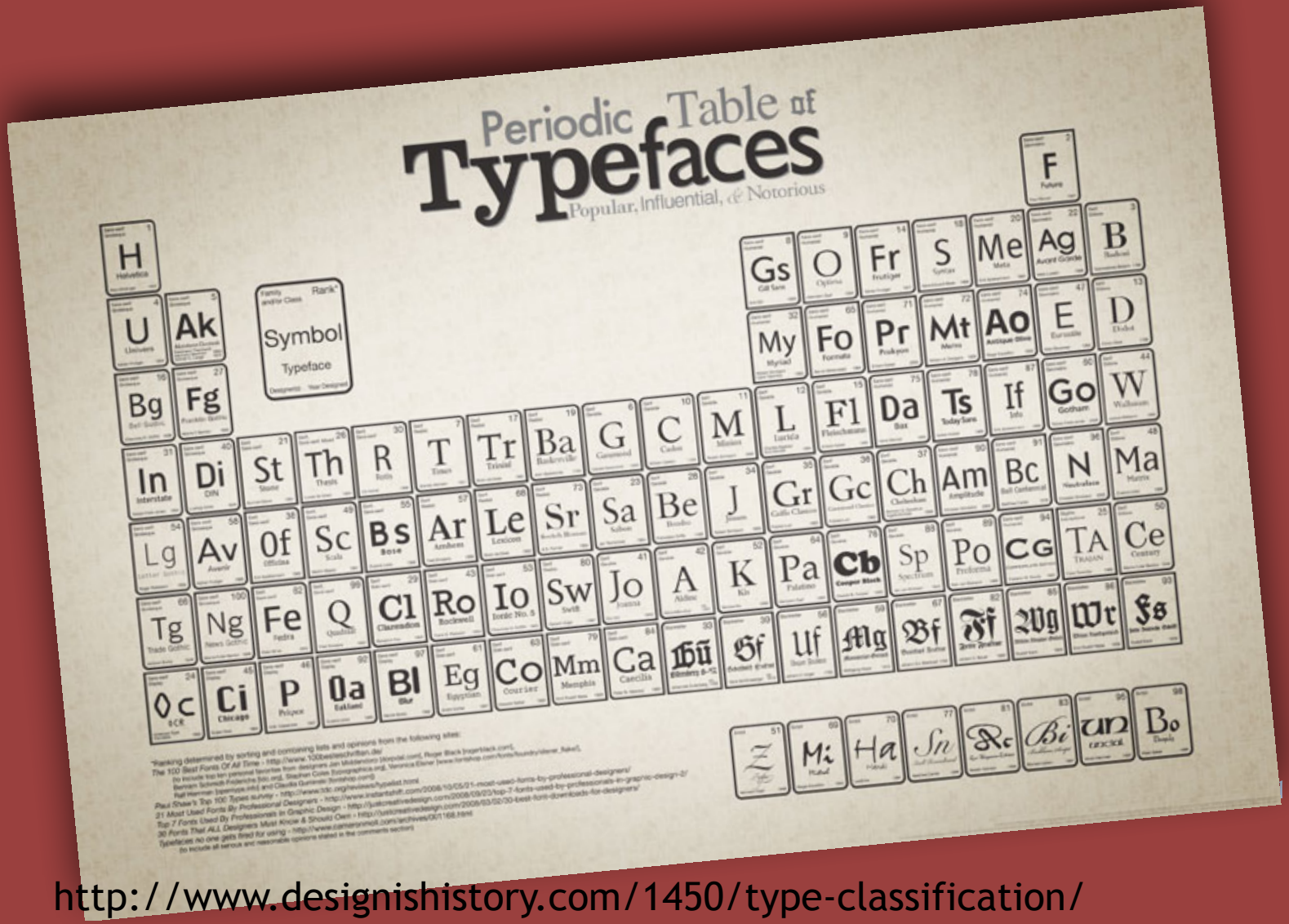
Encoding Text



http://www.designishistory.com/1450/type-classification/

Text and Binary Data

- Up till this point in the course, we've been moving up to bigger and bigger code structures
  - *From ints and floats, to lists and strings, to modules and classes*
- Today, we're heading in the other direction.
  - *We want to know how a computer can store all the types of data we use, when at some level it's all binary, just zeros and ones.*
- When we're just working in Python, we usually don't have to worry about this level of representation … but …

Text & Binary Data

- But as a data scientist, you'll often need to collect data from other sources
  - *Websites or servers with public apis*
  - *Files created by other people*
  - *Text that people type into your application*
- We can classify these sources as text data or binary data. Let's cover text data first.

