
AROUND THE WORLD
IN 80 DOGS
A RUFF GUIDE TO THE
DATABASE CHARACTER SET


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A RUFF GUIDE TO THE
DATABASE CHARACTER SET


ENGLAND
ENGLAND

dog

dog

↓

Her: What's 'S' in Morse? Me: ...

To any blind people offended by that joke, you know where to find me!


dog
↓
[64 6f 67]

~/github/patrickjolliffe/presentations/charset› 🐅 80dogs.txt

Hund
Ha'DIbaH
abwo
alabai
anjing
ashun
aso
cane
cão
câin
câine
câini
chien
chó
cyn
dog
emba
ghaddu
gom
hond
hondur
hualp
huan
hund
imba
imbua
imbwe
inu
it
jindo
kelb
khuy
klèb
koer
koira
kotta
køter
kutya
kutta
köpek
köpeği
mbula
mbwa
mbwagh
mbwá
mbwene
mbʉ
njau
njoka
pa
perro
pes
pies
qen
qeni
sag
sagol
sobaka
suns
szczeniak
tz’i’
ukudla
welpe
xolo
zwin
āso
āšun
šuo
אבו
כלב
كلب
कुत्ता
ฆ่า
犬
狗
ᛕᛁᛟ
łéédchąą’í
🦮
🐕
🐶

- **Before Unicode**
- Unicode
- Oracle CharacterSet

	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x		1	2	3	4	5	6	7	8	9	0	#	@	:	>	√
1x	ƀ	/	S	T	U	V	W	X	Y	Z	≠	,	%	ɣ	\	₩
2x	–	J	K	L	M	N	O	P	Q	R	!	⌗	*	]	;	Δ
3x	&	A	B	C	D	E	F	G	H	I	?	.	⌑	[	<	⍰

```
→ encode.py ascii < 80dogs.txt
✅ ascii: 53 good dogs
  Hund  Ha'DIbaH  abwo  alabai  anjing  ashun  aso  cane  chien  cyn  dog  emba
  ghaddu  gom  hond  hondur  hualp  huan  hund  imba  imbua  imbwe  inu  it
  jindo  kelb  khuy  koer  koira  kotta  kutya  kutta  mbula  mbwa  mbwagh  mbwene
  njau  njoka  pa  perro  pes  pies  qen  qeni  sag  sagol  sobaka  suns
  szczeniak  ukudla  welpe  xolo  zwin
❌ ascii: 27 bad dogs
  cão  cain  caine  caini  chó  klèb  køter  köpek  köpeği  mbwá  mbʉ  tz’i’
  āso  āšun  šuo  كلب  כלב  אבו  कुत्ता  ฆ่า  犬  狗  ᏦᎯᎾ  łéédchąą’í
  🦯  🐕  🐶
✅ ascii: 240 chars encoded in 240 bytes, 1.00 bytes per char
```


Huan
➜[48 75 61 6e] (ascii)

Ha'DIbaH

➜[48 61 27 44 49 62 61 48] (ascii)

ascii	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x	<nul>	<soh>	<stx>	<etx>	<eot>	<enq>	<ack>	<bel>	<bs>	<tab>	<lf>	<vt>	<ff>	<cr>	<so>	<si>
1x	<dle>	<dc1>	<dc2>	<dc3>	<dc4>	<nak>	<syn>	<etb>	<can>		<sub>	<esc>	<fs>	<gs>	<rs>	<us>
2x		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3x	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4x	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5x	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6x	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7x	p	q	r	s	t	u	v	w	x	y	z	{	`	`	}	~

```
"WOOF"→[01010111 01001111 01001111 01000110]
"woof"→[01110111 01101111 01101111 01100110]

"HAU"→[1001000 1000001 1010101]
"hau"→[1101000 1100001 1110101]
```

