

2-Day Introduction to Agent-Based Modelling

Day 1: Session 3

*Internal states, sets, properties, interpretation
and kinds of decision making*



Fixed vs. Reactive vs. Adaptive vs. Reflective Agents vs. ...

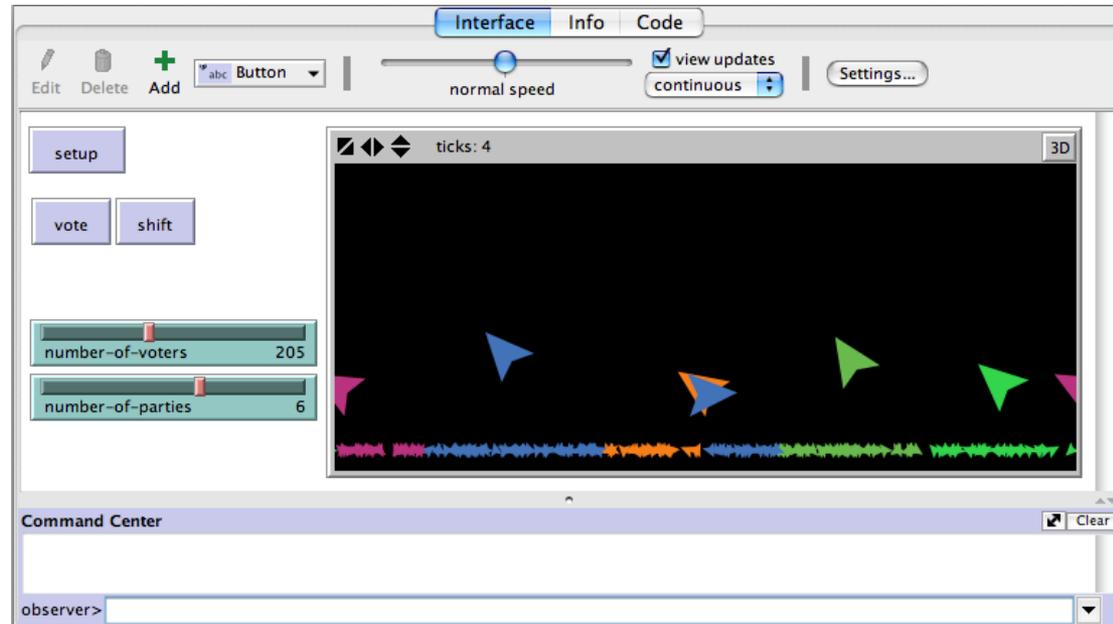
How agents control behaviour is a matter of simulator choice, e.g...

- Behaviour might be *fixed* – an engrained habit, procedure, or built-in reflex
- It might be *reactive* – a certain response is ‘triggered’ under certain circumstances
- The agent might have internal memory/states that are changed by interaction and upon which future behaviour depends – this is *adaptive* behaviour
- The agent might do something more complicated... weighing up future alternatives, solving a puzzle, reasoning about possibilities etc. – these *reflective* actions are quite complex to program

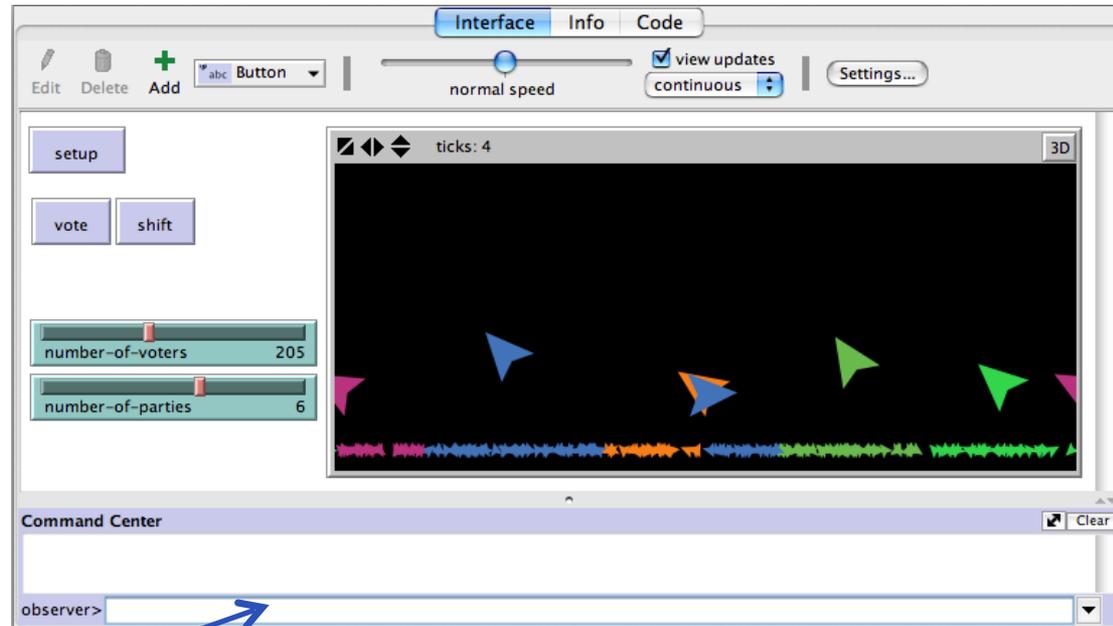
The “voter” simulation

- This is a very simple simulation where votes and parties are spread over a political spectrum – voters vote for the party nearest in position to them, parties shift position if they do not win
- Load the simulation “3-voting-begin.nlogo”
- Choose the number of voters and number of parties you want
- Initialise the simulation (“setup”)
- Then experiment with pressing the “vote” and “shift” buttons (the later causes all parties who did not win to shift their political position randomly)

