Programming Turtles

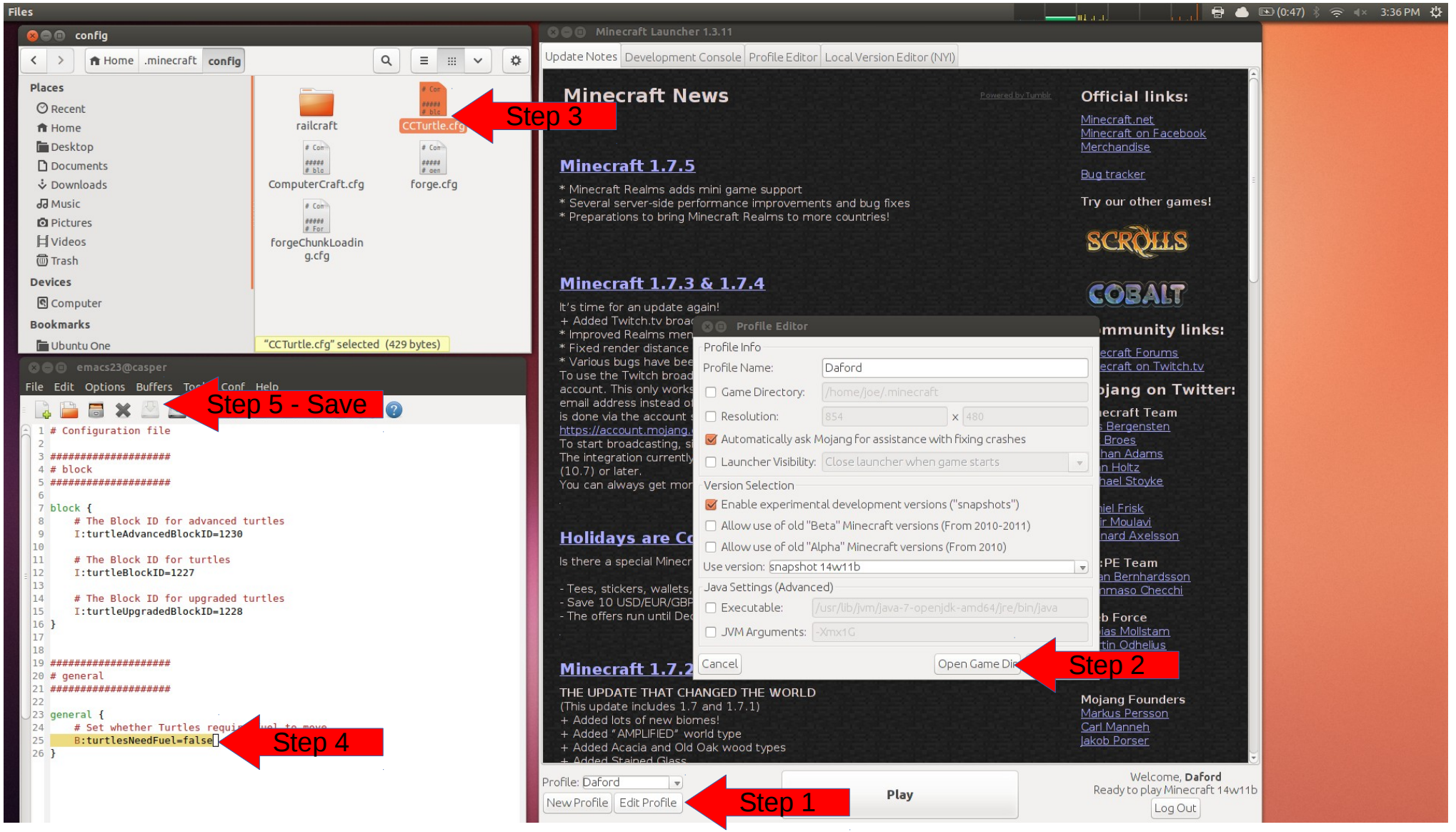
Challenges

- Program a ComputerCraft Turtle to
  - **Beginner:** craft a basic starter home
  - **Intermediate:** craft a customized house (E.g., two story house, basement, etc)
  - **Advanced:** craft a castle (E.g., circular towers, etc)
  - **General Challenge:** Make a house API (Application Programming Interface)

Development Environment Setup

- Make turtles work without having to add fuel
- Craft disk drive with disk to save programs
- Learn how to navigate turtles in case something goes wrong!