iso-8859

Standard	Alias	Region	Year
iso-8859-1	**latin1**	**Western Europe**	1987
iso-8859-2	**latin2**	**Central & Eastern Europe**	1987
iso-8859-3	latin3	South Europe	1988
iso-8859-4	latin4	North Europe	1988
iso-8859-5	cyrillic		1988
iso-8859-6	arabic		1987
iso-8859-7	greek		1987
iso-8859-8	hebrew		1988
iso-8859-9	latin5	Turkish	1989
iso-8859-10	latin6	Nordic	1992
iso-8859-11	thai		2001
iso-8859-13	latin7	Baltics	1998
iso-8859-14	latin8	Celtic	1998
iso-8859-15	**latin9**	**Western Europe (Improved)**	1999
iso-8859-16	latin10	South-Eastern Europe	2001

```
→ encode.py ascii latin1 < 80dogs.txt
✅ ascii ✅ latin1: 53 good dogs
  Ha'DIbaH  Hund  abwo  alabai  anjing  ashun  aso  cane  chien  cyn  dog  emba
  ghaddu  gom  hond  hondur  hualp  huan  hund  imba  imbua  imbwe  inu  it
  jindo  kelb  khuy  koer  koira  kotta  kutta  kutya  mbula  mbwa  mbwagh  mbwene
  njau  njoka  pa  perro  pes  pies  qen  qeni  sag  sagol  sobaka  suns
  szczeniak  ukudla  welpe  xolo  zwin
❌ ascii ✅ latin1: 9 bad dogs turned good
  chó  câin  câine  câini  cão  klèb  köpek  køter  mbwá
❌ ascii ❌ latin1: 18 bad dogs
  köpeği  mbʉ  tz'i'  āso  āšun  łéédhą́ą'í  šuo  كلب  כלב  אבו  कुत्ता  ฆ่า
  КИΘ  犬  狗  🛕  🐕  🐶

✅ ascii→latin1: 53→62 good dogs
✅ ascii: 240 chars encoded in 240 bytes, 1.00 bytes per char
✅ latin1: 278 chars encoded in 278 bytes, 1.00 bytes per char
```

→[63 e3 6f] (latin1)


câine
➜[63 e2 69 6e 65] (latin1)

```
→ encode.py ascii latin2 < 80dogs.txt
✅ ascii ✅ latin2: 53 good dogs
  Ha'DIbaH  Hund  abwo  alabai  anjing  ashun  aso  cane  chien  cyn  dog  emba
  ghaddu  gom  hond  hondur  hualp  huan  hund  imba  imbua  imbwe  inu  it
  jindo  kelb  khuy  koer  koira  kotta  kutta  kutya  mbula  mbwa  mbwagh  mbwene
  njau  njoka  pa  perro  pes  pies  qen  qeni  sag  sagol  sobaka  suns
  szczeniak  ukudla  welpe  xolo  zwin
❌ ascii ✅ latin2: 7 bad dogs turned good
  chó  câin  câine  câini  köpek  mbwá  šuo
❌ ascii ❌ latin2: 20 bad dogs
  cão  klèb  köpeği  køter  mbʉ  tz’i’  āso  āšun  łéédchąą’í  كلب  כלב  אבו
  कुत्ता  ฆ่า  ᛕᛁᛜ  犬  狗  🛕  🐕  🐶

✅ ascii→latin2: 53→60 good dogs
✅ ascii: 240 chars encoded in 240 bytes, 1.00 bytes per char
✅ latin2: 269 chars encoded in 269 bytes, 1.00 bytes per char
```


köpek
➜[6b f6 70 65 6b] (latin2)


šuo
➜[b9 75 6f] (latin2)

ascii	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x	‹nul›	‹soh›	‹stx›	‹etx›	‹eot›	‹enq›	‹ack›	‹bel›	‹bs›	‹tab›	‹lf›	‹vt›	‹ff›	‹cr›	‹so›	‹si›
1x	‹dle›	‹dc1›	‹dc2›	‹dc3›	‹dc4›	‹nak›	‹syn›	‹etb›	‹can›	‹em›	‹sub›	‹esc›	‹fs›	‹gs›	‹rs›	‹us›
2x		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3x	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4x	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5x	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6x	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7x	p	q	r	s	t	u	v	w	x	y	z	{	`	`	}	~
8x																
9x																
ax																
bx																
cx																
dx																
ex																
fx																

