Preparatory Problems: Computing
Running Pong in Scratch

Gábor Csányi, Simon Guest

Version 1, March 2014

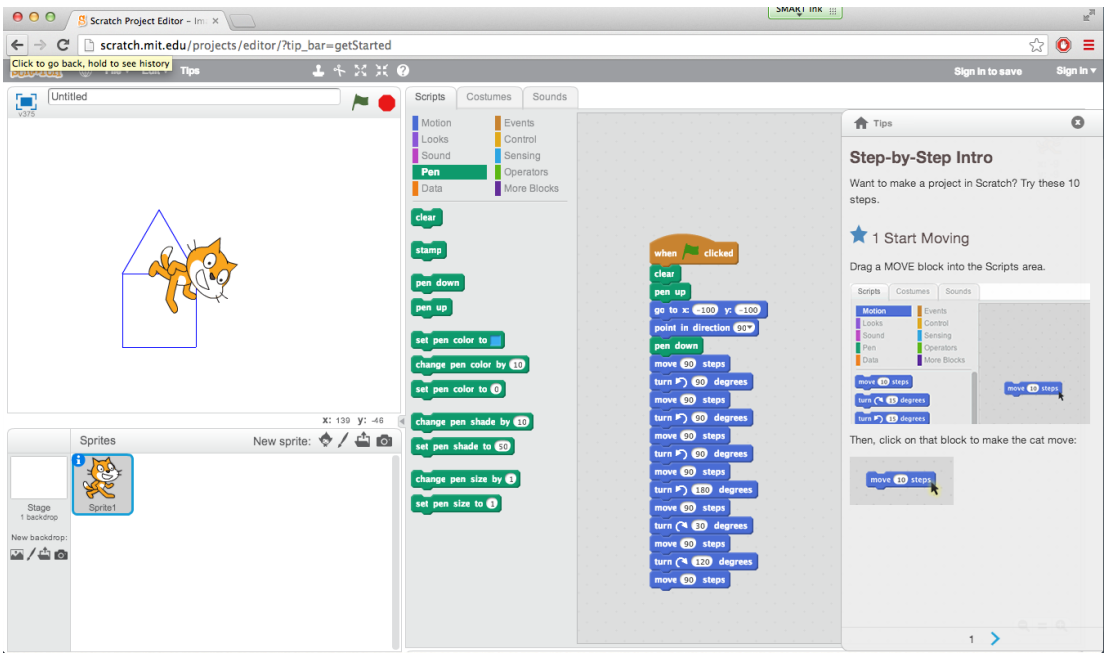
This exercise is designed to introduce you to simple programming — many engineering tasks can best be accomplished by programming a computer, and we hope that this will become second nature to you. The preliminary exercise is designed in 'Scratch' for those who have no prior programming experience. You will need a personal computer to complete this exercise. You can create and use Scratch programs online at `http://scratch.mit.edu`, but it might be more comfortable to download the Scratch application onto your own computer.

Scratch is a graphical environment in which objects (called 'sprites', the default one looks like a cat) can be programmed to move around on a canvas and do things like draw lines as they move, say things through the speaker, and interact with one another.

Task 1: Moving and drawing (45 minutes)

Drag single instructions onto the program panel of the default sprite, and play around, making it do various things (note the 'tips' button, which gives a 'Getting Started' guide and other help).

Explore motion control and pen control. Use the 'repeat' block (in the Control pane) to draw a circle when the green flag is pressed.



Task 2: Pong (1 hour)

Delete the cat, and create a new ball sprite (editing the 'costume' to be a disk). Start the ball off in a random direction (drag a random number generator from the Operators pane into the ellipse containing a number in the 'point in direction' block), and make it move in a straight line. Make the ball bounce repeatedly around the screen (use the 'if on edge, bounce' instruction to keep the ball moving).

Observe the values of variables like 'position' by ticking the corresponding tick box on the Motion pane.

Create another sprite, a paddle, to be a thin horizontal rectangle. Place it towards the bottom of the screen. Make the paddle move left and right by a small amount when you press the keys 'z' and 'x'.

Detect if the ball touches the paddle, using an 'if' block based on a decision from the Sensing panel, and play a sound. Now make the ball bounce off the panel (hint: use the 'direction' variable for the ball, along with the operations in the Operators pane).

Task 3: Further enhancements

After you have a basic Pong game working, here are extra things you could do. Each is independent of the others.

- Create a variable to keep the score. New variables can be created and accessed on the Data pane. Stop the game if the ball gets below the paddle.
- Create an additional sprite to serve as an opposing paddle so that you can play a two-player game.
- Instead of moving the ball in straight lines in between bounces, add gravity. For this, you will need to create a new pair of variables to store the horizontal and vertical velocity of the ball. At each time step, change the vertical velocity by adding a small amount of acceleration as a result of Newton's Law, and then update the horizontal and vertical positions using the values of the current velocity variables.

Acknowledgements

Preparatory programming for the Engineering Tripos is supported by Boeing.