1. Introduction

Social Network Analysis

1. Quiz: Magic Trick

Pass over all movies exactly once.

Must end at KB, learned this in MAT 394 Topic: Algorithmic Graph Theory at ASU.

For fun though.

MS -> RD -> DH -> SS -> JR -> DH -> KB -> JR -> AH -> MS -> KB

Social Networks are connections between individuals that capture relationships between them. Algorithms are how we organize computations to solve a particular problem.

Graph with nodes, edges between them. DH degree 4, KB and MS are the only two odd nodes, so you must start and end on them in order to fully traverse the graph.

1. Quiz: Eulerian Path

Eulerian Path = An undirected, connected graph has an Eulerian path if and only if it has either 0 or 2 vertices of odd degree.

Yes, all such graphs do.

Eulerian Tour!

1. Algorithms Are Cool

* Really useful
* Really clever mathematically

How to make a program fly?

* Careful program design
* Tweaking loops
* Good algorithm design

1. Quiz: Case Study

Need for Mathematics

Theory Stuff (Math) helps

1. Formalize what you are doing
2. Analyze correctness
3. Analyze efficiency – time, memory, power
4. Correctness: Naïve

naive(a, b) = ab

ab = xy + z

Base case: first time: x = a, y = b, z = 0

ab = ab + 0

Inductive step: If ab = xy + z before, then ab = x’y’ + z’ after.

ab = x’y’ + z’ = ab therefore True!

z = ab at end of loop

1. Quiz: Running Time

Roughly linear t ~ c^n

1. Quiz: Russian Peasants Algorithm

Ancient Egyptian Multiplication

y = y << 1 # take whatever y is and binary shift to the left

17 >> 1 = 8

17 in binary = 10001

17 >> 1 = 10001 turns into 1000 or 8

1. Example
2. Correctness: Russian

Case 1: x is odd, case 2: x is even.

1. Quiz: How Many Additions

russian(20, 7)

10100 = 20, 20 >> 1 = 1010 = 10, 10 >> 1 = 101 = 5, 5 has an addition, 5 >> 1 = 10 = 2, 1 has an addition, 0. 2 additions. Other way is seeing two 1s, must be 2 additions while > 0 and bitwise shifting by one.

1. Which Is Faster

Russian is much faster than naïve, 3 seconds vs 2 milliseconds.

1. Quiz: Measuring Time

Simple statement takes unit time.

Loop = body \* iterations

12 units executed

1. Quiz: Counting Steps

23 units time

steps = 3 + 2 \* math.ceil(n / 5.0)

1. Quiz: Steps For Naïve

steps = 2 \* a + 3

1. Quiz: Halving

Floor log\_2 x + 1

1. Steps For Russian

3( floor log\_2 a + 1 ) + 3 + number of bits on in a which is less than or equal to 4 floor log\_2 a + 7 <<<<<< 2a + 3

1. Divide And Conquer

Russian algorithm breaks problem down as cases odd and even, that’s divide and conquer. Compounding halves leads to logarithmic time.

1. Quiz: Recurrence Relation

T(a) = 3 \* floor log\_2 a + 4