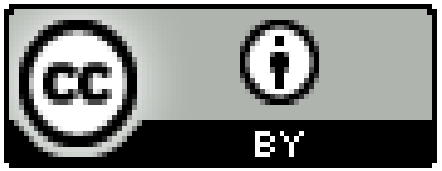
Matlab Programming

Structures and Cell Arrays



Matlab's basic data type is the double array.

Most data is numeric…

… but some is not.

- Labels
- Textual Input
- …

Example: strings

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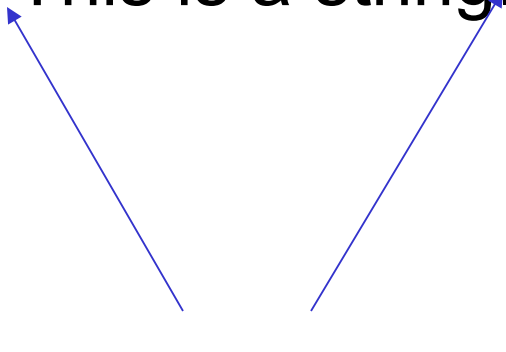

Example: strings

```
>> str = ‘This is a string.’;
>> strArr = [‘string1’, ‘string2’]
strArr =
    string1string2
```

Example: strings

```
>> str = ‘This is a string.’;
>> strArr = [‘string1’, ‘string2’]
strArr =
    string1string2
>> strArr[2]
 ans =
    ‘t’
>> length(strArr)
    14
```

What is a string?

A string IS an array… of characters.

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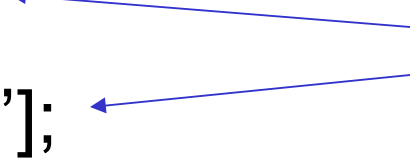
```
>> str = ‘Hi’;
>> str = [‘H’ ‘i’];
```

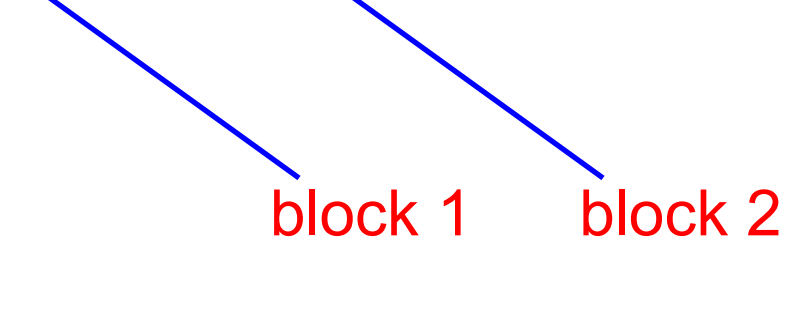


A string IS an array… of characters.

```
>> str = ‘Hi’;
>> str = [‘H’ ‘i’];
```

Arrays of strings behave like arrays:

```
>> strArr = [‘string1’, ‘string2’]
strArr =
    string1string2
```



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In order to have an array of strings, we need to be able to have mixed types.

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In order to have an array of strings, we need to be able to have mixed types.

Matlab arrays: an array of arrays is *flattened* into one big array.

Matlab cell arrays: an array of arrays *is* an array of arrays.

Two data types to handle data with mixed types:

Structure – store hierarchical data of mixed type.

Cell array – an array of containers that can contain mixed data types.

Two data types to handle non-numeric data:

Structure – store hierarchical data of mixed type.

Cell array – an array of containers that can contain mixed data types.

Major difference: cell arrays indexed by integer, structures indexed by arrays.

Colors

red

blue

green

black

orange

```
>> colors = struct();
>> colors.red = [255 0 0];
>> colors.blue = [0 0 255];
>> colors.green = [0 255 0];
>> colors.black = [255 255 255];
>> colors.orange = [255 112 0];

>> colors.orange[2]
ans =
    112
```

Structure as dictionary:

Python:

```
>>> colors = dict();
>>> colors['red'] = [255, 0, 0];
```

Matlab:

```
>> colors = struct();
>> colors.red = [255 0 0];
```

Dynamically creating key-value pairs:

```
>> s = struct();
>> a = ‘file’;
>> s.a = ‘data2_27_11.txt’;
>> s
s =
        a: ‘data_2_27_11.txt’
```

Dynamically creating key-value pairs:

```
>> s = struct();
>> a = ‘file’;
>> s.(a) = ‘data2_27_11.txt’;

>> s
s =
        file : ‘data’
```

Full set of methods to treat s as a ‘dictionary’:

```
isfield(s,’file’);  % 1 if ‘file’ is a field
fieldnames(s); % Return cell array of field names, or keys
orderfields(s); % Return ordered set of fields
rmfield(s,’file’); % Remove the field ‘file’.
```

But only strings can be field names.

