*September 16, 2016*

# Review

*In this class:*

- *Review of topics for midterm*
- *Homeworks 1 & 2 solutions and questions*
- *Potential questions for the midterm*

*Next class*

Midterm

G&C – Chapters 1, 2, 3, 5

*Next next class*

Intro to matrix methods

G&C – Chapters 1, 2, 3, 5

… the midterm …

# Background I assume

Linear algebra

Calculus

Differential equations

Discrete math

Programming

Probability

I'll try to remind you what you need to know

# Topics we've covered

**Week 1**

Details of the class

History of numerical computing

The importance of numerical computing

Mathematical modeling

The XKCD raptor problem

Google's PageRank

**Week 2**

Variables and expressions in Julia

Matrix and vector operations in Julia

Control flow in Julia

**Week 3**

The need for floating point

IEEE Floating point representations

General floating point systems

How to add/sub/mult with floating point

IEEE Rounding modes

Floating point guarantees

Floating point properties

IEEE Exceptions

Problematic floating point computations

**Week 4**

Monte Carlo methods

The Monte Hall prob

Integrating a circle.

Google's random surfer

Monte Carlo integration + variance computations

Central limit theorem & accuracy

# Homework questions

**Homework 1**

Drunkard's walk (or random walk on a line)

A simple economy

Acceleration and raptors

Writing matrices for search engines

Simple Matlab operations

Mandelbrot

**Homework 2**

Floating point representations

Converting random number generators

Nearest number

Relative roundoff error

Floating point exceptions

Fibonacci roots & floating point

Fun with floats!

Monte Carlo integration

The Birthday paradox

Random walks and birthdays

# Homeworks 1 & 2

# Potential questions for the midterm

A trinary digit is a value that is either 0, 1, 2.

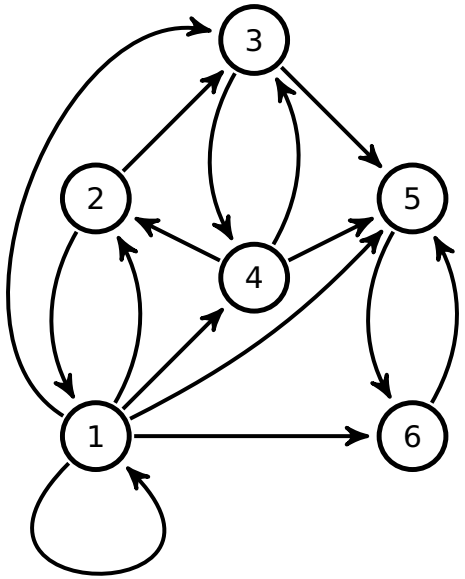
Consider a floating point system with trinary digits (“trits”). Suppose that we use 3 trits for the mantissa to represent $(t1.t2t3)_3$. (This is not a hidden bit representation.) And the set of exponents is -1, 0, 1 (just one trit). Suppose also that we use one trit for the sign.

List all (non-negative) floating point numbers in repeating decimal notation with exponent 0

Is the floating point representation of 0 unique?

How many ways are there to represent 1/3 (decimal) in this system?

# Monte Carlo methods




What is the probability of
Taking a random walk from node 3 to node 5 (assuming we start at node 3).

# Monte Carlo Methods

Write pseudocode to estimate the following probability.

What is the probability that two circles with radius 1 will intersect if their centers are drawn with x and y coordinates that have a random normal distribution with mean 0 and variance 1?

# Solution

```
function circle_intersect()
    c1 = randn(2)
    c2 = randn(2)
    if norm(c1-c2) <= 1 # if the distance between
       return 1         # centers <= 1, they intersect
    else
       return 0
    end
end

Wins = 0
for t=1:ntrials
  wins += circle_intersect()
End
Wins/ntrials
```

# What does the following code do?

```
N = 50
x = linspace(0,1,N)
y = zeros(N)
For i=1:N
  y[i] = sin(x[i]^2)
End
Plot(x,y,title=@sprintf(“.18f”, sum(y)))
```

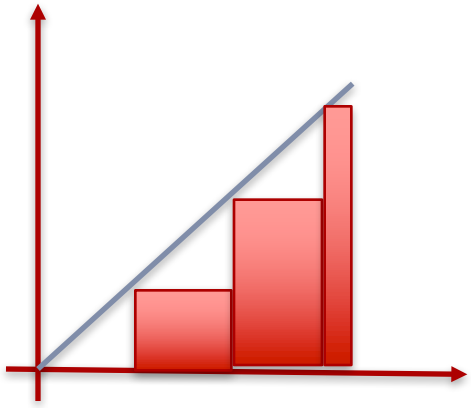
# Mathematical Models

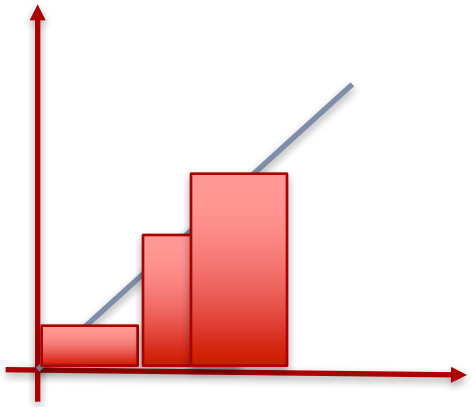
Suppose that we want to simulate a race between two sprinters started by a flag signal. Sprinter 1 runs at 10 m/s and accelerates to this speed in 0.1 s. Sprinter 2 runs at 10.1 m/s and accelerates to this speed in 0.15 s.

Describe an assumption we would need to make to simulate a race.

# Monte Carlo Integration

Explain which figure illustrates Riemann-style integration and which illustrates Monte Carlo integration.





# Relative importance to exam

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**Week 2 (Important to read!)**

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