Curing Recursion Aversion

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Thanks To Rebeca Dunn-Krahn (Video)
Terence Nathan (Volunteer)
Problem

• Looking for interactive ways to teach recursion
• Demonstrate that the concept is not ‘too hard’ to learn
• Demonstrate given the correct abstraction that young students can learn
Outline

• Details of Expectations of Understanding
• Participant and Teacher Demographics
• Classroom Dynamics
• Activities
• Sample Methods of Evaluation and Results
• Outcome and Future Directions
What is recursion?
What is recursion?

to showRecursion :num1 :num2

end
What is recursion?

to showRecursion :num1 :num2

print :num1
print :num2

end
What is recursion?

to showRecursion :num1 :num2

showRecursion :num1 - 1 :num2-1
print :num1
print :num2

end
What is recursion?

to showRecursion :num1 :num2

  if else :num1 < 1[
    print 0
  ] [
    showRecursion :num1 - 1 :num2-1
    print :num1
    print :num2
  ]

end
What is recursion?

to showRecursion :num1 :num2
    ifelse :num1 < 1[
        print 0
    ] [
        print :num1
        print :num2
        showRecursion :num1 - 1 :num2-1
    ]
end
Example Hanoi Solution
Example Hanoi Solution
Example Hanoi Solution
Related Work

1. http://llk.media.mit.edu
Demographic

Boys: 2
Girls: 7

Solving Problems with Algorithms
Robots and ComputerS

Leaders: Ulrike Stege,
Katherine Gunion, Terence Nathan

Sunday, July 5, 2009
Overview of Setup

Unplugged Activities

Clicker Questions

Programming Activities

1 1/2 hours
Overview of Setup

Unplugged Activities

Clicker Questions

Programming Activities

1 1/2 hours
# MicroWorlds vs. Alice

- **Two Languages that Support Recursion**

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- [http://www.alice.org/](http://www.alice.org/)
Microworlds Environment
Alice Programming Environment
MicroWorlds vs. Alice

- Two Languages that Support Recursion

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# Weeks and Activities

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Genome Sorting (pre test)

Sorting coloured envelopes using \textit{comparison based} sorting
Students Solutions

• Initial response: “This is impossible”
• Insertion sort
  - Simplistic & iterative
  - Inefficient
• Simple errors & carelessness
• No groups completed the task
• Students became very frustrated
Visual Recursion
Visual Recursion
Visual Recursion
Visual Recursion

![Borax Image]

![Graphs]

![Fractal Image]
Student Solutions

• “Picture inside a picture”
• Theme of *infinity* or *forever*
• Related to other aspects of their lives
Towers of Hanoi

- Disks to move from one peg to another, moving one disk at a time
- Larger disks are not allowed on top of smaller ones
Student Solutions

• Solved the problem using a reduce and conquer approach
• Even computed number of steps required
Programming Towers of Hanoi

- ‘Move’ function
- ‘Which’ function

Do Towers (How Many Disks) (Source) (Destination) (Auxil)

If How Many Disks = 1
   Move Disk 1 From Source To Destination
Else

   Do Towers (How Many Disks -1) (Source) (Auxil) (Destination)
   Move How Many Disks From Source To Destination
   Do Towers (How Many Disks -1) (Auxil) (Destination) (Source)
A Student’s Solution for Towers Of Hanoi in MicroWorlds

to doTowers :num :src :dest :aux
  if else :num = 1
  [ move :num :dest
  ]
  [
    doTowers :num - 1 :src :aux :dest
    move :num :dest
    doTowers :num - 1 :aux :dest :src
  ]
end
Match Box Sorting (post test)
Student Solutions

• Two piles
• “No reference point”
• Realized they should use recursion
• Designed a ‘quick sort’
• Each took turns on a step
Clicker Questions
Clicker Questions
Is This Image Recursive?

![Is this recursive?](image)

- [ ] correct
- [ ] incorrect
- [ ] invalid
Is This Image Recursive?

![Image of a recursive design]

Voting Results:

- Correct: 5
- Incorrect: 3
- Invalid: 1
What is the Output of This Recursive Function?

To DrawSquares :Num
If else :Num < 1 [  
Fill in the Square that you’re in with red.  
]  
[  
Draw a square size :Num  
Fill it in white  
DrawSquares :Num – 10  
]
Clicker answers became more vague, but following discussion became much clearer and more in depth.
Limitations

• Clicker results
• Small group
• Skewed representation
• Short study (non-longitudinal)
• Not for ‘marks’
• Ethics and public access to the data
Conclusions

• The students *understood* at different levels
• Students seemed to *enjoy* themselves

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<td>Used a problem solving strategy</td>
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<tr>
<td>Too many steps</td>
<td>Found a solution that was easy to implement</td>
</tr>
<tr>
<td>involved</td>
<td></td>
</tr>
<tr>
<td>Frustrated &amp; limited enjoyment</td>
<td>Were enthused by the problem</td>
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Future Work

- Run the program again in the Fall
- Work with other ‘Complex Topics’
- Compare to 1\textsuperscript{st} and 2\textsuperscript{nd} year?
- In 5 years?
- Implemented in the school system?
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Thanks To Rebeca Dunn-Krahn (Video)
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Try to place all the blocks here in order!!
Hit REVEAL to reveal their values

Place blocks on the purple/brown squares, to compare them...

REVEAL!!!

Comparisons:

Press 'c' to compare