HackerFrogs Afterschool Encoding /w Cryptohack.org

Class:
Cryptography

Workshop Number:
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Special Requirements:
Registered account at cryptohack.org

Welcome to HackerFrogs Afterschool!

HackerFrogs Afterschool is a cybersecurity program for learning beginner cybersecurity skills across a wide variety of subjects.

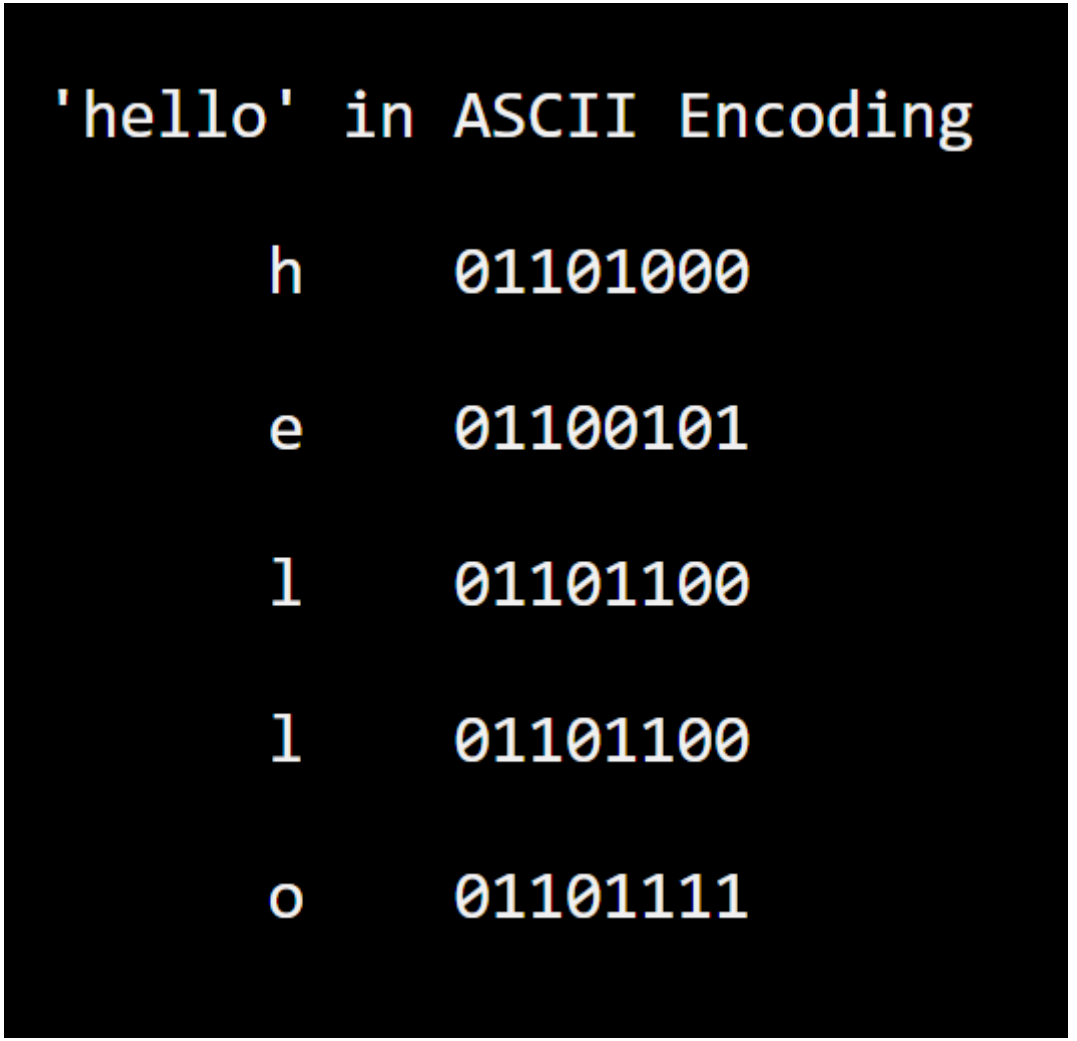
This workshop is the first lesson for cryptography.

Welcome to HackerFrogs Afterschool!

In this first lesson,we'll be easing into simple cryptographic concepts through learning about encoding.

