CMPS 10 Lecture Notes: Lecture 3 (1-12-2016)

SNAP Segment

Pardis will upload video of her SNAP tutorials, which is likely going to be a better resource than these written notes. That said, we'll try to make these notes as helpful as possible!

- Things We'll be covering
  - Custom Blocks
  - Reporters
  - Pen Coloring
  - Multiple Sprites
- Our next assignment: making a kaleidoscope

How To Access SNAP

- Open Chrome
- Look for "snap! Berkeley" in google
- Go to the website, click on "run snap now¡' button at the bottom.
  - **FIRST THING TO DO:** Sign up/log in to an account by clicking on the cloud button.
  - You can then save your project and give it a name. Then you can close it and open it again later to work on it more.

Basic Programming

- To Program, drag blocks from the palette on the left to the big area in the middle.
- A Good starting point is to click on the motion button in the upper left, and then drag over the Move 10 block.
- Clicking on the block will make it happen!
  - You can right click on a block to open up a context menu to duplicate it for convenience!
  - **In the lab computers, we discovered you need to hold "control" when you right click to make the menu pop up.**
- If you want something to happen many times, use the "forever" block in the Control category of blocks.
- Here is a common point of confusion:
  - Some blocks *seem* the same, like in the Looks category there is Say Hello for 2 secs and Say Hello.
  - When you don't specify a time, it shows up so and then disappears so fast it seems like it never even appears. So it is recommended to use the one that specifies a time.

Custom Blocks

- In future assignments, you will be asked to create custom blocks
- As you notice, in Snap, let's say you want to create a square, you don't have something that says "square" so you have to create it on your own.
- But we can build it up ourselves! A square is just a move forward, and then a 90 degree turn, repeated four times!
- BUT we need more than just moving 10 steps and turning 90 degrees
  - If we want to draw something, we need to actually include a line that says "pen down" (can be found in the Pen section).
- By right clicking on the work area, you can choose"make a block"
- you specify what category you want your block to be, let's call it a motion command, and we can give it a name (e.g. square)
  - And then you grab code from your work area and drag it into the little window that has popped up to define the command.

  - And THEN to actually USE the command you have to FIND it again in the category that you specified it. So, for us, it would be in the motion category
- and to clear the canvas, under Pen category (green) there is a clear command, that will clean the canvas.

Custom Blocks with inputs

- But we need to create a capability to be able to specify how big we want the square to be!
- How do we create a custom block with an INPUT!?!
- Currently custom block does not get any input. It just statically creates a square size of a specific size.
- So let‘s make a square that is more flexible.
- You can click on a little PLUS (in the custom block editor) that is attached to the blue block in it, and give it a variable (call it size for now)
  - And now it accepts a parameter!
  - But how to actually USE that variable?
  - You just duplicate the word size, and drag it down to where you want to use that number.

Re-using custom blocks

- So let‘s say that in project one, you create a custom block, and then later on you want to use custom blocks that you‘ve already created in later assignments.
- One way of doing it is to EXPORT blocks!
- You do that by doing the Export Blocks option (click on the page button next to the cloud button) and it saves it as an xml.
- And so in general in this class, when you turn things in, you are going to export them as xml and turn in that file.
- And then in later projects, you can then use ‘import‘ to bring in a block!

- Now we are going to talk about the coordinate system. You remember high school, where you have the Cartesian coordinate system.
- But from one programming language to another, this all changes!
- But not in snap! It is easy, the same as high school! Middle is 0,0.
- To help visualize this, there is a tool under the motion category that lets you know what the ‘x‘ position and ‘y‘ position are.

How to make sprite follow your mouse?

- First thing that comes to mind is to have sprite follow x and y coordinate of the mouse?
- we go to the SENSING category (light blue) and you can drag “mouse x and Mouse y“ to the Go To commands.
- But if you do that, you do not see see anything get drawn. if you want to see something, you STILL NEED TO PUT YOUR PEN DOWN.
- And if you want the sprite to follow you all the time, you need to put the move command in a forever loop. (don’t need to put the pen down command there, though. That only needs to happen once, outside of the forever block).
- But what if what you want to do is make it so that it is drawing TWO lines at once!
  - You can duplicate sprites by right clicking on the sprite in the lower right and choosing duplicate sprite.
  - Each sprite has its own set of blocks attached to it. This means you can give different commands to different sprites.
  - If you want a sprite to move to the negative of the mouse position, you’ll need to use a block from the operator command, and either subtract the value from 0 (e.g. 0 - mouseX) or multiply it by -1.

Event Handling

- It‘s a pain that every time you want to clean your board you have to find ‘clear‘ and click on it.
- It would be nice if there was a way to be constantly listening for something, say a keypress, and then clear on that.
- Let‘s say that thing you are listening for is a click. Then clicking would your canvas gets clean.
- You can do that by adding a ‘when I am clicked‘ control block to the program, and add clear after it.