Commands and Buttons



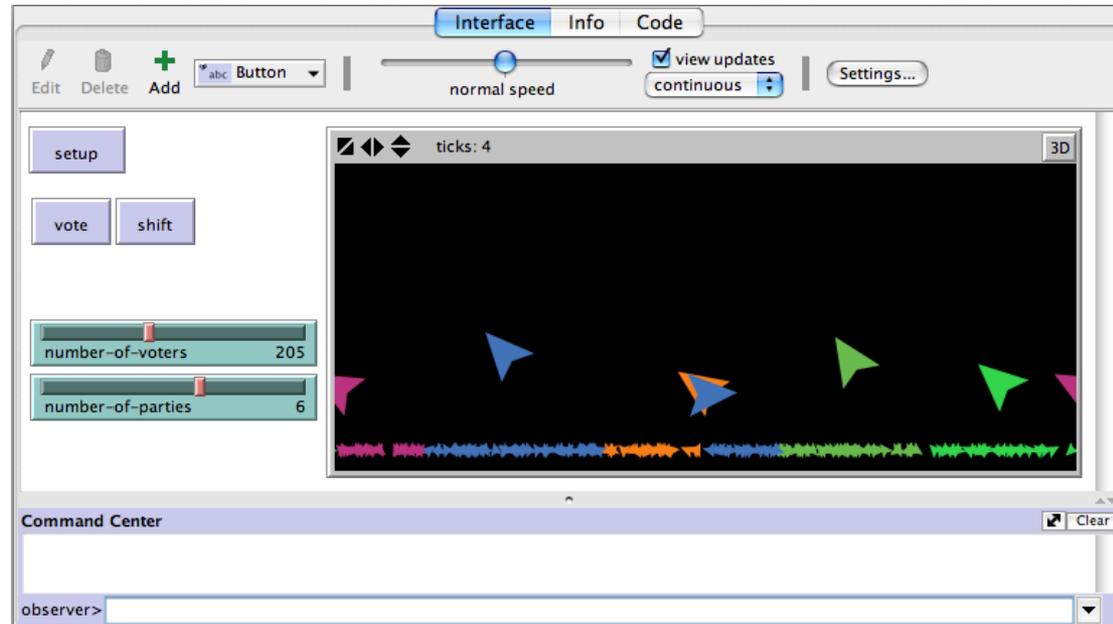
Commands and Buttons



Try typing the commands “**vote**” (followed by enter/return) or “**shift**” here

Commands and Buttons

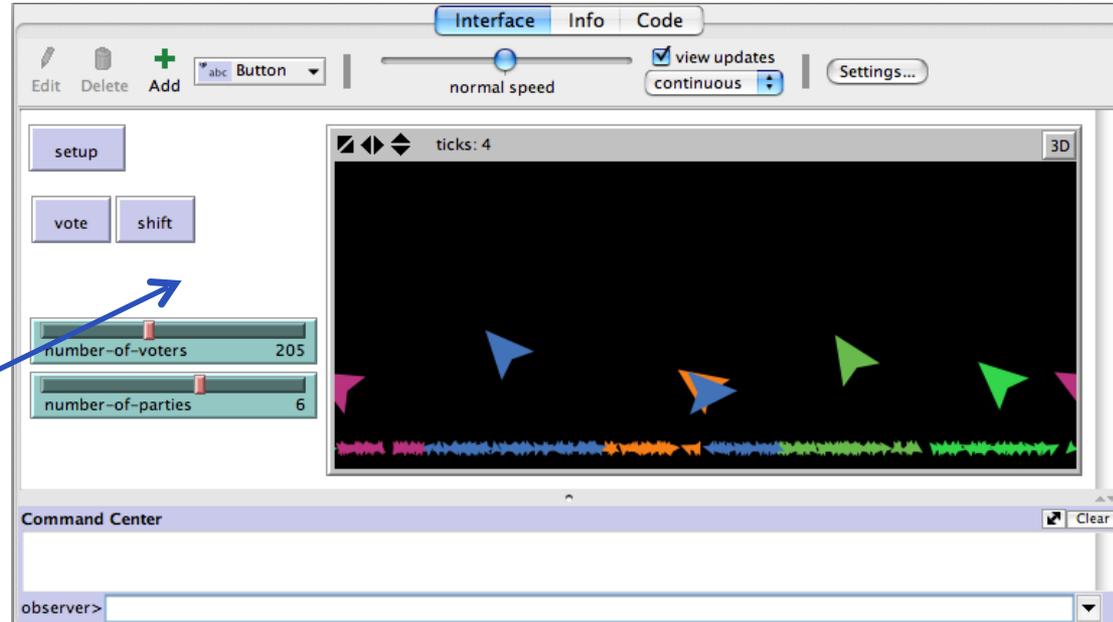
All buttons do is cause a given command to be executed when they are pressed – same as typing them in.



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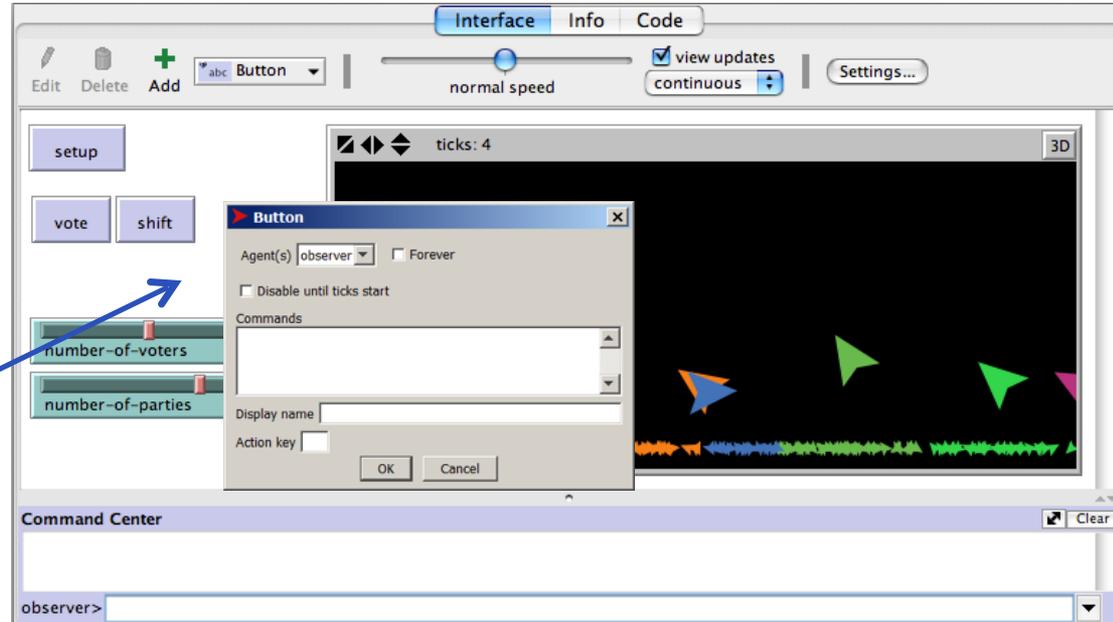
Right-Click (Mac: ctrl+click) on some empty space and choose “Button”



