

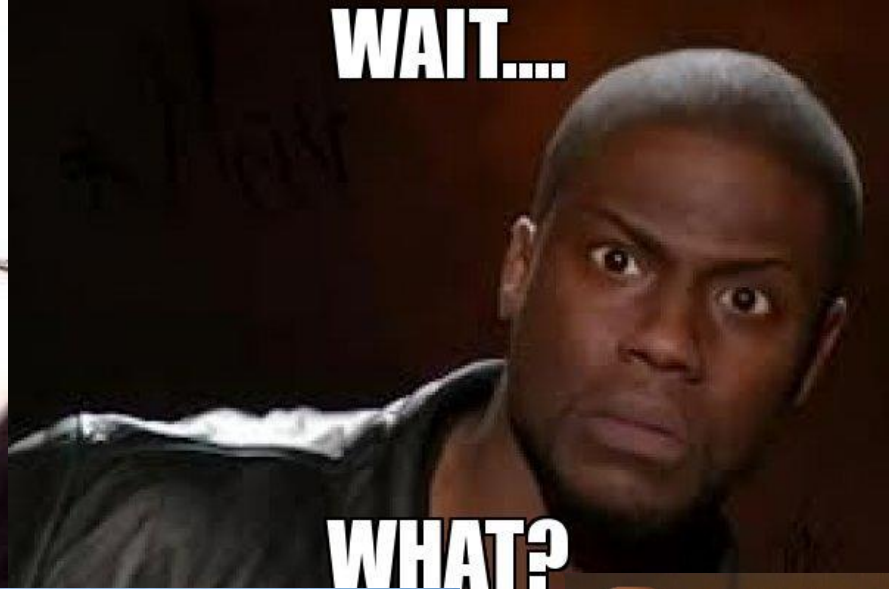
PID controller

What is a PID controller?

P = Proportional

I = Integral

D = Derivative



WAIT....

WHAT?



WHAT!!



DUDE WHAT



What you will need to know:

- Some programming skilz (assume you know some of it)
- If you know python => Good for you!
- If you know game physics => Good for you!
- If you know how to do arithmetics on vectors => Good for you!
- If you know linear combinations => Good for you!
- If you know what flow control domain is => Good for you!
- If you know yourself => Good for you!

If you don't know this, don't worry, we are gonna go though the stuff you need in order to follow along. But also, complement with other sources if there is something specific you don't understand. If you already know the math stuff, just skip ahead (otherwise you'll just be bored!

Outline

Why would you need a PID controller and some applications

Some simpler math stuff (you may wanna skip this if you know it)

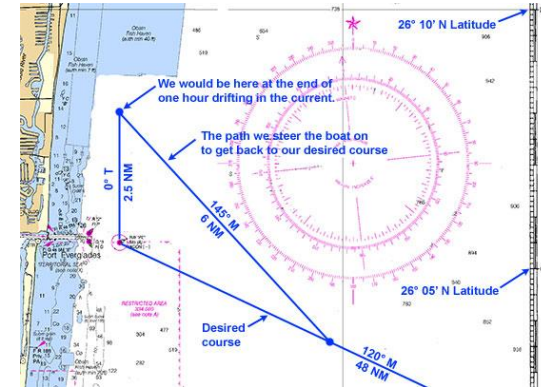
- Vector arithmetics
- Linear combinations

Implementation in python with a simple game

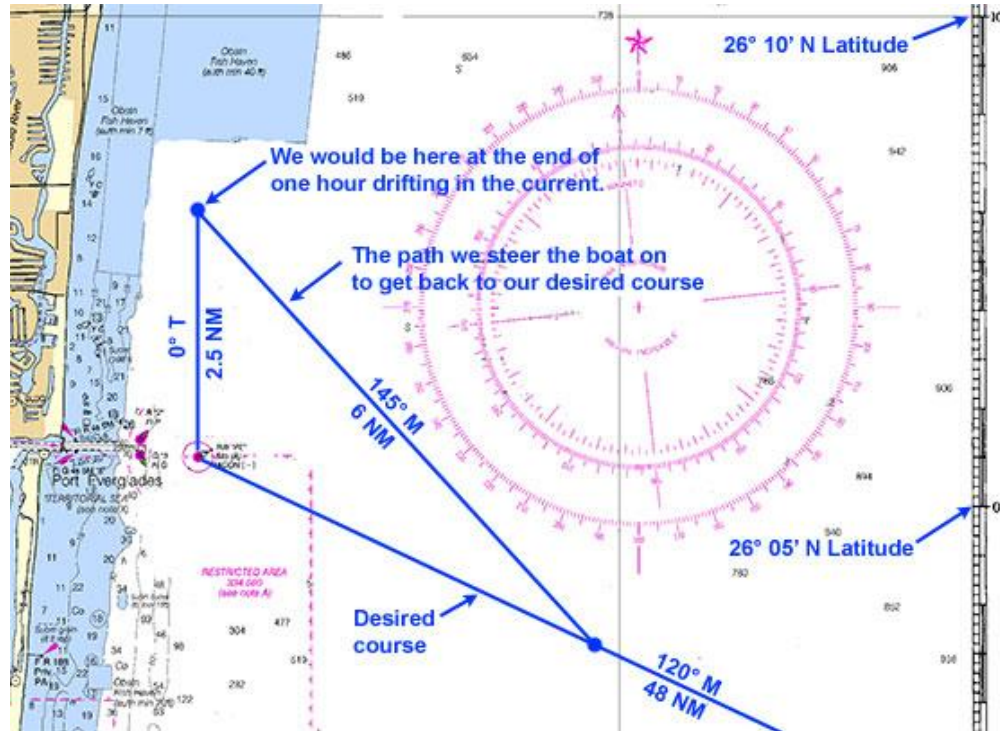
- Code will be provided
- Demo and walkthrough

Why would you need a PID controller and some applications

- Lives in the domain of “flow control problems”
 - How much heating should there be in the building
 - Are we on course
 - How much soda should we put in the office fridge
- You can measure the error
 - How many degrees from the optimal temp are we?
 - How much drift from the course do we have?
 - Are there around 5 cans in the fridge?
- There may be (changing) external factors
 - Bad weather
 - Wind fluctuations and current
 - A lot of consultants some weeks

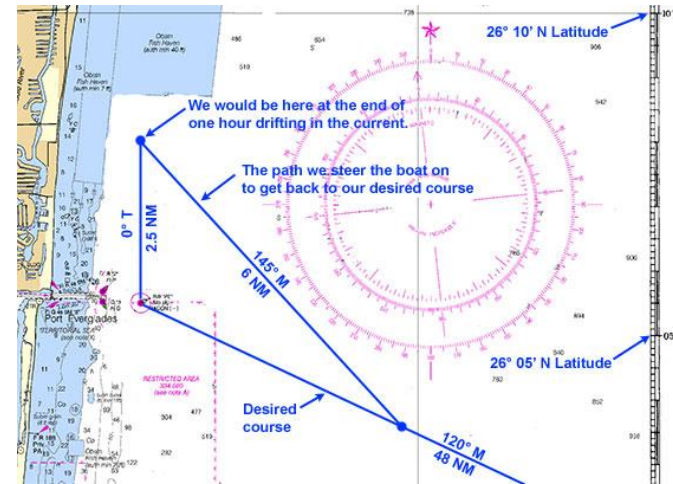
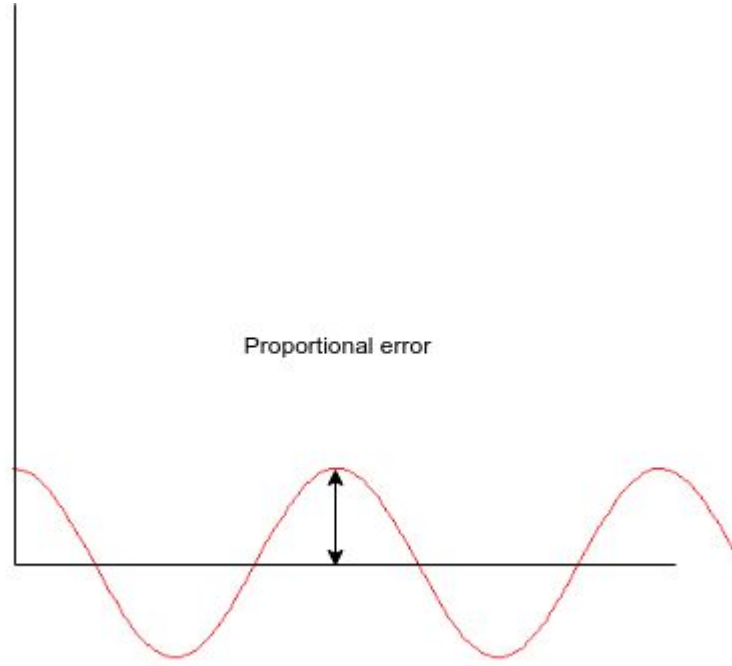


