Hellenic Polytonic HOWTO

Table of Contents

Introduction

The current state of handling Hellenic language characters on GNU / Linux systems is examined. Emphasis is placed on the use of Hellenic polytonic (accented) fonts and keyboard drivers.

Try the pdf version of this document if the html version is not rendered correctly.

History

20111210 – Major update - tlgu.carmen.gr
20060505 – Information update – more free fonts
20060422 – Information update – X information
20051011 – Information update – gnome information
20050830 – Date correction – information request
20050722 – Amendments, addition of keyboard layouts
20050717 – First release: – cap8.gr/tlgu

Acknowledgements

Sindi Keesan, for her valuable notes on the first draft.

Simos Xenitellis, for his “gr” keyboard and font updates.

References

- *Diacritics and Aristophanes Byzantius: http://en.wikipedia.org/wiki/Polytonic_orthography, http://en.wikipedia.org/wiki/Aristophanes_of_Byzantium*
- *Evolution of the written language: http://en.wikipedia.org/wiki/Medieval_Greek, http://www.fordham.edu/halsall/byzantium/paleog.asp*
- *The abolition of the polytonic system: http://www.polytoniko.org/histo.php and www.kairatos.com.gr/polytoniko.htm, including a brief history of the accented script, in Hellenic*
- *Accentuation Tutorial ist-socrates.berkeley.edu/~ancgreek/accenthtml/accentuation.html, and accentuation rules (in Hellenic): http://www.polytoniko.org/kano.php*
- *Introduzione alla Paleografia Greca, Elpidio Mioni, Padova 1973, translation by N. Panagiotakis, National Bank of Greece Cultural Foundation, http://www.miet.gr/web/gr/ekdoseis/more.asp?id=57*
- *bash documentation (man bash) - GNU Bourne-Again Shell, Free Software Foundation, Inc., 2002 (8-bit input and output), other shell program manuals, as referenced in the text*
- *The Linux keyboard and console HOWTO, Andries Brouwer, 12-Oct-2002, http://tldp.org/HOWTO/pdf/Keyboard-and-Console-HOWTO.pdf*

- *X keyboard configuration, www.x.org/docs/XKB/XKBproto.pdf, www.xfree86.org/current/XKB-Config.html, www.xfree86.org/current/XKB-Enhancing.html, http://www.x.org/archive/X11R6.8.1/PDF/XKB-Enhancing.pdf*

- *Unicode consortium code sets, www.unicode.org*

- *Polytonic keyboard use guide, Simos Xenitellis and Costas Pistiolis (in Hellenic), http://www.isg.rhul.ac.uk/~simos/misc/polytonic/WritePolytonic.pdf*

- *Greek Font Society, http://www.greekfontsociety.gr/pages/en_typefaces1.html*

Disclaimer

The usual disclaimer about misconfiguring your system beyond repair or oblueterating your work applies: Don't blame it on me. Do one thing at a time. Read and Learn. Write to tlgu, carmen gr, in case this document contains inaccuracies, errors or if you have some information that others can benefit from.

Accents and “Breathings”

Most ancient Hellenic writings, including stone inscriptions and manuscripts up to the 9th century CE (“Current Era”) use what we now call majuscule, or **capital letters** (both modern Hellenic and “Latin” forms). Words were not separated from one another (scriptio continua). Many times, a scribe would write left-to-right and continue right-to-left (“voustrofedon” - the way oxen move when ploughing a field). People learned and knew how to pronounce each word.

The introduction of punctuation (literally) is attributed to **Aristophanes Byzantius** (c. 200 BCE); upper dot for pause, lower dot for shorter pause (comma) and middle dot for period. Accents were already there and breathings, which started as H and “⊢” for asper and “⊣“for lenis, took a right-angle form before becoming round, as we know them today.

As evidenced by preserved papyri and books the **minuscule** script, (called “**peza” – prosaic**) started appearing in the 6th century CE, taking its standardized form in the 8th century; the iota subscript and the final sigma were introduced in the 12 century. Although it is believed that this script developed from cursive writing, it is interesting to note that lower case letters reflect the form assumed by mouth, tongue and cheeks for voicing each letter.

Accents and breathing marks survived several centuries and were eventually abolished from official use in 1982 save for the **tonos** (accent) and **dialytika** (diaeresis). Like in other parts of the world, “capital” or “city” pronunciation had taken over at one point in time, rendering the original spelling and accentuation of the words obsolete. Fortunately, the correct (as in older - original) pronunciation of many Hellenic words is still preserved in local Hellenic dialects and other languages, as well.

I will provide a couple of **pronunciation examples**, hoping that I am not far off the mark. The well-known beauty abducted by the Trojan prince is now called “Elenee”, the first two “e”s pronounced like the second “e” in el-**e**-ctron. This word used to be written with a “rough breathing” mark (daseia, spiritus asper) which may be pronounced by making the first consonant “denser” (Helen, Yelena) but also as a “c”, like in “super” or “hyper” (same rough breathing mark in front) which would give us Celene (Celine) or Celena (not surprisingly, this is the most common name for earth's lone and bright satellite in Hellenic). As if this was not confusing enough, the current spelling of this word's root is “selen-” (Selene, selenium), with an “s” sound rather than a “z” sound. Note also the last vowel – an “eta” - which is interchangeably pronounced as a long “ee” or as an “a”.

