Project statement - in theory encompasses all goals of the project

- In engineering we like to create project statements because it defines our purpose and our audience
- If there's no statement we're not engineering but gadgetiering
- Create a dynamic program/thing that can track a robot's location and direct it on a 12×12 ft² FTC game field

Our solution

Hardware

- Usage of encoders – Eliminated primary candidates accelerometer and compass because of their individual, inherant flaws
  - Encoder has no noise, no influence of motor electric fields
- Dead wheel – Counters slippage on ledges and makes it adaptable to any base, addition of servo is for secure placement of the wheel on the ground and for lifting

Software

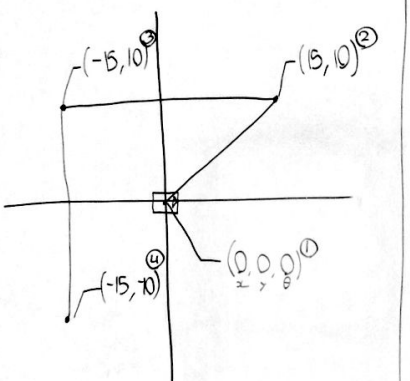
- How set goal works
  - Distance formula
  - arctan
  - relative vs. absolute
  - Input X < currentX
- How go to goal works
  - Arc/Radius
  - Buffers
  - Drift corrections
  - Strafing

Short comings

- No effective counters to drift
- 180° bug
- The balance between buffer and accuracy

Currently working / recently finished

- Strafing (+ drift correction)
- Entach Field Mapper



Two parts:
set goal ← we're focusing on this
go to goal

① → ②

currentX = 0 cm
currentY = 0 cm
currentθ = 0 radians

goalX = 15
goalY = 10

Solve for goalθ and goalRadius:

$\arctan\left(\frac{y}{x}\right) = \arctan\left(\frac{10}{15}\right) = 0.588 (= 33.69°)$

(tan⁻¹)
(atan)

(distance formula)
$\sqrt{x^2 + y^2} = r$

$\sqrt{15^2 + 10^2} = 18.0277$ cm

```
goToAngle(0.588);
goToDistance(18.0277);
```

currentX = 15
currentY = 10
currentθ = 0.588

② → ③

currentX = 15
currentY = 10
currentθ = 0.588

goalX = -15
goalY = 10

Solve for goalθ and goalRadius

$\arctan\left(\frac{gY - cY}{gX - cX}\right)$

$\arctan\left(\frac{10 - 10}{-15 - 15}\right) = 0$

relative to 0° not robot
?? shouldn't be π ?

we must use condition if goalX < currentX, goalθ += π (+180°)

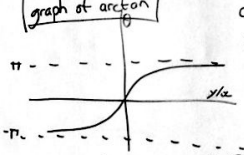
But this time using absolute coordinates to do that, in order to produce relative coordinates

relative r

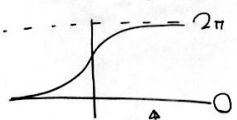
$\sqrt{(gX - cX)^2 + (gY - cY)^2} = r$

$\sqrt{(-15 - 15)^2 + (10 - 10)^2} = 30$

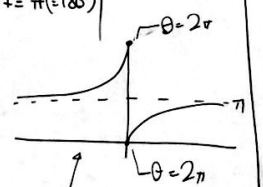
graph of arctan



currentθ's range = 0...2π



doesn't work
arctan(0) + π = π will give incorrect coordinates



compromise

currentX = -15
currentY = 10
currentθ = π

makes input relative

turnAngle = goalθ - currentθ = 2.55

```
goToAngle(2.55);
goToDistance(30);
```

Aim: have robot face the goal point then drive to it

relative turnθ → Rotate robot by turnθ radians → Robot turned turnθ

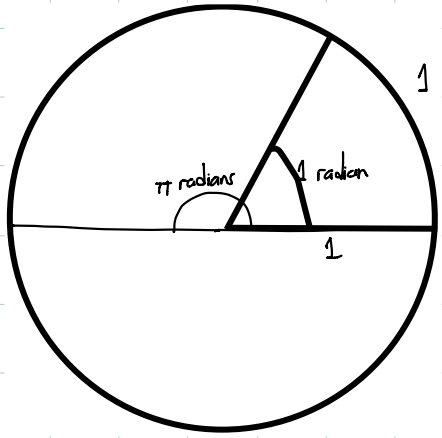
relative goalRadius → Drive forward by goalRadius cm → Robot drove forward goalRadius cm

goToAngle (turnAngle)

CurrentHeading

(only in this method)

- is a relative method - where it's currently facing is set as 0°
  turnAngle is relative to the relative 0°
- Takes 1D input and turns it into a 2D location
- The secret: Arc/Radius = Angle the definition of an angle:



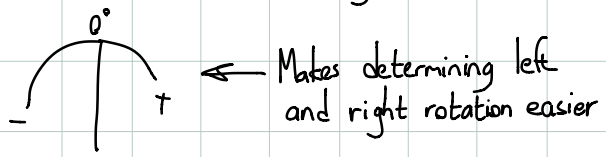
$\frac{Arc}{Radius} = Angle$

$\frac{1}{1} = 1$

- Encoder reads arc when travelling in a circle
- All you need is the radius from center of rotation and you have angle

Comparison

- Condition: while(abs (turnAngle - currentHeading) > 0.005)
  { Search for angle }
  ↑ buffer
- Reason for $-\pi \ldots \pi$ range



← Makes determining left and right rotation easier

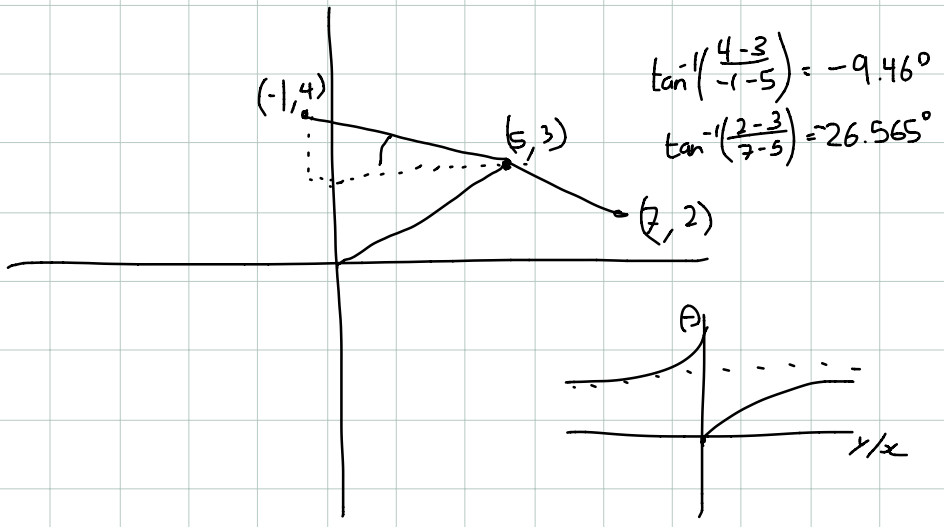
goToDistance (goalRadius)

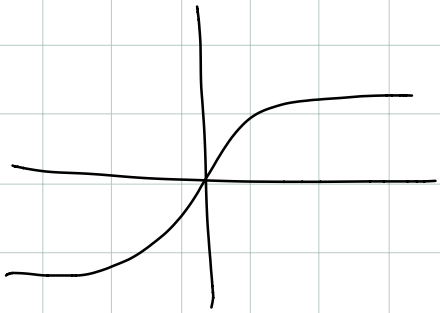
Current Radius

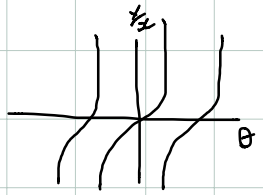
- Very simple, just using encoders conventionally
- But first we have to convert encoder counts → cm

Condition

- while (abs (goalRadius - currentRadius) > 0.1)
- if currentRadius > goalRadius
  drive backwards






θ