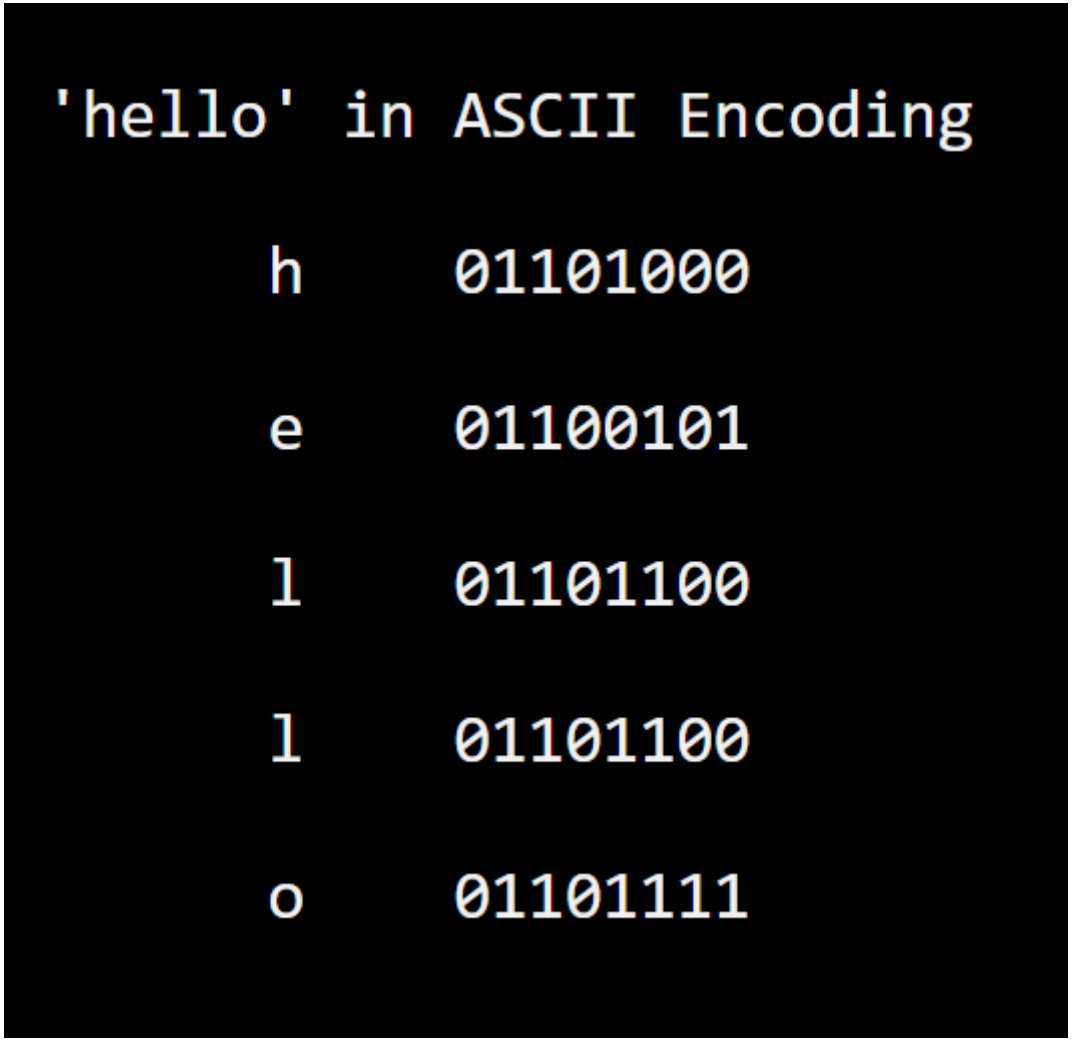
What is Encoding?

Encoding refers to the process of converting data from one form to another, often for the purpose of efficient storage, transmission, or representation.



