SAMS
Programming A/B

Week 3 Lecture – Strings
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Weekend recap

- France wins! (those first 2 goals, though…)
- Pirates win!! (with an assist to the rain!)
- Putin wins! (sorry)

Loop recap

- For loops – how do they work? They *iterate* over a sequence, like this

```
for i in range(n):  # iterates over the sequence?
        statement1
        statement2
statement3
```

Loop recap

- While loops – how do they differ?

```
n = abs(n)
while (n > 0):  # what is true when the loop ends?
    statement1
    statement2
    statement3  #one of these stmts needs to…?
statement4
```

Loop recap

- Choosing between for and while…
  - anything you can do with a for, you can do with a while!

```
for i in range(n):
        statement1
```

is equivalent to

```
i = 0
while (i < n):
        statement1
```

- But you should try to use the most appropriate one…

Loop recap

- De Morgan's laws:
  - not (x or y) is (not x and not y)
  - not (x and y) is (not x or not y)
  - Happy number: loop ends when x = = 1 or x = = 4, so loop condition is

  while (x != 1 and x != 4): # or while not(x = = 1 or x = = 4):

  NOT

  while (x != 1 or x != 4): # which will be infinite, why?

Strings

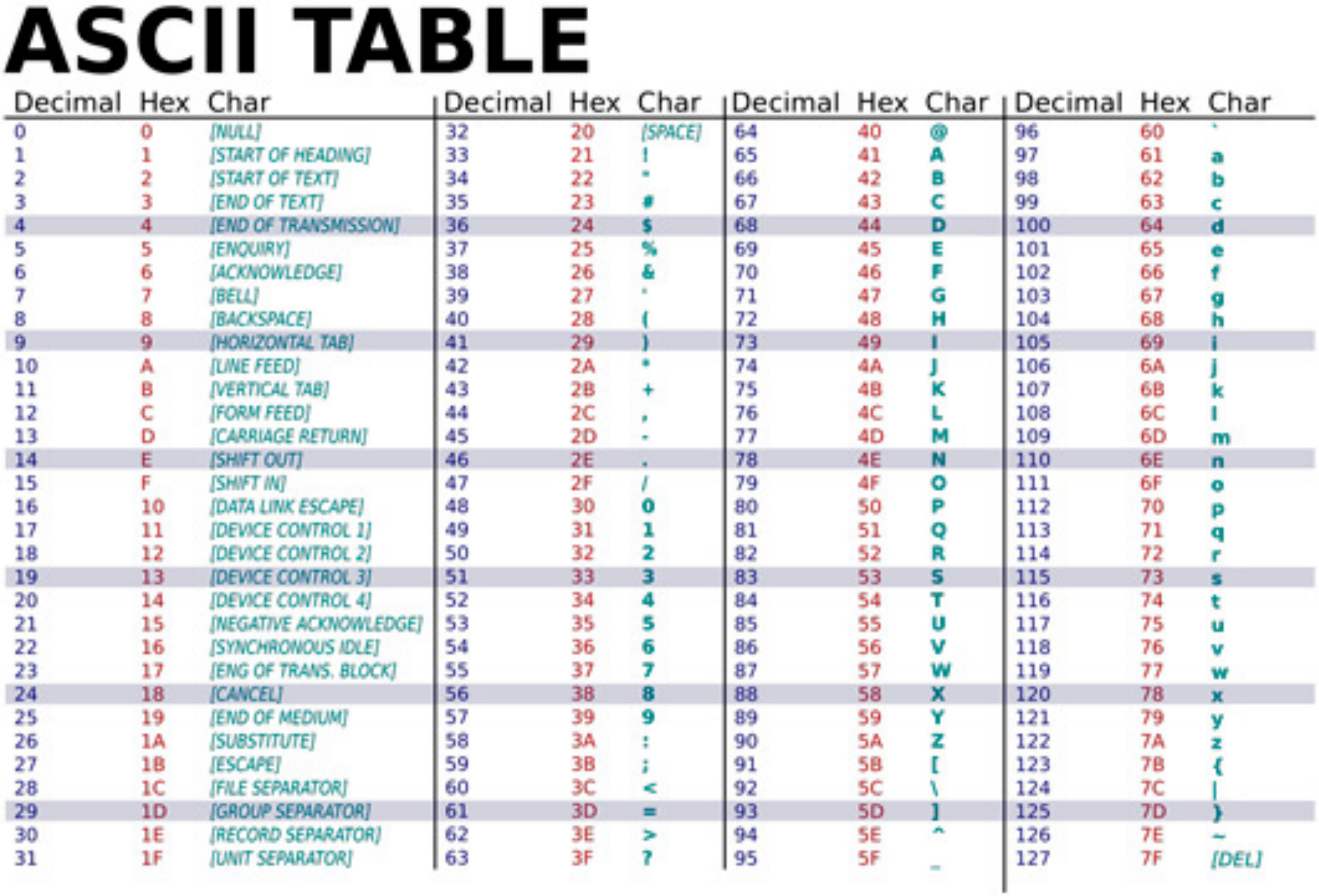
- We have already seen strings – they are sequences of characters delimited by ' and ' or " "
- Let's take a closer look…

