed.

4.2.3.2. The non-alphabetic characters
The alphabetic characters are the minority of contemporary character sets. In fact, they are an ever-growing minority and this looks set to continue. It seems that new knowledge cannot be expressed with the existing vocabulary provided by the alphabet alone; it needs additional non-alphabetic characters. Non-alphabetic characters can be grouped in four categories.

1—Numerals
Numerals were brought to Europe by the Arabs. Latin and Arabic scripts do not share the same shape for their numerals. The standard Latin 'Arabic numerals' are also part of an Arabic font, because these shapes are often used in North African states. In Latin sometimes 'Roman' numerals use the Roman Capital letters to represent numbers. They are often used as part of a typographic numbering system, for example for numbering chapters in a book. There was also a tradition of using these numbers to mark the issue dates of printed matter. Some repertoires incorporate specially designed fractions (a half, a quarter, one-eighth), which were traditionally used for writing interest rates. In addition to all this, superior and inferior numerals used for references and notes, or for mathematical notations, can be included in 'expert sets.'

2—Punctuation marks
Punctuation marks are the characters used to enhance the ease of reading. They help eliminate ambiguity from the meaning of texts. Arabic and Latin use basically the same punctuation marks, only in Arabic some are used flipped or upside down. Arabic fonts sometimes have ornamental versions for a period (called a rosette) or for a pair of parentheses. Often punctuation marks for Arabic fonts are taken from Latin ones and therefore do not always match harmoniously with the other characters.

3—Symbols
Symbols come in an almost endless variety. Every specific part of the universe of human knowledge produces its own set of symbols. Like the real universe, it keeps expanding at an accelerating rate. Some of these are found in special 'symbol' fonts that are made to serve specific purposes. However in standard character sets, the amount of symbols also keeps on growing. The standard set of symbols include simple mathematical notations (i.e., addition, subtraction, division, multiplication, greater, smaller, percentage, and equal symbols); financial symbols for the most widely used currencies; a few of the most used scientific symbols (the square root symbol); legal and other common symbols that have become part of modern life (such as the ®, the copyright, the registered, and the trademark symbols); typographic and reference symbols that were frequently used in old texts (i.e. the asterisk and the dagger). What is often missing (and type-designers should consider including in their standard character sets) are arrows. Signage is nowadays an integral part of corporate identities, and arrows are an important part of that.

4—Other additional symbols
Standard Arabic fonts often include complete Quranic phrases and words as additional characters. Pictograms can be added to any existing font. Fonts can consist of small illustrations, typographic elements, or decorative borders. In fact any type of drawn image is accessible via the computer's keyboard-menu combination, and can therefore be part of a font's character set.

The above mentioned type of characters are in most cases indeed different signs, representing a different meaning. Often character sets also contain different representations of the same sign, mostly appearing around the letters of the alphabet.
4.2.3.3. The shapes of the characters

1—The shapes of the alphabet

The letters of the alphabet do not have only one basic shape for each individual letter. Latin type has three shapes for each letter, while Arabic type has four. The history behind these variations and their purpose differs from Latin to Arabic type.

In Latin the three shape variations are called: Capital letters, Lowercase letters, and Italic letters. These different shapes were originally variations of the alphabet developed over time by different cultures. The Capital letters are taken from the Roman script, and represent the oldest shape of the Latin alphabet. The Lowercase letters developed later from a variation of the Latin script called the Carolingian Minuscule. The Italic letters came from the Italian Renaissance writing styles. Now these three shapes are used within one typeface mainly for marking intervals and pauses within a text; the Capital letters to mark the beginning of a sentence or designate a proper name; the Lowercase letters for the regular body of the text; and the Italic letters are used for emphasis or distinction.

Arabic’s four shape variations—initial, medial, final and free-standing—are entirely determined by the position of the letter within a word. Contrary to the developments in the Latin script, these variations were not developed over time but have always been an integral part of the Arabic script. The fact that the variation in shape of one letter in Arabic is often more prominent than the shape variation between different letters is due to the fact that in Arabic more importance is given to the shape of whole words than to that of individual letters. The reason behind this is Arabic’s strong ties with the handwritten calligraphic script.

2—The alternate shapes

The alternate shapes are mostly developed for aesthetic purposes. Latin type developed two more additional variations to the standard shape variations. The first, the Small Caps, are a variation on capital letters that work better with Lowercase letters and blend nicely within a text. They are often used for abbreviations. The second, the Old Style figures, are designed in proportion with the Lowercase letters and like the Small Caps are used within a text instead of the Titling figures. The Titling figures have the same size as Capital letters, are monospaced (have the same character width), and work best in tables because they can be aligned vertically in columns.

3—The aesthetic enhancements

Some variations in the shape of characters have no other function than that of enhancing the visual quality of words and/or sentences. As stated before, this feature is almost indispensable for Arabic type. These variations of the shape of characters is concentrated around two features: the combination of specific letters, and the extension of the shape of the beginning or ending letters.

The first feature of letter combinations results in glyphs called ligatures. Ligatures are often designed for letters that might collide elegantly when placed next to each other. Some ligatures that are based on some linguistic needs (e.g., or), and have over time developed into an independent character, such as the ampersand (standing for the letter combination et, meaning and in Latin), or the Essef in German (the combination of two s letters), or the Lam-Alpha ligature in Arabic (combining the Lam and the Alpha letters). The third type of ligatures are designed as

\[
\begin{align*}
\text{AA} & \quad \text{EE} & \quad \text{MM} & \quad \text{NN} & \quad \text{BB} & \quad \text{FF} & \quad \text{II} & \quad \text{LL} \\
\text{EE} & \quad \text{TT} & \quad \text{GG} & \quad \text{AA} & \quad \text{FF} & \quad \text{II} & \quad \text{LL} \\
\text{MM} & \quad \text{NN} & \quad \text{BB} & \quad \text{FF} & \quad \text{II} & \quad \text{LL} & \quad \text{AA} & \quad \text{EE} \\
\text{TT} & \quad \text{GG} & \quad \text{AA} & \quad \text{FF} & \quad \text{II} & \quad \text{LL} & \quad \text{AA} & \quad \text{EE}
\end{align*}
\]
artistic expressions. There are considerably more ligatures in Arabic than in Latin. The reason is that the Latin script has developed a typographic tradition that is based on unconnected letters, independent from the calligraphic cursivescript (see also pp. 94–95). Arabic’s strong ties to its calligraphic tradition has dictated the need for a large set of ligatures in order to create the most visually pleasing letter combinations. These ligatures were developed over several centuries, and were expanded in amount and complexity depending on the calligraphic styles and the designer’s taste.

4.3 Morphology of a type family. As in all families, the offspring can be quite distinct from each other with various degrees of individuality. Nonetheless, they all carry traits of a visual kinship that unify them and set them apart as a coherent group. In the late 19th century the American Typefounders Corporation was the first to organise type into families. It was Morris Fuller Benton who came up with the idea of a type family. Type families then consisted of a relatively small number of variations. With time, our concept of families has exponentially changed with the ever-expanding technical possibilities available to a type designer. The variety that falls under one design are constantly challenged by contemporary designers. So how can we define type families within the scope of the new type inventions to date? The simplest would be to start with the conventional families and move forward in time into the less conventional ones.

The second feature of alternate shape variation for beginning or ending letters, is called swashes. These are additions often used at the beginning or ending of sentences. In Arabic the justification of columns is done based on this principle of extension of parts of certain letters. It is called Semitic justification—Kashida in Arabic. In addition to justification purposes, Arabic like Latin also uses swashes for purely decorative aesthetic reasons.

4—Functional enhancements

A functional enhancement is a visual representation of what we have been faced with to represent hyper links on the computer screen. Since Italics were used for other type of distinctions or emphasis within a text, the ‘underline’ feature was selected (by most probably a computer engineer). It became the accepted norm. This choice is unfortunate because it is a regression in ‘style’ to the old crude typewriter days where typographic subtleties were limited by the machines. This is of course unjustifiable on a computer screen, where any shape would have worked just as well and where a more sensible visual icon could have been chosen; for example, an arrow that would illustrate the concept of a hyper link much better. This is often done by selecting a ‘type style’ from the menu bar, which would place an unsightly line—of a set weight, at a set position—under the selected text.
4.3.1. The basic conventional sets of a type family

Most conventional type families are designed as an additional typographic refinement to the existing basic typeface character sets. Their purpose is to accommodate visual hierarchy and add to the typographic richness of a layout. A basic type family consists of Roman, Bold and Italic sets. This basic set can be expanded to include more subtle variations—that can even be programmed into the font as in the case of the Multiple Master fonts—according to two main parameters, the weight and the proportion.