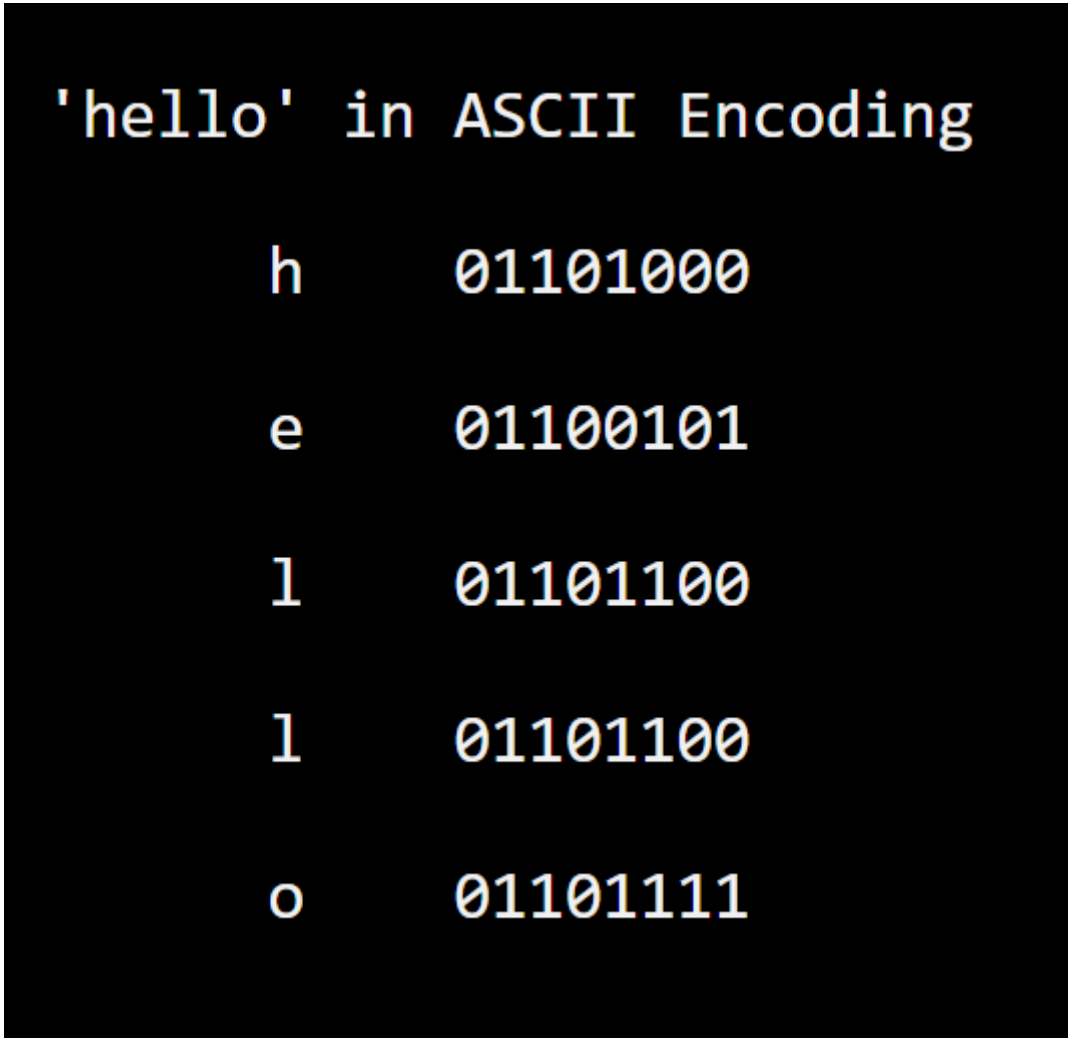
What is Encoding?

For example, before the word **hello** can appear on a computer screen, it needs to be encoded into ASCII characters from the binary numbers that computers use.



