A bit more Recursion

Computer Networks
Homework 2 has been posted
Please contact TA Ross and William for questions
Bonus Project 1 also posted, due March 1st
Quiz 3: Thursday, 2/11, last 10 minutes in class. Topic: Recursion.
Recursion
def recur_fact(x):
    if x == 1:
        return 1
    else:
        print x, "\*", "recur_fact(",x-1,\")"   
        return (x * recur_fact(x-1))

num=int(input("Enter a number: "))
if num >= 1:
    print("The factorial of", num, "is", recur_fact(num))

Credit:
http://www.programiz.com/python-programming/recursion
recur_fact(4)                  # 1st call with 4
4 * recur_fact(3)             # 2nd call with 3
4 * 3 * recur_fact(2)         # 3rd call with 2
4 * 3 * 2 * recur_fact(1)     # 4th call with 1
4 * 3 * 2 * 1                 # return from 4th call as number=1
4 * 3 * 2                     # return from 3rd call
4 * 6                         # return from 2nd call
24                            # return from 1st call

Credit:
http://www.programiz.com/python-programming/recursion
Recursion with Python Turtle

https://trinket.io/python

More reading: https://www.linuxvoice.com/issues/002/02drawing.pdf
import turtle

myTurtle = turtle.Turtle()
myWin = turtle.Screen()

def drawSpiral(myTurtle, lineLen):
    if lineLen > 0:
        myTurtle.forward(lineLen)
        myTurtle.right(90)
        drawSpiral(myTurtle,lineLen-5)

drawSpiral(myTurtle,100)

Credit:
http://interactivepython.org/runestone/static/pythonds/Recursion/pythondsintro-VirtualizingRecursion.html
import turtle

def tree(branchLen,t):
    if branchLen > 5:
        t.forward(branchLen)
        t.right(20)
        tree(branchLen-15,t)
        t.left(40)
        tree(branchLen-15,t)
        t.right(20)
        t.backward(branchLen)

Credit:
http://interactivepython.org/runestone/static/pythonds/index.html
def main():
    t = turtle.Turtle()
    myWin = turtle.Screen()
    t.left(90)
    t.up()
    t.backward(100)
    t.down()
    t.color("green")
    tree(75,t)
    myWin.exitonclick()

main()

Credit:
http://interactivepython.org/runestone/static/pythonds/index.html
from turtle import *

def drawSnowFlake(length, depth):
    if depth > 0:
        for i in range(6):
            forward(length)
            drawSnowFlake(length // 3, depth - 1)
            backward(length)
            left(60)

drawSnowFlake(60,2)
drawSnowFlake(60,3)
Play with Python labs on your own!
Computer Networks
Communication Layer

- Computer networks form an infrastructure that allows data to travel from a source computer to a destination.
- Networks are defined by the ability to communicate, not just physical connections.
Computer Networks

- **Host/Node**: any device on a network
- **Data transfer rate/`bandwidth`**: the speed at which data is moved from one place on a network to another
  - We need to transfer more and larger data
- **Protocols**: a set of rules defining how data is formatted and processed on a network
  - Why is a common set of rules so important?
Client–Server Model

- Computing is not limited to the capabilities of one machine
  - Software systems can be distributed across a network
- A client sends a request to a server (for info or action) and the server responds
- Examples: file server, web server
Local-Area Network

- A **LAN** connects a relatively small # of machines in a relatively close geographical area.
- Usually confined to a room or a building
- How might devices be configured in a LAN?
- **Ethernet**: the industry standard bus technology for LAN
LAN Topologies

Ring topology

Star topology

Bus topology
Wide-Area Networks

- A WAN connects 2 or more LANs over a potentially large geographic distance
- The Internet is essentially the ultimate WAN
Internet

- A vast collection of smaller networks that have agreed to communicate using the same protocols and pass messages along to their final destinations
- **Internet backbone**: a set of high-speed data routes that carry Internet traffic
  - At&T, Verizon, academic, government
  - No central network
- **Internet service provider**: a company that connects directly or indirectly to the Internet backbone
INTERNET CONNECTIONS

- Phone modem: convert data into an analog audio signal
- DSL (Digital subscriber line): uses phone line to transfer digital data (however digital signal degrades, most be close to ISP)
- Cable modem: transfer digital data using cable lines
- Typically download and upload speeds differ
- Fiber > Cable > DSL
Packet Switching

- Messages are divided into fixed-size, numbered packets
- Each packet is sent over the network individually
  - Packets may take different routes to the destination
  - At the destination, packets must be reassembled
- Router: a device that directs packets as they move between networks
  - Each router simply directs the packet to the next router to get it closer to its destination
  - Due to down machines and heavy traffic, routers can send a packet along an alternate route
Network Protocols

- TCP/IP
  - Internet Protocol: routing of packets
  - Transmission Control Protocol: breaking messages into packets and assembling packets back into messages
- Simple Mail Transfer Protocol (SMTP)
- File Transfer Protocol (FTP)
- Telnet: log into a computer from a remote computer
- Hypertext Transfer Protocol (HTTP)
Firewalls

Filters the network traffic coming in and/or going out
The Great Firewall of China

- 1993: Golden Shield Project, a massive surveillance and censoring system, Cisco
- 2007: operate only sporadically at best, proxy servers
- 2008: Operation Tomorrow, crack down on youth usage of internet cafés to play online games and view content declared illegal
- Chilled speech and self-censorship: more effective at blocking internet content than the great firewall
- Filtered searches with Google
- 2013, Google’s search share has declined to 1.7% from its August 2009 level of 36.2%.
- 2014, blocking Google
- Google is on its way back

Credit: wikipedia
Network Addresses

- Ultimately communicating with one particular computer out of all computers in the work
- Hostname: a unique identification that specifies a particular computer on the Internet
- How to find your computer’s IP address? (Take-Home)
  - An IP address requires 32 bits, or 4 bytes, for storage
Domain Name System

- lab1-1.eng.utah.edu
- Contains a machine name and a domain name
- The top-level domain (TLD) name (edu) indicates a particular type of organization, some carefully controlled
- .pizza
- Domain names in unrestricted TLDs were quickly taken
- Domain name system (DNS): used to translate hostnames to IP addresses
- Distributed database with no central organization
Card Trick

What does this have to do with computer networks?

Need a student volunteer.

Parity Bits

- Error can occur during the transmission of data over a network
- Imaging losing a bit, how does that change a value?
- One parity bit is attached to each byte and set to make the number of 1s odd
  - If the byte is 1100 1100, the parity bit is set to 1
  - If the byte is 1111 0010, the parity bit is set to 0
- Upon receiving a byte the parity is checked
  - Odd # of 1s – no error
  - Even # of 1s – error
  - Only limited power in checking errors
THANKS!

Any questions?

You can find me at beiwang@sci.utah.edu

http://www.sci.utah.edu/~beiwang/teaching/cs1060.html
CREDITS

Special thanks to all the people who made and released these awesome resources for free:

- Presentation template by SlidesCarnival
- Photographs by Unsplash