latin1	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x	‹nul›	‹soh›	‹stx›	‹etx›	‹eot›	‹enq›	‹ack›	‹bel›	‹bs›	‹tab›	‹lf›	‹vt›	‹ff›	‹cr›	‹so›	‹si›
1x	‹dle›	‹dc1›	‹dc2›	‹dc3›	‹dc4›	‹nak›	‹syn›	‹etb›	‹can›	‹em›	‹sub›	‹esc›	‹fs›	‹gs›	‹rs›	‹us›
2x		!	"	#	$	%	&	'	(	)	*	+	,	–	.	/
3x	0	1	2	3	4	5	6	7	8	9	:	;	‹	=	›	?
4x	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5x	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6x	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7x	p	q	r	s	t	u	v	w	x	y	z	{	`	`	}	~
8x																
9x																
ax	¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬		®	-	°
bx	±	²	³	´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿	
cx	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
dx	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
ex	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
fx	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ù	ú	û	ü	ý	þ	ÿ

latin2	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x	‹nul›	‹soh›	‹stx›	‹etx›	‹eot›	‹enq›	‹ack›	‹bel›	‹bs›	‹tab›	‹lf›	‹vt›	‹ff›	‹cr›	‹so›	‹si›
1x	‹dle›	‹dc1›	‹dc2›	‹dc3›	‹dc4›	‹nak›	‹syn›	‹etb›	‹can›	‹em›	‹sub›	‹esc›	‹fs›	‹gs›	‹rs›	‹us›
2x		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3x	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4x	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5x	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6x	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7x	p	q	r	s	t	u	v	w	x	y	z	{	`	`	}	~
8x																
9x																
ax		Ą	˘	Ł	¤	Ľ	Ś	§	¨	Š	Ş	Ť	Ź		Ž	Ż
bx	°	ą	˛	ł	´	ľ	ś	ˇ	¸	š	ş	ť	ź	”	ž	ż
cx	Ŕ	Á	Â	Ă	Ä	Ĺ	Ć	Ç	Č	É	Ę	Ë	Ě	Í	Î	Ď
dx	Đ	Ń	Ň	Ó	Ô	Ő	Ö	×	Ř	Ů	Ú	Ű	Ü	Ý	Ţ	ß
ex	ŕ	á	â	ă	ä	Í	ć	ç	č	é	ę	ë	ě	í	î	ď
fx	đ	ń	ň	ó	ô	ő	ö	÷	ř	ů	ú	ű	ü	ý	ţ	˙

gb2312

```
→ encode.py ascii gb2312 < 80dogs.txt
✅ ascii ✅ gb2312: 53 good dogs
  Ha'DIbaH  Hund  abwo  alabai  anjing  ashun  aso  cane
  chien  cyn  dog  emba  ghaddu  gom  hond  hondur
  hualp  huan  hund  imba  imbua  imbwe  inu  it
  jindo  kelb  khuy  koer  koira  kotta  kutta  kutya
  mbula  mbwa  mbwagh  mbwene  njau  njoka  pa  perro
  pes  pies  qen  qeni  sag  sagol  sobaka  suns
  szczeniak  ukudla  welpe  xolo  zwin
❌ ascii ✅ gb2312: 7 bad dogs turned good
  chó  klèb  mbwá  tz’i’  āso  犬  狗
❌ ascii ❌ gb2312: 20 bad dogs
  câin  câine  câini  cão  köpek  köpeği  køter  mbʉ
  āšun  łééchąą’í  šuo  كلب  כלב  אבו  कुत्ता  ฆ่า
  ꓘИΘ  𐀓  𓃡  🐶

✅ ascii→gb2312: 53→60 good dogs
✅ ascii: 240 chars encoded in 240 bytes, 1.00 bytes per char
✅ gb2312: 261 chars encoded in 269 bytes, 1.03 bytes per char
```

狗

→ [b9 b7]


犬
→ [c8 ae]


Hund
➜ [48 75 6e 64] (gb2312)
➜ [48 75 6e 64] (ascii)


?
?
➜[?? ?? ?? ??] (gb2312)


cane
→[63 61 6e 65] (gb2312)


狗犬
→[b9 b7 c8 ae]（gb2312）

?

```
➜[.. b9 b7 ..] (gb2312)
```

狗

→[.. b9 b7 ..] (gb2312)