How do you stay on course?

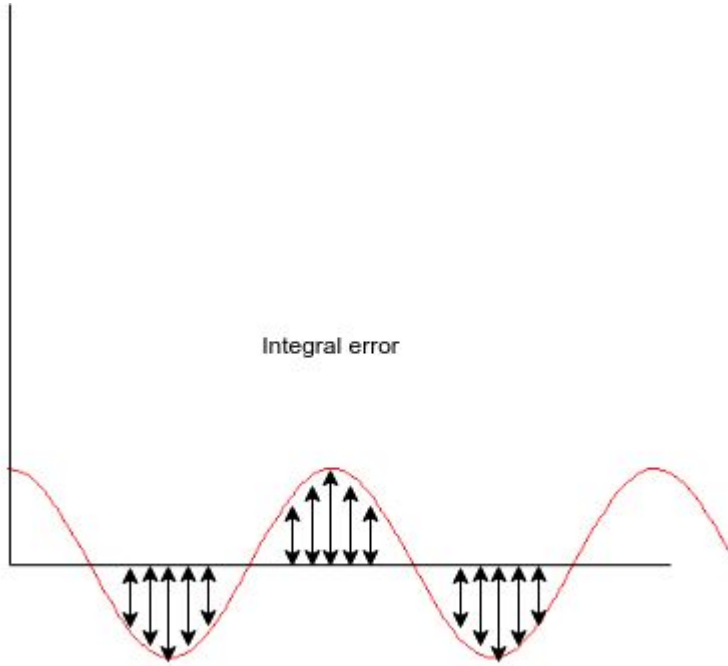


Proportional

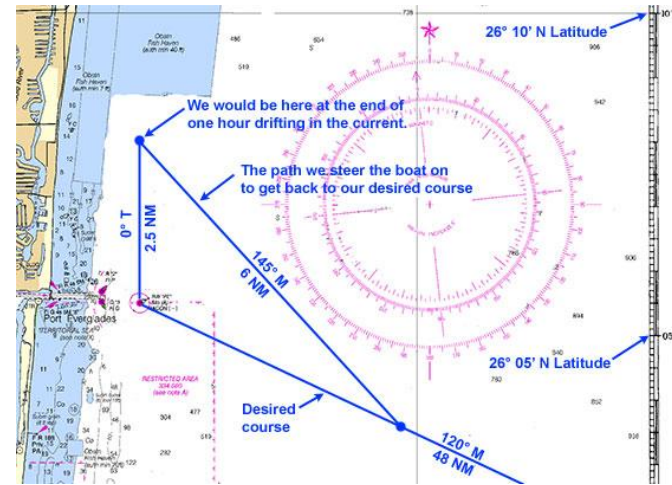
How far of the course are we?



