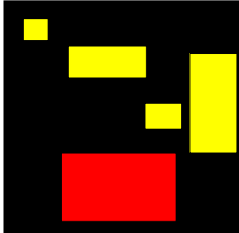


- Previous Lecture:
 - Developing algorithms
 - Nested loops
- Today's Lecture:
 - Developing algorithms
 - Finite/inexact arithmetic
 - Discrete vs. continuous
- Announcements:
 - Project 2 due today at 6pm
 - Prelim 1 on 2/21 (Thurs) 7:30pm

Find the biggest rectangle

Here's the biggest rectangle you drew!

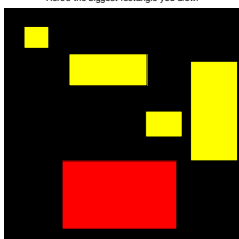


- Draw 5 rectangles that the user specifies using mouse clicks
- Color the biggest one red

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Find the biggest rectangle: develop an algorithm

Here's the biggest rectangle you drew!



- What are the main tasks?
 - Draw 5 yellow rects
 - Find the biggest one
 - Draw biggest one in red
- Repetition is needed! Which kind?
 - Finite iteration → for-loop
- Do I need to keep track of all 5 rectangles?
 - No

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Patriot missile failure



In 1991, a Patriot Missile failed, resulting in 28 deaths and about 100 injured. The cause?



www.namta.nato.int/gatkey/systems

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Inexact representation of time/number

- System clock represented time in tenths of a second: a clock tick every 1/10 of a second
- Time = number of clock ticks x 0.1

“exact” value
 .00011001100110011001100110011...

.0001100110011001100110011 ← value in Patriot system

Error of .000000095 every clock tick

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Resulting error

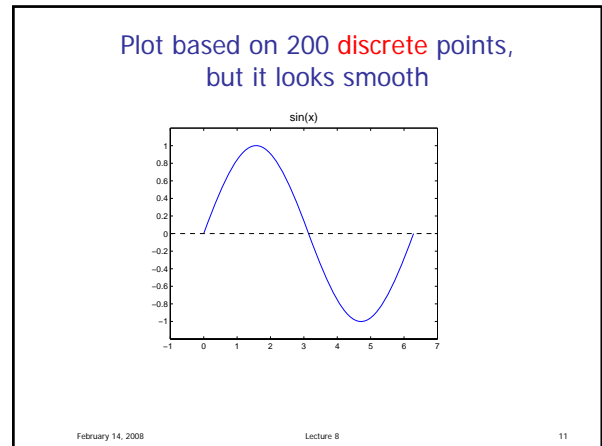
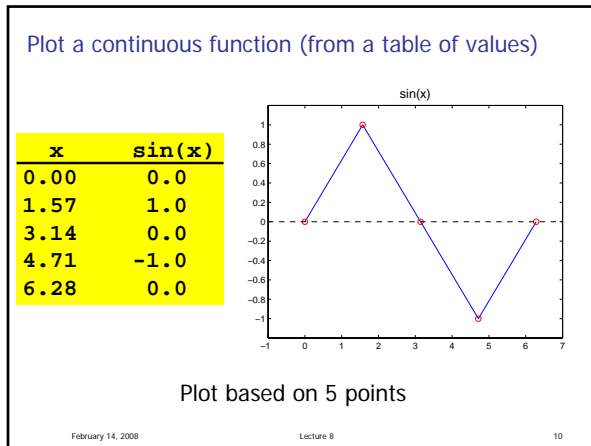
... after 100 hours

.000000095 x (100x60x60)

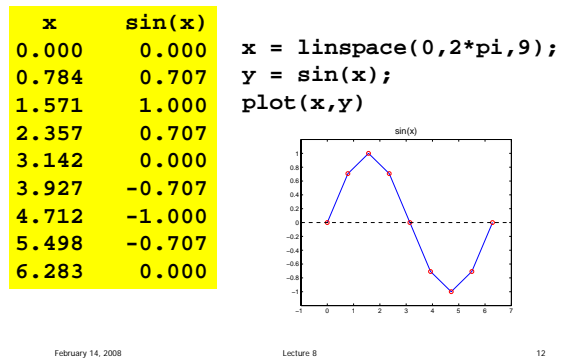
0.34 second

At a velocity of 1700 m/s, missed target by more than 500 meters!