Text

- How can we get a computer to process text characters?
- We know that at some level, text has to be binary, so need to map each character to a binary sequence
  - `You can view every binary sequence as a number in base 2`
  - `0000 is 0`
  - `0001 is 1`
  - `0010 is 2`
  - `And so on…`
- The first major system for encoding text was called ASCII
  - *"American Standard Code for Information Interchange"*
  - *It was published in 1963*
- Every ASCII character takes 7 bits [tho there's also 8-bit ASCII]
  - *This means that you can only get $2^7 = 128$ different characters*
  - *But there is also 8-bit ASCII [https://www.sciencebuddies.org/science-fair-projects/references/table-of-8-bit-ascii-character-codes]*

ASCII

ASCII value	Character	Control character	ASCII value	Character	ASCII value	Character	ASCII value	Character
000	(null)	NUL	032	(space)	064	@	096	
001	☺	SOH	033	!	065	A	097	a
002	☻	STX	034	"	066	B	098	b
003	♥	ETX	035	#	067	C	099	c
004	♦	EOT	036	$	068	D	100	d
005	♣	ENQ	037	%	069	E	101	e
006	♠	ACK	038	&	070	F	102	f
007	(beep)	BEL	039	'	071	G	103	g
008	◘	BS	040	(	072	H	104	h
009	(tab)	HT	041	)	073	I	105	i
010	(line feed)	LF	042	*	074	J	106	j
011	(home)	VT	043	+	075	K	107	k
012	(form feed)	FF	044	,	076	L	108	l
013	(carriage return)	CR	045	-	077	M	109	m
014	♫	SO	046	.	078	N	110	n
015	☼	SI	047	/	079	O	111	o
016	►	DLE	048	0	080	P	112	p
017	◄	DC1	049	1	081	Q	113	q
018	↕	DC2	050	2	082	R	114	r
019	‼	DC3	051	3	083	S	115	s
020	π	DC4	052	4	084	T	116	t
021	§	NAK	053	5	085	U	117	u
022	▬	SYN	054	6	086	V	118	v
023	↨	ETB	055	7	087	W	119	w
024	↑	CAN	056	8	088	X	120	x
025	↓	EM	057	9	089	Y	121	y
026	→	SUB	058	:	090	Z	122	z
027	←	ESC	059	;	091	[	123	{
028	(cursor right)	FS	060	<	092	\	124	¦
029	(cursor left)	GS	061	=	093	]	125	}
030	(cursor up)	RS	062	>	094	^	126	~
031	(cursor down)	US	063	?	095	_	127	⌂

Beyond ASCII

- Of course, ASCII is far too limiting.
  - *It doesn't even cover all the characters we use to write Latin-alphabet languages, such as English, let alone other major languages.*
- There have been a lot of attempts to create larger character encodings.
  - *Windows code, Latin-1, etc*
- These may be incompatible and cause errors if you don't know exactly how to process the bits you're getting.

More on encodings...

Why care about this?

- *Internationalization* ("i18") - mapping between data streams & localization
- *Legacy Systems* - converting data from older systems
- *Standards* - ANSI and ISO and others
- *Typography* - OpenFont, TrueType, others, support "GID" (graphic ID that are not part of the ASCII code page planes) for historical/graphic graphemes

Some sites to visit...

