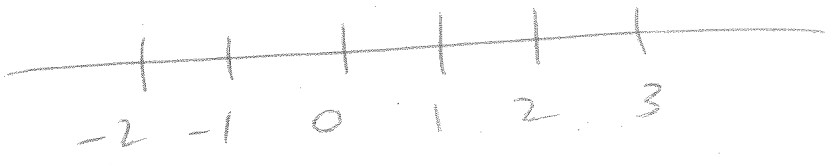
1.2 Linear Inequalities

$3 \geq 2$ $\qquad$ $2 \leq 3$

$3 \geq 3$ $\qquad$ $3 \leq 3$

$-1 \geq -2$ $\qquad$ $-2 \leq -1$



smaller ← $\qquad$ → bigger

- Can add to/subtract from/multiply/divide both sides of an inequality.
- Multiplying or dividing by a negative number reverses the inequality.

Ex: Solve $6 - 2x \geq 8$

$-2x \geq 2$

Divide by -2 Inequality reverses

$x \leq -1$

Standard form for an inequality is

$y \leq mx+b$ or $y \geq mx+b$

Ex. a) Put $8x-4y \geq 12$ in standard form.

$$-4y \geq -8x+12$$

$$\frac{-4y}{-4} \leq \frac{-8x}{-4} + \frac{12}{-4}$$

$$y \leq 2x-3$$

b) Does $(0,0)$ satisfy $y \leq 2x-3$?

$x=0, y=0 \rightarrow$ $y \leq 2x-3$

$0 \leq 0-3$?

$0 \leq -3$?

No

c) Does $(2,-1)$ satisfy $y \leq 2x-3$?

$x=2, y=-1 \rightarrow$ $y \leq 2x-3$

$-1 \leq 4-3$?

$-1 \leq 1$

YES

Ex: Graph $8x - 4y \geq 12$

1) Graph the associated line

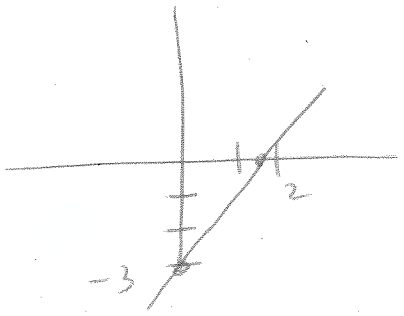
$8x - 4y = 12$

$x = 0 \rightarrow -4y = 12$

$y = -3$ $(0, -3)$

$y = 0 \rightarrow 8x = 12$

$x = \frac{12}{8} = 1.5$ $(1.5, 0)$



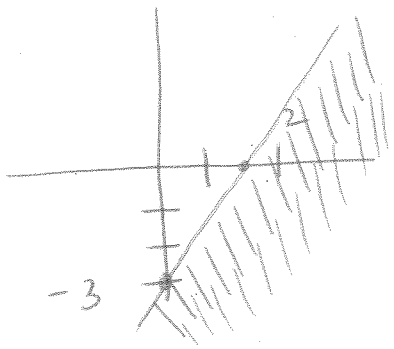
2) The points that satisfy the inequality are on one side of the line. Test any point not on the line.

Test (0,0)

Sub $x = 0, y = 0$ $\rightarrow$ $8x - 4y \geq 12$

$0 \geq 12$?

NO



All shaded points satisfy the inequality.

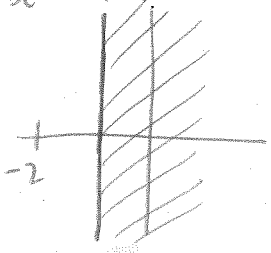
Ex: Graph the feasible set for the system

$$\begin{cases} x+1 \geq 0 \\ x+y \leq 10 \\ -x+0.5y \geq 0.5 \end{cases}$$

$x+1 \geq 0$

$x+1 = 0$

$x = -1$ (vertical line)

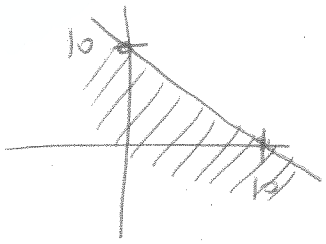


Test (0,0): TRUE

$x+y \leq 10$

$x+y = 10$

Intercepts: (0, 10)
(10, 0)

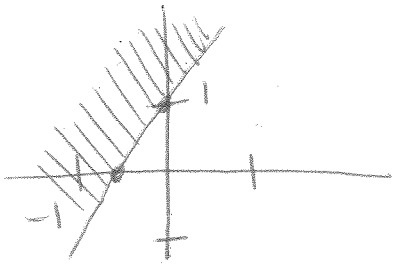


Test (0,0): TRUE

$-x+0.5y \geq 0.5$

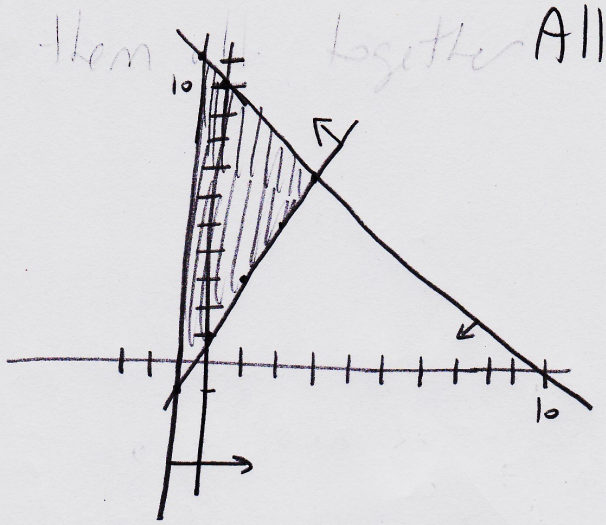
$-x+0.5y = 0.5$

Intercepts: (0, 1)
(-0.5, 0)



Test (0,0): FALSE

All together:



Shaded points satisfy all the inequalities

Ex: Put in standard form

$$0,3x - 0,4y \leq 2$$

$$\frac{3}{10}x - \frac{4}{10}y \leq 2$$

$$3x - 4y \leq 2$$

$$-4y \leq -3x + 2$$

$\div(-4)$ $\qquad y \geq \frac{-3x}{-4} + \frac{2}{-4}$

$$y \geq \frac{3}{4}x - 5$$

Caution:

The answers at the BACK of the coursepack have incorrect shading.

See the solutions on the course website instead.