肮发

→ [b0 b9 b7 a2] (gb2312)

- Before Unicode
- **Unicode**
- Oracle CharacterSet

Codepoint

U+0000→U+10ffff

Plane		Name
0	U+0000 → U+ffff	Basic Multilingual Plane
1	U+10000 → U+1ffff	Supplementary Multilingual Plane
2	U+20000 → U+2ffff	Supplementary Ideographic Plane
3	U+30000 → U+3ffff	Tertiary Ideographic Plane
4 → 13	U+40000 → U+dffff	Reserved
14	U+e0000 → U+effff	Suppl. Special-Purpose Plane
15	U+f0000 → U+fffff	Private Use Area A
16	U+100000 → U+10ffff	Private Use Area B

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
U+000x	‹nul›	‹soh›	‹stx›	‹etx›	‹eot›	‹enq›	‹ack›	‹bel›	‹bs›	‹tab›	‹lf›	‹vt›	‹ff›	‹cr›	‹so›	‹si›
U+001x	‹dle›	‹dc1›	‹dc2›	‹dc3›	‹dc4›	‹nak›	‹syn›	‹etb›	‹can›	‹em›	‹sub›	‹esc›	‹fs›	‹gs›	‹rs›	‹us›
U+002x		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
U+003x	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
U+004x	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
U+005x	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
U+006x	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
U+007x	p	q	r	s	t	u	v	w	x	y	z	{	`	`	}	~
U+008x																
U+009x																
U+00ax	¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬		®	-	°
U+00bx	±	²	³	´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿	
U+00cx	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
U+00dx	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
U+00ex	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
U+00fx	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ù	ú	û	ü	ý	þ	ÿ

Range	Block
U+0000→U+007f	ASCII
U+0080→U+00ff	Latin1
U+0100→U+024f	Latin Extended
U+0250→U+02ff	Phonetic Symbols
U+0300→U+05ff	Greek, Cyrillic, Hebrew
U+0600→U+0fff	Arabic & Indian
U+1000→U+17ff	S & SE Asian
U+1800→U+24ff	E Asian
U+2000→U+27ff	Symbols, Punctuation
U+2800→U+28ff	Braille, Shapes
U+2e80→U+9fff	Chinese
U+ac00→U+d7af	Korean
U+d800→U+dbff	High Surrogates
U+dc00→U+dfff	Low Surrogates
U+e000→U+f8ff	Private Use

Unicode Encodings

- **UTF-32**
- UTF-16
- UTF-8

```
→ encode.py utf-32be < 80dogs.txt
✅ utf-32be: 80 good dogs
✅ utf-32be: 338 chars encoded in 1352 bytes, 4.00 bytes per char
```

犬 = U+72ac

```
→ [00 00 72 ac]                     (utf-32be)
→ [ac 72 00 00]                     (utf-32le)
→ [00 00 fe ff 00 00 72 ac] (utf-32be + BOM)
→ [ff fe 00 00 ac 72 00 00] (utf-32le + BOM)
```

Unicode Encodings

- UTF-32
- **UTF-16**
- UTF-8

```
→ encode.py utf-16be < 80dogs.txt
✅ utf-16be: 80 good dogs
utf-16be: 338 chars encoded in 682 bytes, 2.02 bytes per char
```