Character encodings for beginners

https://www.w3.org/International/questions/qa-what-is-encoding

What Every Programmer Absolutely, Positively Needs To Know About Encodings And Character Sets To Work With Text

http://kunststube.net/encoding/

Unicode Basics

http://ergoemacs.org/emacs/unicode_basics.html

WIN-1252

https://www.w3schools.com/charsets/ref_html_ansi.asp

ISO-8859-x

https://www.i18nqa.com/debug/table-iso8859-1-vs-windows-1252.html

Unicode • http://unicode.org

→ 2160 Ⅰ roman numeral one
004A J LATIN CAPITAL LETTER J
004B K LATIN CAPITAL LETTER K
→ 212A K kelvin sign
004C L LATIN CAPITAL LETTER L
→ 2112 ℒ script capital l
004D M LATIN CAPITAL LETTER M
→ 2133 ℳ script capital m
004E N LATIN CAPITAL LETTER N
→ 2115 ℕ double-struck capital n
004F O LATIN CAPITAL LETTER O
0050 P LATIN CAPITAL LETTER P
→ 2119 ℙ double-struck capital p
0051 Q LATIN CAPITAL LETTER Q
→ 211A ℚ double-struck capital q
0052 R LATIN CAPITAL LETTER R
→ 211B ℛ script capital r
→ 211C ℜ black-letter capital r
→ 211D ℝ double-struck capital r
0053 S LATIN CAPITAL LETTER S
0054 T LATIN CAPITAL LETTER T
0055 U LATIN CAPITAL LETTER U
0056 V LATIN CAPITAL LETTER V
→ 2164 Ⅴ roman numeral five
0057 W LATIN CAPITAL LETTER W
0058 X LATIN CAPITAL LETTER X
0059 Y LATIN CAPITAL LETTER Y
005A Z LATIN CAPITAL LETTER Z
→ 2124 ℤ double-struck capital z
→ 2128 ℨ black-letter capital z

ASCII punctuation and symbols

005B [LEFT SQUARE BRACKET
= opening square bracket (1.0)
• other bracket characters: 27E6 ⟦ –27EB ⟫, 2983 ⦃ –2998 ⦄, 3008 〈 –301B 〛

Lowercase Latin alphabet

0061 a LATIN SMALL LETTER A
0062 b LATIN SMALL LETTER B
0063 c LATIN SMALL LETTER C
0064 d LATIN SMALL LETTER D
0065 e LATIN SMALL LETTER E
→ 212E ℮ estimated symbol
→ 212F ℯ script small e
0066 f LATIN SMALL LETTER F
0067 g LATIN SMALL LETTER G
→ 0261 ɡ latin small letter script g
→ 210A ℊ script small g
0068 h LATIN SMALL LETTER H
→ 04BB ҥ cyrillic small letter shha
→ 210E ℎ planck constant
0069 i LATIN SMALL LETTER I
• Turkish and Azerbaijani use 0130 İ for uppercase
→ 0131 ı latin small letter dotless i
→ 1D6A4 𝚤 mathematical italic small dotless i
006A j LATIN SMALL LETTER J
→ 0237 ȷ latin small letter dotless j
→ 1D6A5 𝚥 mathematical italic small dotless j
006B k LATIN SMALL LETTER K
006C l LATIN SMALL LETTER L
→ 2113 ℓ script small l
→ 1D4C1 𝓁 mathematical script small l
006D m LATIN SMALL LETTER M
006E n LATIN SMALL LETTER N
→ 207F ⁿ superscript latin small letter n
006F o LATIN SMALL LETTER O
→ 2134 ℴ script small o
0070 p LATIN SMALL LETTER P
0071 q LATIN SMALL LETTER Q
0072 r LATIN SMALL LETTER R
0073 s LATIN SMALL LETTER S
0074 t LATIN SMALL LETTER T

Unicode

/uxxxx

/Uxxxx

/N{}

Unicode

- The closest thing we have to a standard is a system called Unicode.
  - *This defines a set of more than 120,000 different characters.*
    - *Modern languages, ancient languages, mathematical symbols.*
- Unicode is actually an abstraction, essentially just assigning an order to characters.
- There are then character encodings that take each unicode character and map it to a sequence of bytes.
  - The most popular one is UTF-8 [though CJK others in UTF-16]
  - The 8 stands for 8 bits, or one byte. Every character in UTF-8 gets 1 to 4 bytes.
    - The original ASCII characters are encoded with 1 byte using their original ASCII encoding. So UTF-8 is very compact for these characters.

Unicode

- UTF-8 is becoming a popular standard.
  - 85.1% of all Web pages in September 2015
  - It is the required encoding for many file types (.json, .xml, etc.)
- This is what you want to use if you have a choice.
- But there are times when you have to interact with other encodings in Python.
- We'll explore how to encode and decode text in the next segments.