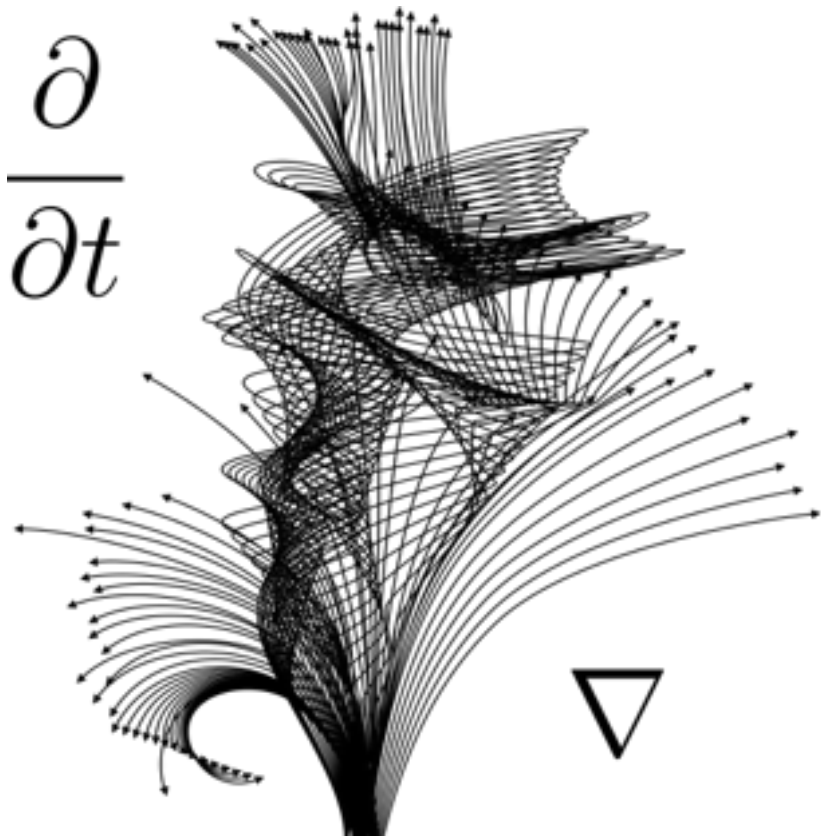
Differential Calculus with Applications to Life Sciences

Math 102:105

Pooya Ronagh

Agenda for today:

- Information about the course
- Properties of Power Functions



Course Information

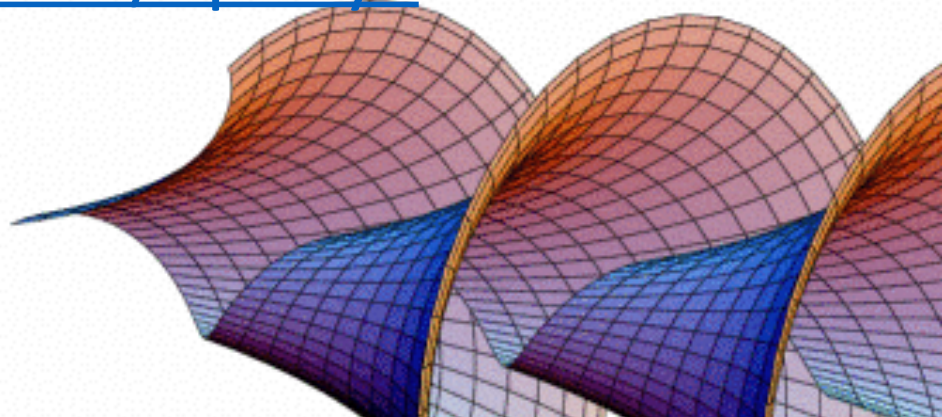
Office Hours: LSK 300B (Mondays 10-12)