Remove Need For Fueling Turtles



Overview of the Turtle API

- Turtle API (Application Programming Interface) used to make house
  - **turtle.forward()** - Returns true if turtle moves forward, otherwise returns false.
  - **turtle.back()** - Returns true if turtle moves backward, otherwise returns false.
  - **turtle.up()** - Returns true if turtle moves up, otherwise returns false.
  - **turtle.down()** - Returns true if turtle moves down, otherwise returns false.
  - **turtle.turnLeft()** - Returns true if turtle turns left, otherwise returns false.
  - **turtle.turnRight()** - Returns true if turtle turns right, otherwise returns false.
  - **turtle.dig()** - Returns true if turtle breaks block in front, otherwise returns false.
  - **turtle.digDown()** - Returns true if turtle breaks block below, otherwise returns false.
  - **turtle.place()** - Returns true if selected block is placed in front of turtle, otherwise false.
  - **turtle.placeDown()** - Returns true if selected block is placed below turtle, otherwise false.
  - **turtle.detectDown()** - Returns true if a block is below turtle, otherwise returns false.
  - **turtle.select(number slotNumber)** – Make turtle select item from provided slot number. (1 is top left and 16 is bottom right)
- Go to http://computercraft.info/wiki/Turtle_(API) for complete list of the Turtle APIs

Introduction to Lua

- **Variables** – Store a changeable value

  local turtleName = “JoeBot”

- **If, Then, Else, End** – Conditional Statement

  if (turtle.forward()) then print(turtleName..” moved forward”) end

- **Functions** – Helps simplify code by separating into functionality to prevent repetition

  ```
  local function moveForward(name)
      if ( turtle.forward() ) then print(name..” moved forward”) end
  end
  moveForward(turtleName)
  ```

- **Loops**
  - For Loop

    ```
    for var = start, end, Interval do
        turtle.forward()
    end
    ```

  - Repeat Loop

    ```
    repeat  turtle.forward() until ( turtle.detect() )
    ```

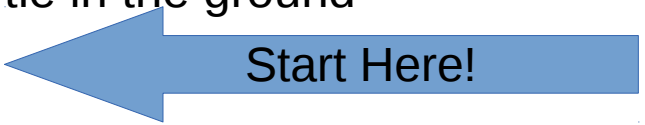
- Go to http://computercraft.info/wiki/Tutorials for a more complete “Basic Tutorial” on Lua

How to Create a House

- Step 1: Break down the problem
- Step 2: Start with simplest part of the program
  (E.g., One call to an existing API)
- Step 3: Test to make sure it works!
  (Note: This step validates that your environment works!)
- Step 4: Code next part of the problem
- Step 5: Test to make sure next part works!
- Step 6: Go to Step 4 until house is complete!

Breaking Down Problem

- Create House
  - Create Floor (E.g., Place many rows of blocks in ground)
    - Place one row of blocks in ground
      - Place one block in front of turtle in the ground
        - Move forward one block
        - Dig one block below
        - Place one block below
        - Return to starting position (E.g., Move back one block)



  - Create Walls
  - Create Ceiling
  - Create Door

Simple placeBlock() Function

Better placeBlock() Function

Global Variable

Private Function

Conditional Logic

repeat – until Loop

Exit function

```lua
MAX_SLOT_NUMBER = 16
local function placeBlock()
  if ( turtle.detectDown() ) then
    turtle.digDown()
  end
  slotNum = 0
  repeat
    slotNum = slotNum + 1
    if ( slotNum > MAX_SLOT_NUMBER ) then
      print ("No blocks to place!")
      return
    end
    turtle.select(slotNum)
  until turtle.placeDown()
end
```

placeBlockRow() Function

Use “for” loop to repeat code

createFloor() Function

Modulo operator (division remainder)