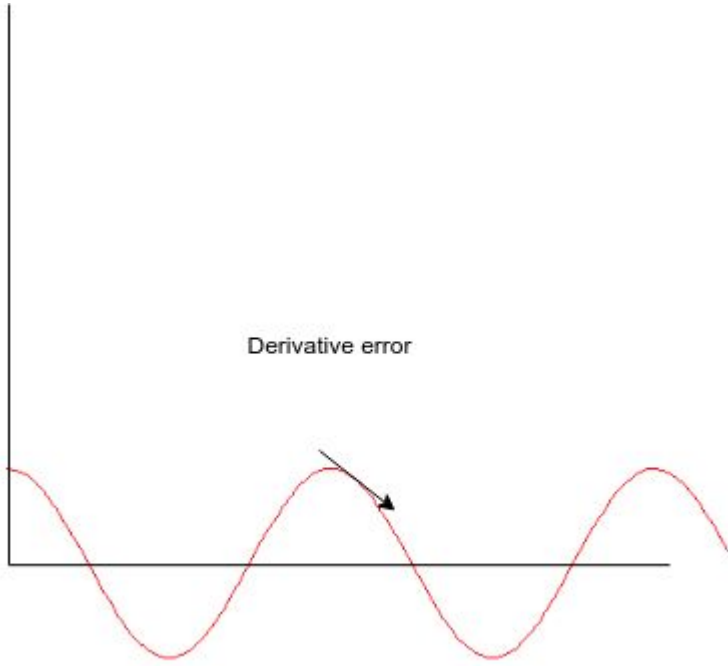
Integral



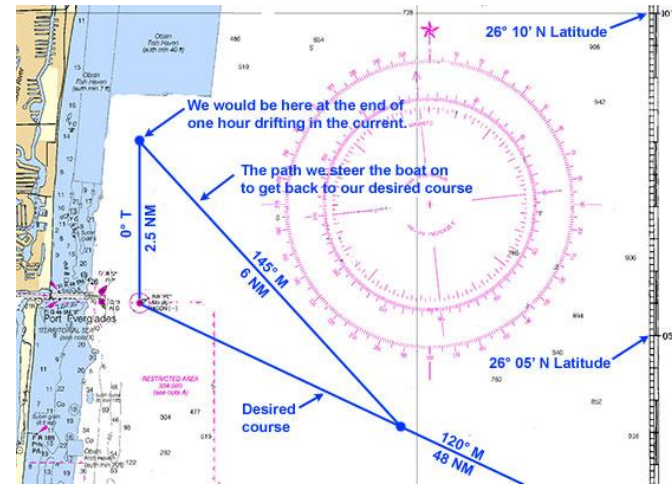
What is the sum of our error?