Cell arrays:

Similar to floating point arrays, but…

each cell can hold a different type of data.

```
>> c = {1 'this is a string' 3 < 5};
```

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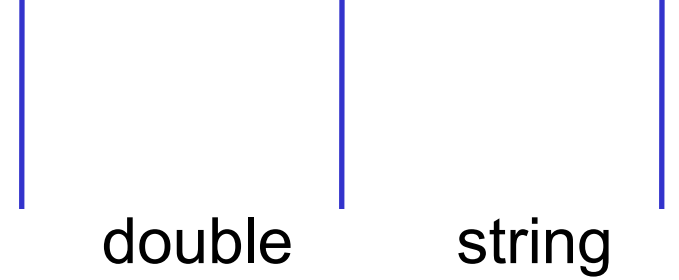


double string Boolean

Indexing cell arrays

```
>> c(1)
ans =
        [1]
```

```
>> c{1}
ans =
     1
```

Why are the results different?

Indexing cell arrays

```
>> c(1)
ans =
        [1]
>> iscell(c(1))
ans =
      1
```

```
>> c{1}
 ans =
      1
>> iscell(c{1})
ans =
      0
```

Curly braces give the *content* of the cell.

Indexing cell arrays

```
>> c(1)
ans =
        [1]
>> iscell(c(1))
ans =
      1
```

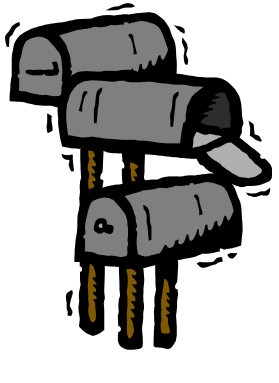
```
>> c{1}
 ans =
      1
>> iscell(c{1})
ans =
      0
```

Curly braces give the *content* of the cell.

Parentheses return a cell array with one element.

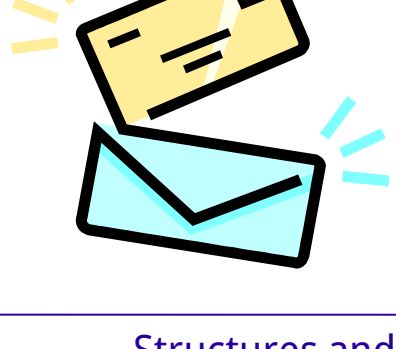
A useful analogy:

A cell array is an array of mailboxes…



A single cell is a single mailbox…

The contents of the cell can be a letter, a package, or some other type.



Helpful cell/struct functions:

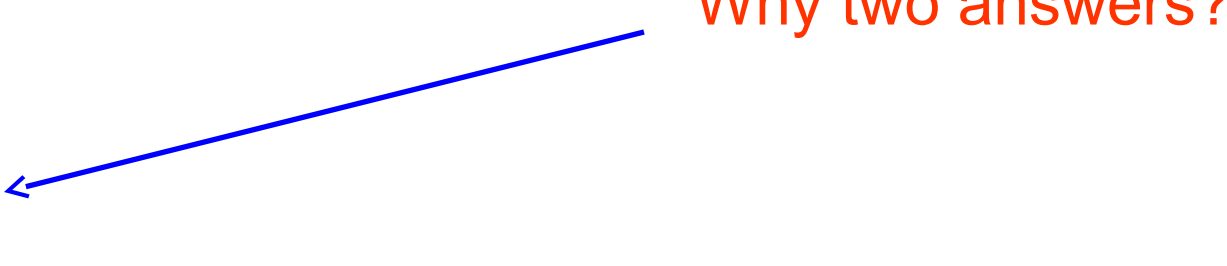
iscell

isstruct

char(str) % Convert a cell array of strings to an array of characters (i.e. a string)

Cell arrays can have more than one dimension:

```
>> c = { ‘a’ , ‘b’, ‘c’ ; ‘d’, ‘e’, ‘f’};
>> c{2,2}
ans =
e
>> c{:,1}
ans =
a
ans =
d
```



What's worse:

```
>> c = { 'a' , 'b', 'c' ; 'd', 'e', 'f'};
>> col = c{:,1};
>> col
ans =
a
```

Where is 'd'?

```
>> col = c(:,1);
>> col
    ['a']
    ['d']
```

Two element cell array

Dictionaries in Matlab

A struct is a dictionary…

… if you can live with strings as keys

A cell array is *not* a dictionary…

… since it fills out a grid with empty arrays

A cell array is more like a Python *list*

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