Weight variations
The basic conventional weight variations within one typeface are the Light, the Medium (Regular or Book) and the Bold sets. To create a richer variety and a possibility of finer nuances, in-between weights are added; the Extra Light (or Ultra Light), the Semi-Light, the Semi-Bold, and the Extra Bold, Ultra Bold (or the Black).

Proportion variations
The basic conventional proportion variations within one typeface are the Condensed and the Extended sets. To create a richer variety, sub-proportion variations are sometimes added, the Ultra Condensed (Extra Condensed), and the Ultra Extended (Ultra Wide).

Angle variations
The conventional angle variation is often considered a totally new character set, but there are typefaces that do not have totally new characters for their Italics, they use the same characters as the Roman set and slant them at various angles of about 12\(^\circ\). This version is called the Oblique set. This feature can easily be incorporated in the MM fonts as an extra parameter that allows for custom-made slanted versions that best accommodate certain design applications on the user's end.

4.3.2. The unconventional sets of a type family

Unconventional type families are also an answer to market demands; or are experiments in ways to challenge conventions and broaden the functional scope of a certain type design; or are inspired by experiments made possible with the type design software applications available today. Sometimes the result combines many of the above considerations.

Terminal detail variations
Recent developments have included extensions to type families that used to fall under a different style category. This type of family extension is strictly directed to mixing terminal detail variations often used for categorising conventional styles; they do not mix other aspects of type design (style such as stroke, weight, contrast or shapes of curves). One such type family can include Serif, Sans Serif and hybrid fonts. Hybrid fonts are called a Mix or an Informal when they combine Serif and Sans Serif or hybrid features within one letter. There are many such examples for Latin fonts developed in the late 80s and 90s, such as the Thesis font family (TheSans, TheSerif, and TheMix) or the Stone family (Stone Sans, Stone Serif and Stone Informal), and a few others.
Decorative and Mixed variations

Another recent creative direction in type family expansions has been to clearly change the general design attributes of a font keeping more or less the same skeletal shapes, by either modifying the serif shapes, or rounding off the edges, or creating special outline and decorative textured variations, as in the Modula font family. A second direction was to create unheard-of variations on decorative fonts such as the CatWest font with its Half Full and Half Empty sets. A third direction has been to include an illustrative or decorative font to the family that carries similar visual traits and colour as the text fonts, as in the blockhead font family. This in fact blurs our concept of a type family further since we would generally classify this as an expansion of the character set.

To conclude, the relation between a character set and a font family can be best explained with the diagram below.
4.4. Type style classifications. Style and writing or text are closely related; the word style originated from the world’s first writing tool, the ‘stylus’. In time the word has come to stand for the visual or literary expression of writing (among other things). It also came to represent the visual expression of certain cultural periods and their influence on the arts and on type production.

Originally categorisation within one style was based on cultural context. This context brought together a variety of social aspects that generated typefaces with distinctive formal characteristics. At the end of the 20th century, this is no longer a useful criterion. Style used to be the name we gave to a coherent—though unplanned—outcome of a constellation of circumstances, over a given time period. That is no longer the case. Style has become a self-consciously planned ingredient of design, sometimes a requirement in design commissions. It has become a modern marketing instrument.

The word visual style may be misleading; formerly typefaces with similar visual characteristics were grouped under one category. Today it is no longer simple to decide upon the criteria by which the distinction between groups should be made. In fact, these criteria have become rather arbitrary; typefaces are grouped according to historical factors, or particular functions, or specific design details such as the shape of letter endings (Serif, what shape of Serif, Sans Serif). In fact, type style categories are now often used as a classification or description system for typefaces that goes beyond the meaning of style. There are many mixed contemporary systems for classification; it is as if everyone more or less creates their own system.

These various aspects of the meaning of style can easily lead to misinterpretation. Classification according to formal characteristics remains however a useful tool to group typefaces together and to make comparisons—or to make the selection of a typeface easier.

Qualitative judgements can never be made over a particular style. No one style is ‘better’ than another and the selection of a style must be based on an informed choice. A specific style may be considered more appropriate for certain design applications. This point is particularly relevant to Arabic type design. Arabic type design still suffers from being chained within the confines of its glorious calligraphic heritage. Calligraphic samples from that heritage are too often used as the one and only way to create quality in Arabic typography. This ill-informed attitude has in fact been an obstruction to the natural progress of Arabic type design—a progress similar to the one that has taken place for the Latin script. Walking towards the future facing backwards does not create the most impressive culture.

Categorisation of type styles can best be done on the basis of overall criteria. Selections can be made with an input of multiple criteria; on co-axes with databases that provide this possibility. Unfortunately, this does not exist for Arabic type. Underneath is an overview of the various criteria.

4.4.1. Primary function of the typeface

In this category there are three major divisions: display, text, and script or decorative typefaces.

hamburger

4.4.1.1. Display typefaces

In this large category typefaces are designed to be used in relatively large sizes for titles or posters. The average repertoire of such typefaces is basically small. Their main purpose is to draw attention. Some typefaces in this category tend to be condensed, because they can fit more letters in limited space at relatively large type sizes.

The quick brown fox jumped over the lazy dog.

The quick brown fox jumped over the lazy dog.

4.4.1.2. Text typefaces

Constraints for text typefaces can be quite extended if intended to be used in a wide range of circumstances. Repertoires can be extensive in number. Expert sets are almost mandatory. The typefaces should be ‘hinted’ for use on screens. Ideally automatic compensation should be incorporated for small type sizes, and in
high resolution print. Typefaces in this category can vary greatly in range of application. Hinting is almost 'normal' in Latin typefaces, but not in Arabic ones. Shape compensation for high resolution prints is incorporated as one of the parameters in a few 'Multiple Master' Latin fonts. Perhaps it is good to know that with such enormous amounts of typefaces around, there is still plenty of room for improvement. A text typeface that can serve both print and screen in a wide range of sizes, at optimal legible representation, and consisting of large character sets, is still exceptional and infrequent.

4.4.3.1. Script or decorative typefaces

The script or decorative typefaces category is a small category of text typefaces with a far smaller range of use than the regular text typefaces. They are more exclusive in style, to be used for special but simple occasions. This category covers a wide stylistic variety ranging from fabulous conservatism to outrageous licence. There is always plenty of room here for contributions from the dedicated followers of the latest 'type fashion.'

4.4.3.2. Overall formal characteristics

Traditionally there is a division in two overall formal characteristics in Latin as well as in Arabic.

In Latin scripts

In Latin the two main divisions are Serif and Sans Serif.

1—Serif typefaces. Variations in size and shape of serifs have been an aspect that requires important design considerations.

Systems for type classification provide refined descriptions for this design detail or feature. Serifs can guide the visual movement of lines of text, and therefore improve the ease of reading.

2—Sans Serif typefaces. With the simplicity of their details, Sans Serif typefaces can improve legibility at extremely small sizes.

In Arabic scripts

The two traditional sections for Arabic are the Kufi and the Cursive typefaces.

1—The Kufi style is based on geometrically constructed letters with a flat baseline. Kufi typefaces are generally monumental, often treated as display fonts. They are also used for decorative lettering on buildings, or for titles in print. They come in an endless variety of decorative extensions and details.

2—The Cursive style is based on fluid handwritten calligraphy. Text typefaces generally use the cursive styles for body text.

4.4.3. Historical perspective

The historical perspective comes closest to the original cultural context of a type style. Giving names to styles is no longer possible. There is too much 'mixing,' 'sampling,' and 'neo' around. It is best to follow the formal timeline—the date of issue.

Following are a few of the categories that are commonly used.

For Latin typefaces.

- **abcdefghijklmno**
  1—Humanist and Venetian Old Style. Italian 15th century faces.

- **abcdefghijklmno**
  2—Garamond, French and Italian Renaissance typefaces.

- **abcdefghijklmno**
  3—Didone, French (Didot) and Italian (Bodoni). Early 19th century.

- **abcdefghijklmno**
  4—Blackletter. German and English 15th century (based on handwritten script tradition). Also known in its style variations as Fraktur, Textura, Bastarda and Rotunda.

- **abcdefghijklmno**
  5—Lineale. 'Skeleton' letters without serifs. Also known as Grotesque, Gothic or Sans Serif. Early 20th century.
6—Computer. Typefaces strongly influenced in shape by computer usage, such as OCR (optical character recognition) typefaces, or bitmapped type representation on screens. It also includes other strange hybrid mixes and fashionable inventions that have been made possible by the use of digital design tools. Late 20th century.