Same thing with John. You may hear it pronounced “E-o-annees” in Hellenic but the rough breathing in front of the first vowel indicates that the original pronunciation would be much closer to “Yannis” or “Johannes”.

Back to the subject – the most common of these **accents** are the **acute** (oxeia), the **grave** (vareia or bareia) and the **circumflex** (perispomeni – distinct from surrounding voicings). The **diaeresis** (dialytica) shows that two vowels are pronounced separately, rather than as a dipthong. There is a **iota subscript** (hypogegrammeni or prosgegrammeni, depending on position) that may indicate a short “e” (iota) after the subscripted vowel. There are also marks to indicate long and short (**macron** and **breve - brachy**).

There are two “breathings”, **smooth** (psili – lenis – thin,) and **rough** (daseia – asper – dense) that may also co-exist with the other accents.

The Hellenic word for accent (stress) is “**tonos**”. The term **polytonic** refers to a script utilizing multiple (poly-) pronunciation marks: which syllable must be stressed, changes in tone, changes in pronunciation, phoneme separation. The contemporary **monotonic** Hellenic script uses one accent to indicate the syllable that must be stressed and diaeresis to indicate vowel separation, if needed.

- Yes, but how were the ancient hellenic words actually pronounced?

Lacking the necessary expertise I can only propose the following, to be pursued outside this HOWTO: Look in your local dialects for words that their insides (stems) look suspiciously close to known ancient accented words. Let us collect them and correlate them with both accented and unaccented forms. Try not to be influenced by established “schools” on this matter. See where it leads us. Examples: ῥοή – βροχή, ὁρῶ – θορῶ, ὑστέρνι – cisterna (κίστη, κύστη) and the well-known sal- stem: ἅλς – σαλάτα – salad, σαλαμούρα...

Many more web references on accentuation, punctuation, and pronunciation exist now, compared to the time when this document was first issued, so look around!

Output

Computers use output devices, like display screens and printers, to communicate stored information to the outside world (for the purpose of this discussion, the “outside world” is you, the computer user).

Information is stored in digital computers as a sequence of binary digits (bits). Therefore, a number of schemes have been devised to represent written language symbols in computer memory, as needs and technology change. We call these codification schemes **internal representation**.

These stored symbols are eventually translated into a graphical (written) representation to be displayed on a computer screen or to be engraved on a more permanent medium. These graphical representations are called **glyphs** (carving strokes). Different **fonts** (assortments of character types) have different glyphs for the same internal representation.

Internal symbol representation may be translated to glyphs in a variety of ways. In the older days of typewriters, when one wanted to type an accented character, one would first press the respective accent symbol key(s). The typewriter platen would not move until a letter symbol was typed (a **dead key**). This allowed the creation of a large number of glyphs. You could use any accent symbol over (or under) any letter character on your keyboard. Some punctuation, notably pause marks, would involve manually rotating the platen to place the symbol at the desired height, relative to the preceding character.

On the other hand, real typographers have typographical elements with all (usual) accented character combinations already cast to facilitate their strenuous job of arranging small pieces of metalwork (type) into their letterpress type holder. The terms **upper case** and **lower case** come from the arrangement of the type elements in corresponding wooden boxes or drawers on the typesetter's desk.

Two different methods, both implemented in today's font processing and text display computer programs. Using the latter method, ready-made accented character glyphs are available in our computer's type boxes, selectable by a **unique code** (one-to-one representation). Using the former “dead accent” method, a **sequence of symbol codes** is translated into a letter-plus-accent(s) combination glyph to be displayed or printed.

Both methods have their pros and cons. We may use our computers to “set type” and communicate our thoughts to others, but we also use them to process and re-arrange data in an effort to extract useful information.

Input

The usual method of entering textual information in a computer at this time is by pressing keyboard buttons - **keys**. This key-press information is eventually translated into internal computer representation codes and stored in computer memory.

Again, the model of our computer's keyboard is the keyboard of a typewriter: letter keys (capitals), number and symbol keys. To save on machinery, early typewriter keys actuated a stem holding more than one metal-type symbol (two or even three characters), which means that some mechanism was needed to select one or the other type element. The **Shift** key would lower or raise the platen relative to the type-holders. Later came the IBM Selectric that translated the (by then) customary shift-key combinations to a movement of a type-ball bringing the desired type element before the platen, followed by the daisy-wheel (a daisy-like structure with flexible radial elements, carrying the type). Type-balls or daisy-wheels had to match the keyboard layout, however.