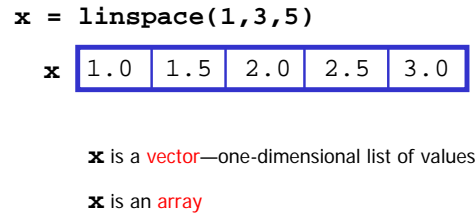
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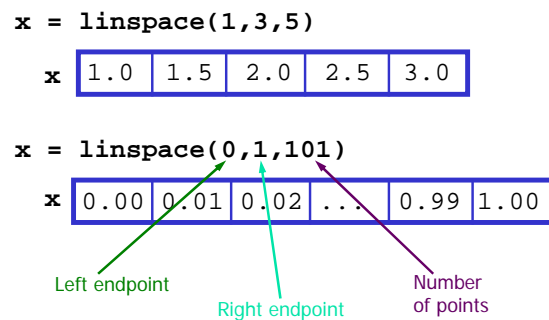
Generating tables and plots



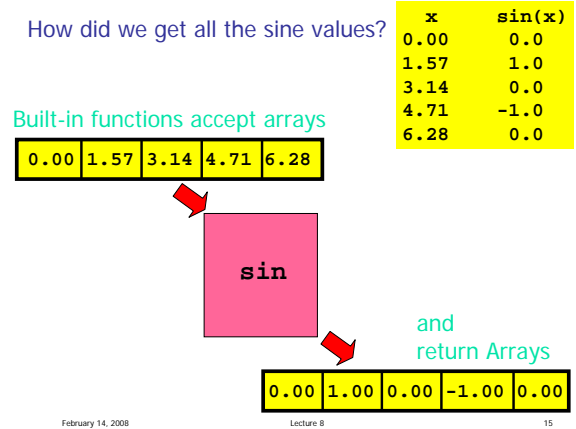
Built-in function linspace



Built-in function linspace



How did we get all the sine values?



Examples

```
x = linspace(0,1,200);
y = exp(x);
plot(x,y)
```

```
x = linspace(1,10,200);
y = log(x);
plot(x,y)
```

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Does this assign to y the values sin(0°), sin(1°),...,sin(90°)?

```
x = linspace(0,pi/2,90);
```

```
y = sin(x);
```

A: yes

B: no

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Can we plot this?

$$f(x) = \frac{\sin(5x)\exp(-x/2)}{1+x^2} \quad \text{for } -2 \leq x \leq 3$$

Yes!

```
x = linspace(-2,3,200);
y = sin(5*x).*exp(-x/2)./(1 + x.^2);
plot(x,y)
```

↑ ↑ ↑
Element-by-element arithmetic operations on arrays

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Element-by-element arithmetic operations on arrays
Also called "vectorized code"

```
x = linspace(-2,3,200);
y = sin(5*x).*exp(-x/2)./(1 + x.^2);
```

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Vectorized addition

$$\begin{array}{r} x \quad \boxed{2 \quad 1 \quad .5 \quad 8} \\ + \quad y \quad \boxed{1 \quad 2 \quad 0 \quad 1} \\ \hline = \quad z \quad \boxed{3 \quad 3 \quad .5 \quad 9} \end{array}$$

Matlab code: **z = x + y**

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Vectorized subtraction

$$\begin{array}{r} x \quad \boxed{2 \quad 1 \quad .5 \quad 8} \\ - \quad y \quad \boxed{1 \quad 2 \quad 0 \quad 1} \\ \hline = \quad z \quad \boxed{1 \quad -1 \quad .5 \quad 7} \end{array}$$

Matlab code: **z = x - y**

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Vectorized code
 —a Matlab-specific feature See FVL 4.1 for list of arithmetic operations

- Code that perform element-by-element arithmetic/relational/logical operations on array operands in one step
- Scalar operation: $x + y$ where x, y are scalar variables
- Vectorized code:** $x + y$ where x, y are vectors of **same shape and length**

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Vectorized multiplication

$$\begin{array}{r} a \quad \boxed{2 \quad 1 \quad .5 \quad 8} \\ x \\ b \quad \boxed{1 \quad 2 \quad 0 \quad 1} \\ \hline = \quad c \quad \boxed{2 \quad 3 \quad 0 \quad 8} \end{array}$$

Matlab code: $c = a .* b$

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Vectorized
 element-by-element arithmetic operations on arrays

A dot (.) is necessary in front of these math operators

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Shift

$$\begin{array}{r} x \quad \boxed{3} \\ + \\ y \quad \boxed{2 \quad 1 \quad .5 \quad 8} \\ \hline = \quad z \quad \boxed{5 \quad 4 \quad 3.5 \quad 11} \end{array}$$

Matlab code: $z = x + y$

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Reciprocate

$$\begin{array}{r} x \quad \boxed{1} \\ / \\ y \quad \boxed{2 \quad 1 \quad .5 \quad 8} \\ \hline = \quad z \quad \boxed{.5 \quad 1 \quad 2 \quad .125} \end{array}$$

Matlab code: $z = x ./ y$

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

A dot (.) is necessary in front of these math operators

The dot in $array .* scalar$, $scalar .* array$, $array ./ scalar$, $scalar ./ array$ not necessary but OK

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