Course Wiki

Section Homepage: www.math.ubc.ca/~pooya/math102.html

Email me: pooya@math.ubc.ca

Find me and course page: www.math.ubc.ca/~pooya



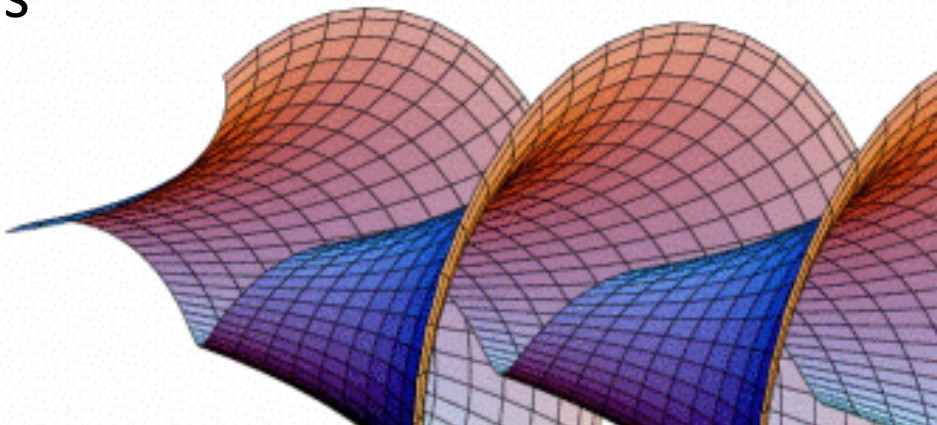
Things to keep an eye on…

Homework types:
- Pre-lecture WeBWorK
- Post-lecture WeBWork
- Old-School Homework (OSH)

Exam types:
- Quizzes (x3)
- Midterm (x1)
- Final (x1)

Connect:
- Twitter
- Piazza

Help:
- Section Homepage
- Course Wiki
- Math Learning Centre (MLC)
- Office Hours



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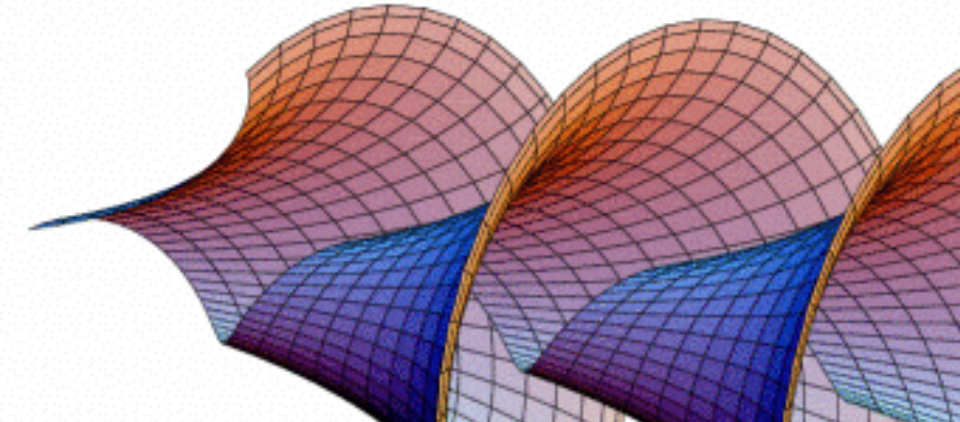
Class format:

- combination of slides,
- interactive questions,
- experiments and
- some board work.

You will be expected to actively think and work!