User-programmable computers allow more flexibility. Contemporary keyboards output specific digital codes when a **key** is pressed (or released) reflecting the key's position on the keyboard. This **keyboard code** is translated into **internal representation** depending on the selected **keyboard translation** and the current state of **keyboard modifiers**. This last one is easier to understand. A "**Shift**" key or a "**Capitals Lock**" key or a "**Control**" key or an "**Alternate**" key is a keyboard modifier. Meaning that the state of the particular key or combination (e.g. the Control and Alt keys pressed at the same time) affects the internal representation code ultimately produced by keyboard translation programs.

The same mechanism may be extended to accent key presses. When a key representing an accent is pressed, this is remembered until a key representing a letter is pressed. The combined effect of accent and letter key presses may be translated into a single code – the internal representation of a complex character (e.g. **~ ¸ω = ω̧**). A similar effect is obtained by the so-called **Compose** key. The Compose key is pressed, followed by the desired combination of characters to produce a code representing a combined glyph (e.g. **Compose A E = Æ, Compose ~ ω = ω̃**). The Compose function can be assigned to any unused key; by default this is the key to the **right of the AltGr key** in GNU/Linux keyboard layouts.

A great benefit, reflecting on the price of keyboards over the years, is that hardware manufacturers don't have to produce different keyboards for different languages. Keyboard electronics stay the same and the only thing that may need to be changed is cheap plastic key caps.

Internal representation

A great number of communications and computer code schemes have been designed and implemented to represent written-language symbols over the years. Some of them are still used though permitting very limited (for current standards) character sets, like the Baudot-Murray and ASCII code sets (32 and 128 codes, respectively).

But the word is multi-lingual and extensions to these limited code sets were devised to allow for multi-lingual character sets in computers where the basic storage element is 8 bits wide (256 code combinations). The ISO 8859 family of code sets – still in use today – represents such an extension, where the plain Latin alphabet is represented within the first 128 different codes and the remaining 128 codes have struggled to carry our world heritage.

Obviously, the large number of distinct accented Hellenic characters could not fit in such a limited space. A solution would be the adoption of **combining diacritics** to form distinct glyphs (at processing / display time). But then there were Asian language symbols, ancient language symbols, artificial language symbols, musical symbols, mathematical / engineering symbols – humans are an inventive lot. And, guess what, each one wants to have access to symbols of special interest along with the usual language symbols. And we do have programmable computers, right?

Enter the Universal Coded Character Set (UCS) efforts, also known as ISO 10646 or **Unicode**, aiming at merging the symbols of all different cultures, current and older, into a unified scheme. This scheme defines both single-point complex characters, as well as multi-character combinations.

Of interest to this discussion are the non-accented and single-accent Hellenic characters in the **Unicode Greek and Coptic** code set (codes numbered 0370-03FF), the accents and accented character combinations in the **Greek Extended** code set (1F00-1FFF), as well as the **Combining Diacritical Marks** code set (0300-036F). These codes are adequate for representing the largest part of Hellenic writings, dating back a few thousand years.

More symbols are constantly being proposed for adoption by the Unicode consortium, like ancient mathematical and engineering notation, ancient and medieval musical notation and even older Hellenic language symbols.

GNU/Linux keyboard translation

Our favourite operating system kernel is quite flexible regarding the translation of keyboard codes into different kinds of internal representation, permitting a relatively high-level definition of how key presses and key press combinations should be handled.

On the other hand, graphical user interfaces (GUI) like the X Window System and window managers are known to add their own layer of keyboard translations and code handling.

Multiple keyboard layouts are allowed. By entering a user-defined key combination on your keyboard you are able to switch between different keyboard layouts. In addition, you may select different sets of keyboard layouts for each application or window.

Hellenic (polytonic) under X

Almost all current general-purpose GNU/Linux distributions carry a full complement of keyboard translation tables and several Unicode fonts, including polytonic Hellenic glyphs. To get additional or better-looking Hellenic characters and symbols on your display you may need to install additional **fonts** that include glyphs for the code sets mentioned above. To produce accented Hellenic script you need to select the proper variant of the Hellenic keyboard translation table (or **layout**).

Instructions are included in this document to help you identify and change the behaviour of your keyboard, if needed.

Hellenic polytonic fonts

Some quite elegant fonts have seen the light in recent years, including Hellenic accented characters and much more. Search the web for “unicode fonts polytonic Hellenic Greek” to find sites for downloading **Gentium** by Victor Gaultney, **Cardo** by David Perry, **Galatia SIL** by Jonathan Kew, **Galilee Unicode Gk** by Rodney J. Decker, **Athena Unicode** by Jeffrey Rusten - Ralph Hancock, **Porson** by Richard Spaulding, Greek Font Society (GFS) fonts: **GFS Didot** and **GFS Bodoni** by Takis Katsoulidis and George Matthiopoulos, **GFS Neohellenic** (rendered from the original Scholderer “New Hellenic”), **GFS Olga** (rendered from the original Porson font - Hellenic characters only), and more: **GFS Complutum**, **GFS Artemisia**, **GFS Baskerville**, **GFS Bodoni Classic**, **GFS Gazis**, **GFS Porson**, **GFS Solomos**, **GFS Elpis**, **GFS Theokritos**. **DejaVu Serif** by Stepan Roh, Ben Laenen, **Kerkis** by Antonis Tsolomitis, **Old Standard** and **Theano** by Alexey Kryukov, **MgOpenCanonica** by Magenta Ltd. and several others.

