MATH 220 – Lecture 1 (08/20/2013)

This is Section 2. Although the four sections are coordinated, individual lectures, projects, etc., will be different.

Instructor: I'm Bala Krishnamoorthy, call me Bala.

I'm originally from India. In WSU since 2004, and have been in USA since 1999. If you do not understand what I say because of my accent, do let me know ☺!

My research interests are in optimization, algebraic topology, applications to biology, medicine, etc.

Discussed syllabus, and http://www.mymathlab.com/

Dude "Math" Major – has a Thursday problem. He has five hours in hand (say, 7pm–midnight), and \$48 to spend. He has two options. The costs for each activity are listed here.

	cost
* can get tutoring →	\$8/hr
* go partying! →	\$16/hr

Q: How many hours to get tutored, and how many to party?

Let x_1 = # hours of tutoring, x_2 = # hours of partying } unknowns or variables

These coefficients are one each

$$1x_1 + 1x_2 = 5$$
$$8x_1 + 16x_2 = 48$$

right-hand side (rhs) numbers

coefficients

This is a system of two linear equations.

the graph of each equation is a line

$$\left.\begin{aligned} 2x_1x_2 + 4x_3 &= -3 \\ -\sqrt{x_1} + 5x_6^3 &= -8 \end{aligned}\right\}$$ system of nonlinear equations

non linear!

The coefficients and rhs numbers could be real or complex numbers. In Math 220, we will work only with real numbers.

In general, a linear equation can have any number of terms, e.g.,

$$5x_1 + \sqrt{3}\,x_2 - 8x_3 \cdots + 10x_9 = -16.43$$

$\sqrt{3}$ is just a coefficient (it's a real number) — it does not create a nonlinearity here!

A solution is a set of values for (x_1, x_2) for which each equation in the system is true.

You can check that $x_1 = 4$, $x_2 = 1$ is a solution.

$$\left.\begin{aligned} x_1 + x_2 &= 5 \\ 8x_1 + 16x_2 &= 48 \end{aligned}\right\} \begin{aligned} &4+1 = 5 \ \checkmark \\ &8\times 4 + 16\times 1 = 48 \ \checkmark \end{aligned}$$

The question, of course, is to **find** a solution. In this case, since we are in 2D, we can use the graphical method.

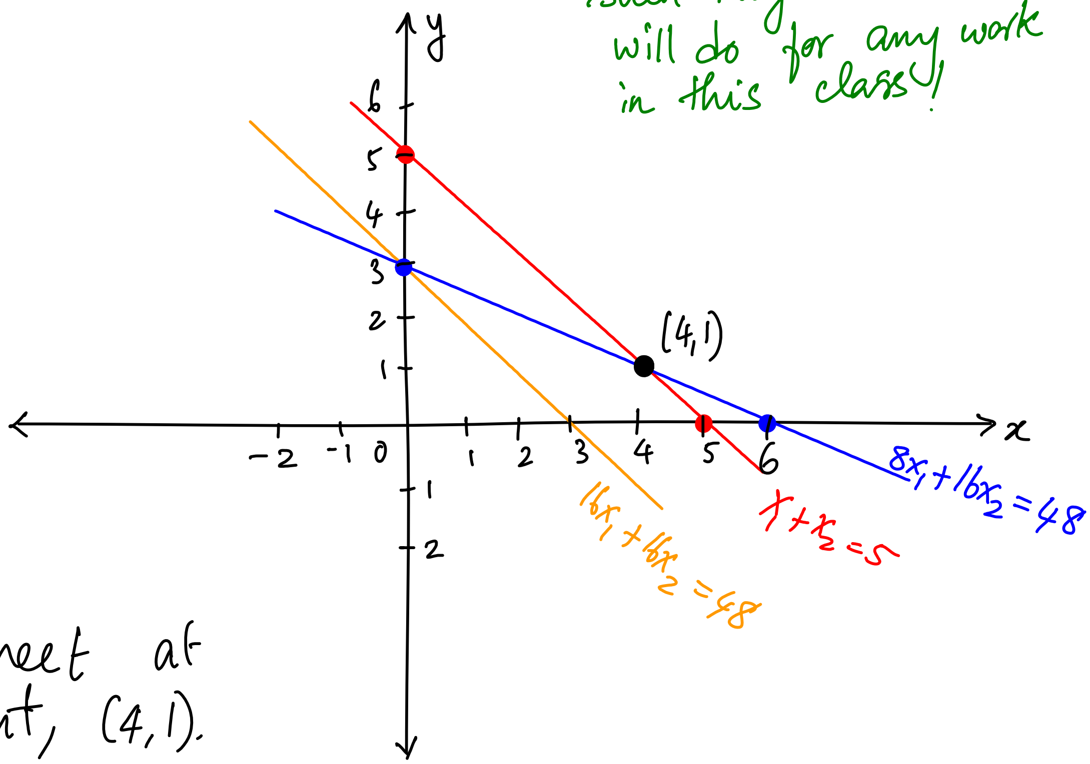
Plot the equations:

$x_1+x_2=5$ (5,0), (0,5)

$8x_1+16x_2=48$

(6,0), (0,3)

Such rough sketches will do for any work in this class!



The two lines meet at exactly one point, (4,1).

Hence, the system has a **unique solution**, i.e., $x_1=4$, $x_2=1$.

This is the "nice" case, where the lines intersect at a single point.

But there are two other extreme cases.

* the two lines do not intersect, i.e., they are parallel. In this case, the system has **no solutions**, or is said to be inconsistent.

Say, tutoring is also \$16/hr.

$$x_1+x_2=5$$
$$16x_1+16x_2=48$$

(0,3), (3,0) are two points on this line

The two lines are parallel — see figure above.

* the two lines coincide, i.e., they intersect at every point.

Here, the system has **infinitely many solutions**.

Say, Dude has only 3 hours to spend now.

$$x_1 + x_2 = 3$$
$$16x_1 + 16x_2 = 48$$

These results hold for systems of linear equations with more than two variables as well. Of course, in this case, we will not be able to use the graphical method. In this class, we will learn all about how to solve such systems with many variables.

In summary, a system of linear equations can have

1. no solution ⟶ inconsistent system.
2. one solution ⟶ unique solution
3. infinitely many solutions.

Notice that a system cannot have 3, 14, or 23 (or any finite number higher than 1) solutions!