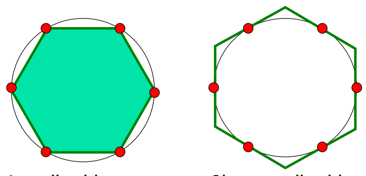
- Previous Lecture:
  - Iteration using **for**
- Today's Lecture:
  - Detail on **for**-loop
  - Iteration using **while**
  - Review loops, conditionals using graphics
- Announcements:
  - Project 2 posted, due Thursday, 2/17
  - We do not use **break** in this course

Example: *n*-gon → circle



Inscribed hexagon $(n/2)\sin(2\pi/n)$

Circumscribed hexagon $n\tan(\pi/n)$

As *n* approaches infinity, the inscribed and circumscribed areas approach the area of a circle.
When will |OuterA – InnerA| <= .000001?

Find *n* such that *outerA* and *innerA* converge

First, itemize the tasks:

- *define how close is close enough*
- *select an initial n*
- *calculate innerA, outerA for current n*
- *diff= outerA - innerA*
- *close enough?*
- *if not, increase n, repeat above tasks*

Find *n* such that *outerA* and *innerA* converge

Now organize the tasks → algorithm:

```
n gets initial value
innerA, outerA get initial values
Repeat until difference is small:
    increase n
    calculate innerA, outerA for current n
    diff= outerA - innerA
```

Guard against infinite loop

Use a loop guard that guarantees termination of the loop. Or just limit the number of iterations.

```
while (B_n-A_n >delta && n<nMax)
```

See **Eg2_2.m**

Another use of the while-loop: user interaction

- Example: Allow a user to repeatedly calculate the inscribed and circumscribed areas of n-gons on a unit circle.
- Need to define a "stopping signal"

areaIndef.m

Common loop patterns

Do something *n* times

```
for k= 1:n
    % Do something
end
```

Do something an indefinite number of times

```
%Initialize loop variables

while ( not stopping signal )
    % Do something

    % Update loop variables
end
```

Important Features of Iteration

- A task can be accomplished if some steps are repeated; these steps form the loop body
- Need a starting point
- Need to know when to stop
- Need to keep track of (and measure) progress

In Matlab, which claim is true? (without `break`)

A: for-loop can do anything while-loop can do

B: while-loop can do anything for-loop can do

C: for- and while-loops can do the same things

for-loop or while-loop: that is the question

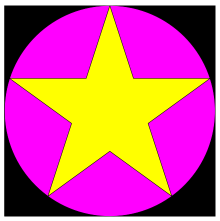
- for-loop: loop body repeats a *fixed* (predetermined) number of times.
- while-loop: loop body repeats an *indefinite* number of times under the control of the "loop guard."

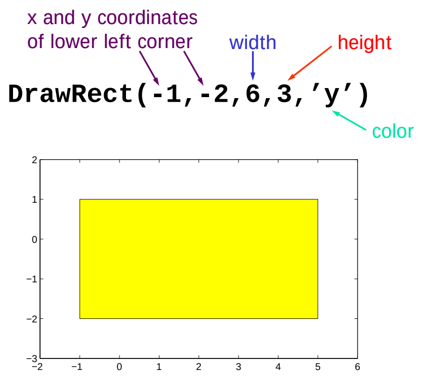
Review loops/conditionals using user-defined graphics function

Draw a black square;

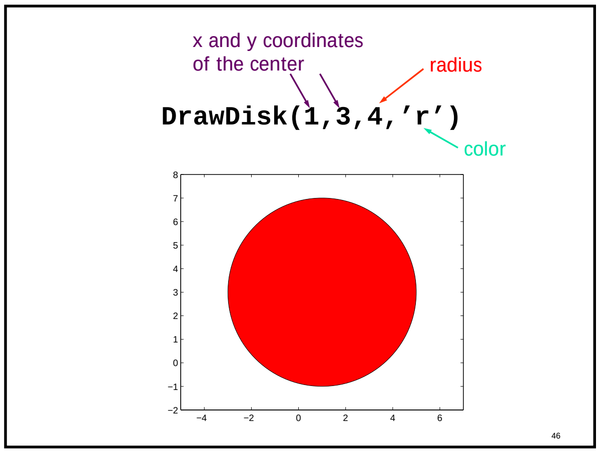
then draw a magenta disk;

then draw a yellow star.