The **IFAO-Grec Unicode** font, Institut français d’archéologie orientale - Le Caire, deserves a special mention due to its extreme coverage of Latin, Hellenic, Coptic, and Cyrillic characters, as well as epigraphic and papyrologic symbols:

http://www.pur-editions.fr/pdf/IFAOGrecUnicodeTable.pdf

The credits at the IFAO page include Ralph Hancock, Adam Bülow-Jacobsen, and Jean-Luc Fournet.

Although the above fonts are freely available on the web, make sure that you **check their licenses carefully** if you intend to use them for publishing your texts. Several non-free polytonic fonts that you may elect to use for your work are also available.

Font installation

Font installation may be performed manually or handled by system administration programs.

Manual font installation involves copying the files to the user or system fonts directory and updating the font cache information. This can be done at the user level or at the system level. The font cache update program will scan the following system directories, looking for fonts:

```
/usr/share/fonts
/usr/lib/X11/fonts
/opt/ttfonts
/usr/local/share/fonts
```

and in the user's **.fonts** (hidden) directory.

For private use, or to test a new font, copy the new font(s) to the **.fonts** directory and run the font cache update program. In the following example the new fonts exist in the user's Download directory:

```
mkdir ~/.fonts
cp ~/Downloads/GFSArtemisia* ~/.fonts
fc-cache -v
```

For system-wide use, copy the new font(s) to one of the system font directories, and run the cache update program. For example:

```
su (sudo su for systems without a root account)
cp ~/Downloads/GFSArtemisia* /usr/share/fonts
fc-cache -vfs
```

You may need to restart your word processor to see the new fonts.

Fonts can also be installed using system administration tools running on your **desktop environment**.

For the **GNOME desktop environment**, open the directory where the new fonts have been downloaded. Right click on the font file and select "**Open as administrator**". After the font preview screen appears, press the **Install Font** button. You have to make sure that the **gnome-font-viewer** program (listed as "**Font Viewer**") is associated with the particular font extension (right click, Properties → Open With → Font Viewer).

A similar program for previewing and installing fonts exists for the **K Desktop Environment (KDE)**. It is called **kfontview**. The way to install fonts under KDE, however, is to press on "**Configure your Desktop**" which runs a program called **systemsettings**. Then select System Administration → Font Installer → Add.

If you are running **PCLinuxOS/Mandriva** systems, there is a font administration tool called **drakfont** (part of the system administration tool, **drakconf**). Use the Import → Add buttons to add new fonts to the system.

Other font browser - character map utilities may also be available for your system, like **fontmatrix**, **kcharselect** and **gucharmap** (see No polytonic keyboard later in this text).

Hellenic polytonic keyboard under X

The X-server will translate **keycodes** representing the physical keys to **keysyms** based on the contents of the key **modifier list** and the **keymap table**. Keyboard symbol codes are arranged in **groups**. A user may switch between groups using a special code. Hmmm... sounds a bit complicated but let's see an actual example.

Keyboard hardware generate **keycodes**. Pressing “A” on a typical QWERTY keyboard results in a keycode of 38, pressing “S” gives 39, pressing “D” gives 40, and so on... In the X translation tables these codes are associated with mnemonics which reflect the position of the key on the keyboard, or with some descriptive name.

The mnemonic definitions may be found in **/usr/share/X11/xkb/keycodes**. Keys in the alphanumeric section are counted from the bottom row up and from left to right, starting with zero. For example, the letter “A” is on the third row from the bottom and it is the second key from the left in the alphanumeric section of the keyboard. Its mnemonic is <AC01> meaning: Alphanumeric section, third row, key 01 (starting with zero).

The keycodes produced when a key is pressed are translated into character codes, called **keysyms**. The keycode produced when we press the key marked “A” (38) is translated into keysym 0x61 (hexadecimal), representing the symbol “a”, when no other keys modify this process, that is. If we press the same key having previously pressed the Caps Lock key, the keysym produced is 0x41, representing the symbol “A”. The Caps Lock key served as a **modifier** to produce another symbol from the same key press. Similarly, we can use other keys to modify the behaviour of the keyboard.

If we use a certain key, or key combination to change the entire layout of the keyboard, we have changed **groups**. For example, the Ctrl/Shift or Alt/Shift combinations may be used to switch between the Latin and Hellenic keyboard layouts.

The keycode and modifier key mappings are defined in **/usr/share/X11/xkb/symbols**. Defined symbols may be found in **/usr/include/X11/keysymdef.h**

Another mechanism used to produce specific symbols from the keyboard, is the **composition** process. In this process, a key press is followed by additional key presses to produce a symbol. This function is usually assigned to a special key called the **compose** key or **multi-key**, but it is the same mechanism which is used to produce accented characters by pressing the accent key, followed by the letter to be accented. For example, pressing **Compose** (to the right of the AltGr key) followed by **S**, followed by **O** produces the paragraph (**§**) symbol on the Latin keyboard. Similarly, pressing **acute** (to the right of the L key) followed by **A** produces the accented alpha (**ά**) symbol on the Hellenic polytonic keyboard.

Compose sequences are dependent on the selected locale (user “language and cultural preferences”). The compose sequences for the Hellenic keyboard layout are defined in **/usr/share/X11/locale/el_GR.UTF-8/Compose**.

For changing the keyboard layout, the **setxkbmap** program is available to perform the necessary actions and notify the X-server. We must keep in mind, however, that keyboard translations are affected by **locale** environment data. What we are interested in here, is a single environment variable (LC_CTYPE) which defines character attributes, such as case conversion. The commands below may be used on a console or they may be placed in a file called **.bashrc** (or **.profile** for remote logins) in the user's home directory, for automatic execution after logging-in.

```
export LC_CTYPE=el_GR.UTF-8
setxkbmap us,el -variant ,polytonic -option grp:ctrl_shift_toggle -option grp_led:scroll
```

After you add these lines to your **.bashrc** (or **.profile**), you need to execute them to test their effects:

```
source .bashrc
```

The first command will set the **locale** variable affecting character handling (LC_CTYPE) to Hellenic, Unicode (UTF-8).

The second line is the one doing the actual loading of the keyboard translation tables. This one defines two translation groups: U.S. English and Hellenic – polytonic variant. Now, by pressing Ctrl/Shift, the keyboard layout will change from the plain Latin one to Hellenic, allowing the creation of Unicode internal representation corresponding to the key pressed. The **Scroll Lock LED** will light to indicate that your keyboard is not in the default group (**us** in this example).

Leave out the word **polytonic** and you are left with a contemporary Hellenic (single-accent) keyboard.

Current GNU/Linux distributions support up to four (4) different groups (keyboard layouts). The following example allows the selection of U.S. English, Hellenic, and Russian keyboards by pressing Alt/Shift rather than Ctrl/Shift.

```
setxkbmap us,el,ru -option grp:alt_shift_toggle,grp_led:scroll
```

If you keep playing with options and/or the compose key, you may reach a point that you do not get the expected behaviour. To clear stored options, use the same command without any option arguments (**man setxkbmap**):

```
setxkbmap -option
```

To set the default **system-wide** keyboard behaviour, the system administrator (root) may edit the **/etc/X11/xorg.conf** file (after saving a backup copy...)

Mine used to read:

```
Section "InputDevice"
  Driver       "Keyboard"
  Identifier   "Keyboard[0]"
  Option       "MapName" "Standard Keyboard [ pc104 ]"
  Option       "Protocol" "Standard"
  Option       "XkbLayout" "us"
  Option       "XkbModel" "pc104"
  Option       "XkbRules" "xfree86"
EndSection
```

I modified it to read as follows, in order to be able to change groups using Ctrl/Shift and have a visual indication on my Scroll Lock LED (similar to the **setxkbmap** command, above):

```
Section "InputDevice"
  Driver       "Keyboard"
  Identifier   "Keyboard[0]"
  Option       "MapName" "Standard Keyboard [ pc104 ]"
  Option       "Protocol" "Standard"
  Option       "XkbLayout" "us"
  Option       "XkbModel" "pc104"
  Option       "XkbRules" "xfree86"
# use us,gr or us,el if your system does not support both
#  Option       "XkbLayout" "us,el"
  Option       "XkbLayout" "us,gr"
  Option       "XkbVariant" ",polytonic"
  Option       "XKbOptions" "grp:ctrl_shift_toggle,grp_led:scroll"
EndSection
```

Note that the X-server needs to be restarted for these changes to take effect (Ctrl/Alt/Backspace or log-out)

To see a graphical representation of the keyboard layout active in the current display, use the following console commands:

```
xkbprint -nkg 2 -eps -lc el_GR.utf8 $DISPLAY kbd.ps
gv kbd.ps (or ggv kbd.ps)
```

Following is a presentation of polytonic keyboard layouts.

The Hellenic Polytonic keyboard:

As computer keyboards are modelled after typewriter keyboards, let me depict a **typical polytonic typewriter keyboard** to use as a reference. Trying to cater for the business needs of the 20th century, the keyboard featured a full complement of modern Hellenic glyphs, dead accent keys - including the common combinations of psili-oxeia and psili-perispomeni, all accessible by the little finger of the right hand, and Latin capital letters. Notice the lack of numerals one “1” and zero “0”, depicted by capitals “I” and “O”, as well as the lack of ano teleia (semicolon), formed by manually rotating the cylinder to lower the paper and hitting the period “.” key.