犬 = U+72ac

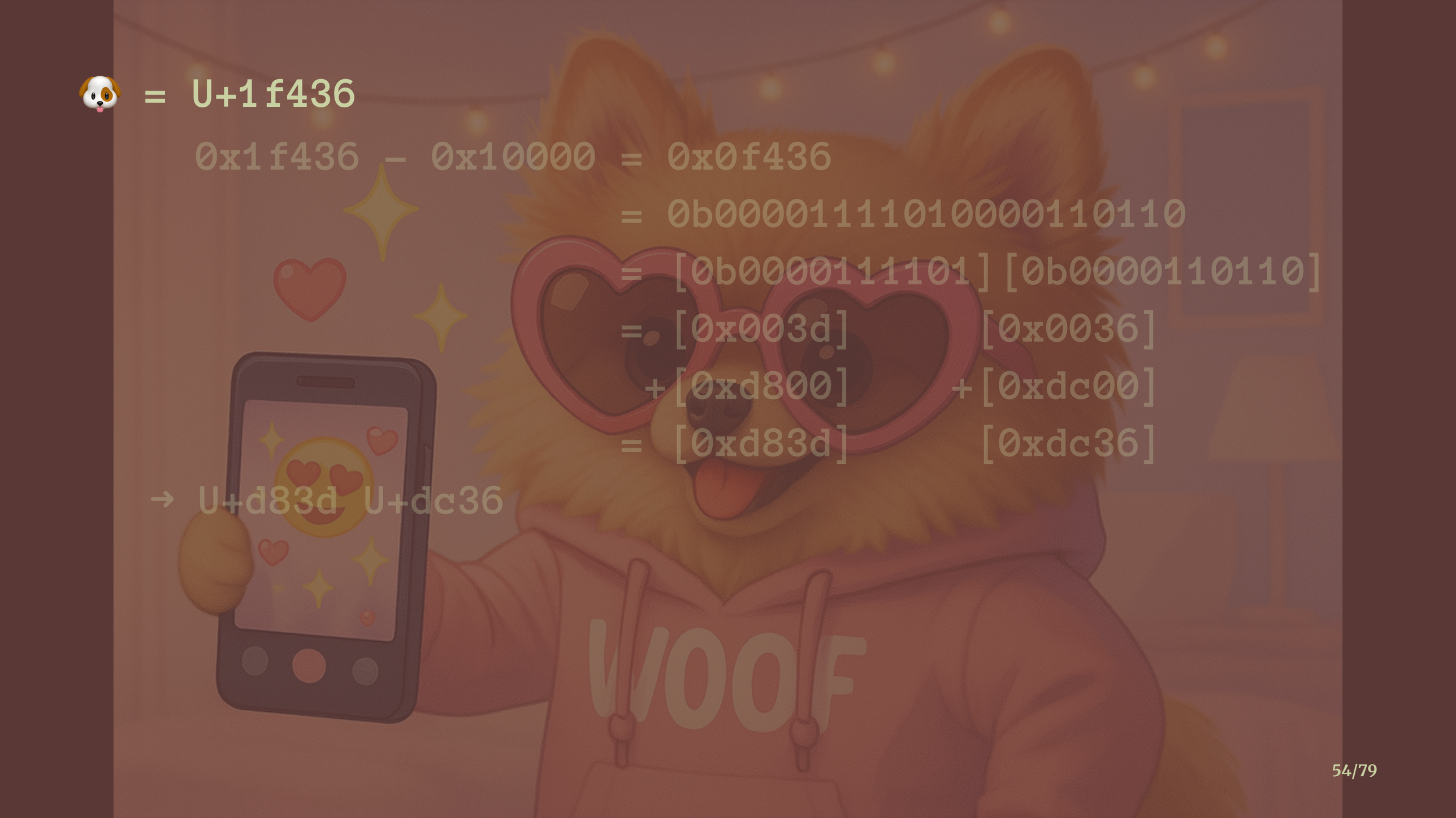
```
→ [72 ac]                (utf-16be)
→ [ac 72]                (utf-16le)
→ [fe ff 72 ac] (utf-16be + BOM)
→ [ff fe ac 72] (utf-16le + BOM)
```


WOOF

= U+1f436

→ [?? ??] (utf-16)

Range	Block
U+0000→U+007f	Latin Basic
U+0080→U+00ff	Latin Supplement
U+0100→U+024f	Latin Extended
U+0250→U+02ff	Phonetics
U+0300→U+05ff	Greek, Cyrillic, Hebrew
U+0600→U+0Fff	Arabic, Indian
U+1000→U+17ff	S & SE Asian
U+1800→U+24ff	E Asian
U+2000→U+27ff	Symbols
U+2800→U+28ff	Braille, Shapes
U+2e80→U+9fff	Chinese
U+ac00→U+d7af	Korean
U+d800→U+dbff	**High Surrogates**
U+dc00→U+dfff	**Low Surrogates**
U+e000→U+f8ff	Private Use