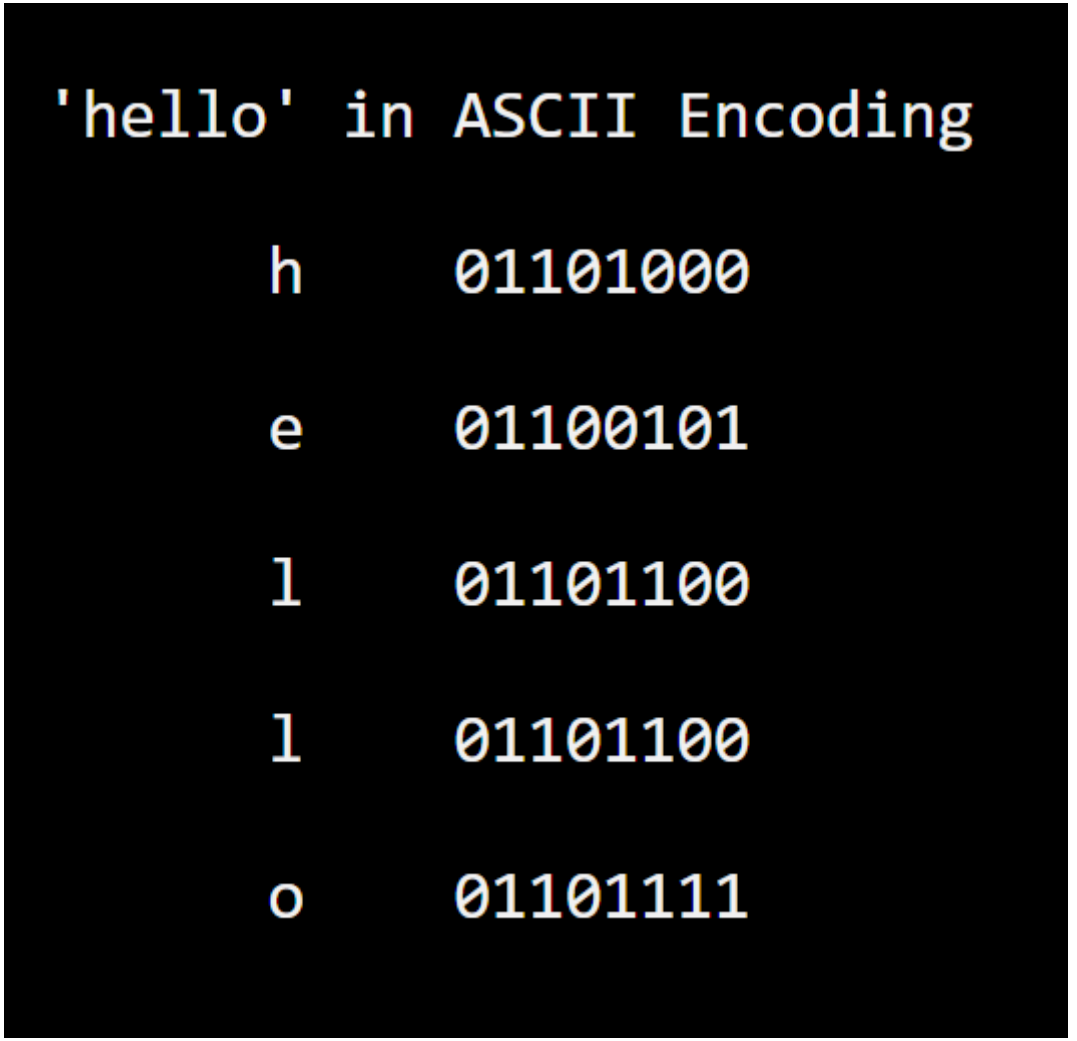
What is Encoding?

Although encoding transforms data from one form to another, it is **not** considered cryptography, because the purpose of encoding isn't to keep data secret.



What is Encoding?

Nonetheless, encoding is a good introduction to cryptography, because it introduces us to transforming data according to different systems and rules.



The CryptoHack Platform

We'll be learning encoding basics by working through the intro course on the CryptoHack platform, which is a great free platform for learning cryptography concepts

The CryptoHack Platform

If you don't already have an account there, you can signup at the following link:

https://cryptohack.org/register/

You might need this website to complete registration:

https://cryptii.com/pipes/caesar-cipher

The CryptoHack Platform

After you're logged in, navigate to this link to start the course:

https://cryptohack.org/courses/intro/course_details/

ASCII Encoding

The first system of encoding that we'll look at is ASCII, which is a common text encoding system which assigns numerical values to letters, numbers, and symbols

```
'h' in ASCII encoding

binary      = 01101000
hexadecimal = 68
decimal     = 104
```

ASCII Encoding

ASCII can take its input in different numerical formats, such as binary (base 2), hexadecimal (base16), and decimal (base 10).

```
'h' in ASCII encoding

binary      = 01101000
hexadecimal = 68
decimal     = 104
```