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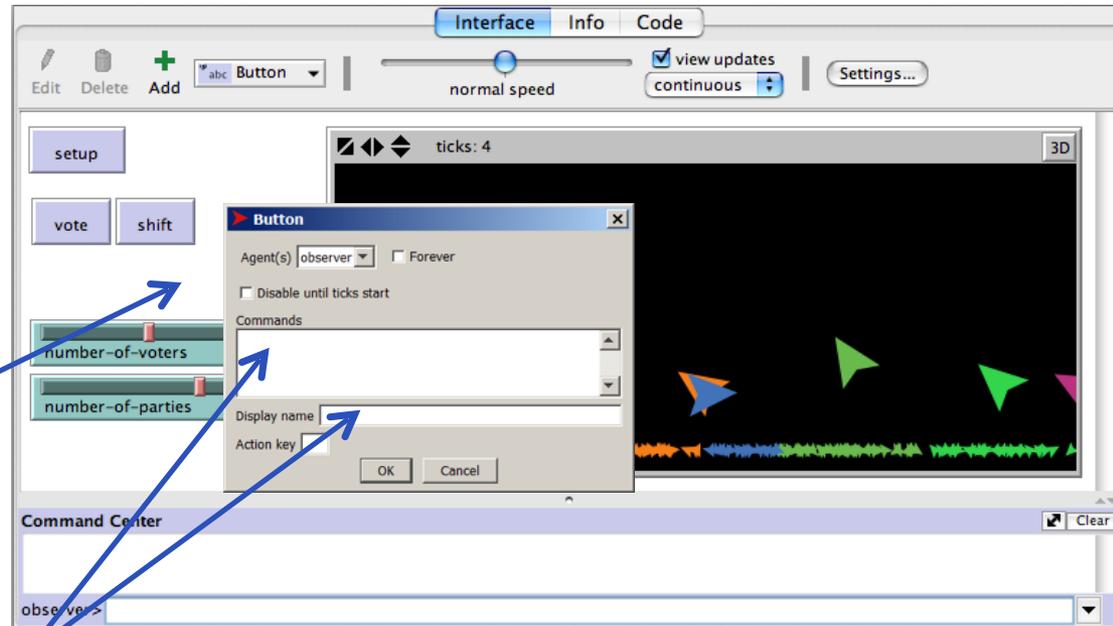


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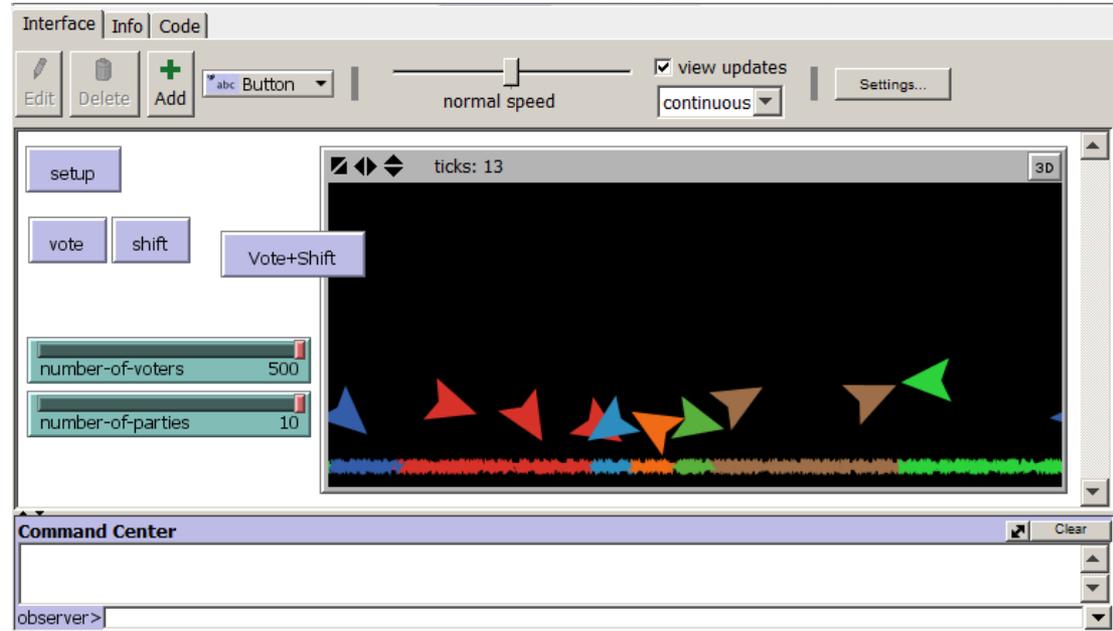
Right-Click (Mac: ctrl+click) on some empty space and choose “Button”

Type in the commands you want, in this case “**vote shift**” and the button name you want “**Vote+Shift**” then “**OK**”



Commands and Buttons

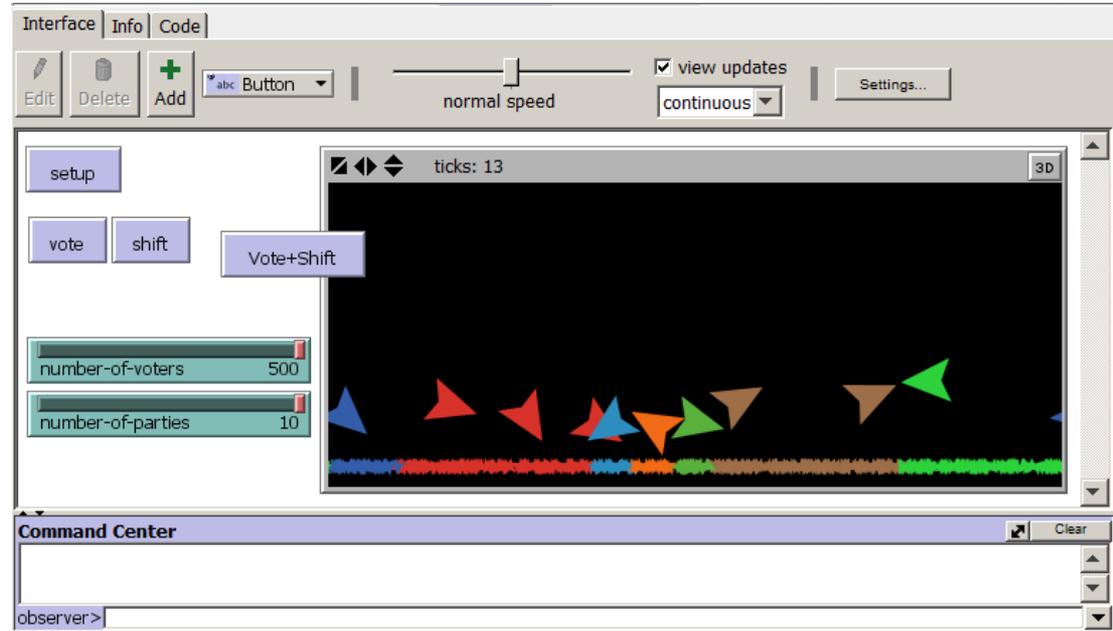
Now try your new button.



Commands and Buttons

Now try your new button.

Create a new button called
“10xVote+Shift” that does the
command
“repeat 10 [vote shift]”

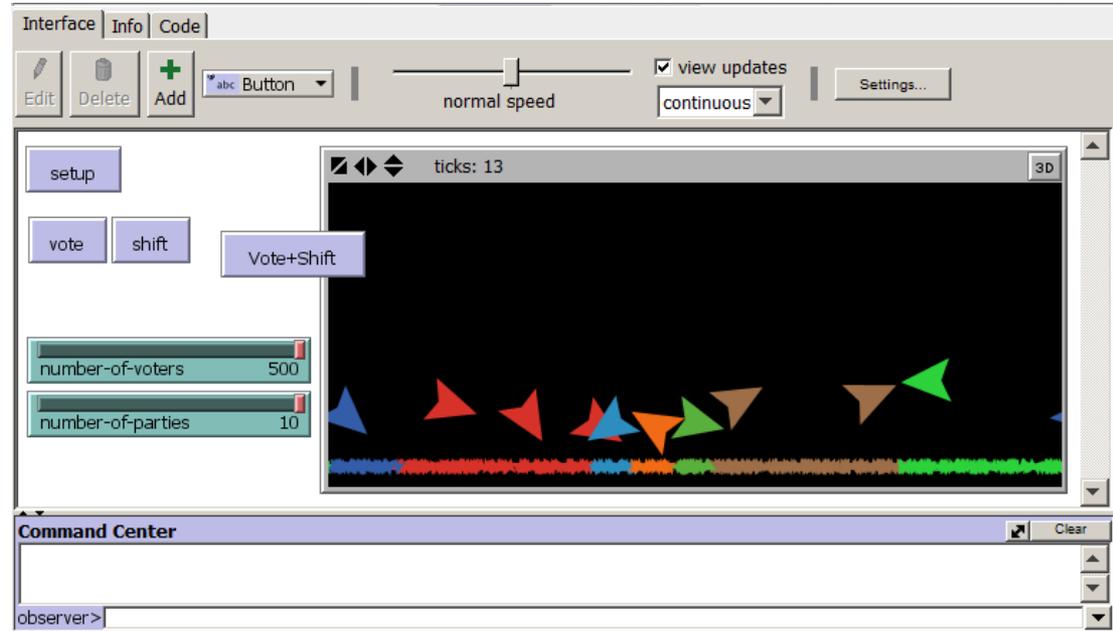


Commands and Buttons

Now try your new button.

Create a new button called “10xVote+Shift” that does the command “repeat 10 [vote shift]”

Now create a button called “go” that does the command “vote shift” but with the “forever” option selected

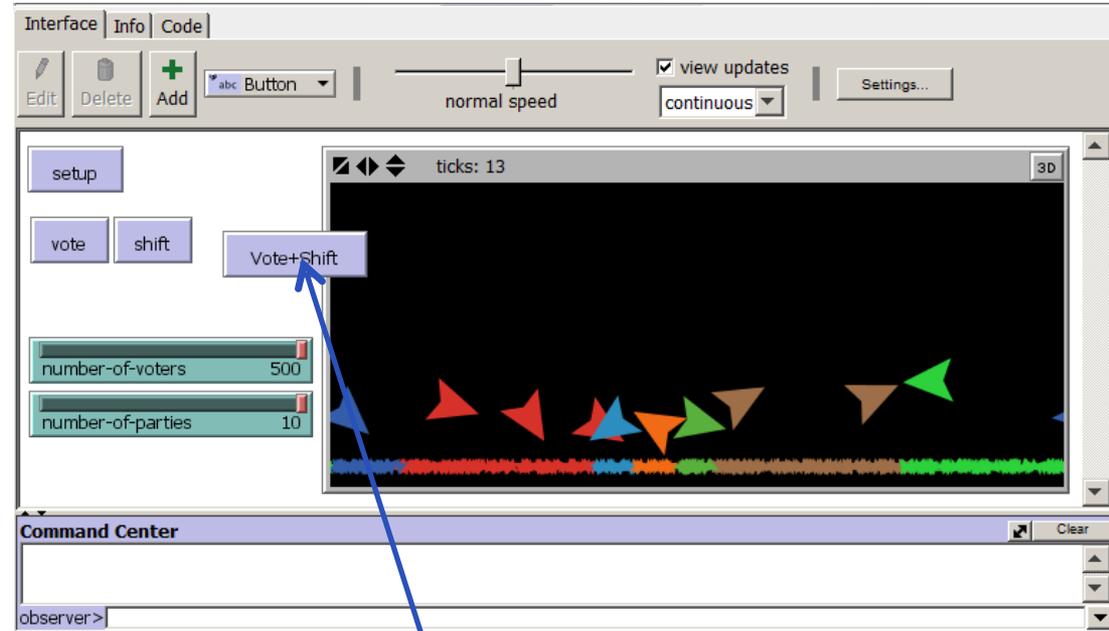


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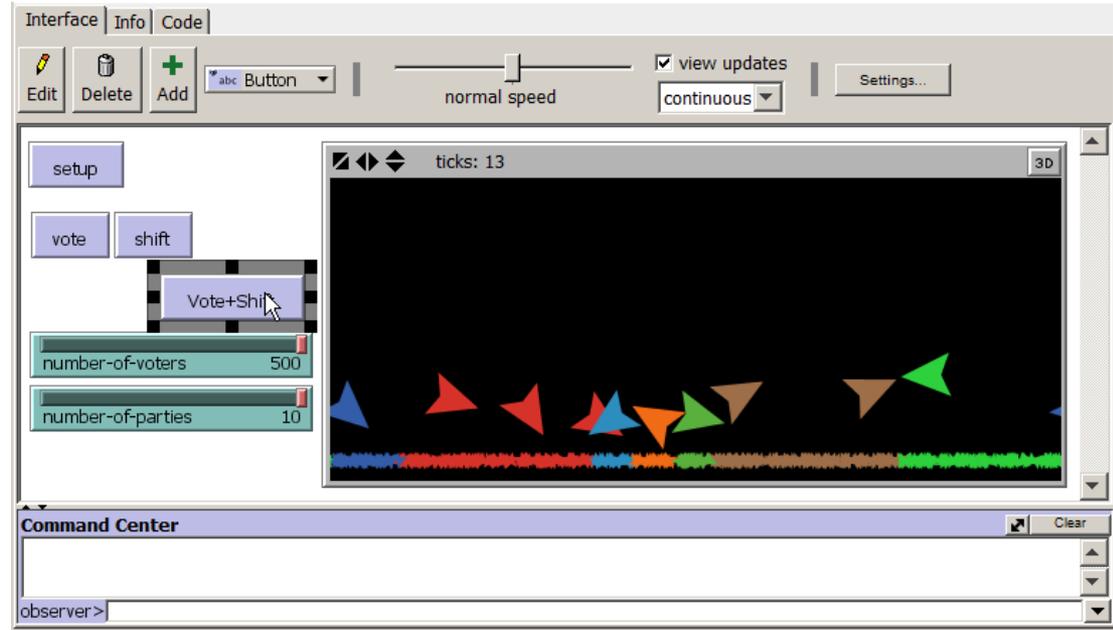
If you need to move/resize the button right-click and “Select” it then drag/adjust it

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Improving the look

- Add the command `set shape "person"` within the **update-voter-appearance** procedure
- Add the command `set color [color] of chosen-party` within the “`ask voters [...]`” within the “**go**” procedure. after the “**set chosen-party...**” command
- go back and try the simulation now
- within the **update-party-appearance** procedure add the command:
- `ifelse won?`
 - `[set shape "face happy"]`
 - `[set shape "face sad"]`
- go back and try the simulation again
- experiment with changing the code so that the size of parties depends on how many votes they got

“AgentSets” in NetLogo

One powerful facility in NetLogo is the ability to deal with sets of agents. Examples include:

- `turtles` – all agents
- `parties` – all agents of the breed “party”
- `parties with [not won?]` – the set of parties with the `won?` property set to false
- `[color] of chosen-party` – extracts the value(s) from a set of agents
- `one-of voters` – a random one from all in voters
- `max-one-of parties [votes]` – the agent in parties with the most of property: votes
- `min-one-of parties [abs (political-position - [political-position] of myself)]` – the agent in parties with the minimum value of `abs (political-position - [political-position] of myself)` in other words, the closest to its own political position

Look at the code again and see if you identify when sets of agents are used and how the code works

The category called “**Agentset**” in the NetLogo dictionary shows some of the primitives that can be used with these

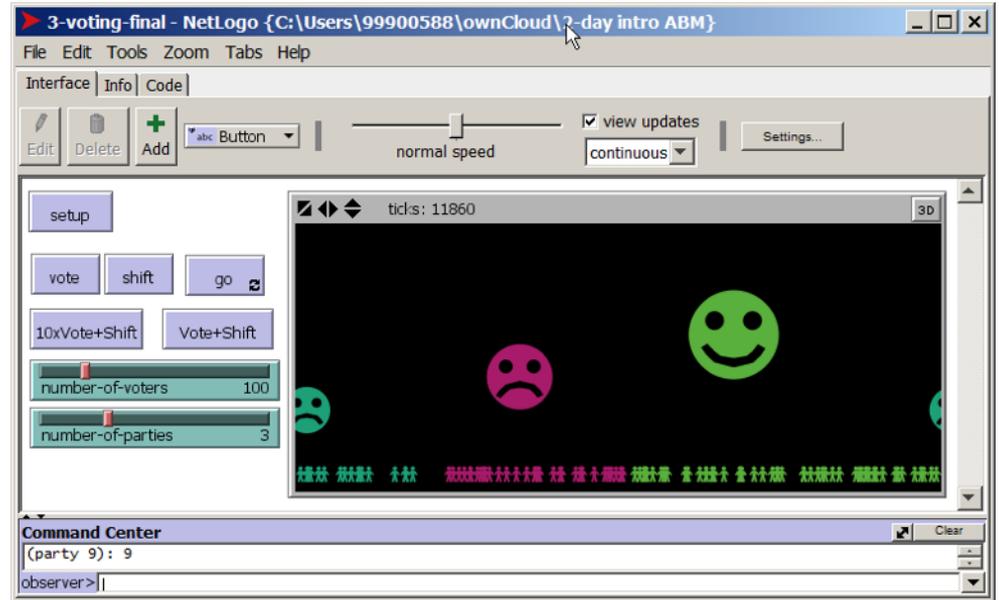
An Investigation

- Set the number of voters to 100, the number of parties to 3
- Run it quite a few times
- Observed what tends to happen, e.g.
 - How do parties in the middle fare compared to parties on the wings
 - Under what sort of conditions does a party dominate for a period of time?
 - Under what sort of conditions does power switch rapidly between parties?

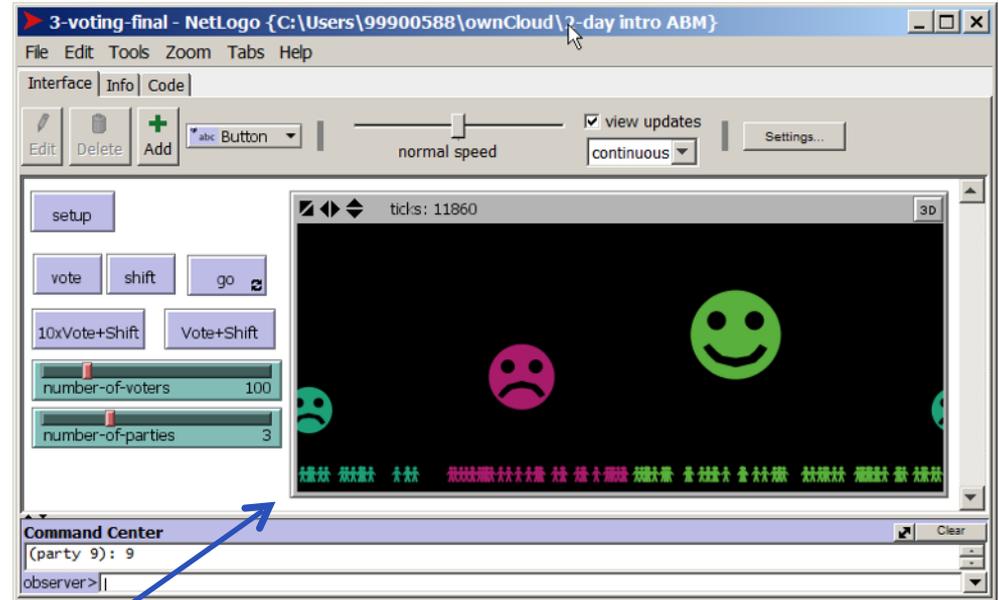
The importance of visualisations

- Due to the fact that it is (relatively) easy to create a simulation you do not understand and that...
- ...You can not rely on your intuitions and classic outputs such as aggregate measures/graphs
- Making good visualisations of what is happening is very important
- I often spend as much time on getting the visualisations of a model right as I do the original “core” programming
- And this can allow a “step change” in my understanding
- The NetLogo “world view” is ideal for this