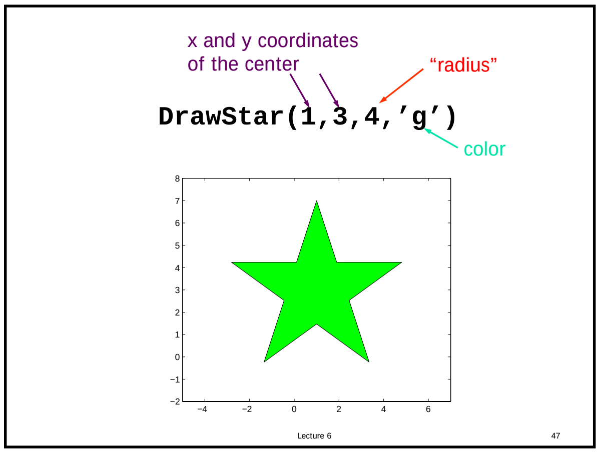




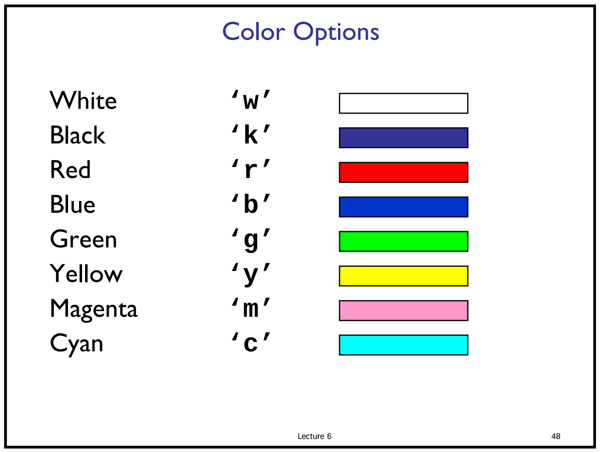
```
DrawRect(-1,-2,6,3,'y')
```



`DrawDisk(1,3,4,’r’)`

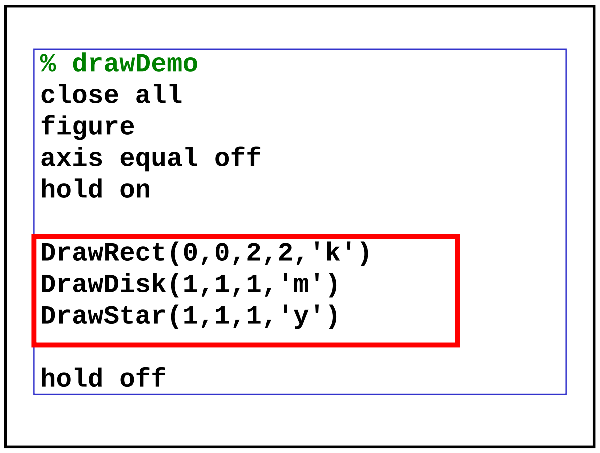


`DrawStar(1,3,4,’g’)`



Color Options

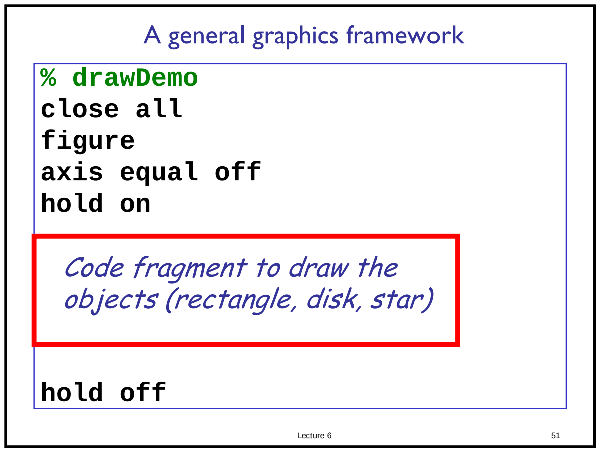
White	‘w’	⬜
Black	‘k’	⬛
Red	‘r’	🟥
Blue	‘b’	🟦
Green	‘g’	🟩
Yellow	‘y’	🟨
Magenta	‘m’	🟪
Cyan	‘c’	🟦



```
% drawDemo
close all
figure
axis equal off
hold on

DrawRect(0,0,2,2,'k')
DrawDisk(1,1,1,'m')
DrawStar(1,1,1,'y')

hold off
```



A general graphics framework

```
% drawDemo
close all
figure
axis equal off
hold on

  Code fragment to draw the
  objects (rectangle, disk, star)

hold off
```

Example: Nested Stars