The Original ASCII Characters

ASCII TABLE

Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char
0	0	[NULL]	32	20	[SPACE]	64	40	@	96	60	`
1	1	[START OF HEADING]	33	21	!	65	41	A	97	61	a
2	2	[START OF TEXT]	34	22	"	66	42	B	98	62	b
3	3	[END OF TEXT]	35	23	#	67	43	C	99	63	c
4	4	[END OF TRANSMISSION]	36	24	$	68	44	D	100	64	d
5	5	[ENQUIRY]	37	25	%	69	45	E	101	65	e
6	6	[ACKNOWLEDGE]	38	26	&	70	46	F	102	66	f
7	7	[BELL]	39	27	'	71	47	G	103	67	g
8	8	[BACKSPACE]	40	28	(	72	48	H	104	68	h
9	9	[HORIZONTAL TAB]	41	29	)	73	49	I	105	69	i
10	A	[LINE FEED]	42	2A	*	74	4A	J	106	6A	j
11	B	[VERTICAL TAB]	43	2B	+	75	4B	K	107	6B	k
12	C	[FORM FEED]	44	2C	,	76	4C	L	108	6C	l
13	D	[CARRIAGE RETURN]	45	2D	-	77	4D	M	109	6D	m
14	E	[SHIFT OUT]	46	2E	.	78	4E	N	110	6E	n
15	F	[SHIFT IN]	47	2F	/	79	4F	O	111	6F	o
16	10	[DATA LINK ESCAPE]	48	30	0	80	50	P	112	70	p
17	11	[DEVICE CONTROL 1]	49	31	1	81	51	Q	113	71	q
18	12	[DEVICE CONTROL 2]	50	32	2	82	52	R	114	72	r
19	13	[DEVICE CONTROL 3]	51	33	3	83	53	S	115	73	s
20	14	[DEVICE CONTROL 4]	52	34	4	84	54	T	116	74	t
21	15	[NEGATIVE ACKNOWLEDGE]	53	35	5	85	55	U	117	75	u
22	16	[SYNCHRONOUS IDLE]	54	36	6	86	56	V	118	76	v
23	17	[ENG OF TRANS. BLOCK]	55	37	7	87	57	W	119	77	w
24	18	[CANCEL]	56	38	8	88	58	X	120	78	x
25	19	[END OF MEDIUM]	57	39	9	89	59	Y	121	79	y
26	1A	[SUBSTITUTE]	58	3A	:	90	5A	Z	122	7A	z
27	1B	[ESCAPE]	59	3B	;	91	5B	[	123	7B	{
28	1C	[FILE SEPARATOR]	60	3C	<	92	5C	\	124	7C	|
29	1D	[GROUP SEPARATOR]	61	3D	=	93	5D	]	125	7D	}
30	1E	[RECORD SEPARATOR]	62	3E	>	94	5E	^	126	7E	~
31	1F	[UNIT SEPARATOR]	63	3F	?	95	5F	_	127	7F	[DEL]

Let's Learn ASCII with Cryptohack

Let's learn more about ASCII by working through a challenge on Cryptohack. Navigate to the following URL

https://cryptohack.org/courses/intro/enc1/

Hexadecimal Numbers

Hexadecimal is a system of counting in base 16, whereas our “normal” counting system (decimal) is base 10. Here's what the numbers 0 to 16 look like in hexadecimal:

0 1 2 3 4 5 6 7 8 9 A B C D E F 10

Hexadecimal Conversion

Hex Number	Decimal Number	Binary Number
1F	31	00011111
AA	170	10101010
FF	255	11111111

One reason why hexadecimal representation is used in computing is because it allows 8-digit binary numbers to be represented with 2-digits

Hexadecimal to ASCII

Hex Number	Binary Number	ASCII Char
41	01000001	A
23	00100011	#
77	01110111	w

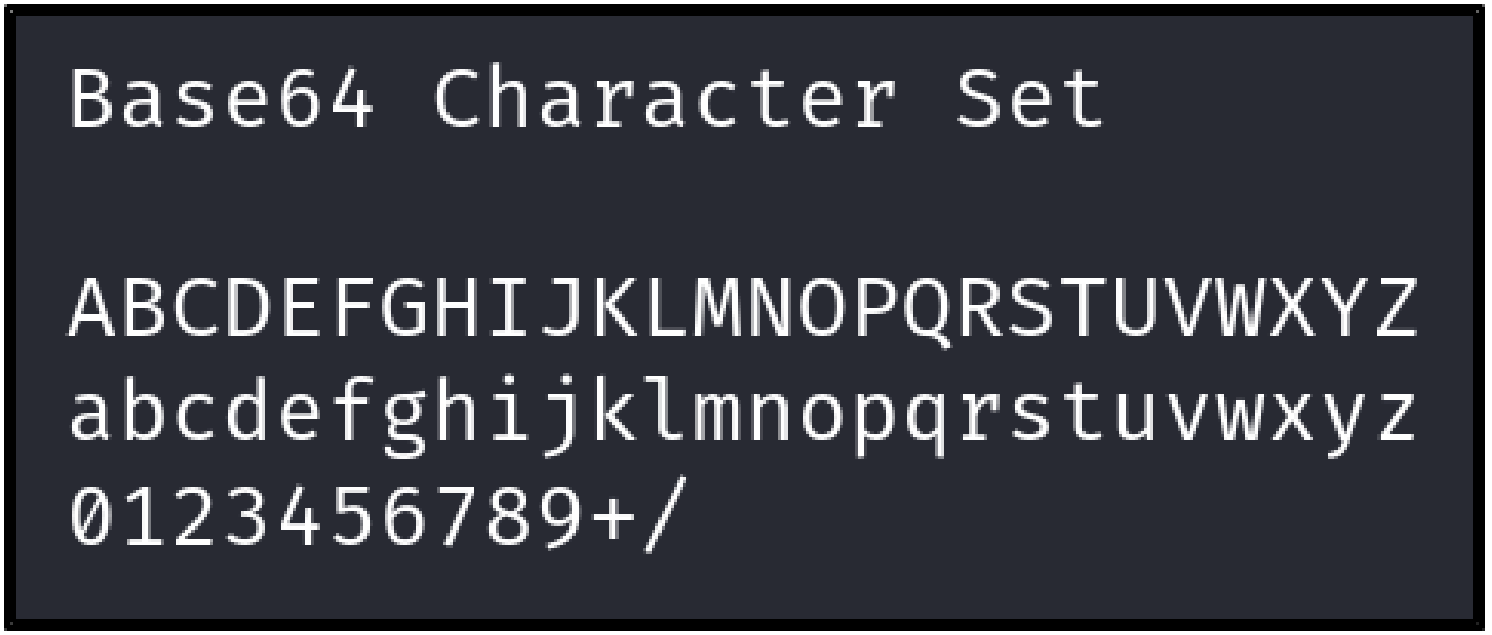
It's also very convenient to represent ASCII characters with Hex because it allows non-printable ASCII characters to

