Welcome to Math 518!

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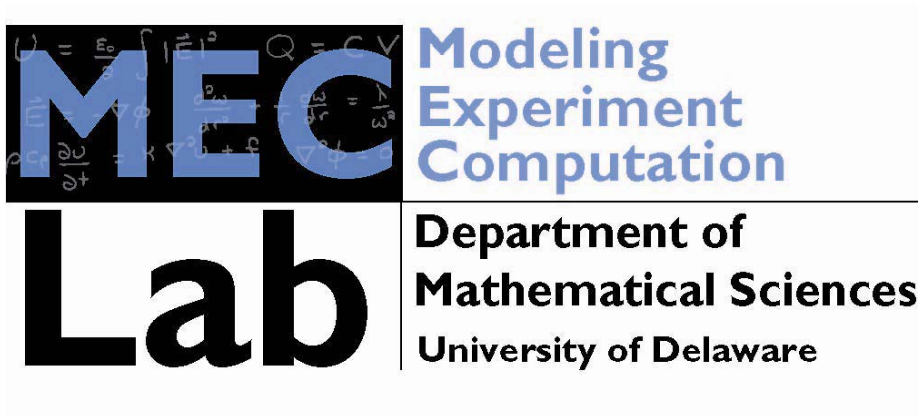
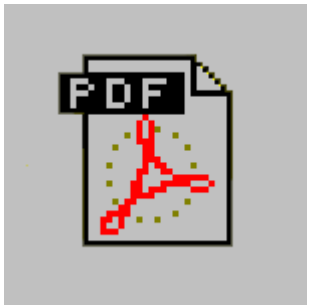
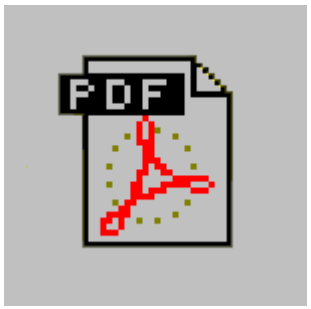




Syllabus



Project Proposal

http://www.nctm.org/

Index Card Information

- Name and major
- Birth month and day in upper right hand corner
- Did you study mathematical modeling in high school in any form?
- What do you hope to learn in this course?
- Are you taking this course for honors?
- Are you currently teaching?

Team One

Team Two

Team Three

Team Seven

Team Four

Team Five

Team Six

Some large numbers

- The Empire State building is 1250 feet high
- The Queen Mary weighs 75,000 tons
- The largest recorded iceberg covered 10,000 square miles
- The Panama Canal required the excavation of 250,000,000 cubic yards of rock
- The current budget before congress is $2.77 trillion

How do we make large numbers understandable?

The current budget before congress is $2.77 trillion dollars

$2,770,000,000,000

That's roughly $9200 per person in the U.S.

How do we estimate numbers?

- How many piano tuners are there in NYC?
- How many jelly beans would fit in a 1-liter soda bottle?
- How many golf balls would fill a suitcase?
- What is the total mass of the student body at UD?
- What's the circumference of the earth?

Fermi Questions

The Nobel-prize-winning physicist, Enrico Fermi, came up with this simple and intuitive way to deduce the circumference of the earth.

1. How many time zones do you pass through when you fly from New York to Los Angeles? Answer, 3
2. How many miles is it, about, over that same distance? Answer, about 3000.
3. How many miles per time zone, on average? Answer, about 1000
4. How many time zones must there be around the world? Answer, 24 because there are 24 hours in a day
5. How many miles around the world? Answer, 24 time zones x 1000 miles per time zone = 24000 miles

Yes, it is about 24000 miles around the world.

Work on the following problems with your group. Each group must hand in one copy of your answers. Please list all group member names on your final answer sheet. You will be evaluated on how understandable you make your answers.

1. How much human blood is there in the world?
2. If you were to count $1 bills, one at a time, at a rate of one per second, how long would it take you to count $5 billion?
3. How many dollars would each person on this planet possess if there were a "mole" of dollars to distribute?
4. If you folded a piece of paper in half 50 times, how thick would the resulting stack of paper be?

How much human blood is there in the world?

$$\text{Human Blood} = \#\,\text{of people} \times \text{Blood per person}$$

$$= (6\times10^{9}\,\text{people}) \times \frac{1\,\text{gallon}}{\text{person}} = 6\times10^{9}\,\text{gallons}$$

This is an *incomprehensible* number! How to illustrate?

It would fill 13,000 Olympic swimming pools.

It would cover Central Park to a depth of 20 feet.

It will fill this classroom X times over.

Not: That's 6 billion gallons of milk! (Still incomprehensible!)

If you were to count $1 bills, one at a time, at a rate of one per second, how long would it take you to count $5 billion?

This is an easy calculation, answer is about 160 years. Note, 160 years is a comprehensible number.

How many dollars would each person on this planet possess if there were a "mole" of dollars to distribute?

One mole is 6.02×10^{23} , There are about 6×10^{9} people on earth, so each would have about 10^{14} dollars! (More than the new U.S. budget.)

If you folded a piece of paper in half 50 times, how thick would the resulting stack of paper be?

L = Initial thickness

t_n = Thickness after n folds

$t_n = 2^n * L$

$$t_{50} = 2^{50} L$$

You need to do three things:

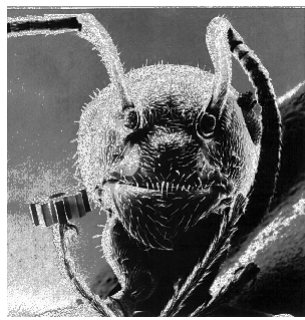
1. Estimate the initial thickness
2. Estimate or compute the thickness after 50 folds
3. Make your answer comprehensible

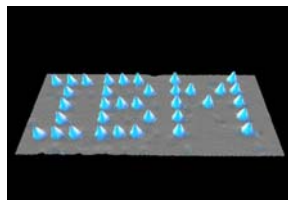
The Size of Things

Length	Organisms	Machines
10 kilometers		Long bridge
1 kilometer		Long train
100 meters	Tallest trees	Big ship
10 meters	Largest fish	Bus
1 meter	Human child	Car engine
100 millimeters	Largest insect	Electric razor
10 millimeters	Smallest fish	Watch movement
1 millimeter	Smallest insect	
100 microns	Plant cells	
10 microns	Animal cells	
1 micron	Bacteria	
100 nanometers	Virus	

Vogel, 1998

	Length	Natural Systems	Machines
Macro	10 kilometers		Long bridge
	1 kilometer		Long train
	100 meters	Tallest trees	Big ship
	10 meters	Largest fish	Bus
	1 meter	Human child	Car engine
	100 millimeters	Largest insect	Electric razor
	10 millimeters	Smallest fish	Watch movement
MEMS	1 millimeter	Smallest insect	
	100 microns	Plant cells	Silicon gear
	10 microns	Animal cells	
	1 micron	Bacteria	
Nano	100 nanometers	Virus	
	10 nanometers	DNA Molecule	Carbon nanotube
	1 nanometer		
	1 Angstrom		Single atom





$$L \approx 0.1\text{mm}$$

$$t_{50} \approx 10^{11}\text{m}$$

This is about 70 million miles, or roughly 2/3 the distance from the Earth to the Sun.