Fall 2021 Pre-calculus
Lesson 12.1

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Lehman High School
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students need calculators
no new vocab

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do now

be sure to: Get out your **binder**. Copy **goal** and answer **do now** questions below. Show all work or write a complete sentence for each answer:

1. How do you find two points that satisfy the equations to the right?
2. How do you plot these equations

$$5x + 4y = 80$$
$$10x + 20y = 200$$

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

see handwritten notes for solution

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framing

- **what:** use graphical method to find the optimal solution for a problem?
- **why:** this is actually another way to represent the algorithm we learned before break
- **where to:** Fun with polynomial functions

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

the plan: We'll go through one of the Pset #5 word problems together.
You'll work with a partner to solve some other word problems

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Warm up

be sure to: do all work below

1. How do you plot these inequalities?

$$5x + 4y \leq 80$$
$$10x + 20y \leq 200$$

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see handwritten notes

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Vocabulary

be sure to: copy definitions below

Feasible region
The part of a graph that satisfies all the constraints for an optimization problem

Graphical method
The optimal solution for a problem is always one of the vertices of the feasible region

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

a. A pebble is dropped in the pond. The ripples are 'concentric' circles. r(t) = 0.6t. A(r) = pi*rt^2.
b. A sensible answer would be a real number.
   +What could be an interval for this number?
   +Do we think the answer will be negative? no because all the numbers here are positive
   +will the answer be bigger than 10? hard to know but 1.3 is pretty small so probably not
   so we know that the answer is probably somewhere between 0 and 10

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Mini lesson: the carpenter problem

be sure to: do all work below

1. What's the key information in this paragraph?
2. How could we represent this info as inequalities?
3. What do you think we'll try to maximize?
4. What's the feasible region?
5. How could we find the optimal solution using the graphical method?

A carpenter makes tables and bookshelves. Tables take 10 units of lumber and five units of labor, and are sold for $180. Bookshelves take 20 units of lumber and four units of labor, and are sold for $200. The carpenter doesn't want to work more than 80 hours in a week and only has 200 units of lumber.

Feasible region
The part of a graph that satisfies all the constraints for an optimization problem

Graphical method
The optimal solution for a problem is always one of the vertices of the feasible region

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

see handwritten notes

based on video: https://www.youtube.com/watch?v=K7TL5NMlKIk

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Independent work :the carpenter problem

be sure to: do all work below

1. Now the carpenter only wants to work 40 hours and has 120 units of lumber on hand. Tables still take 10 units of lumber and five units of labor, and are sold for $180. Bookshelves take 20 units of lumber and four units of labor, and are sold for $200. How many tables and bookshelves should the carpenter make to maximize revenue?
2. How does the problem change if the carpenter can only work 20 hours in one week?

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

a. It resembles problems involving combinations of functions. In this case, it's specifically composite functions, because the radius goes into the area.
b. A good first step could be finding the composite of A and r.
+How do we know whether to compose A with r or r with A? It's A with r because the input for A is a radius, which is the output for r.

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3. Execute your plan
4. Review your work

A pebble is dropped into a calm pond, causing ripples in the form of concentric circles. The radius (in feet) of the outermost ripple is given by *r* $r(t) = 0.6t$, where *t* is the time (in seconds) after the pebble strikes the water. The area of the circle is given by $A(r) = \pi r t^2$. Find the radius of the largest circle after 1.3 seconds.

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

WORK THROUGH ON BOARD
r(t) = 0.6t
A(r) = pi r t^2

(A . r)(t) = A(r(t)) =
pi (0.6 t)t^2 = 0.6 pi t^3

We could appoximate the coefficient by multiplying 0.6 with pi, but right now I want to keep things as simple and accurate as possible.

Final step. plug t = 1.3
0.6 pi (1.3)^3 = 4.14

review work.
Go through our calculations. +Do we see any mistakes? maybe! it depends on if I do something wrong here.
+does this answer make sense, yes it's bigger than 0 and less than 10. So this seems like a reasonable answer!

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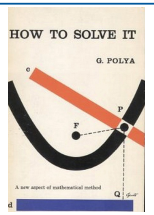
activity

be sure to: Work with **one (!)** neighbor (someone right next to you!). Answer the questions below for each problem.

1. **Understand the problem!**
   What question are you answering and what would be a reasonable answer?
2. **Make a plan!**
   What combination of function will you use?
3. **Execute plan!**
   Show all your work
4. **Review your plan**
   Does your answer make sense? How can you solve it better?



class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

+How do I make a plan? Make sure you understand the question, then think about which combination of functions will make sense here.
+ how do I know if my answer is correct? Maybe check in with another group. If there 's a difference you can talk about what you did differently.

1. Your highly successful vegan chopped cheese restaurant has two locations. The annual sales (in thousands of dollars) of each store can be given by the models:

   $S_1 = 973 + 1.3t^3$ and $S_2 = 349 + 72.4t$

   Where t is the year, with $t = 21$ corresponding to 2021.

   What will be the total sales in 2022?

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

See answer key.

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2. The spread of a contaminant is increasing in a circular pattern on the surface of a lake. The radius of the contaminant can be modeled by $r(t) = 5.25\sqrt{t}$, where r is the radius in meters and t is time in hours since contamination. When the contaminated area will equal 6250 square meters

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?

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3. The number of bacteria in a refrigerated petri dish is given by

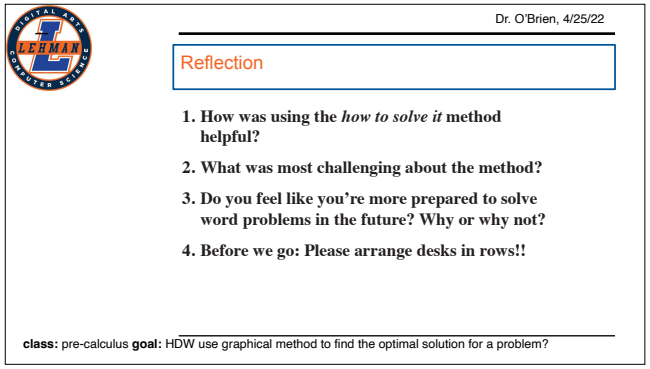
   $N(T) = 20T^2 - 80T + 500,$
   $2 \le T \le 14$

   where T represents the temperature of the petri dish. When the petri dish is removed from the refrigerator, the temperature of the petri dish is given by

   $T(t) = 4t + 2, \quad 0 \le t \le 3$

   where t is time (in hours). When will the number of bacteria in the petri dish reach 2772?

class: pre-calculus **goal:** HDW use graphical method to find the optimal solution for a problem?



apply box method = -4x^3+4x^2 -2x + 3.
5. N.T(t) = 20(4t+2)^2 -80(4t+2) + 500 =
20(4t+2)[4t+2 - 4]
20(4t+2)(4t-2) + 500=
20[4t^2 -4] + 500 = 2000
1500/20 = 4t^2 - 4
79 = 4t^2

t = sqrt(79)/2

+is this in the domain of our function? no its about 4.44. so the bacteria count will never reach 2000.