Adding a graph

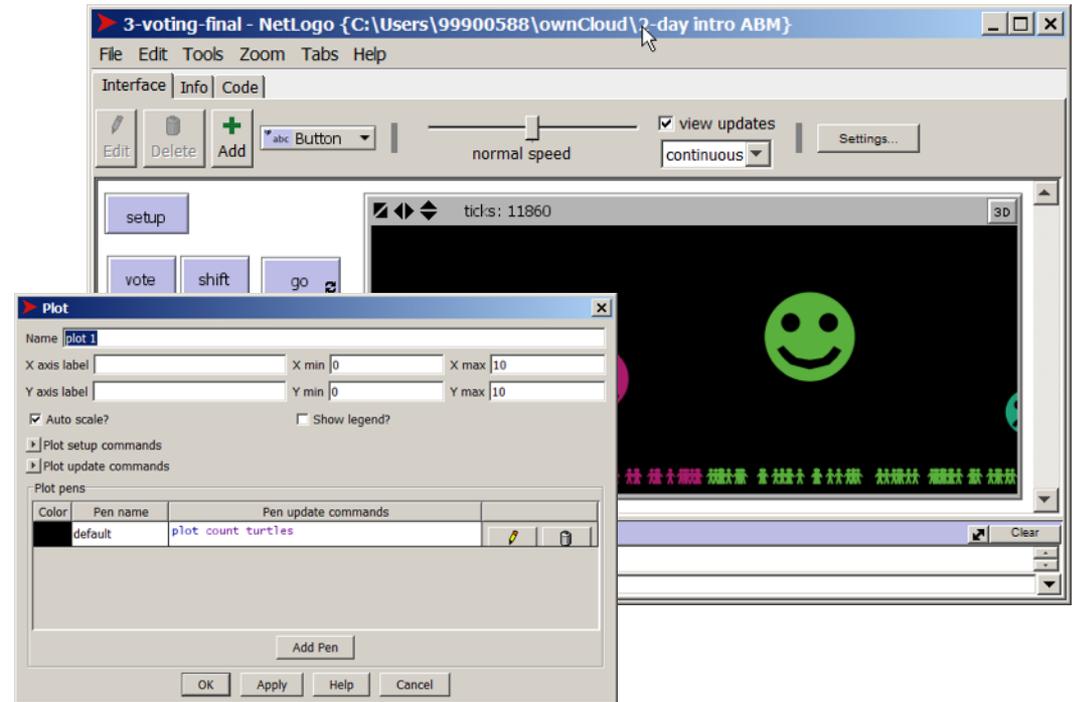


Adding a graph

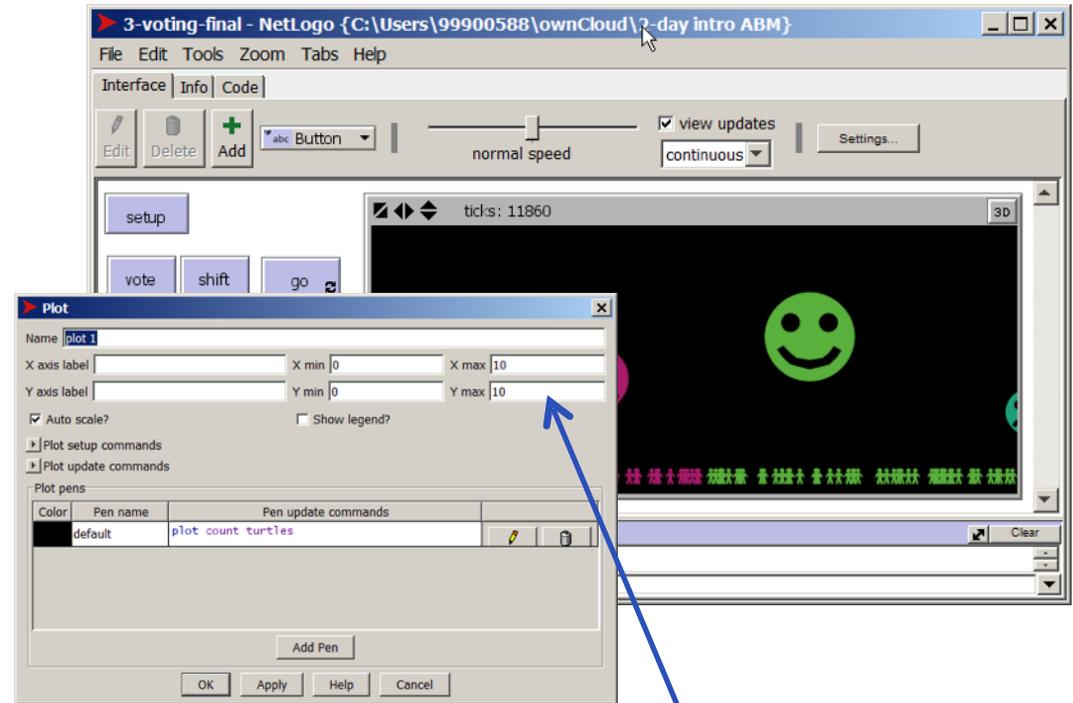


Right-Click (Mac: ctrl+click)
on some empty space near
the bottom and choose
“Plot”

Adding a graph



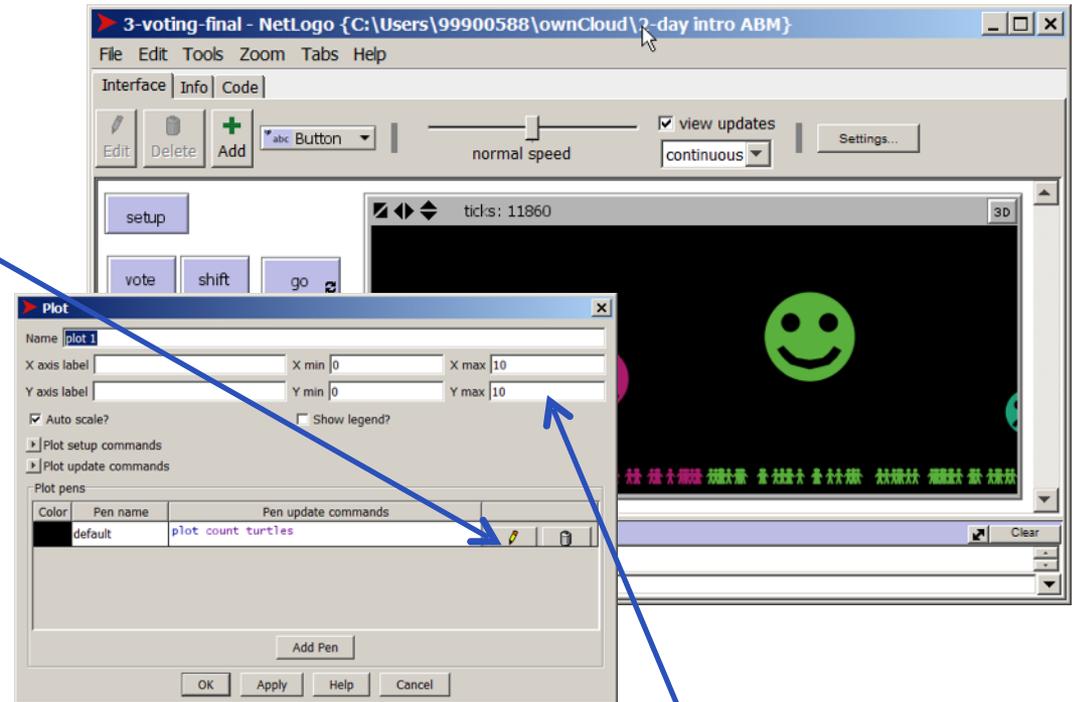
Adding a graph



Change the Y max value to "1"

Adding a graph

Replace the
“plot count turtles”
command there with:
plot [political-position] of
max-one-of parties [votes]
then “OK”

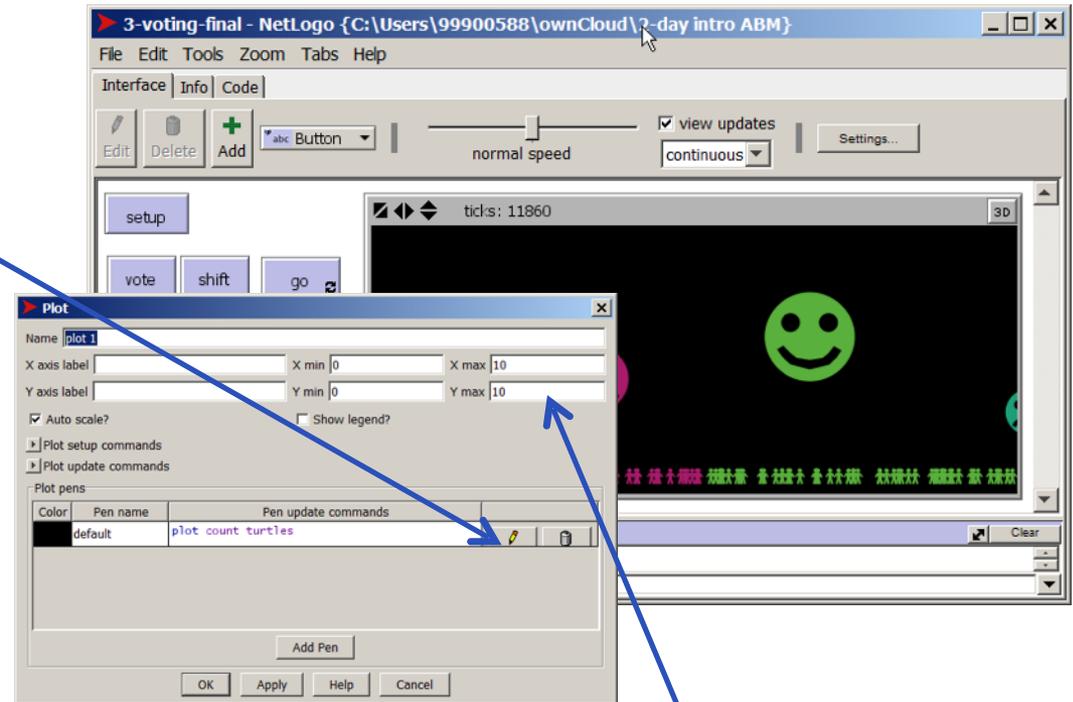


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Replace the
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plot [political-position] of
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then “OK”

In other words to plot the
political position of the
winning party



Change the Y max value to “1”

Adding a graph

The screenshot shows the NetLogo interface for a simulation titled "3-voting-final". The window title is "3-voting-final - NetLogo { C:\Users\99900588\ownCloud\2-day intro ABM }". The interface includes a menu bar (File, Edit, Tools, Zoom, Tabs, Help) and a toolbar with buttons for Edit, Delete, and Add. A speed slider is set to "normal speed", and there are checkboxes for "view updates" (checked) and a dropdown menu set to "continuous". A "Settings..." button is also present.

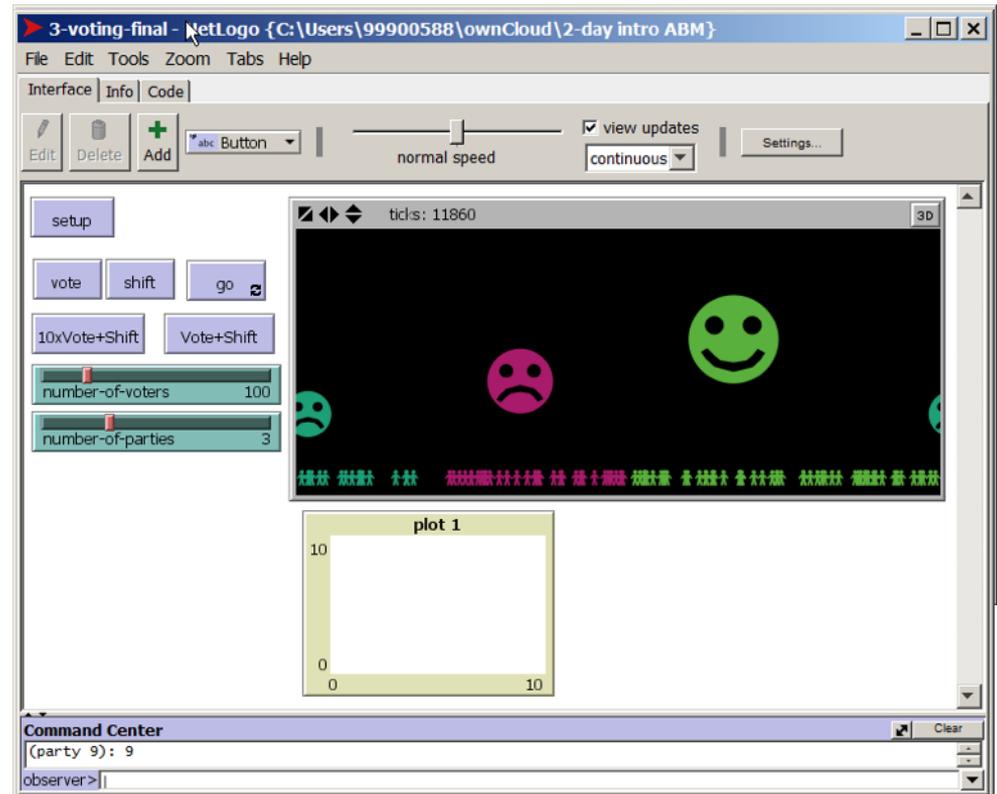
The main workspace contains a "setup" button and several action buttons: "vote", "shift", "go", "10xVote+Shift", and "Vote+Shift". Below these are two sliders: "number-of-voters" set to 100 and "number-of-parties" set to 3.