Helper Function (see next page)

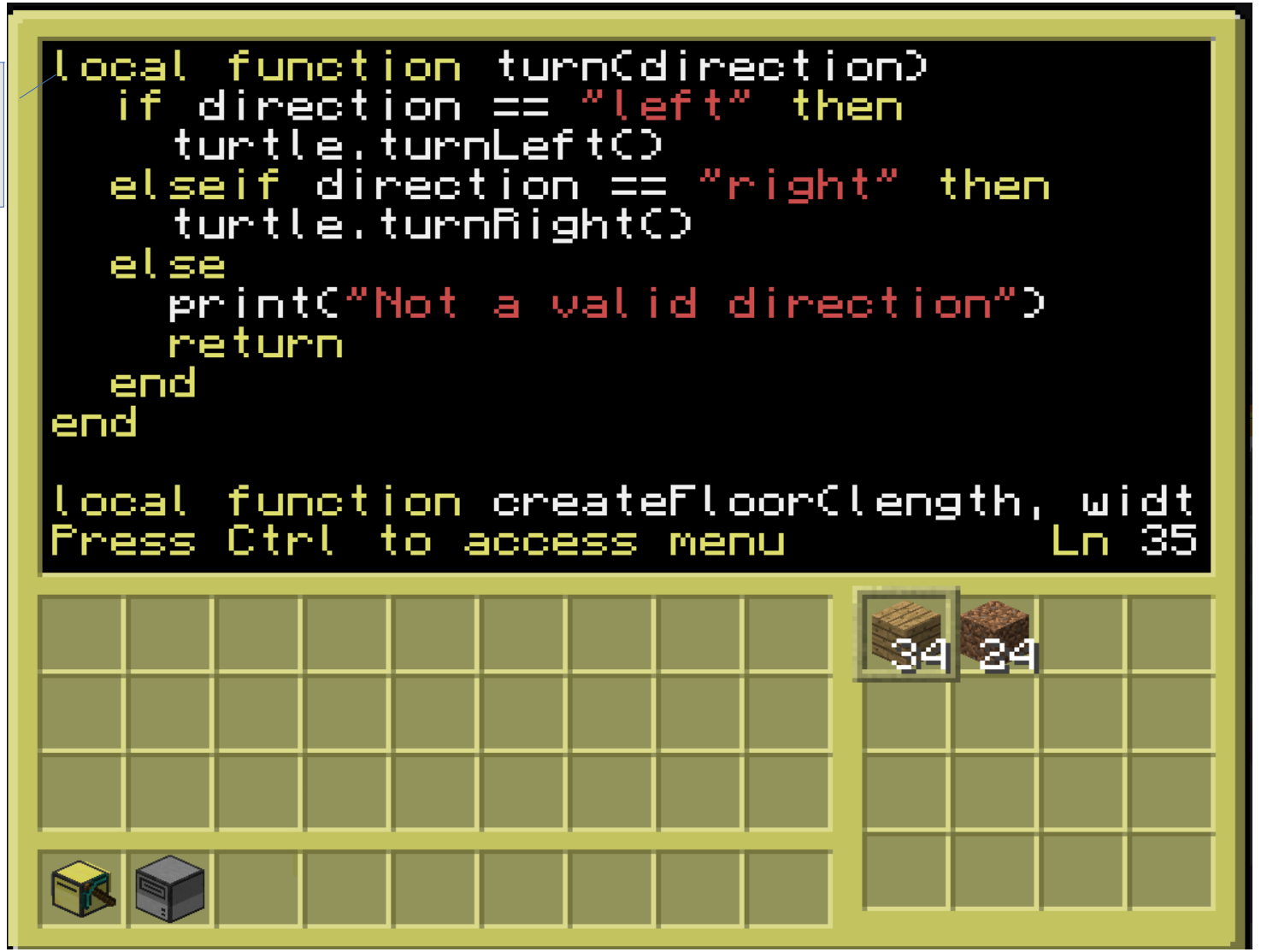
Start to return turtle to starting position