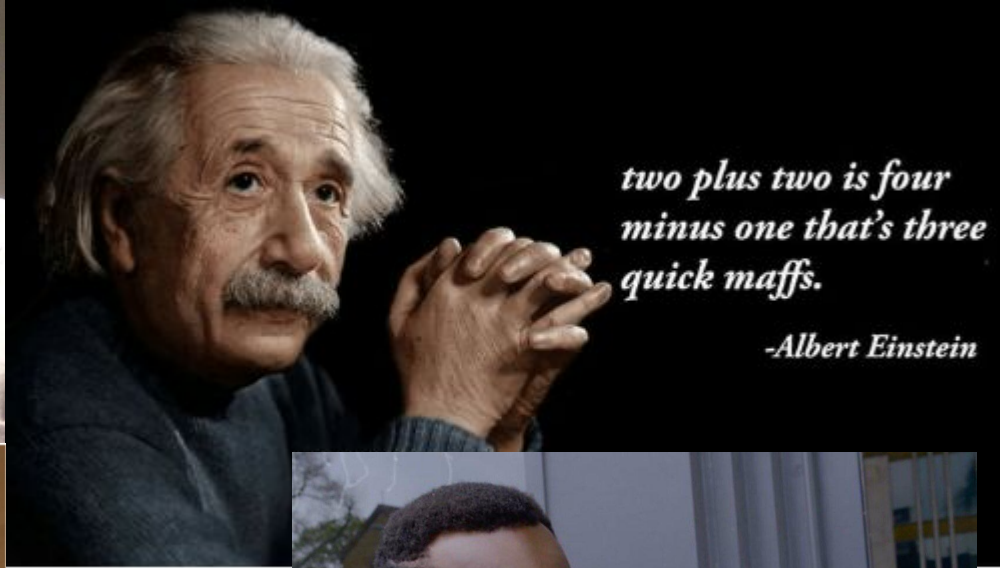
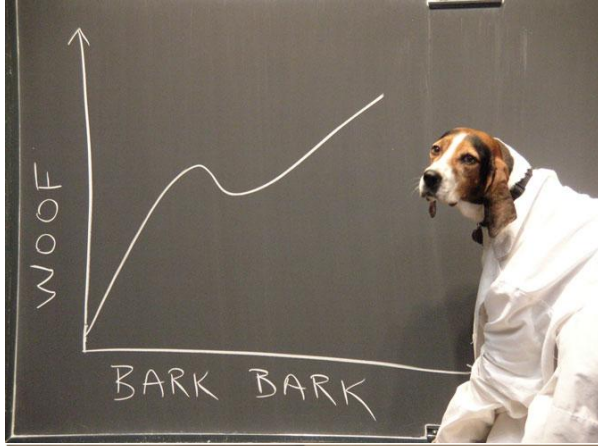
Derivative



How fast are we coming into course?



Quick maffs



Vector operations

Can be done with python numpy (np) library but not with regular python lists

- Addition
- Subtraction
- Multiplication
- Division

$A = [10, 20]$

$B = [30, 40]$

$A + B = [40, 60]$

$B - A = [20, 20]$

$A * 2 = [20, 40]$

$A / 2 = [5, 10]$

Vector operations - Simple game physics

Pos [0, 0] is top left corner

pos = [10, 20]

force = [1, 1]

// Apply the force

new_pos = pos + force

new_pos = [11, 21]

// Or, for short

pos += force

pos = [11, 21]

force = [-1, 1]

force = [-1, -1]

force = [1, -1]



Now is a good time to pause the video and work this through the scenarios if it's not intuitive to you

Linear combinations



Three parts

- Input (x)
- Weight (θ)
- Output (score)

Linear combinations

Three parts

- Input (x)
- Weight (theta)
- Output (score)

Weights (theta) [-1, 1]

- Full frontal nudity = -0.2 t_1
- Violence = 0.5 t_2
- Romance = 0.8 t_3

Inputs (x) [-1, 1]

- Full frontal nudity = 0.8 x_1
- Violence = 0.1 x_2
- Romance = 0.5 x_3

$$\text{score} = (t_1 * x_1) + (t_2 * x_2) + (t_3 * x_3)$$

$$\text{score} = -0.2 * 0.8 + 0.5 * 0.1 + 0.8 * 0.5$$

$$\text{score} = 0.29$$



Now is a good time to pause the video and work this through the scenarios if it's not intuitive to you

Linear combinations - PID application

Pick a weights for each component of the PID controller

- How these are picked is not covered

Measure the three different errors (PID)

- You will get a two dimensional vector in a 2D world
- You will get a three dimensional vector in a 3D world
- Etc..

Do a linear combination with the measured errors and your selected weights

- You will get a vector with the “force”

Apply the “force” to the controller

- Could be the navigation system or hot water system or whatever it is you are trying to control

ALRIGHT STOP!



DEMO TIME

memegenerator.net