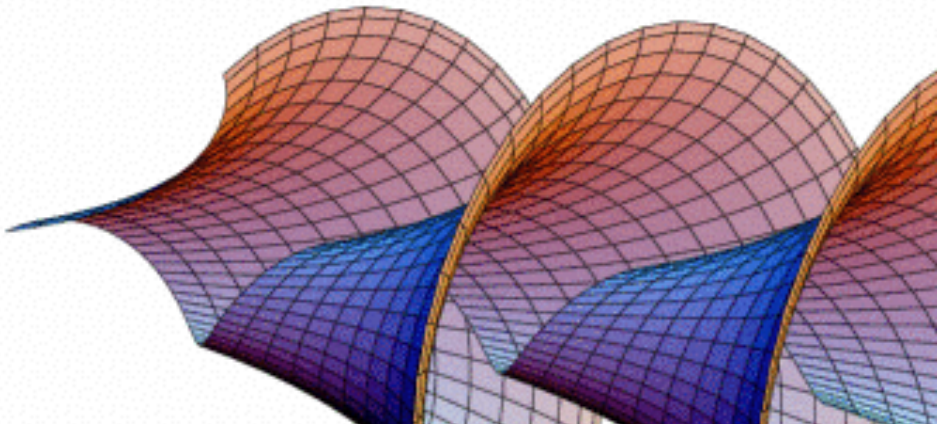
Power Functions

$$y = f(x) = K \cdot x^n$$

constant

power

Problem: Find the intersection point of $y_1 = ax^n$ and $y_2 = bx^m$.



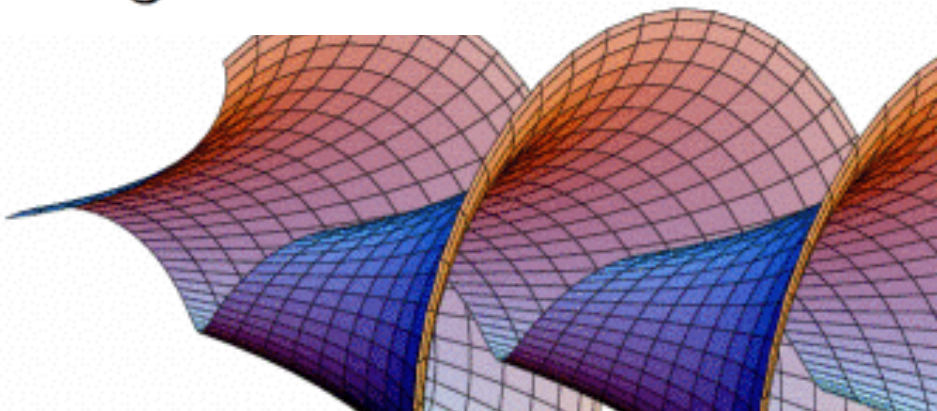
Example: Nutrient balance in a spherical cell

Absorption of nutrition is **proportional** to the surface area.

$$S = 4\pi r^2 \qquad A = k_1 S = 4k_1 \pi r^2$$

Consumption is **proportional** to the volume.

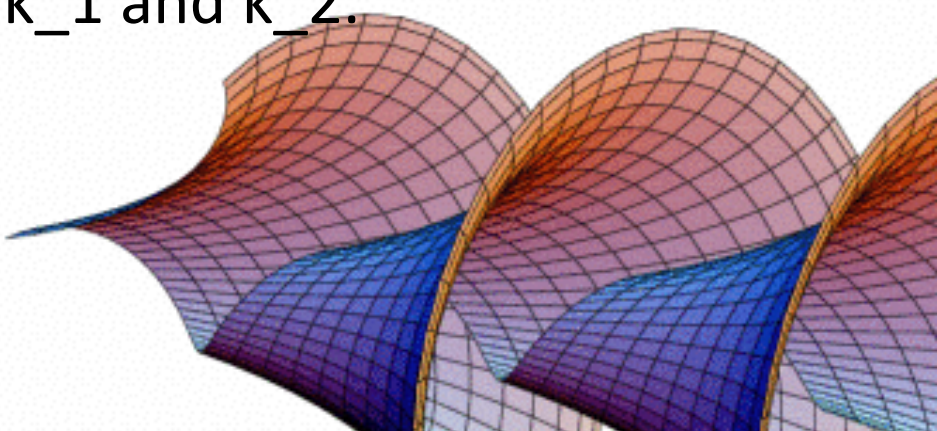
$$V = \frac{4}{3}\pi r^3 \qquad C = k_2 V = \frac{4}{3} k_2 \pi r^3$$



Which one is true?