For Arabic typefaces

1—Kufi. The first monumental inscriptive style, that developed into more geometric and decorative directions. It became widely used in display sizes for titling and architectural ornaments. (7th century). Semi-cursive variations are the Maghrebi or Western Kufi styles. (50th century).

2—Thuluth. A cursive style used as a text face, mostly used for short texts and titles. It has an overall light colour, short descenders and tall ascenders. (7th century).

3—Naskh. A cursive style that has become the industry standard as a text face. It is compact with clear and simple letterforms. (7th century).


5—Nastaliq. A cursive text face used mostly in Eastern Muslim countries such as Iran, Pakistan, and Afghanistan. It is fluid with letters that hang in clusters like grapes. (15th century).

6—Modern. This applies to all typefaces that were developed in the mid to late 20th century and which deviated from the calligraphic tradition, often under the influence of modern technologies. Some look modern in their simplified design approach although they were designed to accommodate hot-metal typesetting (i.e., the Lakhdar Ghzali font). They consist of hybrid mixes and decorative faces.

4.4.4.4 Proportional measurements

The visual appearance of typefaces depends to a large extent on the relative measurements of their proportions.

1—Contrast. The difference between the thickest and the thinnest parts of the letters.

2—Stress. For Latin typefaces, the angle of the axis of a symmetric round letterforms like the letters a and e.

3—X-height. The X-height is related to the height of the em square. For Arabic typefaces the tooth-height and loop height can be used instead.

4—Stem weight. The relation between the H-height and the thickness of the stem. For Arabic the relation between the tail stroke and the aleph height can be taken.

5—Slant degree. The degree of inclination of the vertical strokes of letterforms.

6—Character width. The average width of characters per em square.

Further classifications based on 'emotional' criteria such as warm/cold, feminine/masculine, static/dynamic, must be considered as entirely useless. Style is one binding element in the design of a font. But style alone does not stand for a design. Design goes far beyond dressing up objects in a style. It is not a thin layer that is pulled over things, but an integral structural part. Design encompasses a number of—sometimes personal—considerations about the object to be designed. The visual presentation is only one of those. The final result should be a well considered joint point of view on a variety of aspects. Good design takes a clear stand, becoming an integral part of a product.
4.5. Visual perception and type. In the Renaissance and at the peak of Arabic calligraphic achievements, there was a strong belief in the divine harmony to be obtained through geometrically perfect proportions of letterforms. The difference today is that we perceive letterforms as simply a collection of abstract elements that work together to achieve a pragmatic purpose. This approach has led to some scientific research. Though not conclusive in providing easy answers that are applicable to typography, the research has proven that perceived balance in proportions of shapes is hardly ever represented by perfect mathematical measurements. It is not precisely known how our visual perception works, and there are no scientific ‘laws’ to follow in order to accomplish optimal legibility of a text. The eye sees things differently than what the ruler dictates. When designing a typface knowledge of the physiological aspects of visual perception plays an important role in guiding the designer to achieve the desired visual effect.

The human eye is capable of distinguishing minute details and differences in shape or proportion at reading distance. It is unfortunate that our visual abilities in a physiological sense are in a fast and steady decline that starts almost directly after birth, and proceeds at an accelerated pace throughout our lifetime. This growing gap in our visual capabilities is compensated by our learned experience, and our ability to make a better guess at what to expect. For the major part of our life, perceiving very small details remains an important factor in something we all do practically every day — reading. As designers we tend to be seduced by the imperceptible details that our modern machines can achieve. But no matter how far these machines evolve, our human perception remains the same and its limitations should be taken into consideration. A type designer should assess his design decisions based on what is perceived and not on preconceived assumptions.

Within the obvious physiological limits of our visual perception, what we consider easy to read is based on our habits. It also has something to do with our deeply rooted sense of harmony and visual balance or order. This inner sense of harmony for form is similar to our sense of colour. A lot of us share similar associations with colours — a blue sky, a green field or a yellow/red fire. The emotions we carry, based on deeply embedded genetic experiences, are impressed on us by our natural surroundings. Perhaps our sense for harmony in typography has the same roots. We are capable of spotting disharmony or disruption in nature at a level of unbelievably minute details, even in visually complex environments. Nature has an inherent, strict harmony; plants grow in groups of a natural order related to their size. When they grow too close to each other, only the strongest survive. All living things need to be surrounded by their natural space. When this is disrupted, it can be detected immediately. Hunters—men and animals alike—cannot live without this natural talent for detecting minute details. Their sense for visual order is deeply rooted in an instinctive sense for survival and hunting opportunity.

Typography can be seen as fields of characters. A well balanced and evenly ‘coloured’ background is needed to follow the tracks the designer has set out for us to find our way through these fields as easily as possible. Our eyes are capable of spotting minor differences and irregularities that give us a lead. Details are important in type. The eye, not the ruler, is the final judge in creating the necessary order in these landscapes of letters; regardless whether this landscape is the austere flatness of the Lowlands, or the flowery Mediterranean hills.

**stellae**
While reading our eyes move according to a specific rhythm of what is called "saccadic" movements that perform consecutive short pauses known as 'fixations'. Throughout this oculomotor process, reading in a familiar and recognizable script is not done on the level of letters but rather in groups of word-images. Therefore, the recognizability of a letter and its harmonious integration within words plays an important role in contributing to the ease of reading. It has to perform like an instrument in an orchestra in congruence with the other instruments yet capable of holding its own ground. The human eye distinguishes minute details by visually processing the interaction between contrasting elements of form and colour. Space and objects are two independent aspects of the same phenomena; they cannot be perceived without each other. The silhouette of the printed letters is as important as the blank spaces that they enclose or that surrounds them. The unity of text depends on balancing out these negative and positive areas into a harmonious rhythm or sequence. The smaller the counterforms, the tighter the letterspacing can be, and the smaller the type with open counterforms the wider the letterspacing. This balance is achieved by starting with the letters that enclose the biggest counterforms such as the capitals O, Q, B, C, etc.

Optical compensation in certain specific cases is achieved by adjusting the shapes of letters and details, in order to create a coherent visual balance between the different letters within a typeface design. Following are certain optical rules where formal adjustments are most needed.

**Optical size and proportions**

1. Straight lines or edges delineate shapes more clearly than curved or angular forms. That is why a square looks bigger when placed next to a triangle or a circle of the exact same size. For them to look optically aligned and of equal size, the curved or angular forms have to extend slightly beyond the linear limits (of the baseline and top of the square).

2. Rounded forms often look more steady when they are slightly wider at the bottom.

3. If the size of ascenders and descenders is made equally the same the descenders will look longer. To adjust this the length of strokes of descenders is often slightly shortened. In classical Arabic cursive styles (with the exception of the 'Thuluth style') descenders are markedly and intentionally designed to be lower with longer curving tails. The consideration listed above for Latin type, becomes a concern when designing a modern Arabic typeface for use in publications and newspapers where economy of space is a serious design limitation.

4. When a square or curved shape is horizontally scaled (condensed or extended), the height should be slightly adjusted for it to look the same size as the original. Wider shapes always look larger than narrow ones.

5. Whenthe stroke weight of a square or curved shape is increased (made bolder), the height should be slightly adjusted for it to look the same size as the original. Shapes with thick strokes always look shorter than ones with lighter strokes. These optical corrections will apply to all type, both Latin and Arabic alike.

**Optical middle**

When a space is divided horizontally into two equal parts, the top part always looks bigger than the lower part. In order for both parts to look equal, the top part has to be made slightly smaller. This means that the optical middle is a little higher than the exact middle. This applies to a variety of situations:

1. Shapes that have double counterforms, the top form has to be reduced slightly to make both look the same size (i.e. F, S, X).

2. The positioning of a cross bar, a slanted or curved connecting stroke (i.e. H, F, E, R, etc.) on some letters has to be made a little higher than the exact middle.

3. Modulated vertical strokes (straight and curved) where the thinnest or thickest point has to appear at the optical middle. Otherwise the letter will look top-heavy and visually unstable.

In Arabic, most letters are open at the top and the overall direction of the movement of the strokes is horizontal; vertical symmetry is practically non-existent. These optical corrections are rarely considered in classic Arabic typefaces, but might be applicable to fonts with even letter height and geometric letterforms.

**Thickness of strokes**

The thickness of strokes within a letter have to be adjusted in fine increments in order to achieve the desired evenness and balance in the letterform and the overall font.

1. Vertical strokes always appear lighter than horizontal ones regardless of whether these strokes are straight or curved.