	) (	C 2	S 3	D 4	R 5	G 6	U 7	J 8	F 9	L -	῀ ῁	V “
	Q &	W ς	E ε	P ρ	T τ	Y υ	Θ θ	I ι	O ο	Π π	῾ ~	→
Caps Lock	A α	Σ σ	Δ δ	Φ φ	Γ γ	H η	Ξ ξ	K κ	Λ λ	¨ ´	῾ ’	
Left Shift	Z ζ	X χ	Ψ ψ	Ω ω	B β	N ν	M μ	: ,	/ .	῎ ῞	Right Shift	

The “**el polytonic** or **gr polytonic**” Hellenic layout, found in current (2011) GNU/Linux distributions, is presented below. The additional symbols are produced when the AltGr key is pressed on the keyboard. In order to produce an accented character, dead accent key(s) must be pressed first, followed by the character to be accented.

~ `	! 1	@ 2	# 3 £	$ 4	% 5 €	^ 6	& 7	* 8	(9	) 0 °	_ - ±	+ =
Tab	: ; ·	Σ ς	E ε €	P ρ ®	T τ	Y υ	Θ θ	I ι	O ο	Π π	¨ ~ ¯	˘ ῾
Caps Lock	A α	Σ σ	Δ δ	Φ φ	Γ γ	H η	Ξ ξ	K κ	Λ λ	’ ´	῾ `	| \
Left Shift	Z ζ	X χ	Ψ ψ ©	Ω ω	B β	N ν	M μ	< , «	> . »	? /	Right Shift	

The two unshifted keys next to Lambda (L) are the dead-accent keys for the **acute** (oxeia) and **grave** (vareia). The same two keys, shifted, will produce **lenis** (psili) and **asper** (daseia).

The unshifted keys next to Pi (P) will produce the dead-accent keys **circumflex** (perispomeni) and hypogegrammeni – prosgegrammeni (iota **subscript**). Shifted, the key next to P will produce the dead-accent code for **diaeresis** (dialytika).

The same two keys, with the Right-Alt (Alt Gr) pressed will produce the dead-accent codes for **macron** and **breve** (brachy).

The “Q” key will produce the usual semi-colon and colon symbols, while with the Right-Alt (Alt Gr) pressed will produce the code for period centered “·”, used as semicolon (not quite an **ano teleia**).

The “E” key, with the Right-Alt (Alt Gr) pressed will produce the **Euro** (€) code (suspiciously looks like the sign for five obols ;-) The less “<” and greater “>” symbols with the AltGr key pressed will produce the codes for **guillemot left** “«” and **guillemot right** “»” respectively (eisagogika).

Now, there are more character glyphs defined in the Hellenic keyboard layout file, hidden under the name of the “basic” variant, which provides a single-accent keyboard, with additional ancient glyphs, accessible via the Alt Gr key:

```
setxkbmap us,el -variant ,basic -option grp:ctrl_shift_toggle -option grp_led:scroll
```

I would like to have both active at the same time, so here is a variant of a Hellenic polytonic keyboard, codenamed Aias (Ajax) after the one who convinced me that it is easier to hit the asper key with the left hand and the lenis key with the right (assuming you have a long pinky). Installation instructions are provided below.

~ ʹ ` ͵	! ¹ 1 ¹	@ ² 2 ½	# ³ 3 £	$ ¾ 4 ¼	% 5 €	^ 6	& 7 ϗ	* 8	(9	) 0 °	_ _ ¯	+ = ˘
Tab	: Ϙ ʽ ϙ	· Ϛ ϛ ϛ	Ε ε €	Ρ ρ ®	Τ τ	Υ ə υ є	Θ θ	Ι ι j	Ο Þ ο þ	Π ϖ π ϡ	˛ { ~ [	} ʼ]
Caps Lock	Α α	Σ Ϲ σ ϲ	Δ δ	Φ Ϝ φ ϝ	Γ ɣ ɸ	Η η	Ξ Ͻ ξ ϵ	Κ ϟ κ ϟ	Λ λ	¨ ´	ˌ ″ ˋ ˌ	Enter
Left Shift	Ζ Ɔ ζ ɜ	Χ Ɔ χ ɔ	Ψ ψ ©	Ω ω ϖ	Β β ϐ	Ν ¸ ν ʹ	Μ Ϻ μ ϻ	< « , «	> » . »	; ? /	Right Shift	

The characters to the right in each key cell are produced by **Alt Gr** (top is shifted, bottom is unshifted).

Top row: the symbol next to the tilde is an upper antenna (**ano keraia**), indicating that the letter represents a numeral, and the symbol next to the grave is a lower antenna (**kato keraia**), indicating thousands. The symbol next to numeral 7 is the **kai** “ϗ” (ampersand). The symbols next to the hyphen and equal sign are the **macron** and the **brachy**, respectively (dead keys).

Q key: asper (dead key), colon, koppa. W key: final sigma, **ano teleia**, stigma, Y key: lunate epsilon, I key: yot, O key: sho, P key: sampi (thick s, 900), followed by the dead keys for **perispomeni** – **ypogegrammeni**, and lenis (**psili**).