The central display area shows a 3D view of a simulation with a black background. It features three smiley faces: a green one on the left, a pink one in the center, and a green one on the right. Below the faces is a horizontal bar chart with green and pink segments. The top right of the display area shows "ticks: 11860" and a "3D" button.

Below the main display is a "plot 1" area, which is currently empty. The plot has a vertical axis labeled "0" and "10" and a horizontal axis labeled "0" and "10".

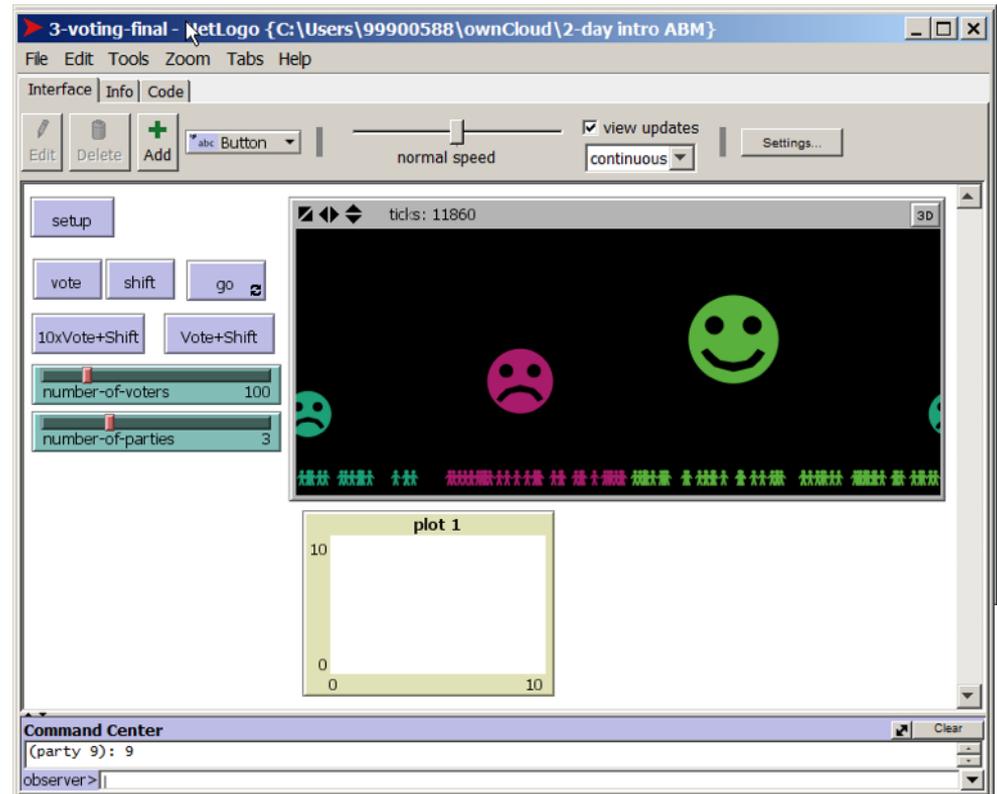
At the bottom is a "Command Center" with a "Clear" button. The text "(party 9): 9" is displayed, and the prompt "observer>" is visible.

Adding a graph



If necessary, expand the NetLogo window to see the new plot window

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Now re-run the simulation looking the political position of the ruling party

Discussion – Interpreting an ABM



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- Simulations (indeed any model) is meaningless without *some* interpretation of what things are meant to stand for to guide model development and investigation
- *How do **you** interpret your observations of the model with 100 voters and 3 parties?*
- The questions:
 - How meaningful is the simulation?
 - How empirically realistic is the simulation?

Discussion – Interpreting an ABM

- Simulations (indeed any model) is meaningless without *some* interpretation of what things are meant to stand for to guide model development and investigation
- *How do **you** interpret your observations of the model with 100 voters and 3 parties?*
- The questions:
 - How meaningful is the simulation?
 - How empirically realistic is the simulation?
- Are not *quite* the same!

A change to the simulation setup

- In the setup procedure, where voters are created, change the command `set political-position random-float 1` to: `set political-position random-normal 0.5 0.15`
- This changes the initial distribution of voters from a uniform one to a normal distribution
- Go back and re-investigate the behaviour of the simulation with this setup
- How much does it change the results? Just a bit? Qualitatively different?

Other things to try

- Does changing the initial distribution of parties on the political spectrum change the behaviour of the simulation
- Can you try to change how the political parties adapt to losing?
- Can you add a rule so that voters change their political position as well?
- Can you change the simulation so that all parties somewhat adjust between elections but after an election there is a bigger or different shift?

Randomness!

- It is very tempting when some process is either complex or unknown to chuck in a random choice
- But this is as much a definite choice with consequences as any other and should be used with **caution!**
- It is OK when...
 - this is just a temporary ‘stub’ which will be replaced later (but then this needs to be declared if it is left in)
 - One just needs a variety of behaviours for exploratory/testing purposes (but then if you are publishing the results you have a different purpose)
 - One knows the behaviour IS random (check the evidence that this is so)
 - One is pretty sure that the behaviour is irrelevant to the outcome one is looking at (run the model with different kinds of behaviour and check it makes no difference)
- But otherwise it might be better to replace it with something more definite or more realistic

The End

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<http://cfpm.org/simulationcourse>