2. A vertical straight stroke will appear thicker than a curved stroke of equal thickness.

3. All right strokes (straight, curved or slanted) appear thicker than the exact same left strokes.

In a letter these considerations have to be adjusted to achieve the desired balance and effect of the overall design. These considerations are important to all scripts.
4.3.8 Correlation of connecting or crossing strokes

Correction of stroke joints is important for avoiding unpleasant optical illusions and visual imbalance of strokes.

1. Connection of contrasting stroke weights. In general, typefaces with strong stroke contrast (of thick and thin) are more fragile at junctions of the thick and thin strokes. This is especially the case at small type sizes. With such typefaces an adjustment is made by adding a curve to what seems to be straight strokes in order to avoid a visual break of the letterform at these delicate connection points (i.e. the tips or points on letters like A, V, N, Z).

2. Connection of strokes: the connections of straight to curved or slanted strokes (or curves to other curves, or slanted to other slanted strokes) always require an optical adjustment of indentation or traps cut into the angles of these strokes in order to avoid optical filling in of the corners.

3. Crossing strokes: in the case of an x, for example, a compensation has to be made to avoid optical illusions. The crossing strokes have to be slightly staggered for them to look as if they are continuously crossing each other. Otherwise they will look shifted.

All the above also apply to Arabic letters where such similar shape occurrences take place (i.e. in letters like the Kuf, the Ayn and Faa, and in the Lam-Aleph ligature).

Shape corrections in relation to type size

4.5.10 In the left column, the square and octagon are reduced without adjustment. On the right side, the strokes look lighter and narrower. This is compensated by the right column by making the strokes a little thicker and the overall shape a little wider as shown in the last row.

4.5.11 With type showing four necessary optical compensations, formal type sizes, on the right is the optimum size and on the left is the square size. The contrast of stroke weights is reduced, the strokes are a little thicker, the letters are wider and shorter, the size of punctuation marks is increased, and fine details simplified. On the right side this is relatively the same shape in relation to the same strokes.

4.5.97 The reason why the letters in the left column are much larger is that throughout this section only the strokes are shown (the stems and letters are omitted). The left column is shown at full size, with the letters smaller and in the center column (shown in the center). On the right side the letters are expanded to show the various type sizes more clearly (shown in the right column).

These adjustments allow for the type to retain the same colour as its large size version. These considerations are also applied to type designed for architectural or highway signage. They apply to Latin and Arabic type alike.

Optical correction of shapes in relation to angle and width

Correction of letterforms when their proportions or angles are modified is important for avoiding unpleasant distortions.

1. Slanted letterforms have to be adjusted so that they don’t look distorted. Automatic slanting on the computer is often done for badly designed fonts (especially Arabic fonts where a real italic font simply does not exist). Distortion takes place mostly in round shapes and in characters with obliques strokes. In these particular letters, the different strokes within one letter lose their even visual weight. The vertical strokes tend to look thinner than those in the regular font. The overall stability of shapes is lost and the angle stress is distorted. The curves become swollen and heavy.

2. Extended or condensed letters have to also be adjusted to keep the weight of strokes in balance with each other and with the size of the counterforms. Horizontal scaling will affect only the vertical strokes.

Optical correction of serifs

In order for serifs not to look as if they were curving upwards, specially in typefaces where the contrast of thick and thin is high, this optical illusion is compensated by making the bottom of a serif concave instead of straight. This last consideration is mostly applicable to Latin typefaces since the concept of serifs is not commonly used in Arabic—though it rarely appears in type adaptations of Latin fonts into Arabic equivalents. But these adaptations remain often on the level of logo adaptations rather than whole font designs. Nonetheless, when serifs are applied to Arabic type they appear only at the top of ascenders and facing in the Arabic reading direction. However, quoting Frutiger that ‘concave feet are more mobile than flat feet’ when describing the need for concave serifs, would simply not do for those oddly shaped Arabic serifs.

4.5.12. Straight vertical and horizontal strokes are made concave to better the overall form and promote a more natural movement in the case of the feet of serifs, it makes them ‘fit’ more naturally into the letterform. By giving the serifs such a curved appearance, they look as if they are not protruding.
4.6. The type design process. The design of a typeface and the production of a font today may be the work of one individual, depending on the size and technological complexity of the font. Type design as well as font production have always followed a systematic and organized working process. It is based on a large tradition and is considered as one of the first examples of high quality mass production. The computer now plays a key role in both design and font production. Productivity rates in both have risen astonishingly over time. The oeuvre of a modern type designer (including the production of the fonts) can easily hold ten to hundreds of fonts. Still, to dive into the production of a large font that is suitable for a varied range of applications is a huge undertaking. Working methods of type designers have not changed much, only their tools have. Tools have become in fact so easily accessible that the number of type design practitioners has increased explosively.

4.6.1. General design considerations

The inspirational starting point of a design can come from any source. This important element is individualistic and can therefore vary from one designer to another. Some designers may take their environment as a point of departure, or mundane elements from their private lives and experiences (like their favorite newspaper or the packaging of their breakfast crunchies). Others may set about their type design by starting with pragmatic considerations that are either market-driven or aimed at specific functions, keeping reading or media limitations in mind.

Whatever the final purpose of the type design, a visual rhythm is attempted based on the harmonious interaction between letterforms and the blank spaces that surround them; on the ordered recurrent elements of curves and strokes; and on the linear movement created with the shape of the letter strokes. In typography, all elements are interdependent, and they can exert considerable influence over each other and consequently on the overall appearance of a text. A type design consists of a collection of abstract elements brought together under one visual system, in order to collectively construct a coherent image. This is often the result of careful considerations that balance pragmatic constraints of legibility and production, with personal exploration and vision. The latter varies tremendously from one designer to another, giving the final result a definite signature that reflects the temperament of each designer.

To achieve this, one first sets a few basic guidelines, then proceeds in a systematic manner to complete the design task—this can vary according to the set goals of the designer, from a simple to a highly complex design.

Setting the basic proportions and measurements is inevitably the first design stage. Following are a few elements to consider for Latin in type, some of which are also applicable to Arabic.

For Latin:
1—the Cap-height, the x-height, the ascender and the descender heights.
2—proportions of the character width to character x-height (i.e. using the lowercase x is a good start).
3—the ratio of dark to light, or the thickness of the stroke in relation to the counterforms. This determines the overall 'colour' of a typeface.
4—the thickness of strokes and their contrast (from extremes of thick to thin, to even strokes with little or no contrast).
5—The pivoting point of the round forms, know as the ‘vertical axis’ or ‘stress’, which relates to the general writing or pen angle.
6—Deciding to use or not to use serif, their size and shapes. This contributes to the whole style of the typeface.
7—Deciding on the shape of curves and how they connect to straight strokes.

4.6.1.3 Arabic type measurement units (from right to left and top to bottom):
- Ascender height: lower-case letter height.
- Descender height: lower-case letter height.
- Cap height: upper-case letter height.
- Toporraine height: upper-case letter height.
- Base line: base line height.
- Foot height: ascender and descender height.

4.6.1.4 Arabic type proportions could be made slimmer and more consistent for better line and text flow.

4.6.2 Test letters, words, and sentences

For Arabic:
1—the ascender height, the descender height, the tooth-height and the loop-height.
2—proportions of the character width to character height (i.e. using the Sin is a good start).

4.6.2.1 The type design for Latin starts with the two capital letters H and O. Afterwards, the lowercase letters a, e, o and w will be annexed to the capitals. With only these few letters a solid platform for a complete typeface can be made. The x-height, capital, ascender, and descender proportions; as well as letter contrast, average letter width and letter spacing can be established.

One string of letters forming a word, has become an international standard for this purpose. Hamburger was Hamburgeros or Hamburgeres.

Only using these letters complete text columns can be set. Sometimes type designers come up with their own test sentences, like Matthew Carter's gruesome regale embarrases sober shaman's measuring sham summer house among rose shrubs. Adobe designed a whole page-size column of text only using these letters!

4.6.2.2 A string of letters for Arabic and Latin typeface comparisons of weight and overall size: for Arabic and Latin Arabic font.

4.6.3 Arabic test sentence and Latin test word

For Arabic type there seems to be no set standard conventions for test words and sentences. The reason being that Arabic typography as a well-developed field in its own right, with its own history of highly professional type design practice and conventions, has become rather impoverished. Below are personal suggestions for some test letters, words and sentences.

For Latin type the design starts with only two letters: the capitals H and O. Afterwards, the lowercase letters a, e, o and w will be annexed to the capitals. With only these few letters a solid platform for a complete typeface can be made. The x-height, capital, ascender, and descender proportions; as well as letter contrast, average letter width and letter spacing can be established.