Let's Learn Hex with Cryptohack

Let's learn more about hexadecimal encoding by working through a challenge on Cryptohack. Navigate to the following URL

https://cryptohack.org/courses/intro/enc2/

Base64 Encoding



Base64 is a system which converts data bytes into strings made up of characters in the Base64 character set

Base64 Encoding

```
└─$ echo 'hackerfrogs!' | base64
aGFja2VyZnJvZ3MhCg==
```

Here's an example of encoding a string using base64. Note the presence of equal signs at the end of the base64-encoded string

Base64 Encoding

```
└─$ echo 'hackerfrogs!' | base64
aGFja2VyZnJvZ3MhCg==
```

Base64 encoded strings will always consist of a number of characters that is divisible by the number 4

Base64 Encoding

```
└─$ echo 'hackerfrogs!' | base64
aGFja2VyZnJvZ3MhCg==
```

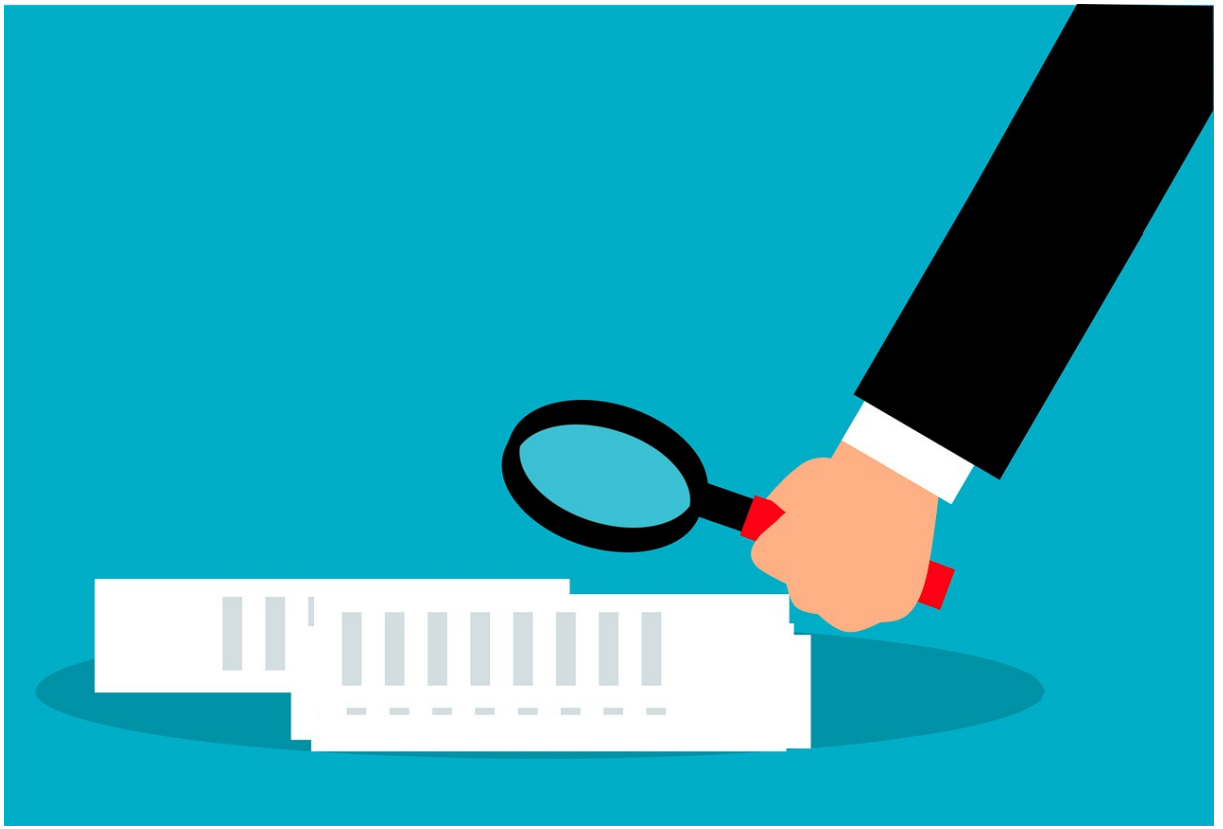
And if that is not the case, then a number of equal signs (padding characters) will be placed at the end of the string so that it of the correct length

