- Previous Lecture:
  - Developing algorithms
  - Nested loops
- Today's Lecture:
  - Review
  - Finite vs. Infinite
  - Introduction to vectors, vectorized code
- Announcements:
  - Discussion this week in UP B7 lab
  - Prelim I: 9/23(R) 7:30-9pm. Location Statler Aud.
  - Review sessions: 9/21(T) 5-6:30pm, 2/22(W) 5-6:30pm. Locations TBA. They're *optional*–attend one if you wish.

Rational approximation of π

- π = 3.141592653589793…
- Can be closely approximated by fractions, e.g., $\pi \approx 22/7$
- Rational number: a quotient of two integers
- Approximate π as p/q where p and q are positive integers ≤M
- Start with a straight forward solution:
  - Get M from user
  - Calculate quotient p/q for all combinations of p and q
  - Pick best quotient → smallest error


```
% Rational approximation of pi

M = input('Enter M: ');
% Best q, p, and error so far
qBest=1;  pBest=1;
err_pq = abs(pBest/qBest - pi);
% Check all possible denominators
for q = 1:M
  % Find best numerator for this q

  for p = 1:M  % Check all possible p



  end




end
myPi = pBest/qBest;
```


Analyze the program for efficiency

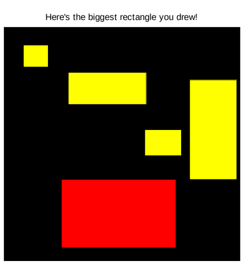
- See Eg3_1 and FasterEg3_1 in the book

```
for a = 1:n
   disp('alpha')
   for b = 1:m
      disp('beta')
   end
end
```

How many times are "alpha" and "beta" displayed?

- A: n, m
- B: m, n
- C: n, n+m
- D: n, n*m
- E: m*n, m

Find the biggest rectangle



- Draw 5 rectangles that the user specifies using mouse clicks
- Color the biggest one red

The savvy programmer…

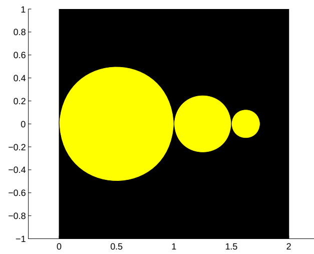
- Learns useful programming patterns and use them where appropriate
- Seeks inspiration by working through test data "by hand"
  - Asks, "What am I doing?" at each step
  - Sets up a variable for each piece of information maintained when working the problem by hand
- Decomposes the problem into manageable subtasks
  - Refines the solution iteratively, solving simpler subproblems first
- Remembers to check the problem's boundary conditions
- Validates the solution (program) by trying it on test data

Xeno's Paradox

- A wall is two feet away
- Take steps that repeatedly halve the remaining distance
- You never reach the wall because the distance traveled after n steps =

$$1 + \tfrac{1}{2} + \tfrac{1}{4} + \ldots + 1/2^n = 2 - 1/2^n$$

Example: "Xeno" disks

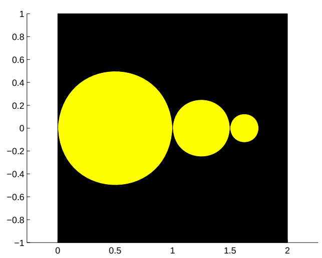


Draw a sequence of 20 disks where the (k+1)th disk has a diameter that is half that of the kth disk.

The disks are tangent to each other and have centers on the x-axis.

First disk has diameter 1 and center (1/2, 0).

Example: "Xeno" disks



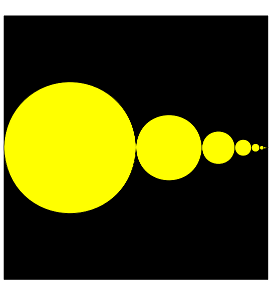
What do you need to keep track of?

- Diameter (d)
- Position
  Left tangent point (x)

Disk	x	d
1	0	1
2	0+1	1/2
3	0+1+1/2	1/4


```
% Xeno Disks

DrawRect(0,-1,2,2,'k')
% Draw 20 Xeno disks


for k= 1:20








end
```

Here's the output… Shouldn't there be 20 disks?



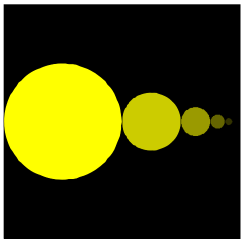
The "screen" is an array of dots called pixels.

Disks smaller than the dots don't show up.

The 20th disk has radius<.000001

End of Review Material for Prelim 1

Fading Xeno disks

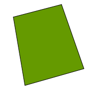


- First disk is yellow
- Last disk is black (invisible)
- *Interpolate* the color in between

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]
```

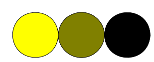


- Each component is a real value in [0,1]
- [0 0 0] is black
- [1 1 1] is white


```
% Draw n fading Xeno disks
d= 1;
x= 0;  % Left tangent point
yellow= [1 1 0];
black=  [0 0 0];
for k= 1:n
   % Compute color of kth disk


   % Draw kth disk
   DrawDisk(x+d/2, 0, d/2, _______)
   x= x+d;
   d= d/2;
end
```


Example: 3 disks fading from yellow to black

```
r= 1;  % radius of  disk
yellow= [1 1 0];
black = [0 0 0];

% Left disk yellow, at x=1
DrawDisk(1,0,r,yellow)
% Right disk black, at x=5
DrawDisk(5,0,r,black)

% Middle disk with average color, at x=3
colr= 0.5*yellow + 0.5*black;
DrawDisk(3,0,r,colr)
```



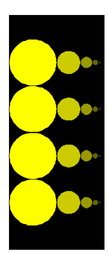
Linear interpolation

x	g(x)
:	:
9	110
10	118
10.25	?
10.50	?
10.75	?
11	126
12	134
:	:

$g(10.5) = \frac{1}{2}\, g(11) + \frac{1}{2}\, g(10)$

$g(10.25) = 1/4 \cdot g(11) + 3/4 \cdot g(10)$
$g(10.50) = 2/4 \cdot g(11) + 2/4 \cdot g(10)$
$g(10.75) = 3/4 \cdot g(11) + 1/4 \cdot g(10)$

Rows of Xeno disks



for y = __ : __ : __

Code to draw one row of Xeno disks at some y-coordinate

end

Be careful with "initializations"