Turning in your Assignment

- But first, let‘s say the project is done and you are ready for it to be turned in. You export it, which saves it as xml, and that is what you turn in
- If you don‘t submit as XML you receive a 0
- Full credit is 10.
- Make sure all four sprites start from the same point

Break

Communicating in 1s and 0s

- So how many people think the class is harder than they were anticipating?
  - No hands. So no one has been scared off yet.
- Last time we talked a little bit about secret communications.
  - And we had an example with a sender that may want to send some binary string (a sequence of 1s and 0s) that we called a “MESSAGE“
  - And then they did something to the message to come up with a RANDOM string that they actually send to the receiver, and so on.
- So, a Message is a sequence of 1s and 0s.
- But today, we will spend a bit of time on the idea that this is UNIVERSAL
- the idea that any time anybody wants to send anything to anyone else, it can be sent as a sequence of 0s and 1s.
- The point being driven at: the notion of information is actually quantifiable.
- The class was asked for an informal definition of information. What does it mean to give someone information. To relay knowledge that you did not know previously? But then what is knowledge? Something you learn? Okay, so what does that mean then?
- Let us say that the DOW Jones will be UP tomorrow. What does it mean to KNOW this to be true?
- Claim is: before we said anything, there were two possible worlds. One where stock market goes up, one where stock market goes down.
- In our internal model of the world, both of them were valid possibilities. And not only were they valid, they were equally likely (we won‘t formally define that for now, save it for later), but if they WEREN‘T equally likely in our minds, then why even bother taking the class, we should go get rich in the stocks!
- BUT, they were equally likely in mind, until the teacher tells us what will happen
- And so now the set of all possible worlds is REDUCED. THE WORLD WHERE THE STOCK MARKET GOES DOWN no longer exists. The world in which we live in is the one where the stock market goes up.
  - This is the one and only definition of information that we need and it is Universal!
  - That is, **information is that which causes the reduction of uncertainty.**
  - And one way to think about the reduction of uncertainty is “there exists a set of possible worlds. To give you information is to make the set of possible worlds a smaller set. A set containing fewer elements.“
    - Refresher on sets.
    - A set is something you can think of as a bag, and it contains objects.
    - In our example, the set of possibilities contains two elements, the “up“ possibility and the “down“ possibility.
    - That is the set that contains the possible worlds of our mental state with respect to what the Dow Jones will do tomorrow.
    - But what teacher did was say, ACTUALLY, the true set of possibilities only contains the ‘up‘ possibility. In other words, the stock market tomorrow will go up.
    - **So the claim is: information is that which reduces the set of possibilities.**

So Just How Universal is This?

- Claim: a slower way to teach class is for teacher to stop talking and just raise his hands. Lift either left hand or right hand.

  - It would be slow, but it would be everything.
  - Let‘s make it obvious to the whole class. (we‘ll cheat a little bit but not in a significant way.)
  - First cheat: assume that everything we receive in lecture is equivalent of receiving a TRANSCRIPT of the lecture (so any dramatic flair or anything other than the literal words spoken gets thrown out).
  - Let‘s say that there are 26 letters of English language, and 6 symbols of punctuation: questionMark, exclamation point, comma, space, semi-colon, and period. (so we are at 32 symbols total)
  - Transcript of lecture is made up of this alphabet of 32 letters.
  - We can assign a number to each symbol in our alphabet (A is 1, B is 2, C is 3, ? is 27, ! is 28, comma is 29 period is 30 space is 31 semicolon is 32.
  - so “JUST THE“ would be So to say JUST THE that would translate to 10 21 19 20 31 20 08 05
  - Note that we need to be careful when saying letters with a value less than 10: we say 08 instead of just 8. Now there is no ambiguity. You decode two digits at a time, and you know each of those corresponds to exactly one symbol in the alphabet.
  - **THIS WILL BE ON THE TEST.**

- So observe, we‘ve already made some progress! At least we‘ve gone from natural language down to numbers.
- But the teacher had made an even stronger claim. How can we translate these numbers into the hand gestures?
- We can all agree, if we come up with 32 hand gesture sequences, one that each corresponds to a symbol, then we are set.
- (Note we are cheating a little bit. We are not only relying on the hands, but we are ALSO relying on timing, implicitly. We would like to eliminate that crutch on time. AND we‘d like to introduce further efficiency. And we can achieve this by using both hands.
  - We then draw a tree structure. There is one vertex (one dot) at the top. Our tree will have a branching factor of two, which means that each vertex will have two branches leading to one new vertex each. So the first level has 1 vertex, the second level will have 2 vertices, the next will have 4, then 8, then 16, then 32. We see that it doubles at each level, because each element gives rise to two elements in the layer beneath it.
  - For each branch, we can call one of them the “Left“ branch, and the other one the “Right“ branch.
  - The bottom layer vertices are called leaves. We have 32 of them. We can assign one of the symbols from our alphabet to each one.
  - And note that it does not have to be in alphabetical order here! It can be totally arbitrary!
  - In order to understand the “hand only“ lecture, the idea is that this tree is known to us before hand. It is on the syllabus or website or wherever. The point is that we know it by heart.