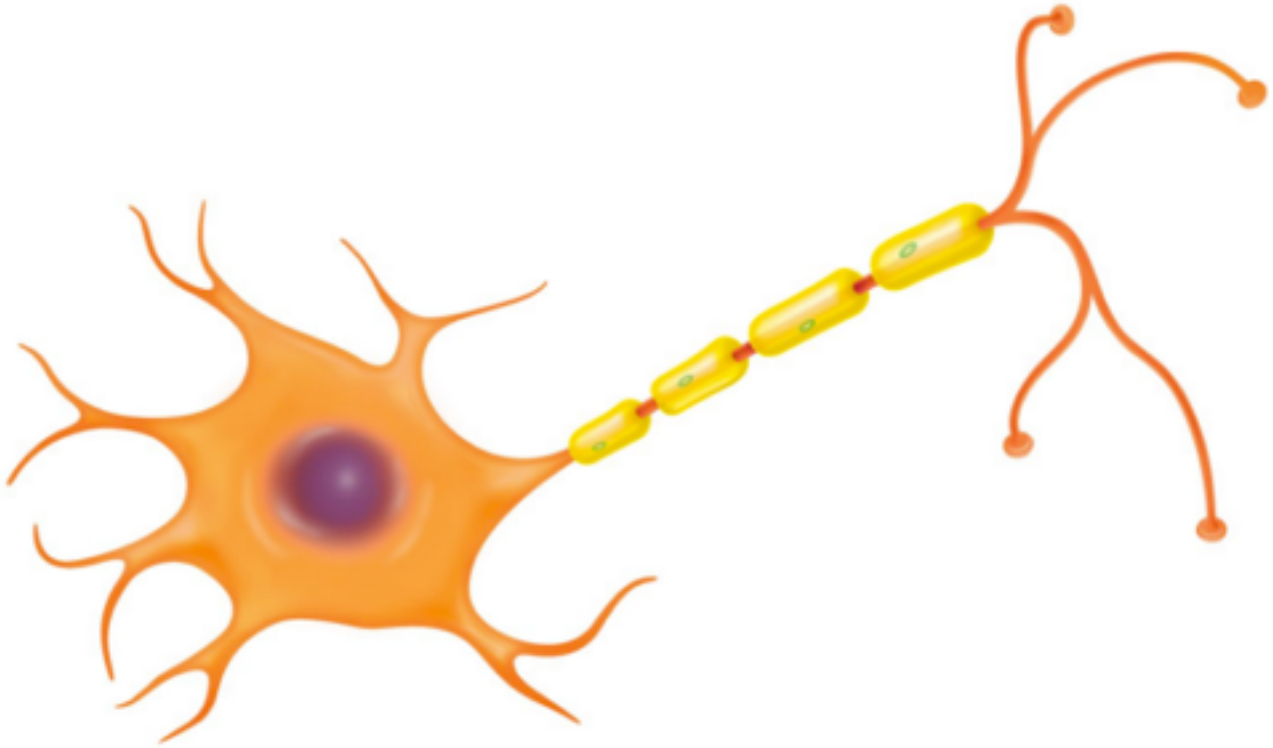
$$C = \frac{4}{3} k_2 \pi r^3 \qquad A = 4 k_1 \pi r^2$$