Let's Learn Base64 with Cryptohack

Let's learn more about base64 encoding by working through a challenge on Cryptohack. Navigate to the following URL

https://cryptohack.org/courses/intro/enc3/

Summary



Let's review the cryptography concepts we learned in this workshop:

What is Encoding?

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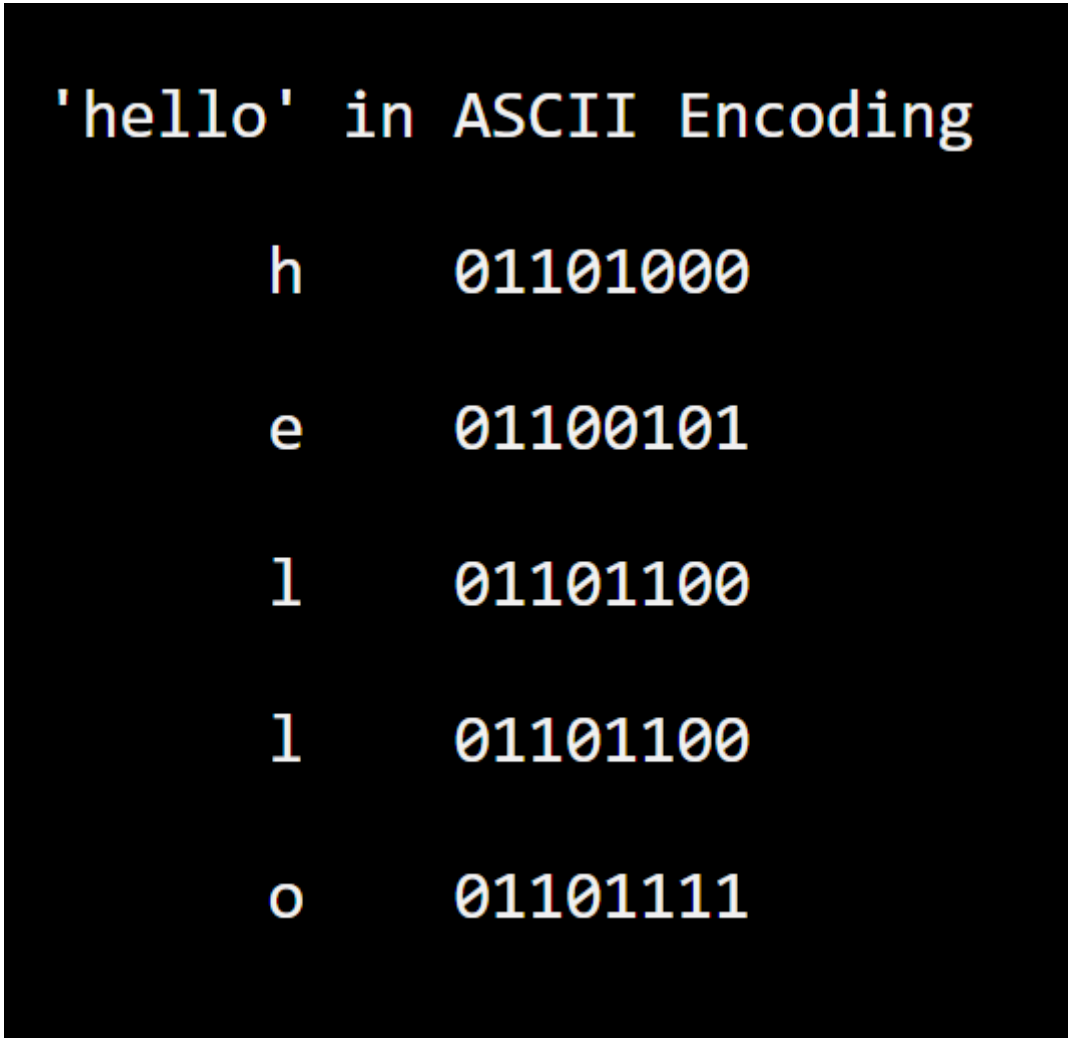