🐶 = U+1f436

```
0x1f436 - 0x10000 = 0x0f436
                  = 0b00001111101000000110110
                  = [0b0000111101][0b0000110110]
                  = [0x003d]      [0x0036]
                  +[0xd800]      +[0xdc00]
                  = [0xd83d]      [0xdc36]
```

→ U+d83d U+dc36


= U+1f436
→ U+d83d U+dc36
→ [d8 3d] [dc 36] (utf-16)
WOOF

Unicode Encodings

- UTF-32
- UTF-16
- **UTF-8**

```
→ encode.py utf-8 < 80dogs.txt
✅ utf-8: 80 good dogs
✅ utf-8: 338 chars encoded in 413 bytes, 1.22 bytes per char
```

U+0000→U+007Fff

→[0xxxxxxx]

U+0080→U+07ff

→[110xxxxx 10xxxxxx]

U+0800→U+ffff

→[1110xxxx 10xxxxxx 10xxxxxx]

U+10000→U+10ffff

→[11110xxx 10xxxxxx 10xxxxxx 10xxxxxx]

```
U+00e3 ('ã')
  =   00011100011
  =      00011    100011
     110xxxxx 10xxxxxx
  → [11000011 10100011]
  = [c3       a3]
```

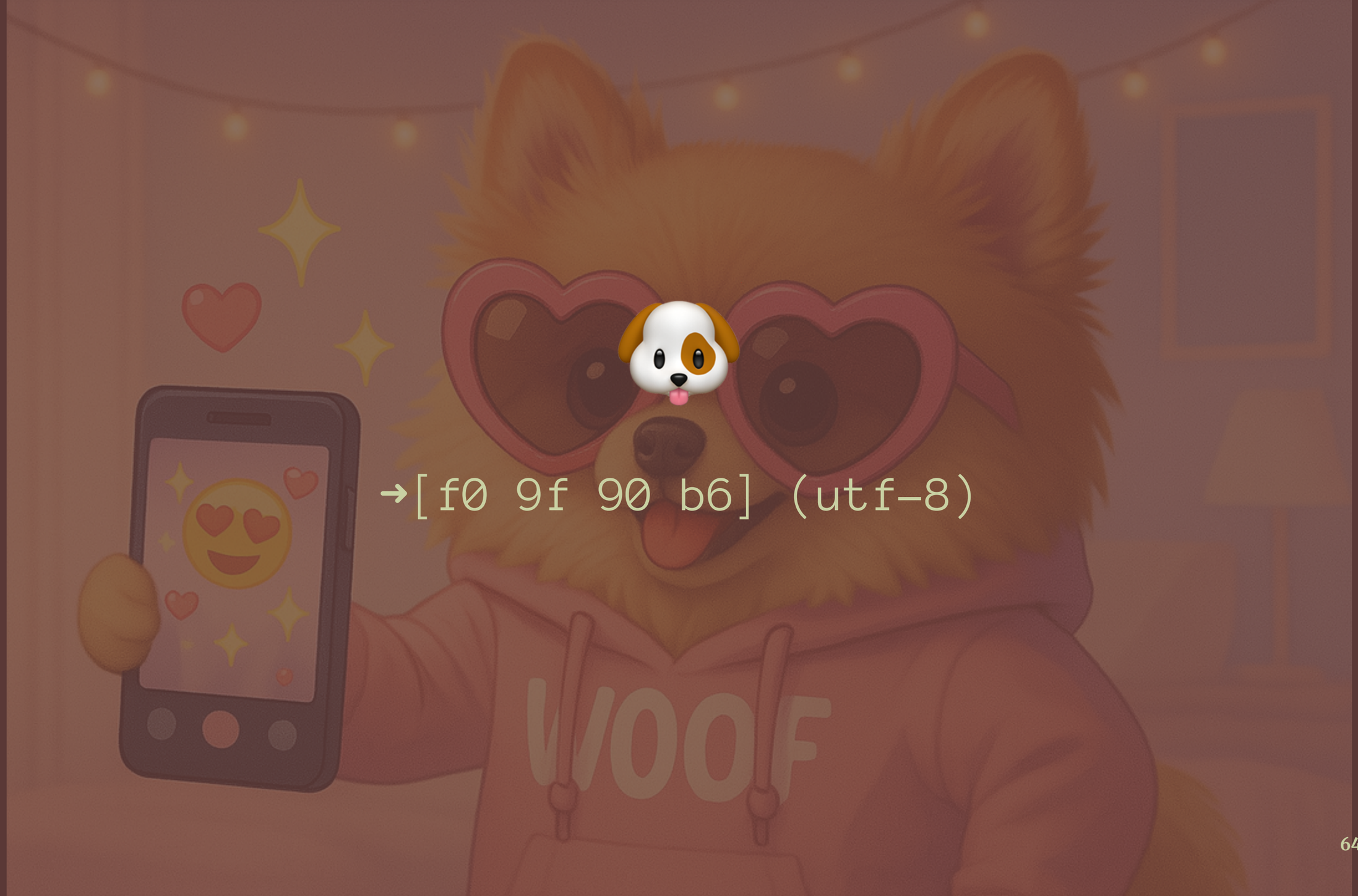
```
[0xxxxxxx]
[110xxxxx 10xxxxxx]
[1110xxxx 10xxxxxx 10xxxxxx]
[11110xxx 10xxxxxx 10xxxxxx 10xxxxxx]

[0xxxxxxx] ASCII
[10xxxxxx] Continuation
[110xxxxx] Lead of 2 byte sequence
[1110xxxx] Lead of 3 byte sequence
[11110xxx] Lead of 4 byte sequence

[...10100011 10100011 11000011 10100011 01010101...]
```


