Knoxcraft: Teaching introductory computer science with Minecraft

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tl;dr

- Knoxcraft is a free, open-source, Minecraft-based **3-D turtles program**
- **Multiple languages**: Java, Python, with other language support included
- It has a **visualization tool**
- Spin up your own **server** today!

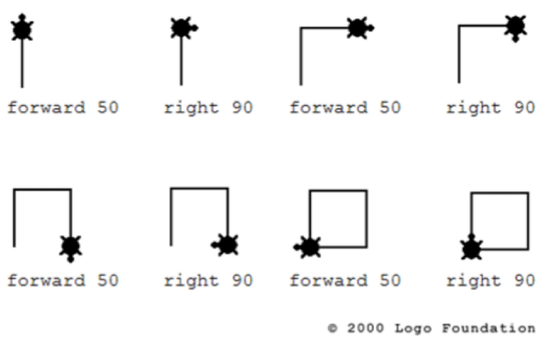
Motivation

- Lack of Inclusivity
  - 57% of graduates female/ 14% CS graduates female
  - 25% of computing workforce female; of this, 3% African-American, 4% Asian, 1% Hispanic [1]
- Visual applications
  - Allows for creative expression
  - More tangible product

Media Computation

- We built this to be included in a Media computation style intro class.
  - It has been shown that this leads to better retention in computer science [2]
  - Makes code more relatable to students
- 2D Logo takes simple commands and draws shapes on the screen in two dimensions

Logo Code



- Knoxcraft is basically 3D logo, with Minecraft as the visualization platform
- By adding another dimension, the creative potential of students in unleashed

Requirements

- Students need
  - BlueJ (free!)
  - Minecraft (must be purchased)
- System is platform **independent**
  - Server runs both Minecraft and submission server
- Easy installation : all you need
  - JDK
  - Knoxcraft.jar
- Web Interface for Instructor to view and download source code of submissions

Features

- Adding support for new languages is easy! Just provide methods that target our JSON representation of Knoxcraft commands!
  - language flexibility
  - easy additions to code
- Example Java to JSON conversion:

```
public static void main(String[] args) {
    Turtle3D t=Turtle3D.createTurtle("script-test");
    t.forward(10);
}
```

```
{
 "scriptname" : "script-test",
 "commands" : [
     {"cmd" : "forward",
         "args" : {"dist" : 10}},
```

- Get the source code here:

https://github.com/jspacco/Knoxcraft

Intial Trial

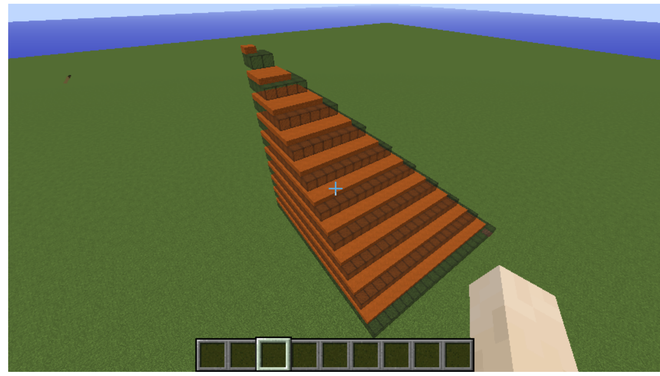
- Integrated into CS1 in Fall 15 at Knox College
  - Overwhelming positive feedback from students
- Issues
  - Some scalability issues were exposed
  - Stack tracing
  - What students meant when reporting errors

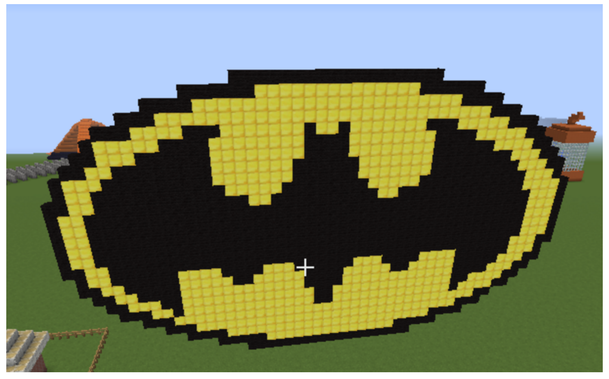
Screenshots

Student Code in BlueJ

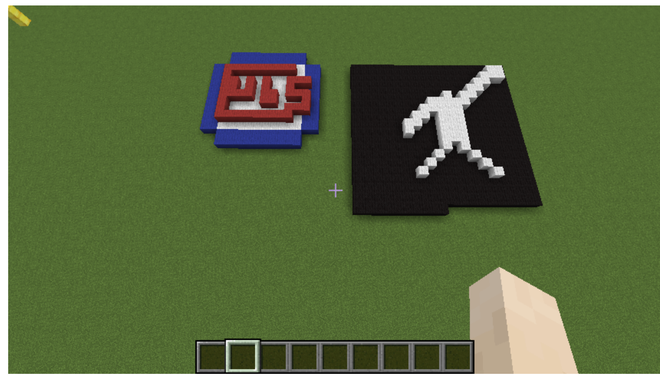
```
public static void main(String[] args) {
    Turtle3D t=Turtle3D.createTurtle("pyramid");
    t.setBlockPlace(true);
    int size = 21;
    int height = 0;
    for (int j=0; j<size; j++) {
        height++;
        if (height % 2 == 0)
            t.setBlock(BlockType.RedSandstoneSlab);
        else
            t.setBlock(BlockType.BlackGlass);
        for (int i=0; i<size-height; i++) {
            t.setBlockPlace(true);
            t.forward(size-height);
            t.setBlockPlace(false);
            t.backward(size-height);
            t.right(1);
        }
        t.left(size - height);
        t.setBlockPlace(false);
        t.up(1);
        t.right(1);
        t.forward(1);
    }
```

Code ran in Minecraft





Student Code



Future Work

- In-game Sprites and Animations
  - currently blocks "magicaly" appear
  - add an action to placement, canceling
- Refactoring current code
  - Handle scale-up
  - Better logging of errors

References

[1] National Center for Women and Information Technology. By the numbers. 2013.

[2] Mark Guzdial. Exploring hypotheses about media computation. In *Proceedings of the Ninth Annual International ACM Conference on International Computing Education Research*, ICER '13, pages 19–26, New York, NY, USA, 2013. ACM.

Support

- Knox College Baker-Velde
- Knox College ASSET funding

Get involved!

We want you to play Knoxcraft too!

- We have starter student code and server jar
- Are you ready to learn Java with Minecraft?
- What are you waiting for?

https://sites.google.com/a/knox.edu/knoxcraft/