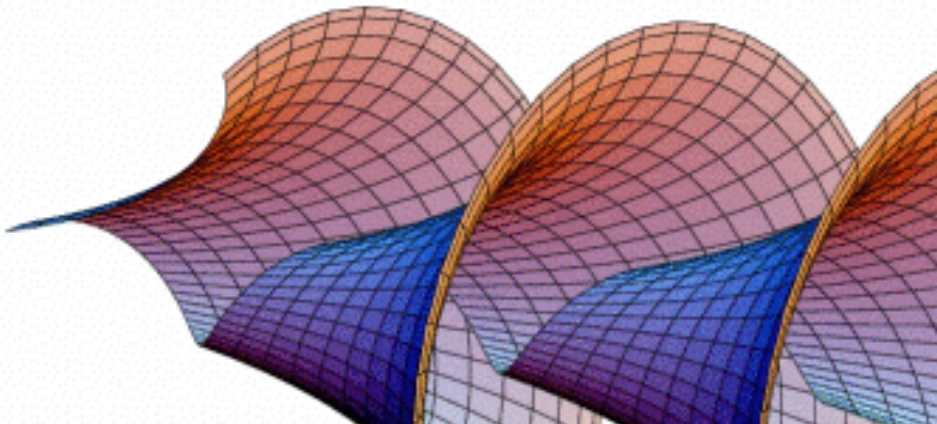
(A) Absorption (A) is greater than consumption (C) for a very large cell and vice versa for a very tiny cell.
(B) Consumption is greater than absorption for a very large cell and vice versa for a very tiny cell.
(C) Both are possible, it depends on the constants k_1 and k_2.
(D) I am totally lost. Please explain more.



Example: Nutrient balance in a spherical cell

This is why the biggest cells are not spherical usually!





Drawing simple functions

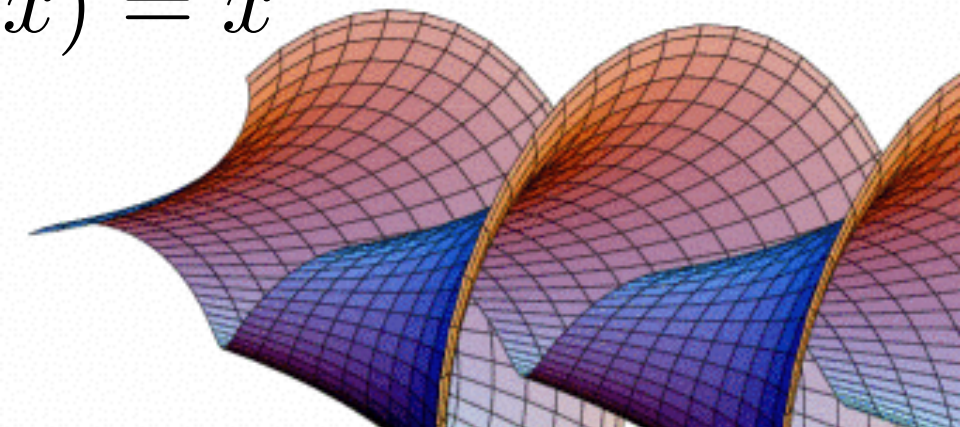
We will try to understand the shape of

$$g(x) = x^2 - x^3$$

only by understanding the asymptotic behaviour of the following power functions:

$$f_1(x) = x^2$$

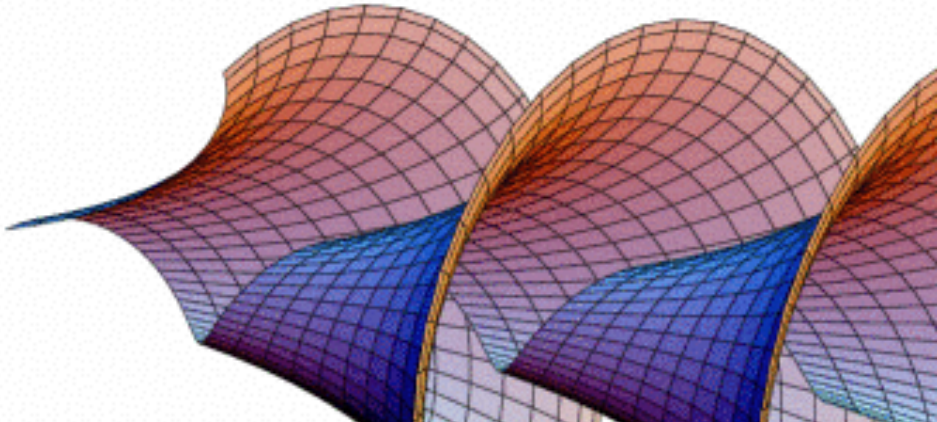
$$f_2(x) = x^3$$



Drawing simple functions

Question 1:
Which function is much larger when x is **positive** and **close to zero**?

