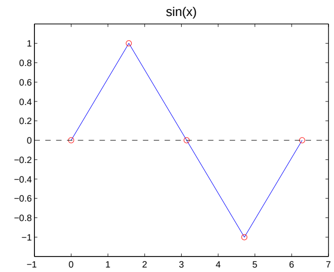
- Previous class:
  - User-defined function
  - Nested loops
- Now:
  - Working with colors
  - 1-dimensional array—vector

Plot a continuous function (from a table of values)

x	sin(x)
0.00	0.0
1.57	1.0
3.14	0.0
4.71	-1.0
6.28	0.0



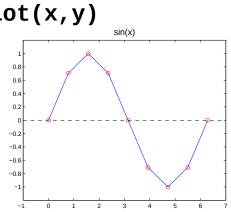
Plot based on 5 points

Generating tables and plots

x	sin(x)
0.000	0.000
0.784	0.707
1.571	1.000
2.357	0.707
3.142	0.000
3.927	-0.707
4.712	-1.000
5.498	-0.707
6.283	0.000

x, y are vectors. A vector is a 1-dimensional list of values

```
x= linspace(0,2*pi,9);
y= sin(x);
plot(x,y)
```



Note: x, y are shown in columns due to space limitation; they should be rows.

Built-in function `linspace`

```
x= linspace(1,3,5)
```

x | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |

```
x= linspace(0,1,101)
```

x | 0.00 | 0.01 | 0.02 | . . . | 0.99 | 1.00 |

Left endpoint

Right endpoint

Number of points

How did we get all the sine values?

x	sin(x)
0.00	0.0
1.57	1.0
3.14	0.0
4.71	-1.0
6.28	0.0

Built-in functions accept arrays

| 0.00 | 1.57 | 3.14 | 4.71 | 6.28 |

sin

and return arrays

| 0.00 | 1.00 | 0.00 | -1.00 | 0.00 |

Vectorized addition

		2	1	.5	8
	x	2	1	.5	8
+	y	1	2	0	1
=	z	3	3	.5	9

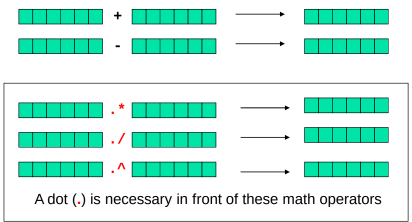
Matlab code: `z= x + y`

Vectorized multiplication

	a	2	1	.5	8
×	b	1	2	0	1
=	c	2	2	0	8

Matlab code: `c= a .* b`

Vectorized element-by-element arithmetic operations on arrays



Shift

	x	3			
+	y	2	1	.5	8
=	z	5	4	3.5	11

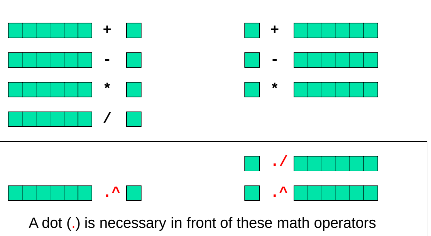
Matlab code: `z= x + y`

Reciprocate

	x	1			
/	y	2	1	.5	8
=	z	.5	1	2	.125

Matlab code: `z= x ./ y`

Vectorized element-by-element arithmetic operations between an array and a scalar

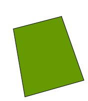


The dot in .* , .* , ./ not necessary but OK

Color is a 3-vector, sometimes called the RGB values

- Any color is a mix of red, green, and blue
- Example:

  `colr= [0.4 0.6 0]`



- Each component is a real value in [0,1]
- [0 0 0] is black
- [1 1 1] is white
- [.2 .2 .2] is dark gray
- [.4 .6 .1] is a colorized hue

Mix two colors

Implement this function:

```
function newc = mixEqual(c1,c2)
% Average colors c1 and c2.
% c1, c2, and newc are vectors
%   representing colors.
% Display the three colors.
```

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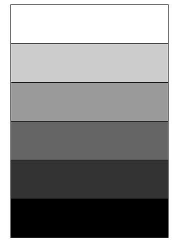
Let's show the "paint chips" from white to black



Name the script **`white2black`**

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1-d array: **vector**

- An array is a named collection of like data organized into rows or columns
- A 1-d array is a row or a column, called a *vector*
- An *index* identifies the position of a value in a vector

score	93	92	87	0	90	82
	1	2	3	4	5	6

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Array index starts at 1

x	5	.4	.91	-4	-1	7
	1	2	3	4	5	6

Let k be the index of vector x, then

- k must be a positive integer
- 1<= k <= length(x)
- To access the kth element: x(k)

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Accessing values in a vector

score	93	99	87	80	85	82
	1	*2*	*3*	*4*	*5*	*6*

Given the vector **`score`** …

```
score(4)= 80;
score(5)= (score(4)+score(5))/2;
k= 1;
score(k+1)= 99;
```

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A few different ways to create a vector
(More later!)

`count= zeros(1,6)`

count	0	0	0	0	0	0

`x= linspace(10,30,5)`

x	10	15	20	25	30

`y= [3 7 2 1]`

y	3	7	2	1

`Z= [3; 7; 2]`

z	3
	7
	2

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Drawing a single line segment

```
a= 0;  % x-coord of pt 1
b= 1;  % y-coord of pt 1
c= 5;  % x-coord of pt 2
d= 3;  % y-coord of pt 2
plot([a c], [b d], '-*')
```

x-values (a vector)

y-values (a vector)

Line/marker format

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Drawing a polygon (multiple line segments)

```
% Draw a rectangle with the lower-left
% corner at (a,b), width w, height h.
x= [                    ];  % x data
y= [                    ];  % y data
plot(x, y)
```

Fill in the missing vector values!

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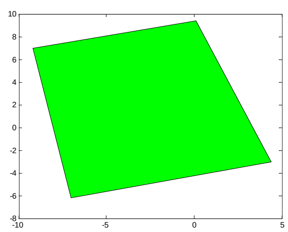
```
x= [0.1 -9.2  -7  4.4];
y= [9.4  7   -6.2  -3];
fill(x,y,'g')
```



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Example

- Write a program fragment that calculates the cumulative sums of a given vector **v**.
- The cumulative sums should be stored in a vector of the same length as **v**.

1, 3, 5, 0 **v**

1, 4, 9, 9 cumulative sums of **v**

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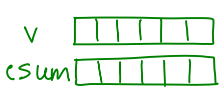

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A twinkling constellation

- Write a script that generates 9 random positions—the configuration of my constellation
- Simulate 10 rounds of twinkling
  - In each round, each star is equally likely to be lit or black
- Can you add some random adjustment to the color of the star?

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