CS101: Intro to Computing
Fall 2015

Lecture 15

Administrivia

- Homework 11 released on today
  - Due in 1 week (Monday)
- On RELATE, not Codelab
- Test your code before submitting it
- Install Anaconda

https://www.continuum.io/downloads

REVIEW

```
NameError: name 'y' is not defined
```

What code produces this error?

a) x=1
   y=x*2

b) x=0
   y+=1

c) x="ABCD"
   y=x[2]

IndexError: list index out of range

What code produces this error?

a) ```
x="ABCD"+"E"
x[5]
```

b) ```
x=[1,2]
x[2]
```

c) ```
x={1:2,2:3}
y=x[2]
```

SyntaxError: invalid syntax

What code produces this error?

a) ```
if x < "HAPPY":
    print x.lower()[1]
```

b) ```
if x in "ABCD":
    print "E"+x[0]
```

c) ```
if x = (1,2,3):
    print x[2]+1
```

Which of these will correctly display a plot?

a) ```
import matplotlib.pyplot as plot
plot.plt([1,2,3],[4,5,6])
```

b) ```
import matplotlib.pyplot as plt
plt.plot([1,2,3],[4,5,6])
```

c) ```
from matplotlib import pyplot
pyplot.plt([1,2,3],[4,5,6])
```

d) None of the other answers

# MODELING AND SIMULATION

# Modeling

- Model - a program to simulate a real-world process or system over time
- Useful for making predictions or solving problems
- Simulation - a run of a computer model
- First "build a model" then "run a simulation"

# Example models

- Climate and weather models
- Economic forecasting
- Population modeling
- Video game physics engines
- Earthquakes
- Planetary motion
- Poker hands

# Modeling design

1. Determine equations governing the system and entities involved.

2. Determine state variables, units, initial conditions, and constants.

3. Determine how state variables are updated through time (transition.)

4. Implement model and begin simulation.

5. Validate and refine model.

# State variables

- A collection of variables describing the current state of the system.

- Describe all information we are interested in.

- Describe all information needed to determine the future state.

# Example

- Model a population of fish in a pond
- What might the state variables be?
- What might the initial conditions be?
- What might the state be updated (transition)?

# Model pseudocode

```
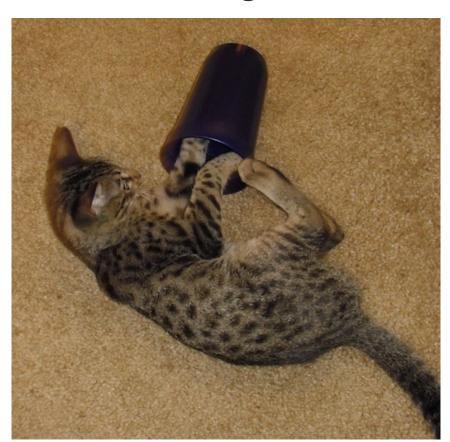set constants
state=initial_state
while not simulation_over:
    state=update(state)
```

Example

- A kitten knocks a cup off of a 1-meter high table. How long until it hits the ground?

- $g = -9.8 m/s^2$

- $v_0 = 0 m/s$, $y_0 = 1m$

- $v_{t+1} = v_t + g*\Delta t$

- $y_{t+1} = y_t + v_t*\Delta t$

- $\Delta t = ?$

Time step size

- How much time passes between iterations of our simulation.

- What is Δt?

- Determines the resolution/fidelity of our model.

- Smaller step size means more accurate reproduction of reality.

- Smaller step size means longer run time.

How accurate?

- Can find analytical solution using calculus

$$t = \sqrt{\frac{2d}{g}}$$