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string of letters constituting the essential basic letter shapes can
give a clear image of the whole typeface's alphabet. Only using
these letters a wide range of words can be invented to set com-
plete text columns that provide clear information on the overall
colour of the text.

After many trial and error proof prints with these 'test pilots' of
type design and consequent shape corrections, a firm foundation
is laid down to build on a font of any desired size, in any desired
script or combinations thereof. The size corresponds to the size of
the character set that will be designed.

4.6.3. The full character set

The simplest way for designing the character set is to start pro-
ducing the so-called titling font, a font exclusively used for tiles
and consisting of the basic alphabet in capital letters. The next
extension is the ascii set: the upper- and lowercase letters plus a
minimal set of signs and symbols. The next extension to the
standard sets follow the Apple, Microsoft, Adobe. These charac-
ter sets cover most languages using the Latin script. In addition
another extension can be made to an expert set. This usually consists
of small caps, old style figures and extra ligatures and symbols.
Further extensions can be practically limitless. Either in the
direction of including more writing scripts within one font (support-
ing the Unicode standard), or additional symbols, arrows,
pictograms, borders, illustrations, or whatever graphic elements
one can think of. The latter extensive additions are organised
according to specific subjects, and are called 'Pi-fonts'.

For designing Arabic fonts, the process is basically similar. Since
Arabic has a different kind of glyph varieties, it is always the cus-
tom to start with the free-standing letters and work from there
on to develop the alternate letterforms, and diacritics (dots and
vocalisation marks). The other extensions to the basic sets can be
in the ligature sets, and according to what is needed for the style
of the typeface. Other non-alphabetic sets can be expanded in
precisely the same way as done in Latin fonts, with signs, sym-
bols, decorative motifs and pictograms.

Completing a full character set, regardless of script, is a task that
involves a highly structured and automated working method.
Many character shapes can almost be copied to create new ones.
Further technical or aesthetic enhancements are even technolo-
gically based. Today typefaces must have preferably a universal
application, but of course this is a far-reaching ideal. A

typeface especially designed for use in a newspaper will appear
at its best under these specific printing conditions. When printed
on smooth art print paper, it will appear too angular and may be
uncomfortably sharp. There is no way to avoid this from happen-
ing. There is no typeface ideal for highway signage as well as for
a tax application form. There is simply no dress for all occasions.
A lack of all trades as a universal tool is generally good for none.

4.6.4. Providing technical instructions

However most typefaces nowadays have a lot of instructions
built into their fonts that adjust the appearance of the characters
when appearing under specific conditions. It would be unwise
to neglect these possibilities entirely. First there is the kerning
table that optimises letter spacing for certain difficult letter com-
binations. Second there are hinting instructions that adjust the char-
acter outlines to optimise the character representation in low
resolution bitmap output. Third there is the latest invention of
anti-aliasing that optimises output on the screen by adding grey
scale pixels. Fourth there is the possibility of creating Multiple
Master typefaces to optimise representation of letters in large
and small sizes (among the many other possibilities that the M M
technology can provide). These technical aspects are applicable
to all fonts in all languages, including of course Latin and Arabic
scripts.

4.6.5. Building type families

Designers blessed with sufficient stamina can go further in cre-
a ting a family for what is at this stage only a solitary typeface.
For Latin type, the first and most important member of that fam-
ily is the creation of an Italian matura. The cusineau letter or the
italic, is an important punctuation tool used in body text. This
family member can be created easily by slanting the Roman
father. A far more elegant solution however is to use the original
italic letter forms for this purpose. This choice involves certainly
more work (depending on the size of the character set). For
Arabic an italic version simply does not exist, and often one
questions the need for slanted fonts in certain typeface styles.
The Arabic oblique fonts are often produced by automatically
slanting the whole character without making any optical shape
adjustments, often producing visually unappealing distortions.

Further procreation in the typeface family is exponential by
nature. Every extension doubles all the members created in the
preceding stage or extension. This easily leads to the creation of
enormous amounts of glyphs. Weight variations are generally up to six. Most weight variations within one type size have to take place on the horizontal level while the vertical dimension remains constant, in order to preserve the same character height. The thickness variation is most visible on the vertical strokes; the curves and letter endings preserve their shape in relation to the varied stroke weights. Proportion variations—extended and condensed versions—vary from three to four. For Arabic, the weight and proportional variations within a type family, for most fonts on the market, are often done automatically with few design considerations. There are exceptions there especially in established typefoundries like Monotype and Linotype’s old typeface designs that were originally created for metal type, where automatically produced variations were not possible. The first to make one of the most fecund type families for Latin script was Adrian Frutiger with his Univers font. Many type designers have followed suit and expanded their type families even further. In Latin there are many such high quality fonts, like the Lucida type family by Kris Holmes, and the Thesis type family by Lucas de Groot to name a few. In Arabic there have been some attempts in that direction, but none as extensive or as to the same standard. This can of course change when more designers of high calibre get involved and the market matures enough to respect and receive their new creations.

### 4.6.6. Making smart fonts

<table>
<thead>
<tr>
<th>abcdefghijklmnopqr</th>
<th>AAAA</th>
<th>R21</th>
</tr>
</thead>
<tbody>
<tr>
<td>abcdefghijklmnopqr</td>
<td>AAAA</td>
<td>R22</td>
</tr>
<tr>
<td>abcdefghijklmnopqr</td>
<td>AAAA</td>
<td>R23</td>
</tr>
</tbody>
</table>

Designers with a marathon condition can take their type design even further. The territories of barely exploited or yet unexplored using technological possibilities are vast. Instructions can be built into fonts to induce random change of character shapes, or to animate the letters when they appear on the screen. Here we treed a field in the process of exploration, under the pioneering zeal of a few type designers—or type needs. A field where character shapes are no longer precisely defined as form but rather as more generic mathematical formulas that materialize only in specific circumstances, or following user instructions. Multiple Master and Metafont fonts have already taken a bold step in that direction.
4.7 The technical aspects of font development. Font development, like all industrial production, has been influenced by the continuously evolving technologies. Gutenberg’s invention can be seen as an early step in what was to become the gigantic Industrial Revolution. The shift in technological terms has been from innovations in mechanical means of production towards innovations in the combined fields of microelectronics and computer science. From nuts and bolts to microchips and binary codes, from the genius of craftsmen to that of computer nerds, from manipulating matter to manipulating data.

There are two major obstacles in describing in simple terms the current technical aspects of font making. The terminology used in the professional field is not consistent; connotations taken from earlier days are still around, and are occasionally given a slightly different meaning, or confused with other aspects carrying similar names. The difficulty in providing a simple explanation of the production process lies in the fact that the production of text and image has become a seamlessly integrated process from the input of data to the final output. This process can however be divided in three simple stages: text input, storage and manipulation of the data with instructions, and output (for instance on paper, screen, plate or film). The second stage is by far the most complex part. Fonts play an important role in that stage. They must perform in collaboration with other software, with the operating system of the computer, the text processing or DTP software, and the image processing software. In our digital age, fonts can contain more and more information and instructions. They have become incredibly complex—or ‘smart’—devices.

There are four major technical aspects of font design to explore. The aspects related to the basic measurements of fonts known as the font metrics; the basic ingredients that constitute a font which are the font formats and font files; the type of different fonts in use; and finally the tools available for developing fonts which are the type design software applications.

4.3.1 Font metrics

Font metrics are a crucial ingredient in the production of type. From the outset, movable type needed a basic grid on which all elements of the font were correlated. It had to be possible to create text lines of precisely the same length to produce text blocks while each line was built up from different characters. This was only possible when one minimum measurement was common to all the elements of a font. Standardisation of this one minimal measurement unit would allow printers to use typefaces from different typefoundries within one layout. Standardisation never really took place on a global level. Three systems became most widely used:

— The Didot system in Europe. A duodecimal system with a minimum unit of 1 point (1 pt = 0.356 mm).
— The Pica system in England and the USA. Also a duodecimal system with a minimum of 1 point (1 pt = 0.353 mm).

Duodecimal systems have the advantage that 12 was divisible by 2, 3, 4 and 6 whereas the decimal system was only divisible by 2 and 5.

— The inch system originally used in England and the USA. England became metric late in the 19th century but the USA remained completely inch-based despite its ratification of the international metric convention. One inch equals about 27 Pica points. The inch system is a hybrid system. One inch is divided in 1/2, 1/4, 1/8, 1/16, etc. of an inch. Every measurement is the half of the previous one and can be used as a unit for notation. A decimal notation of the inch also exists.

