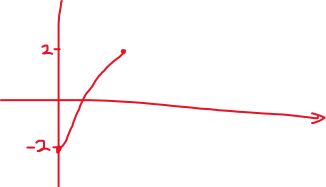
# Week 1 Lecture 3

* Application of Intermediate value theorem:
  + Show that
  + Has a solution on the interval .
  + Solution
    - Let .
    - Then because of the following facts:
      * .
      * .
      * is continuous on .
    - We deduce from the intermediate value theorem that there exists a such that



* Improper integrals § 9.2.1
* We know how to integrate function f(x) on when f(x) is a continuous function. An improper integral is anything else.
* Examples:
  + ; Not defined at x=0.
  + ; Not defined at x=2.
  + ; is not a finite interval, therefore improper.
* Improper integrals arise in many applications:
  + Pendulum example:
  + This function (in the integrand) is singular as ; denominator becomes 0.
* What not to do:
  + This can’t be correct because
  + for , which would imply that the integral should be greater than 0 if it existed.
* Define improper integrals:
  + To define an improper integral like
  + We first regularize the integral by considering
    - ; this is guaranteed to be continuous on since we made sure .
  + We then define as the limit
  + In this case we get:
  + Since the limit DNE, we say that this integral is a divergent, improper integral.
* Example:
  + Since the limit exists, we say that this integral is a convergent improper integral.
* Example:
  + This shows that the integral is a divergent improper integral
* Example

But now, if we treat the limits as independent…

I.e., the limits don’t exist, therefore it’s a divergent improper integral.

* Summary
  + If DNE and f(x) is continuous on then
  + If DNE and f(x) is continuos on then
* Example: