



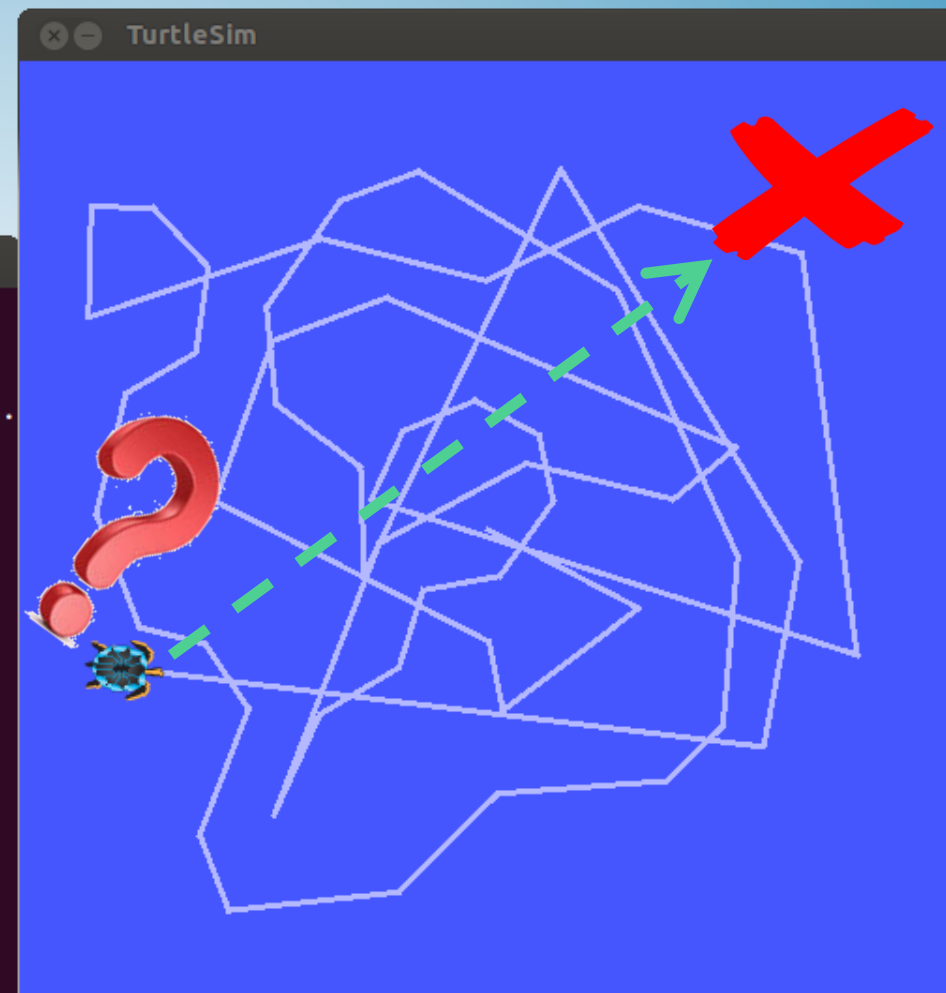
# **CIS 579 PROJECT: SELF-TAUGHT AI CONTROL**

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```
viki@c3po: ~  
viki@c3po:~$ rosrn turtlesim turtle_teleop_key  
Reading from keyboard  
-----  
Use arrow keys to move the turtle.  
█
```

- Develop an AI to get to desired x,y destination from random start position
- Have it learn the solution itself given it's current state and available actions



# BACKGROUND

- ROS Framework

- TurtleSim

- Messages

- turtlesim/Pose
    - geometry\_msgs/Twist

- Services

- turtlesim/TeleportAbsolute
  - turtlesim/SetPen
  - turtlesim/Spawn
  - turtlesim/Kill

# ALGORITHM: FEATURES

Low Level Feature	Description
<b>xt</b>	Turtle's x position from turtlesim/Pose message
<b>yt</b>	Turtle's y position from turtlesim/Pose message
<b>theta</b>	Turtle's theta position from turtlesim/Pose message
<b>xg</b>	Randomly generated x coordinate of goal
<b>yg</b>	Randomly generate y coordinate of goal

Derived Feature	Equation	Description
<b>thetag</b>	$\text{atan2}(yg - yt, xg - xt)$	Angle of the vector going from the current position to the turtle to the goal position
<b>thetad</b>	$\text{angleDiff}(\text{thetat}, \text{thetag})$	The difference between the turtle's theta and the theta it needs to be pointing in to be driving towards the goal.
<b>d</b>	$\sqrt{(xg - xt)^2 + (yg - yt)^2}$	The distance from the turtles current position to the goal

# ALGORITHM: INITIAL POLICY

- Initial Policy:

- $LinearVelocity = A \times thetad + B \times d$
- $AngularVelocity = C \times thetad + D \times d$

- Score:

- $(5.0 - distance(state.x, state.y, XG, YG))$

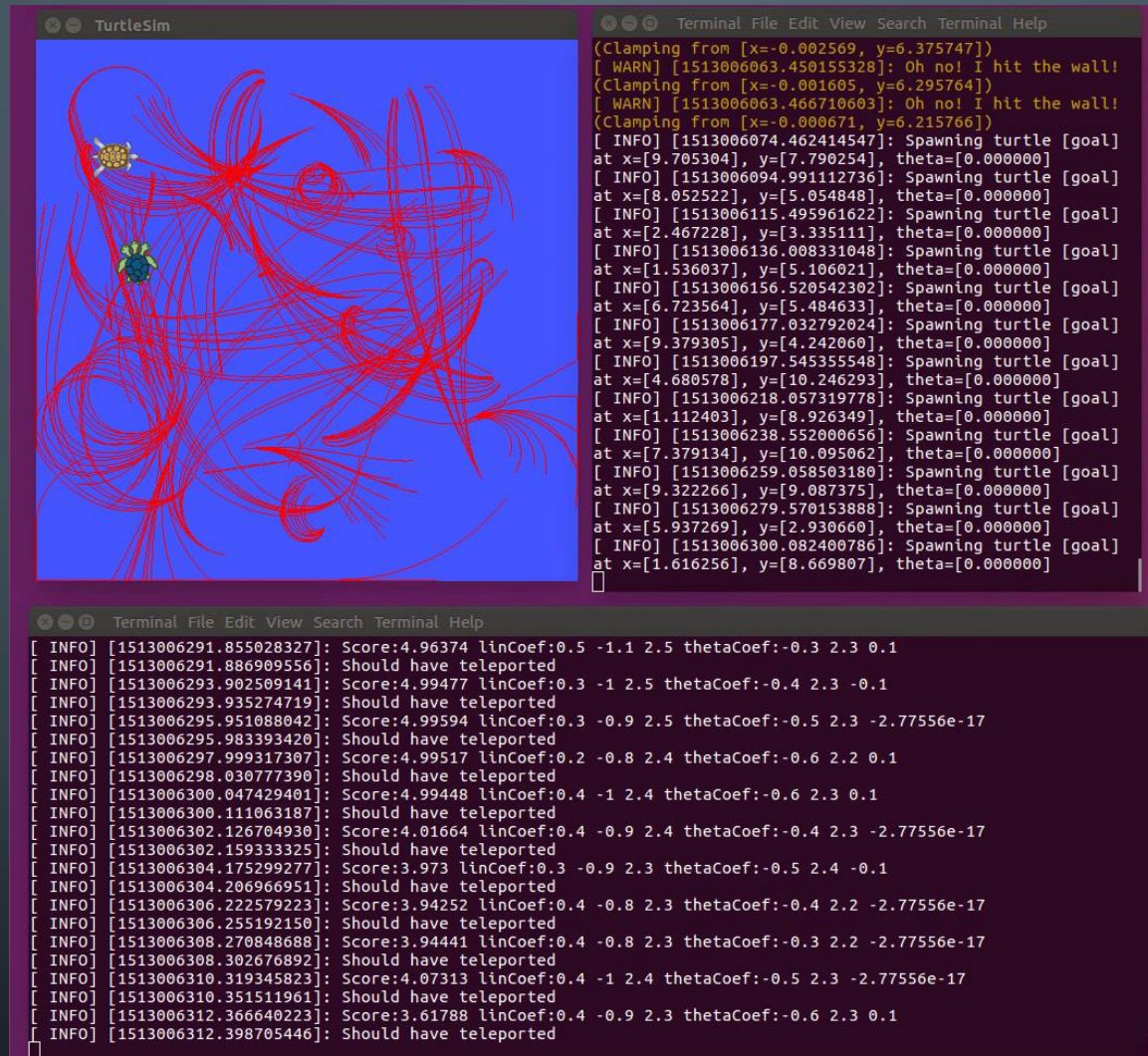
## ALGORITHM: NEW POLICY

$$\textit{LinearVelocity} = A \times \textit{abs}(\textit{thetad}) + B \times d + E$$

$$\textit{AngularVelocity} = C \times \textit{thetad} + D \times d + F$$



# RESULTS



The image displays a simulation environment (TurtleSim) and its associated terminal output. The TurtleSim window shows a blue square arena with two small robot icons (one yellow, one green) and a dense, chaotic network of red lines representing the robots' movement paths. The terminal window, titled 'Terminal File Edit View Search Terminal Help', shows two separate log outputs. The top terminal log contains messages about clamping coordinates, hitting walls, and spawning turtles with their initial positions and goals. The bottom terminal log shows a series of INFO messages for various turtle IDs, each reporting a score, linear coefficient (linCoef), and theta coefficient (thetaCoef), along with a status indicating whether they should have teleported.

```
[Clamping from [x=-0.002569, y=6.375747]]
[ WARN] [1513006063.450155328]: Oh no! I hit the wall!
[Clamping from [x=-0.001605, y=6.295764]]
[ WARN] [1513006063.466710603]: Oh no! I hit the wall!
[Clamping from [x=-0.000671, y=6.215766]]
[ INFO] [1513006074.462414547]: Spawning turtle [goal]
at x=[9.705304], y=[7.790254], theta=[0.000000]
[ INFO] [1513006094.991112736]: Spawning turtle [goal]
at x=[8.052522], y=[5.054848], theta=[0.000000]
[ INFO] [1513006115.495961622]: Spawning turtle [goal]
at x=[2.467228], y=[3.335111], theta=[0.000000]
[ INFO] [1513006136.008331048]: Spawning turtle [goal]
at x=[1.536037], y=[5.106021], theta=[0.000000]
[ INFO] [1513006156.520542302]: Spawning turtle [goal]
at x=[6.723564], y=[5.484633], theta=[0.000000]
[ INFO] [1513006177.032792024]: Spawning turtle [goal]
at x=[9.379305], y=[4.242060], theta=[0.000000]
[ INFO] [1513006197.545355548]: Spawning turtle [goal]
at x=[4.680578], y=[10.246293], theta=[0.000000]
[ INFO] [1513006218.057319778]: Spawning turtle [goal]
at x=[1.112403], y=[8.926349], theta=[0.000000]
[ INFO] [1513006238.552000656]: Spawning turtle [goal]
at x=[7.379134], y=[10.095062], theta=[0.000000]
[ INFO] [1513006259.058503180]: Spawning turtle [goal]
at x=[9.322266], y=[9.087375], theta=[0.000000]
[ INFO] [1513006279.570153888]: Spawning turtle [goal]
at x=[5.937269], y=[2.930660], theta=[0.000000]
[ INFO] [1513006300.082400786]: Spawning turtle [goal]
at x=[1.616256], y=[8.669807], theta=[0.000000]
[ INFO] [1513006291.855028327]: Score:4.96374 linCoef:0.5 -1.1 2.5 thetaCoef:-0.3 2.3 0.1
[ INFO] [1513006291.886909556]: Should have teleported
[ INFO] [1513006293.902509141]: Score:4.99477 linCoef:0.3 -1 2.5 thetaCoef:-0.4 2.3 -0.1
[ INFO] [1513006293.935274719]: Should have teleported
[ INFO] [1513006295.951088042]: Score:4.99594 linCoef:0.3 -0.9 2.5 thetaCoef:-0.5 2.3 -2.77556e-17
[ INFO] [1513006295.983393420]: Should have teleported
[ INFO] [1513006297.999317307]: Score:4.99517 linCoef:0.2 -0.8 2.4 thetaCoef:-0.6 2.2 0.1
[ INFO] [1513006298.030777390]: Should have teleported
[ INFO] [1513006300.047429401]: Score:4.99448 linCoef:0.4 -1 2.4 thetaCoef:-0.6 2.3 0.1
[ INFO] [1513006300.111063187]: Should have teleported
[ INFO] [1513006302.126704930]: Score:4.01664 linCoef:0.4 -0.9 2.4 thetaCoef:-0.4 2.3 -2.77556e-17
[ INFO] [1513006302.159333325]: Should have teleported
[ INFO] [1513006304.175299277]: Score:3.973 linCoef:0.3 -0.9 2.3 thetaCoef:-0.5 2.4 -0.1
[ INFO] [1513006304.206966951]: Should have teleported
[ INFO] [1513006306.222579223]: Score:3.94252 linCoef:0.4 -0.8 2.3 thetaCoef:-0.4 2.2 -2.77556e-17
[ INFO] [1513006306.255192150]: Should have teleported
[ INFO] [1513006308.270848688]: Score:3.94441 linCoef:0.4 -0.8 2.3 thetaCoef:-0.3 2.2 -2.77556e-17
[ INFO] [1513006308.302676892]: Should have teleported
[ INFO] [1513006310.319345823]: Score:4.07313 linCoef:0.4 -1 2.4 thetaCoef:-0.5 2.3 -2.77556e-17
[ INFO] [1513006310.351511961]: Should have teleported
[ INFO] [1513006312.366640223]: Score:3.61788 linCoef:0.4 -0.9 2.3 thetaCoef:-0.6 2.3 0.1
[ INFO] [1513006312.398705446]: Should have teleported
```

## FUTURE WORK

- Adding Time to the Reward Function
- More complicated Policies
- Single Parameter instead of random