The point was the measurement unit for all typography; type sizes were always given in points—sometimes creating a little confusion about which kind of point was precisely meant. When typesetting was still done in lead the point size was a real physical part of the product. It could be measured in the various sizes of the letter blocks that carried the characters. With the arrival of phototypesetting that block disappeared completely. The point indication for type size remained the convention, thus creating even more confusion. The height of the letter H or of the capital letters given in millimetres was tried by German manufacturers as a replacement of the original point size, but it was never widely accepted. Still today the point size remains as a rather vague
indication for the size of type. The size of the x-height would nowadays be a better indication of type size. For Latin type legibility and perceived size are best determined by the x-height of the characters. As a result of the calligraphic nature of Arabic, a given type size in points is hardly an indication of its perceived size and therefore the level of its legibility.

In addition to the absolute minimum measurement unit, fonts are also based on a system of relative units. Originally this system was developed for purely aesthetic reasons. During the Renaissance, artists and architects believed the aesthetic ideal was based on geometry. Ideal proportions and shapes could be determined in circles, squares and triangles. Geometry has played alternating strong and weak roles in design ever since—the opposite of shapes based on rigid geometry is often referred to as the Arabic style. When commissioned by the French King Louis XIV to design a royal typeface for his chancellery, Philippe Grandjean—the chief engraver of the Royal Academy of Medals and Inscriptions—based his design on a 'holy' grid of 48 x 48 units.

During the Industrial Revolution, the grid of relative measurements attained an indispensable role in the production process; a role it still retains to this day. The need for the grid system arose when Tolbert Lanston created the Monotype typecaster. He separated the input of text from the output in metal type by constructing two machines. The first was focused on a rather extended keyboard and produced a paper roll with punched holes, this roll of paper was fed to the second machine which used it as instructions to actually manufacture and set the type. The typesetters [keyboard operators] typing on the first machine needed to know when a new line was needed within a given column width. There were no metal metal letter blocks to make this obvious, like for the old hand typesetters, so this had to be done with the help of mathematical calculations. Of course a cumbersome solution for this problem would be to measure the widths of all the different typefaces in all different type sizes available. But Mr Lanston figured out a simpler solution. He put all characters of one typeface on a squared grid of 18 units. Every character had to fit within this grid—that is to say every block on which the character appeared. The face of the actual character was most of the time smaller than this block to allow for correct letter width between characters. The face could also be bigger and sticking out of the block—this last possibility was specially useful for Arabic type. Using this method every character took a specific number of units of the grid. A simple calculation could be made to calculate the length of every character for all type sizes.

The number of units was first multiplied by the type size and the outcome divided by the total units of the grid. The result was the length of that character in points. This number could not be fractionated; it had to be rounded up to an integer number, since there was no smaller measurement than one full point. With this calculation method the typesetter on the Monotype machine knew when all the characters [and widths] in one line would add up to the length of a set column width. Warned by the sound of a bell, he could start typing the following line of text. This system of dividing a square in units where all characters of a font would fit in (the so called em square) and the rounding off to integer numbers is still at the core of all font technology to this day. The amounts of units used, however, have varied greatly over time.

The typewriter used only one unit per em square, because the paper moved only one fixed amount to the left (or to the right for Arabic) after every imprint of each character. All characters had the same width, and were called monospaced. The old typewriters also had a bell sound to signal the end of a line, suggesting the need for the paper to be moved to the next line. In a refined typewriter in many ways. The typographic refinement led to a system with an em square of 9 units for the miniscule Composer.

Most phototypesetters, except for the very early ones, could get away with the 18 units of the original Monotype machines. This changed with the possibility of creating inexpensive matrices for fonts. The only difficulty with the creation of new matrices was to fit all characters of a typeface design originally made for lead, or even completely new designs, into the 18 unit system. More units per em square could make this task considerably simpler, though not necessarily leading to better results. Slowly the em square changed to ever finer grids, from 18 to 36, to 48, and even to 72 unit systems.

Phototypesetting added something else to the font metrics: kerning tables. Photo composition did not need a steady carrier per character. Letterspacing in lead was an important part of the type design. It could not be changed easily after production. The typographic convention was that extra letterspacing was only allowed for spacing individual characters in titles made out of capital letters. Phototypesetting changed this situation. It was very easy to change letterspacing, just as easy as to change the leading or the wordspacing. One could not only add white to the em square values, but could also subtract white space from it. Minus spacing was born—often with dreadful results. The
keyboards for text input became more computerised. The machine stored the typed information on the keyboard first before processing it. The production method allowed the use of kerning tables to give specific letterspacing instructions when certain letter combinations were typed in. Now traditional difficult letter combinations such as 79, or AW could be solved by instruction after the type design was made. This new facility was also specially helpful for typface designs in Arabic. It was not complicated anymore to bring one part of a character over or under another. Also composition of characters out of loose parts was easier. Accents above characters in Latin text were composed out of separate glyphicsthis method reduced the amount of characters in a font. The same accent could be used to create different letters. During this period designs were made for Arabic fonts to compose characters during the typesetting process not only by adding diacritic dots and/or the many vocalisation marks used in Arabic but also to use parts of characters to compose complete letters (see also p. 78).

Typesetting has grown over time into a completely computerised process. It brought about the invention of easy to use software for creating new typefaces and fonts. However, in the process, it steadily developed into a mind-boggling complicated mathematical structure of computer instructions, of which the font metrics is only a part. Let's take a look at what has really happened to the good old em square in this new digital context.

With the first machines of image digitisation the em square became simpler, reduced back to 9 units because memory was still expensive. But as soon as memory became cheaper and easily expandable, the sky became the limit. Em squares are now 1000 units or more. It seems to be best for calculation purposes that the amount of units are a square root 2 number. The reason most probably being that the units could easily be split in half. The shapes of the characters themselves are done in three formats: as outlines, bitmaps or as a combination of both. The outline format is likely to prevail in future. Nowadays we work with a very fine em square grid and easy scalable images of the individual characters. The granularity of the em square has to be much finer than ever before because it contains not only the information of the character width but also the exact location of all the reference points of the outlines of each character. The so-called resolution of the output is now the absolute value, just like the point size used to be. It is the major constraint for the quality of the end result whether printed or displayed on a screen. The resolution is a number that indicates the level of refinement of the final output. In other words, the amount of dots per inch that are used to build up the image. Output resolutions vary depending on the machine; a professional Image Writer for print creates about 2400 dpi (dots per inch); a desktop printer varies between 300—600 dpi; the output on screen is far coarser varying between 72—96 dpi. Many other types of printers have existed with rather coarser resolution, but these will be eventually totally replaced by laser printers with a range of 600—1200 dpi resolution, and film imagesetters of 5000 dpi.

On low resolution output devices, the good representation of small characters becomes problematic. The outline of that character at the required size might not cover the dots essential for good representation of that character. To solve this problem, hinting of individual characters was invented. Hinting is based on the principle of interpolation, which means that a shape will be transformed into a different one that is more suitable for certain conditions, still keeping the characteristics of the original. Hints can be added to the outlines of characters. These hints become active under specific conditions; for instance when
characters are used in a small size on a low resolution output device. Under this condition all stems of the characters can be made to have the same width; also the serifs, and the general characteristics like cap or x-height can be kept similar. The inner shapes of characters can also be influenced to match exactly the grid of the dot-resolution, which explains why one of the aspects of hinting is called grid-fitting. It means that the outline of a character will be altered under certain conditions to optimise its representation. Font files used to have two formats of the same typeface: a bitmapped version of the font in one or more small sizes and an outline version of the same font. The bitmapped format was for representation on the screen, and the outline format for print on high resolution. Hinting or grid-fitting basically automates and improves the quality of representation in low resolution conditions.

The latest development is not only to rearrange the original shape of the characters of a font to match the ideal configuration of dots in the bitmap image, but also to use the method of anti-aliasing. Anti-aliasing is a method of softening the contours of the character shape by adding to the black dots of the bitmapped image some dots in various tints of gray.

4.7.2. Font formats and font files

A font format indicates the specific way by which all data of a font is described and stored away. Font formats are important because a specific "interpreter" is needed in order to make this information visible and therefore usable. At this moment there are only two important font formats: PostScript and TrueType. Soon there will be only one needed: Open Type. This third is an extension of the other two type formats, which allows the use of all three formats.