- **First day of class, teacher wants to say something to us. That sentence has a first word. That word has a first letter.**
- By doing the hand gestures, we go down the branches of the tree.
  - When he raises his left hand, it manes he takes the left branch. So if he raises left hand twice, you take the left branch twice.
  - And so you raise your hand 5 times, (2 left, 3 right) and teacher knows (and you know) that you just said the letter C (in the example that was on the board).
  - AND you don‘t have to do anything special with timing or anything, because you know that every letter has exactly 5 hands associated with it (just like how before, every number had two digits associated with it)
  - And also observe that there is no timing information. We can pause and it doesn‘t mean anything. We don‘t have to rely that much on visual acumen, time is out of the equation.
  - And there is nothing sacred about hand raising. It could be knocking on something, one knock for left, two knocks for right (though this brings timing in again). It could be winking. Or lifting legs.
  - ALL that matters is that there are two distinct states, and you can distinguish between the two of them.
  - Remember: Information is that which causes the reduction of uncertainty. So first day of class comes, teacher is about to say the first word, that first word has a first letter. In principle, that would could start with ANY ONE of the 32 symbols (or, at least one of the 26 symbols that represent the english alphabet. But still, 26 possibilities at least!)
  - At first, we don‘t know what the first letter of the first word of the first lecture is.
  - But by him raising his hand ONCE, it cuts the possibility space in half, because we took a branch down the tree. And when he raises it again, it splits in half again. and again. Eventually it goes down to just a single possibility. And that is when you KNOW what that first letter will be.

  - As we said before, we reduced the set of possibilities down to 1.

- And so, let‘s pretend that instead of Left and Right, we just call that 0 and 1.
  - And that‘s it. There is nothing else. One more time: **there is nothing else**.
  - So let‘s say that there is a sequence of abstractions.
  - So teacher raises hands a bunch (so that‘s 10110 for example)
  - You take five of those, and then move to the next level of representation. (0s and 1s go to letters).
  - So from sequences of symbols in the set of letters, you go to words (letters go to words)
  - And then finally, from words we go to MEANING. but we aren‘t going to touch meaning in this class.
  - Because as far as teacher is concerned, we are all zombies, and he has no way of knowing if we are understanding it (although there does exist some evidence to the contrary)
  - So where does the teacher get off from thinking that by making air molecules move around, teacher is making chemical reactions in our brain.
  - There are chemical reactions in our brain that translate to desire that translate to language that translate to phonemes that translate to muscle movement that translate to changing air to going in your ear drum to rubbing against the hair in your ear drum. So the air mechncailly moves the hair in our hair which chances the conductivity of the ION CHANNEL at the bottom of the hair in your ear. That makes electrons that go into your brain.
  - That‘s PRETTY CRAZY. We are relying on air molecules to transmit information.
  - But that‘s exactly what‘s happening, at least as far as we know.
  - Teacher can say the exact same thing in a different language. So we use different phonemes, but the IDEA at least is the same.

So one last example.

- We might think that this is fine, we have the transcript.
- But what about the video? What if you want to see it.
  - But the truth is, even though it SEEMS like we are seeing things in continuous time, it is actually the case that our brain is just constantly taking pictures, and not at a particularly high rate. Claim that you can show 24 frames per second is enough. In real life, we are seeing things in continuous time.
  - Our brain is not smart enough to understand that its not smart enough.
  - So, if we wanted to give us video, Then it is enough to just give us a series of static images. So a series of pictures.
  - And we agree that if he gives us photographs, then we are good to go, it will FEEL like a continuous movie to us (and, of course, movies do this exact thing too).
- Retina display of Apple
  - In addition to not being very smart, humans also don‘t have very good vision.
  - So, if we take a scene, and divide it up into little squares, little pieces, and give us 65536 colors on a spectrum, with absolute white on one end and absolute black on the other. (in reality there is an infinite number of colors, but this should be enough – for every colors they are assigned a single number between 1 and 65536).
  - If the number of cells is big enough, you would not be able to distinguish this from what you normally see. And that number is not even all that crazy big. For example, 4,000 by 4,000 is more than enough, which is a grid of 16 million pixels.
  - so if we have a sequence of 16 million numbers, each of which is in the range of our color specturm, then we would not be able to tell the difference between that and real life.
  - if our Alphabet Tree went down 16 levels, that would be enough! 16 hand movements would get us one pixel!! So if we do that 16 million times we get one picture. And if can do THAT 24 times a second, THEN we have achieved the equivalent of a video!