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Hexadecimal Conversion

Hex Number	Decimal Number	Binary Number
1F	31	00011111
AA	170	10101010
FF	255	11111111

Hexadecimal can be used to represent ASCII characters, and conversion between hex and ASCII is a form of encoding

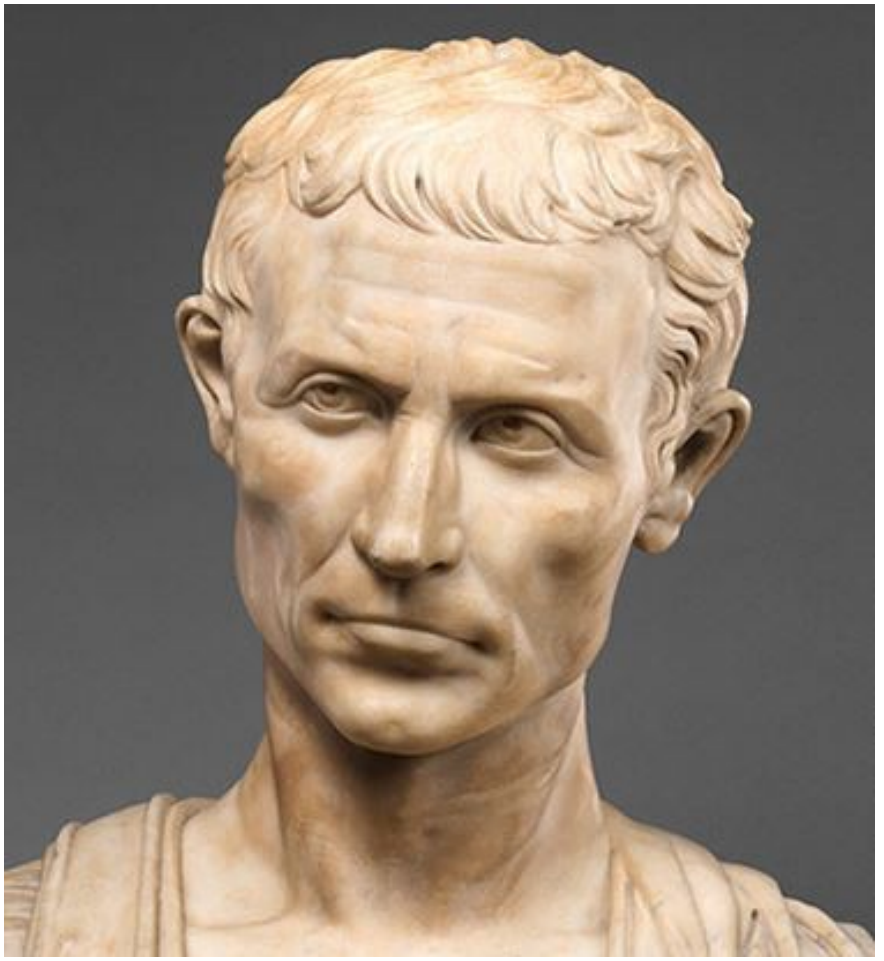
Base64 Encoding

```
└─$ echo 'hackerfrogs!' | base64
aGFja2VyZnJvZ3MhCg==
```

Base64 is a method of converting data bytes into alphanumeric strings, and is often featured in CTF challenges

What's Next?

In the next HackerFrogs Afterschool Cryptography workshop, we'll begin our look at classical encryption methods, which are often featured in cybersecurity CTF competitions



Until Next Time, HackerFrogs!