Previously, font formats were created by companies that also produced typesetting machines. These font formats were proprietary, for use only in combination with the output machines of the same company that issued the fonts. Font formats were originally based on bitmapped storage of the characters, which are dot configurations that mimic the shape of a character. The American company Adobe changed this situation drastically. It developed a "page description language" they called PostScript. PostScript had huge advantages over other existing font formats:

- It used outlines as a way to store the characters in a font.
- Outlines describe the contours of characters in the form of a mathematical formula—in so-called Bézier curves. This method is superior to bitmapped storage because it occupies less memory space and is scalable to any desired size.
- Outlines are uncomplicated to incorporate in tvr software. Outlines can be manipulated easily: rotated, extended or condensed, tinted, skewed, etc.
- The font format was made completely transportable to all output devices as long as these had an interpreter, a so called PostScript RIP (Raster Image Processor) built into them.
- The character outlines had special instructions connected to each character allowing for enhanced quality even under difficult output circumstances such as hinting instructions that are optimised at any particular size or resolution. Adobe issued two PostScript formats: Type 1 (with hints) and Type 3 (without).

The computer manufacturer Apple was the first to license the PostScript technology for its printers. It was also the one that initiated the next important other font format True Type because it wanted to free itself from its ties with Adobe (and perhaps the royalty payments that came with it). Apple took the initiative, Microsoft joined in later and made the True Type format an important rival. The True Type format is similar to the PostScript format. The mathematical formula for its curves is slightly different, and it uses the same outlines for representation on the
screen as well as for the printed output. This was a clear advantage over the PostScript format. Its major advantage was that its interpreter was freely available and based on Apple's Quick Draw technology. PostScript reacted almost instantaneously. It issued ATM (Adobe Type Manager). This software used the outline information to build the screen image as well. And because of this it also allowed Apple printers to use this information for their output making the PostScript ECP practically obsolete for desktop use.

All information put into a font has grown over time. The font file has come to include not only the font outlines (sometimes combined with a few bitmapped versions to be used for specific sizes on the screen), but also a lot of 'tables' that can make the font adaptable to all kinds of different circumstances. With the attempt to make fonts 'smarter', font files are made incredibly complex. Below is a concise overview of a font file:

1—The general information. This basically contains the font ID number, the name of the font and its creator. This can be extended to contain a lot more information which helps for classifying the font in the many classification systems.

2—Outline information. Each glyph is described mathematically on a steady grid defining its shape, width and vertical position to a baseline. Each glyph has a numeric code or is encoded according to specific encoding methods.

3—Hinting information. These ensure and preserve certain characteristics under all circumstances. They contain instructions that can change the shape of the original outline to produce bitmaps of the best quality. There are overall hinting instructions and special ones for each specific glyph.

4—Kerning tables. Kerning tables adjust and maintain even letter spacing for character combinations, in balance with other combinations. They exist in True Type and Open Type formats.

5—Character substitution tables. Character substitution tables are at the base of automatically substituting characters with more appropriate ones, while the keystroke remains the same. A sequence of specific characters can result in the replacement of one or more characters by other ones. This is especially important for Arabic type where the shape of the character is dependent on its position within the word. Also in Arabic certain combinations of characters have a special design. These special designs of letter combinations are called ligatures. These ligatures are stored as special characters in the font. And will be used automatically if a special table for using these is available. In Latin ligatures occur far less frequently and are mostly used in highly refined fonts.

Refinement in the use of ligatures for Arabic is dependent on the font style, and practically indefinite in certain cursive styles.

The above are only a few of the tables in the font files, which can easily contain more than 40 tables. Variations of types of tables are practically endless. Designers can use these tables to specify the shape of characters under various conditions. Many of these tables have to do with font adaptation for all kinds of specific circumstances, such as the character composition tables. These tables use more than one keystroke, or 'dead' key combinations, to produce a character. They are most used for adding accents over existing characters, or to accommodate particular languages or scripts. They are often stored in keyboard programs. It is often hard to imagine that the interpreter has to go through such a huge pile of instructions to make one character visible. These processes take place at the speed of light. Nobody can really imagine that speed since it goes beyond the limits of our normal experiences.

The latest development in font technology revolves around the representation of characters on the screen. This is of course due to the global spread of the Internet network, with its main outlet the computer screen. The big players in the new developments for screen fonts are Adobe and Microsoft. They brought forward Cool Type and Clear Type format to allow for better representation of type on screens. Microsoft's Clear Type uses anti-aliasing to manipulate the color of pixels. It is used for 320×240 screens.

### 4.3.5. Type of fonts

Fonts vary not only in their format, the way in which their content is mathematically described or organised, but also in a more important way, the content of the font file. There are in principle two major variations. The first variation is determined by the amount of characters contained in a single or composite font file. The second variation is determined whether and to what extent the individual glyphs in the font are generated by built-in parameters. In extreme cases glyphs can be almost completely synthesised on-the-fly. This type of fonts is referred to as 'parametric fonts'. Of course such extreme variations will result in new font formats or in extensions of an existing format.
4.7.3.1 Fonts with large character sets

In the early development of PostScript fonts for large character sets (i.e., Japanese, Chinese, and Korean), Adobe invented the 'Type 1' composite fonts. These composite fonts had one fixed character order with the glyphs as basic components. They consisted of a large collection of subfonts (each with its set of glyphs), arranged according to a fixed hierarchy that directly implied the encoding. This type of fonts is now succeeded by CRO (Character Recognition) fonts, which allow the remapping of characters through external tables that organize the link between the character code and the glyph code.

4.7.3.2 Parametric fonts

Multiple Master fonts

The first invented and most important type of parametric font is an extension of the PostScript Type 1 font called the Multiple Master font. This invention provided the possibility of making fonts 'on the fly' by manipulating outlines within a given set of one or more built-in parameters (with a maximum of four). The Multiple Master fonts, as the name indicates, contain two masters at the extremes of each axis (for instance, the lightest and the boldest parameters on the weight axis) between which customized variations can be achieved with the help of mathematical interpolations. In other words, the user of the font can determine the weight of the stems of the font within a given range. This way one font file can include all the possible weights of a font instead of having different font files for each different weight. The same parameters can be applied to the width of the individual glyphs, or to the width of the serif, or to the angle of inclination of the letters. It is a huge task to design a Multiple Master font, so there is a relatively small number of high-quality Latin MM fonts around. One of the refined features of MM fonts is the ability to generate fonts with optical compensation for character shapes and letter spacing, that are appropriate to each type size. This feature is an improvement on PostScript Type 1 fonts where one master is automatically scaled sometimes resulting into uneven perceived weight within the same font; light at very small sizes and heavy at large sizes.

Adobe has used the MM technology in what they called the Super ATM software. Super ATM allows the computer to mimic fonts when the original font file with outlines is missing. When this software is installed a missing font will not be replaced by the default font of your computer but the original font will be imitat-
ed. Only the metric information (like letter width or stroke weight) of the used font will be used. The missing outlines are also imitated within these constraints using Adobe's SETFM or SANSAM fonts. This new font version will occupy exactly the same space as the original font. The clear advantage of this was that a lot of people could install something practically unchanged without needing to have a lot of fonts on their computers.

In Arabic Multiple Master fonts are not yet available.

Metafont and tex typesetting

Metafont was developed by Donald Knuth. It is based on a programming language specially designed for font development, that uses structural parameters to generate glyphs. Complete font families can be designed using variations of certain parameters (i.e., thickness of stems, serif shapes, angle). A dedicated typesetting system was developed to complement the Metafont design tool, called TeX. It originally ran only Metafont fonts. However, now software extensions were developed which allow the use of Postscript fonts.

Finosce and Infinfont

A company called ElseWare has attempted to develop a limited amount of parameters that could describe any typeface. Once all these parameters were known, the font could be classified or even completely 'synthesised'. A typeface design can with the help of this technology be classified to a precise detailed level. This information can be sent along with the character codes over the Internet resulting in a best matching typeface at the receiver's end. It is a kind of font-matching system, similar in principle to the well-known colour-matching system of Pantone. ElseWare even went so far as designing around 100 fonts that could generate on-the-fly True Type fonts when specified. Hewlett-Packard bought this technology to use on their printers and renamed it Infinfont. All these classification systems only exist for Latin fonts; no such formal-style classification system has been developed for Arabic fonts yet.

LiveType

The latest development on creation of parameters to (re)generate font families is done by two researchers in Jerusalem. They call their product LiveType. They are also working on a system of glyph composition for Oriental scripts which attempts to reduce the extensive amount of glyphs needed for these scripts. The system will replace whole characters with a limited amount of modular elements that can be used to compose all the required characters.
4.7.4. Type design tools

The process of type design usually starts with pencil scribbles. Soon after, computer software will play an important role in the process of further development. There are a few available software applications that help in the type design work for both Arabic and Latin scripts.

