

- Previous Lecture:
 - Working with images
- Today's Lecture:
 - Characters and strings
- Announcements:
 - Prelim 2 will be returned at end of lecture. If your paper isn't here, pick it up from CS1112 consultants in ACCEL during consulting hrs (starting today after 4pm)
 - Discussion this week in classrooms as listed on roster
 - Project 4 posted. Due Mon, Apr 4th, at 11pm

Characters & strings

- We have used strings already:
 - `n = input('Next number: ');`
 - `sprintf('Answer is %d', ans)`
- A string is made up of individual characters, so a string is a 1-d array of characters
- 'CS1112 rocks!' is a character array of length 13; it has 7 letters, 4 digits, 1 space, and 1 symbol.

'	C	'	S	'	1	'	1	'	1	'	2	'	'	r	'	o	'	c	'	k	'	s	'	!	'
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
- Can have 2-d array of characters as well

'	C	'	S	'	1	'	1	'	1	'	2	'
'	r	'	o	'	c	'	k	'	s	'	!	'

2x6 matrix

Matlab types: char, double, uint8, logical

There is not a type "string"! What we call a string is a 1-d array of chars

<code>a = 'CS11'</code>	<code>a</code> is a 1-d array with type <code>char</code> components. We call <code>a</code> a "string" or "char array"
<code>b = [3 9]</code>	<code>b</code> is a 1-d array with type <code>double</code> components. <code>double</code> is the default type for numbers in Matlab. We call <code>b</code> a "numeric array"
<code>c = uint8(b)</code>	<code>c</code> is a 1-d array with type <code>uint8</code> components. We call <code>c</code> a "uint8 array"
<code>d = rand > .5</code>	<code>d</code> is a scalar of the type <code>logical</code> . We call <code>d</code> a "boolean value"

Lecture 17 4

Strings are important in computation

Numerical data is often encoded in strings. E.g., a file containing Ithaca weather data begins with the string

`W07629N4226`

meaning

Longitude: 76° 29' West
Latitude: 42° 26' North

We may need to grab hold of the substring `W07629`, convert `076` and `29` to the numeric values 76 and 29, and do some computation

Lecture 17 5

Comparison of genomic sequences is another example of string computation

- E.g., looking for a pattern:
Given the sequence `ATTCTGACCTCGATC...`
Look for the pattern `ACCT`
- E.g., quantifying the difference between sequences:

<code>ATTCTGACCTCGATC</code>
<code>ATTCGTGACCTCGAT</code>

What if this nucleotide is removed?

Lecture 17 6

Single quotes enclose strings in Matlab

Anything enclosed in single quotes is a string (even if it looks like something else)

- `'100'` is a character array (string) of length 3
- `100` is a numeric value
- `'pi'` is a character array of length 2
- `pi` is the built-in constant 3.1416...
- `'x'` is a character (vector of length 1)
- `x` may be a variable name in your program

Lecture 17 7

Strings are vectors

Vectors	Strings
<ul style="list-style-type: none"> ■ Assignment v = [7 0 5]; ■ Indexing x = v(3); % x is 5 v(1) = 1; % v is [1 0 5] w = v(2:3); % w is [0 5] ■ : notation v = 2:5; % v is [2 3 4 5] ■ Appending v = [7 0 5]; v(4) = 2; % v is [7 0 5 2] ■ Concatenation v = [v [4 6]]; % v is [7 0 5 2 4 6] 	<ul style="list-style-type: none"> ■ Assignment s = 'hello'; ■ Indexing c = s(2); % c is 'e' s(1) = 'j'; % s is 'jello' t = s(2:4); % t is 'ell' ■ : notation s = 'a:g'; % s is 'abcdefg' ■ Appending s = 'duck'; s(5) = 's'; % s is 'ducks' ■ Concatenation s = [s ' quack']; % s is 'ducks quack'

Lecture 17 8

Some useful string functions

```
str = 'Cs 1112';

length(str) % 7
isletter(str) % [1 1 0 0 0 0 0]
isspace(str) % [0 0 1 0 0 0 0]
lower(str) % 'cs 1112'
upper(str) % 'CS 1112'

ischar(str)
% Is str a char array? True (1)
strcmp(str(1:2), 'cs')
% Compare strings str(1:2) & 'cs'. False (0)
strcmp(str(1:3), 'CS')
% False (0)
```

Lecture 17 9

Example: capitalize 1st letter

Write a function to capitalize the first letter of each word in a string. Assume that the string has lower case letters and blanks only. (OK to use built-in function `upper`)

```
function [str, nCaps] = caps(str)
% Post: Capitalize first letter of each word.
% str = partially capitalized string
% nCaps = no. of capital letters
% Pre: str = string with lower case letters & blanks only
```

look for the spaces

Look For The Spaces

See caps.m

Lecture 17 10

ASCII characters

(American Standard Code for Information Interchange)

ascii code	Character	ascii code	Character
:	:	:	:
:	:	:	:
65	'A'	48	'0'
66	'B'	49	'1'
67	'C'	50	'2'
:	:	:	:
90	'Z'	57	'9'
:	:	:	:

Lecture 17 11

Character vs ASCII code

```
str = 'Age 19'
% a 1-d array of characters
code = double(str)
% convert chars to ascii values
str1 = char(code)
% convert ascii values to chars
```

Lecture 17 12

Arithmetic and relational ops on characters

- 'c' - 'a' gives 2
- '6' - '5' gives 1
- letter1 = 'e'; letter2 = 'f';
- letter1 - letter2 gives -1

- 'c' > 'a' gives true
- letter1 == letter2 gives false

- 'A' + 2 gives 67
- char('A' + 2) gives 'C'

Lecture 17 13

What is in variable `g` (if it gets created)?

```
d1= 'Mar 3'; d2= 'Mar 9';  
x1= d1(5); x2= d2(5);  
g= x2-x1;
```

- A: the character '6'
- B: the numeric value 6
- C: Error in the subtraction operation
- D: Error in assigning variables `x1`, `x2`
- E: Some other value or error

Lecture 17

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What is in variable `g` (if it gets created)?

```
d1= 'Mar 13'; d2= 'Mar 29';  
x1= d1(5:6); x2= d2(5:6);  
g= x2-x1;
```

- A: the string '16'
- B: the numeric value 16
- C: Error in the subtraction operation
- D: Error in assigning variables `x1`, `x2`
- E: Some other value or error

Lecture 17

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