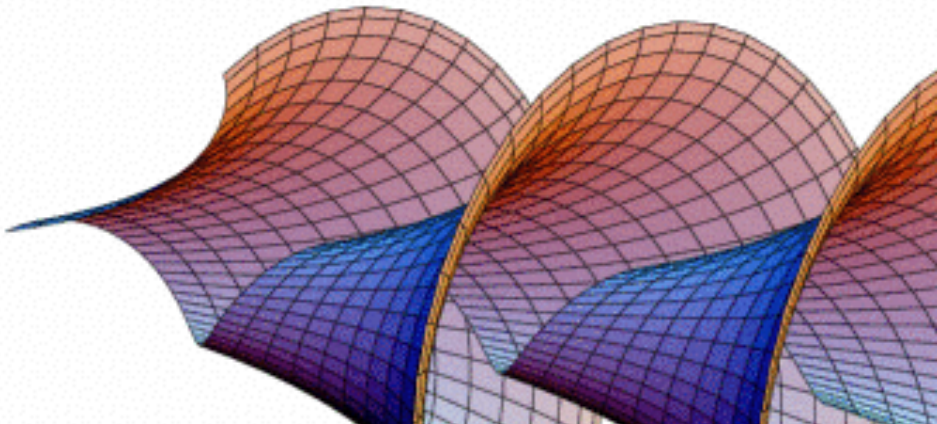
$$f_1(x) = x^2 \qquad\qquad f_2(x) = x^3$$



Drawing simple functions

Question 2:
Which function is much larger when x is a **very large positive number**?

$$f_1(x) = x^2 \qquad\qquad f_2(x) = x^3$$

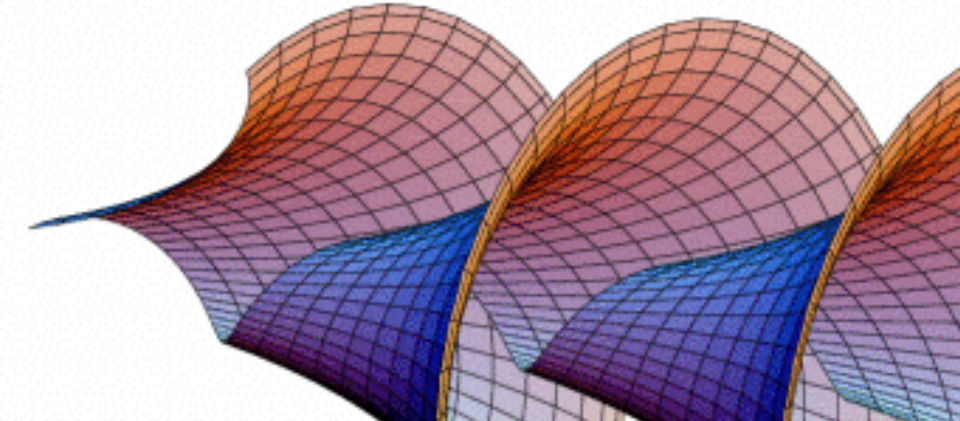


Drawing simple functions

Question 3:
Which function is **dominating** when x is very close to zero or very large?

$$f_1(x) = x^2 \qquad\qquad f_2(x) = x^3$$

Question 4:
Which function is **dominating** when x is a very large **negative** number?



Reminder

PL 2.1 is due on Monday (Sept 12)

We will continue discussing graphs of functions on Tuesday

Have a good weekend :)