Another Helper Function (see next page)

```
41 local function createFloor(length, width)
42   for i=1, width do
43     placeBlockRow(length)
44     direction = "left"
45     if ( (i % 2) == 0 ) then
46       direction = "right"
47     end
48     turn(direction)
49     turtle.forward()
50     turn(direction)
51     turtle.back()
52   end
53   if ( direction == "left" ) then
54     moveTurtleForward(length+1)
55     turtle.turnLeft()
56     turtle.turnLeft()
57   end
58   turtle.turnRight()
59   turtle.up()
60   moveTurtleForward(width)
61   turtle.down()
62   turtle.turnLeft()
63 end
```

turn(direction) Helper Function

Helper function must come before function that uses it.



moveTurtleForward Helper Function

```
35 local function moveTurtleForward(distance)
36   for i=1, distance do
37     turtle.forward()
38   end
39 end
```

createWalls Function

“for" loop to create four house walls

Helper Function (see next page)

Return turtle to start position

```
78 local function createWalls(length, width, height)
79   for i=1, height do
80     turtle.up()
81     for j = 1, 4 do
82       placeBlockRow(calculateDistance(j, length, width))
83       turtle.turnLeft()
84     end
85     turtle.turnRight()
86     turtle.forward()
87     turtle.turnLeft()
88     turtle.back()
89   end
90   for i=1, height do
91     turtle.down()
92   end
93 end
```

calculateDistance Helper Function

```
49 local function calculateDistance(index, length, width)
50   if ( index == 1 ) then
51     distance = length
52   elseif ( index == 2 ) then
53     distance = width - 1
54   elseif ( index == 3 ) then
55     distance = length - 1
56   else
57     distance = width - 2
58   end
59   return distance
60 end
61
62 local function createWalls(length, width, height)
63   for i=1, height do
```

createCeiling() Function

```
 95 local function createCeiling(length, width, height)
 96   for i=1, height+1 do
 97     turtle.up()
 98   end
 99   createFloor(length, width)
100   for i=1, height+1 do
101     turtle.down()
102   end
103 end
```

Reuse createFloor function. The ceiling is equivalent to the top floor

createDoor() Function

```
105 local function createDoor()
106   turtle.turnRight()
107   turtle.forward()
108   turtle.turnLeft()
109   moveTurtleForward(2)
110   turtle.turnLeft()
111   turtle.dig()
112   turtle.up()
113   turtle.dig()
114   turtle.down()
115   turtle.select(MAX_SLOT_NUMBER)
116   turtle.place()
117   turtle.select(1)
118   turtle.turnLeft()
119   moveTurtleForward(2)
120   turtle.turnRight()
121   turtle.forward()
122   turtle.turnRight()
123 end
```

The door must be in the last slot!

Putting It All Together With createHouse() Function

```
125 local function createHouse(length, width, height)
126   createFloor(length, width)
127   createWalls(length, width, height)
128   createCeiling(length, width, height)
129   createDoor()
130 end
131
132 createHouse(5,5,5)
```

Setup Required Before Starting

Make it an API

- What is an API (Application Programming Interface)
- How to make a house API
  - local (private) vs non-local (public) methods
  - Remove “local” from the following methods
    - createFloor(), createWalls(), createCeiling(), createDoor()
  - Move all code except createHouse() into API file called “house”. (Refer to API version in Appendix for example)
  - Update makeHouse to use API
    - To use the api call os.loadAPI(“house”). Now you can just use house.createFloor(), etc.

More Lua Resources

- http://www.lua.org/manual/5.1/manual.html
- http://coderdojosv.github.io/mobile-games/section-00/docs/introduction.html
- http://repl.it/languages/lua

Thank You

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Appendix