pies
→[70 69 65 73] (ascii)
→[70 69 65 73] (utf-8)

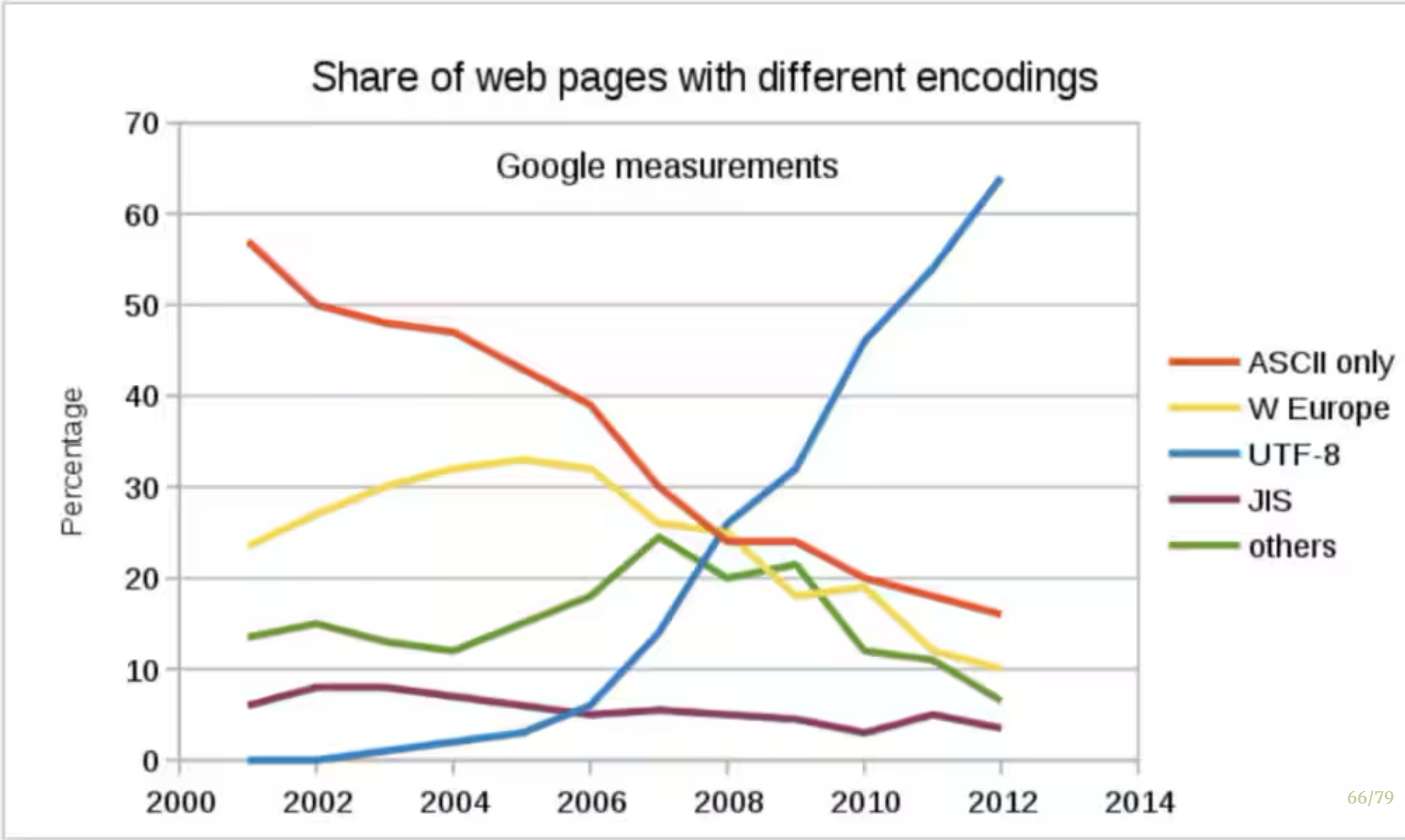

cão
→[63 c3 a3 6f] (utf-8)

狗

→[e7 8b 97] (utf-8)


→[f0 9f 90 b6] (utf-8)
WOOF

Encoding	Good Dogs	Bytes per Char
ascii	53	1.00
latin1	62	1.00
latin2	60	1.00
gb2312	60	1.03
utf-8	80	1.22
utf-16	80	2.02
utf-32	80	4.00


Share of web pages with different encodings
Google measurements
Percentage
70
60
50
40
30
20
10
0
2000
2002
2004
2006
2008
2010
2012
2014
ASCII only
W Europe
UTF-8
JIS
others

- Before Unicode
- Unicode
- **Oracle CharacterSet**

```
create database piesek
   characterset we8iso8859p1
   national character set al16utf16
...

create table dogs (name     nchar(2),
                   language char(10 char));

insert into dogs (name,  language)
          values (n'🐶', 'Emoji');
```

```
SQL> create table t (nfilter nchar(2), padding varchar2(1000));

Table T created.

SQL> insert into t
  2  select case when mod(level, 1000) = 0 then 'A'
  3              when mod(level, 1000) = 1 then 'B'
  4              else 'X'
  5         end,