Fontographer

Originally developed by Alloys before the company was taken over by MacroMedia. It is by far the most popular font design program for Mac and Windows. The most recent version is Fontographer 4.5. The program imports and exports PostScript Type 1 and Type 3, and TrueType fonts. Macromedia has a Fontographer support area on their site.

FontLab 3.0, was written by SoftUnion in St. Petersburg, Russia. The distribution in North America is now in the hands of Pyrus and is available for Mac as well as for Windows. It is an excellent program for creating and editing PostScript Type 1 fonts. Version 3.0 comes with native TrueType curve editing and hinting, something that no other mainstream editor offers. It also has superb capabilities to create Multiple Master PostScript Type 1 fonts. FontLab 3.0 is part of a family of font-making tools comprising: FontLab Composer (for double-byte Unicode fonts), ScanFont, TypeTool, Signmaker and TransType.

FontStudio

FontStudio was written by Ares and marketed by Letraset, then bought by Adobe. FontStudio is regrettably no longer marketed. FontStudio remains the choice of many professional type designers. According to Adobe’s David Lemon, “most of Adobe’s new designs are created in the old FontStudio.” It appears to be highly unlikely that Adobe will ever update and re-market this programme.

FontMonger

FontMonger was also written by Ares and is now owned by Adobe. FontMonger runs on Windows and allows basic outline editing, importing and exporting of PostScript Type 1 and TrueType formats, plus several other scalable formats. Its auto-hinting is not bad either. The software is no longer promoted. It is still available from a limited number of computer stores.

Ikarus

Ikarus was written for the Rudolf Weber company and is now owned by urw. It was the first software that used outlines for digitised fonts. The native curves of Ikarus are Hermite splines, with the important property of having all the control points lie on the outline itself. Being the first software of its kind, it did not succeed in setting the standard. Designers have generally accepted off-curve Bézier handles. However, Ikarus has been used by many typefoundries to store thousands of their designs. Ikarus is now available for Mac (Ikarus M), Windows and Unix workstations. The current version can import and export PostScript Type 1 and True Type. Its hinting capabilities are very limited.

Type Designer

Type Designer was written by Manfred Albracht in Germany. This software runs on Windows and lets you design professional quality PostScript Type 1 and TrueType fonts. A complete PostScript Type 1 editor makes Type 1 to TrueType conversions. It is a low-priced product that has a relatively good converter inside Windows NT, which examines each Type 1 font and re-encodes it as TrueType instructions. Most other software has separate automatic TrueType auto-hinters, the results of which are often unpredictable. It is no longer sold.

Metafont

Metafont, written by Donald Knuth, is a programming language, specifically developed for type design. The design software is parameter driven, which means that overall characteristics of the font design are specified prior to font generation. Metafont is most useful for the design of large families of related fonts. Not blessed with a graphic interface, this software has a rather steep learning curve. TEx: Metafont software is available for Windows and UNIX.

Robofrog

Robofrog was written by the Dutch type designers Just van Rossum, Petr and Erik van Blokland. It is an extension of Fontographer 3.5 for the Mac. It allows you to write programmes in the Python language to economise the type design. Scripts for many tasks are also available. The software can be licensed on a subscription basis.
4.8. Conclusion. Historically speaking, the concept of the modern implied an inevitable break with the past or the classical. For Latin type this meant a clear dissociation from the calligraphic past had to take place for typography to flourish in its own right as a refined art. Ideal letter proportions and aesthetic values had to develop independently in congruence with every age’s contemporary tools and communication needs. Arabic type is at a point in its historical development where severing the ties with the glorious past is unavoidable. Arabic type should be perceived, like any written script, as a collection of parts designed to serve specific communication needs, and fit for modern means of reproduction and media.

Often non-Latin calligraphic fonts were considered challenging by western manufacturers fascinated by the complexity and interested in inventing machines that could reproduce this mechanically. Their primary concern was technologically driven. Rather than creatively developing new formal solutions, they and their clients wanted to preserve the old traditional forms, and force the machines to mechanically and later photographically and digitally copy them. All for the sake of the technical challenge. More often these typefaces were developed by western craftsmen for other nations as in the case of the Arabic script. However, when some enlightened Arab scholars and designers called for a reform and visual development of the script from a strong calligraphic tradition a typographic one, their purpose was not so much to submit the script to the restrictions of the machines as to modernise it and by this to project an image of reform to all Arab and Muslim societies. As can be seen through the display in the appendix of the work of some of the world’s most active type designers and foundries, it is invariably the work of the Arab type designers (as opposed to western type designers working with traditional Arab calligraphers) that shows the most daring and experimental solutions. Their starting points vary, from a traditional style, to a modern look or feel that might have originated from a Latin or other kind of script. This is precisely the attitude and design initiatives that render Latin fonts so rich in visual vocabulary and diversity of character, as can be witnessed through the thousands of Latin fonts available on the market today. The continued collective quest of Arab type designers will generate the much needed new aesthetic standards for a modern and dynamic Arabic typography.

In the words of Robert Bringhurst, ‘every alphabet is a culture’, and cultural identities are often tightly linked to the written form of languages. Arabic as a script has come to represent all Islamic cultures as an emblem for the holy scriptures of the Qur’an. But Arabic script is not restricted to holy texts, its use is daily life as a secular and pragmatic tool of communication is far reaching. The concern today goes beyond the traditional means of book design to embrace the all too powerful digital media. We daily interact with each other through our computer screens, using text as our primary means of communication. There should be no difference in visual quality between the representation of Arabic and Latin type on the screen.

At the dawn of every technological development, a need for setting new standards arises. This is never the work of one individual alone, but a group effort of professionals working towards the same goal. It is precisely the same type of involvement of Arab calligraphers in the past that has brought Arabic calligraphy to the high level of sophistication it has reached from the 18th century onwards. But the tools of pen and ink, and the traditional dedication of calligraphers to their old masters, are no longer useful — in fact they are more of an obstacle. Arabic calligraphy is no longer sufficient to contemporary communication needs, nor appropriate to modern tools and media. Every age has its needs and its trends, and every medium its inherent aesthetics. Arabic calligraphic styles would not have developed had the calligraphers not been progressive and experimental in adapting their script to the contemporary technological developments of their times. Arabic type today should find a way to retain its aesthetic livelihood on unforgiving rough computer screens. Arabic type needs to be adapted to the low resolution limitations that require clarity and formal simplicity. A new Arabic digital aesthetic needs to be created. Designing a typeface requires a thorough understanding of abstract form, and the skill to interpret handwritten letters into drawn forms. It is not the copying of calligraphic form, but rather the drawing anew of letters that take into consideration the limitations of where and how these letterforms will be used. The reading process and recognizability of letters is practically the same for all scripts — Arabic included. It is based on recognizing the skeletal shape of letterforms and interpreting them within a specific word context. This explains why people can read a text regardless of the type style as long as the skeletal shapes of letters is not dramatically tampered with.

This has been previously discussed in detail throughout this chapter, and suggestions have been made for what needs to be adjusted and considered when designing a font. Furthermore, the type design process should be simplified opening up this field to young fresh design blood — much of which is
bubbling in growing quantities in the Middle East today. A few simple guidelines for Arabic type design, with the aim of establishing workable coherent typographic conventions, are in much need. A standard character has been put forward with Unicode, consisting of all the letters, ligatures and non-alphabetic symbols. A basic grid for overall proportional measurements should be set up. A standard set of letters, words and sentences for testing the feasibility of type design ideas should be developed. The technical obstacles in the way of making Arabic type compatible with all commonly used programs, will soon be solved.

fight piracy and encourage research and development, as well as educational venues. Arab type designers have to work together in order to raise the standard of Arabic typography.

It would be a cultural disgrace to let the world's second most used script be so improperly represented in today's most influential communication media.

The prevalence of blatant sloppiness and mediocrity of the average set of Arabic fonts delivered by big American software companies and their resellers is disgraceful. That fonts are distributed and sold which fail to meet the lowest level of basic drawing skills—often automatically traced (most probably illegally and uncorrected)—is a sign of the general state of decay of a once rich heritage. Often the piracy is a result of insufficient copyright regulations and tax law enforcement in the Arab world. However, flagrant negligence on the part of those involved in the field, mainly the big software companies, is simply inexcusable. Unless those companies start to value the intellectual property rights of type designers (the way they protect their own software), and not simply use Arabic fonts as a means to market their own products, the situation is not likely to be rectified. Under the current circumstances, Arabic type design remains insufficiently lucrative as a business to attract serious talent, and encourage investment and development of diverse and innovative designs. The general public should be made aware of this situation and of how poorly they are being served. There is a need for a type foundry or type design association that will take up the initiative of bringing together a force that can