S key: lunate sigma, F key: digamma, G key:, J key: sigma periestigmenon, K key: numerical koppa (90). Next to L are the dead keys acute (**oxeia**) – diaeresis (**dialytica**) and the grave (**bareia**).

Z key: antisigma periestigmenon, X key: antisigma, V key: pi (script), B key: beta, N key: upper – lower antennae, M key: san.

The "standard" (single-accent) Hellenic keyboard:

Tab	: ; ·	Σ ς	Ε ε €	Ρ ρ	Τ τ	Υ υ	Θ θ	Ι ι	Ο ο	Π π	{ [	}]
Caps Lock	Α α	Σ σ	Δ δ	Φ φ	Γ γ	Η η	Ξ ξ	Κ κ	Λ λ	¨ ΄	" '	| \
Left Shift	Ζ ζ	Χ χ	Ψ ψ	Ω ω	Β β	Ν ν	Μ μ	< ,	> .	? /	Right Shift	

Similar to the above, the dead accents are next to Lambda (L), limited to the "**tonos**" (stress mark) and diaeresis (**dialytica**).

Instructions to install an alternate gr keyboard layout

```
# Note that keyboard translation is affected by both the symbol translation table
# and the compose sequences file, found, respectively at:
#
# /usr/share/X11/xkb/symbols/gr
# /usr/share/X11/locale/el_GR.UTF-8/Compose
#
# Alternate gr keyboard layout files may be found in tlgu.carmen.gr
# Download the files to your home directory which, for this example, is
/home/aias/Downloads
# Change to the administrator (root) account
  su
     # or, for distributions without a root account:
     sudo su

# Save the original Hellenic keyboard layout under the name of gr.distribution
  mv /usr/share/X11/xkb/symbols/gr /usr/share/X11/xkb/symbols/gr.distribution
```

```
# Copy the new layout translation table in place and clear the xkb cache;
# the system will automatically compile a new translation table.
  cp /home/Downloads/gr.aias.111210 /usr/share/X11/xkb/symbols/gr

  rm -f /var/lib/lib/xkb/*
  rm -f /var/lib/xkb/*

# Clear the current keyboard options and set the new keyboard
# (in this example the layout is changed with Alt/shift)
  setxkbmap -option ""

  setxkbmap us,el -variant ,polytonic -option grp:ctrl_shift_toggle -option
grp_led:scroll
```

Hellenic polytonic keyboard under KDE and GNOME

If you experience problems with these procedures, use one of the methods described above, preferably the ".bashrc" method.

To run an individual program, press **Alt/F2** (Run Application) and type in the program's name.

This is the **KDE4 Control Center** way:

- Click on the **System Settings** icon on your KDE panel (the one with the tools) or press **Alt/F2** and type **systemsettings**.
- Select **Hardware → Input Devices → Keyboard → Layouts**
- Click on **Configure layouts** → **Add Layout**; select **Layout**: **Greece**, **Variant**: **Polytonic**
- Click on the **Main shortcuts** button to select the layout switching combination. You may also select whether the keyboard layout change is Global (all applications), separate for each Desktop, separate for each Application, or separate for each Window.

Note that the default layout-switching key combination is **Ctrl/Alt/K** (now shown as **Alternative shortcut** in the Layouts panel). Alas, this default combination is ill-fated as the moment you enter the layout switching combination, "K" is no longer "kay", it is "kappa". You are stuck with a Hellenic keyboard. You have to go back with the mouse and reconfigure.

And this is the **Gnome Preferences** way:

- On your **Gnome Panel click** on the **System** menu.
- Select **Preferences → Layouts → Add → By Language → Greek → Greece Polytonic**

The program actually running is **gnome-keyboard-properties**, which can also be invoked by the **gnome-control-center** program.

A nice feature is the ability to have a **Separate layout for each window**, selectable by ticking the appropriate field in the **Layouts** tab. You can type Hellenic in one word processor window and English in another, without having to switch keyboard layouts.

You may then click on the **Options** button in the **Layouts** tab to define the **Key(s) to change layout**, for switching between languages, and/or any other desirable keyboard behaviour.

Locales

"A locale is a set of language and cultural rules. These cover aspects such as language for messages, different character sets, lexigraphic conventions, etc. A program needs to be able to determine its locale and act accordingly to be portable to different cultures." (see **man 7 locale, man 1 locale**)

The locale setting (comprising a number of environment variables) may affect the way our keyboard works, most notably defines the **compose sequences**, and the way our text is sorted and displayed. These variables may have already been set based on your (or someone else's) selections at system installation time. Also be aware of the fact that **file names may be encoded according to your locale setting**, rendering them inaccessible to other computer systems. Be very conservative on file names – use plain Latin characters as much as possible.