String literals

- A string literal is anything in quotes
- But **everything** in the computer is stored in binary, so each character is stored as a number
- Examples:

```
ord("a")  –>  97
chr(97)   –>   'a'
ord("b")  –>  98
ord("A") –>  65
"a" < "A"  –>  False
```

ASCII values



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]

How might we use this?

```
def toUpperCaseLetter(character):
    if ("a" <= character and character <= "z"):
        return chr(ord(character) – 32)
    return character
```

Escape sequences

- Escape sequences:

– single quote	\'
– double quote	\"
– backslash	\\
– newline	\n
– tab	\t

String operators

- Operators:
  - Concatenation +
  - Multiple concatenation *
  - Length len (a function)
  - Indexing [valid values are -len(s) to len(s) -1]
    - *String*[n]
      - gives you the character at position n (starting from 0)
    - *string*[-n]
      - gives you the character at position len(string) - n
    - examples…

String Indexing

s = "Professor Mark"

len(s) –> 14 (so valid indices are -14 .. 13)

s[0] –> 'P'

s[len(s)-1] –> 'k'

s[-1] –> 'k'

s[-14] –> 'P'

s[42] –> error

More string operators

- Slicing
  - *string[start:end:step]*
    - gives you the substring beginning at *start* up to, but not including, *end*, counting by *step*
  - Examples

```
s = "Professor Mark"
s[10:12]  –>  'Ma'
s[10:]  –>  'Mark'
s[:10]  –>  'Professor ' (10 characters, pos 0-9 with space)
```

More string operators

- Contains
  - in
    - "ark" in "Mark" –> True
    - "Mark" in "Professor Mark" –> True
    - "Mark" in "Professor" –> False
  - not in (this is OK in Python, as opposed to not (c in s))
    - not "Mark" in "Professor" –> True
    - "Mark" not in "Professor" –> True

Strings are immutable

- A string, once created, cannot be modified

```
s = "abcd"
s[0] = "d"  # error!
```

- But s can hold a different, new string…

```
s += "efg"
print(s)   # prints "abcdefg"  Why?
```

Suppose I wanted to reverse the contents of a string variable? How could I do that?

Strings and loops

- Iterating over a string with a for loop
  - likely to use len( )
  - an example

    ```
    for i in range(len(stringVariable)):
            print(i, stringVariable[i])
    ```

  - a different way to iterate over a string (if position is not needed):

    ```
    for c in stringVariable:
            print(c)
    ```

  - examples: let's write isInteger() and isPalindrome()

String constants

- String constants (must do what to use these?):

– string.ascii_letters	'a..zA..Z'
– string.ascii_lowercase	'a..z'
– string.ascii_uppercase	'A..Z'
– string.digits	'0123456789'
– string.punctuation	lots of things ☺
– string.whitespace	space, tab, return
– string.printable	letters + digits + punc + whitesp

String methods (v. functions, constants)

- String functions and methods
  - Functions take a string as a parameter, e.g.,
    - len( ) – takes what as a parameter? returns what?
    - input( ) – takes what as a parameter? returns what?
  - Methods operate *on a particular* string, e.g.,
    - str.find( ) [and str.replace ( ), str.count( )]
    - str.isdigit( ) [.isalpha(), .islower(), .isupper(), .isspace()]
    - str.lower( ) [and str.upper( ), str.capitalize( )]
    - str.split( ) [and str.strip ( )]
- https://docs.python.org/3/library/stdtypes.html?highlight=strip#string-methods