  6  rpad('X', 1000, 'X')
  7* from dual connect by level <= 100000;

100,000 rows inserted.

SQL> select count(*) from t where nfilter in ('A','B');

   COUNT(*)
-----------
        200

SQL> select count(*) from t where nfilter in ('A','B');

   COUNT(*)
-----------
          1
```

we8iso8859p1
al16utf16

```
we 8 iso8859p1
al 16 utf16
```

Database Version	CharacterSet	National CharacterSet
6	we8iso8859p1	
7	we8iso8859p2, zhs16cgb231280	
8i	utf8	utf8
9i	al32utf8	al16utf16

UTF8 (≠ UTF-8)

U+0000→U+007f
→[0xxxxxxx]

U+0080→U+07ff
→[110xxxxx 10xxxxxx]

U+0800→U+ffff
→[1110xxxx 10xxxxxx 10xxxxxx]

~~U+10000→U+10ffff~~
~~→[11110xxx 10xxxxxx 10xxxxxx 10xxxxxx]~~

 = U+130e5

= U+130e5

→ U+d83c U+dce5
→ [ed a0 bc ed b3 a5]

In Summary

- CharacterSet: AL32UTF8 (not UTF8)
- National CharacterSet: AL16UTF16 (not UTF8)

[54 48 41 4e 4b 53] (ascii/latin1/gb2312/utf-8)

[11110000 10011111 10011001 10001111] (utf-8)

[54 48 41 4e 4b 53] (ascii/latin1/gb2312/utf-8)

→ **THANKS**

[11110000 10011111 10011001 10001111] (utf-8)

→ U+1f64f → 🙏