A locale name is of the form language[_territory][.codeset][@modifier]. A few examples:

```
LC_CTYPE=el_GR.UTF-8
LC_CTYPE=el_GR
LC_CTYPE=el_GR.ISO-8859-7
LC_CTYPE=el_GR.UTF-8@euro
```

For a list of all locales currently **supported** by your computer, use

```
locale -a
```

The default storage location for the locale files is: /usr/X11R6/lib/X11/locale

Let's take a look at some of these variables:

LC_ALL - sets all LC_xxx variables to a given locale (affects character translation, message translation, number representation, time format, collating sequence and monetary representation).

LC_CTYPE - determines what characters are allowed, and whether they should be treated as letters, digits, punctuation, or control characters.

LANG - determines the language used

The **first non-empty value** among these three determines the current locale for character handling, and in particular the **default text encoding**.

You may query current locale settings. e.g.

```
locale -k LC_CTYPE
```

Hellenic keyboard at the console (CLI)

To get Hellenic characters at the console we need the following:

A keyboard map.

A font with Hellenic characters.

We also need to tell the shell (bash) not to mutilate the codes produced by our keyboard translation table and the terminal subsystem to use the display codes loaded.

```
# A polytonic font is available but a corresponding keyboard translation table is missing;
# therefore, this does not yet comprise a polytonic solution
# setfont greek-polytonic.psfu

# load the Hellenic translation table
loadkeys gr

# load a corresponding font and unicode console translation map (one of)
setfont iso07.16
setfont -m 8859-7

# leave my characters alone
set input-meta on
set convert-meta off
set output-meta on

# switch on the user-defined character sets
echo -ne "\033(K\033)K" >/dev/tty
```

I found the compressed keyboard map (by Sarantos, dated 21-June-1997), including comments on its use, in **/usr/lib/kbd/keymaps/i386/qwerty/gr.map.gz** (used to be in /usr/share/kbd/keymaps/i386/qwerty/gr.map.gz)

The console font was stored in **/usr/lib/kbd/consolefonts** where there are also several gr737 and gr928 fonts. Note that the ISO-8859-7 codes are translated to Unicode (UCS-2) for output (**man setfont**).

man bash and a quick search for input-meta, convert-meta and output-meta tells us that

input-meta must be on for 8 bits, **convert-meta** must be off otherwise our 8th bit is translated into an escape character and **output-meta** must again be on for 8 bits.

Finally, the "Linux keyboard and console HOWTO – The console character sets" states that to **select the user-defined character sets** for display we must send the "ESC (K" and "ESC) K" sequences to the console (/dev/tty).

Following are the instructions provided in gr.map.gz by its author:

```
# Left-shift-alt is the greek-lock key (the same as in Win95).
# The new win95 keys (on win95 keyboard) can be used too
# (until a better use of them is found):
# Left and Right win95 keys act like shift-to-greek,
# and Right win95menu key acts like greek-lock.
#
# I was unable to define two dead keys in a row, so:
# For both accent and dialytika use Ctrl and the accent key.
#
# For bugs/remarks, send mail to sarantos@ics.forth.gr
# You can get updated versions from
# http://www.ics.forth.gr/~sarantos/gr.map
#
# This is an iso-8859-7 mapping. Use together with "setfont iso07.*"
# activated by sending Esc ( K to the console.
```

Now if you manage to reach a point where your console is unusable, try the following:

Press "Esc" followed by "c" or blindly type

```
echo "\033c" > /dev/tty/
```

Blindly type "**reset**" or "**setterm – reset**" or "**tput reset**" or "**tput init**" or "**tput clear**" at the console prompt. You may also have to type a line feed before and after these commands:

e.g. Press **Ctrl/J**, type **reset**, press **Ctrl/J** again.

Loop to initialize all terminals (for startup files, experts only):

```
for tty in /dev/tty[0-5]*;
        do echo -ne "\033(K\033)K" >$tty;
done
```

No polytonic keyboard

Sometimes one may wish to just enter a few characters, without having to grapple with keyboard maps and such. Enter the **character map** programs:

gucharmap by Noah Levitt and **kcharselect** by Reginald Stadlbauer will be of great help, as will be **fontmatrix**, initiated by Pierre Marchand. All feature a selection mode for characters which can then be copied to the clipboard and pasted in your text.

Same with "**Insert → Special Character**" in your favourite word processor.

Word-processing and display applications

Just a few highlights – most contemporary GNU / Linux applications should be able to handle Unicode. If this is not the case, please report the problem(s) to their maintainers.

OpenOffice/LibreOffice handles Hellenic accented characters well. Its search and replace function includes an option for using powerful **regular expressions** (**grep**-like syntax). It will produce **html** and **pdf** files using UTF-8 encoding.

Plain text editors: **kate** (3.6), **kwrite** (4.6), **vim/cream** (7.3), **gedit** (2.30).

Adobe **Acrobat 9.x** for Linux works and allows for polytonic characters in its search box, although it translates accented characters to its non-accented form. **evince (2.30)** allows full Unicode input and does discriminate between accented and non-accented letters.

Browsers (**konqueror**, **firefox**, **iron**) will happily display UTF-8 codes, as long as **charset** is defined and fonts match.

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