Professor Reed presents to the The Central Ohio Python Users Group

April 27th, 2015 @1830hrs

Where we are all headed tonight!

- Part 1 Rapid Refresher on IFs
- Part 2 Pseudo Case/Select Class
- Part 3 Using Asserts Properly

linear Delnoom

computer Functional

) paradigms

Procedural

Python

UI thumk IMO Imperative

Programming Object-oriented

But what does he really know about "modern" Computing???

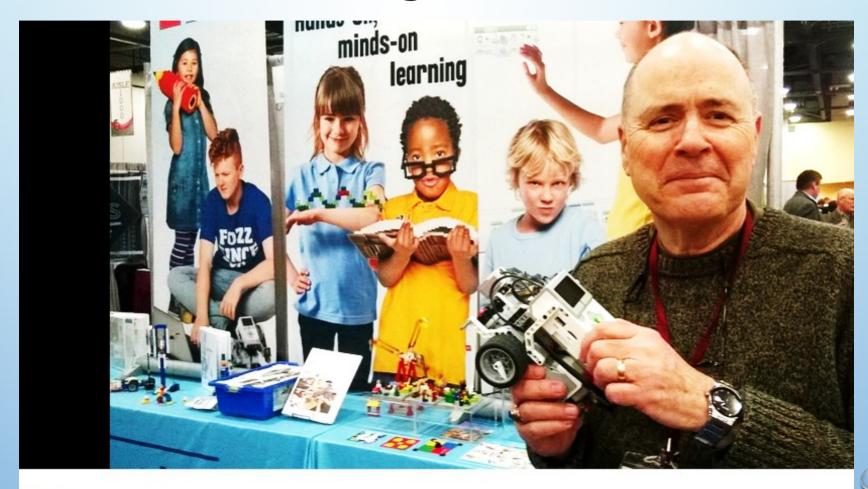
IBM Hollerith Punch Card

Early Computing



IBM 360 MF

Demonstrating at OETC 2015







Coming to OETC 2016 – Python Robotics!



In Python

Part I

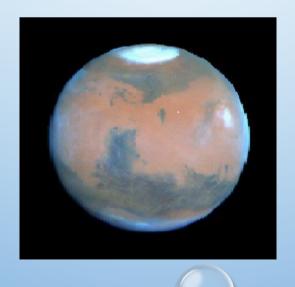


Rapid Refresher On Python IFs

Begin Part 1

What are we \$\$\$ paid to do (Academic vs Business)?

- Make good & correct decisions in Python Computer Programs
- Let's look at a Poor Decision "Mars Polar Lander"



Mars Polar Lander Lost!



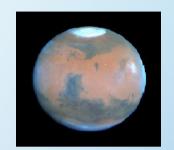
(CNN) -- NASA lost a \$125 million Mars orbiter because a Lockheed Martin engineering team used English units of measurement while the agency's team used the more conventional metric system for a key spacecraft operation, according to a review finding released Thursday.

The units mismatch prevented navigation information from transferring between the Mars Climate Orbiter spacecraft team at Lockheed Martin in Denver and the flight team at NASA's Jet Propulsion Laboratory in Pasadena, California.

Space craft declared lost on Dec. 3rd, 1999

Update this is <u>NOT</u> what happened! Prof. Reed, April 2015

Why did Mars Polar Lander fail?



Investigators of the mishap later pinpointed the most likely cause of the failure. The leading candidate: creation of spurious signals when the craft's legs were deployed during descent.

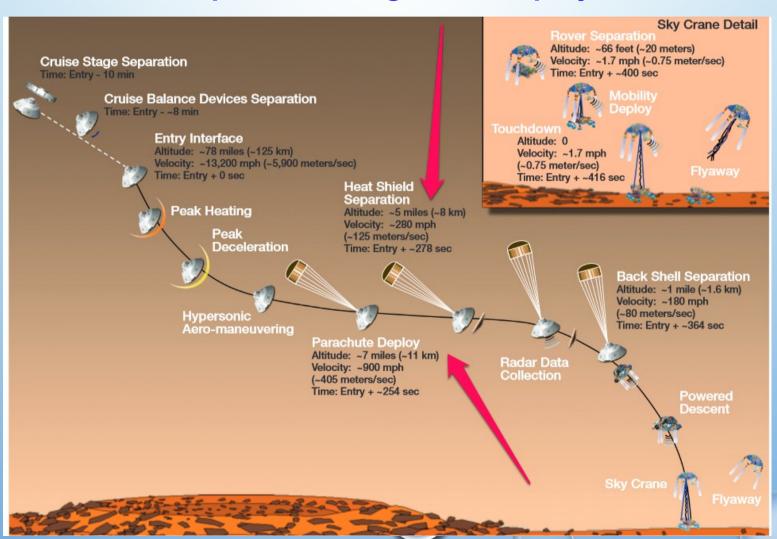
On-board brains of the lander took the faulty signals as indication that touchdown on Mars had taken place. Software then commanded the craft's set of braking engines to turn off.

What are we \$\$\$ paid to do (Academic vs Business)?

- Make good & correct decisions in Python Computer Programs
- Let's look at a Great Decision "Mars Curiosity Lander"

Premise tonight: Hurdling towards Mars Landing Site at 200 mph+ with drag shoot deployed!!!

Premise tonight: Hurdling towards Mars Landing Site at 200 mph+ with drag shoot deployed!!!



http://www.jpl.nasa.gov/video/details.php?id=1090







The Angry Red Planet 1959



A complicated landing

The \$2.5-billion MSL spacecraft launched from Cape Canaveral, Florida, on Nov. 26, 2011, and arrived on Mars on Aug. 6, 2012, after a daring landing sequence that NASA dubbed

"Seven Minutes of Terror."

Premise tonight: Hurdling towards Mars Landing Site at 200 mph+ with drag shoot deployed!!!

MSL - Mars Science Laboratory

Dec. 5, 2014. Orion launched on its first test flight at 7:05 am

What I said at OETC 2014, "...are you students ready—not will your students be ready"

Are You?

"...can we afford another failed Mars landing with humans aboard??? (estd: to be in 2025)

Major Milestone on Agency's Journey to Mars

NASA marked a major milestone Friday on its journey to Mars as the Orion spacecraft completed its first voyage to space, traveling farther than any spacecraft designed for astronauts has been in more than 40 years.

"Today's flight test of Orion is a huge step for NASA and a really critical part of our work to pioneer deep space on our Journey to Mars," said NASA Administrator Charles Bolden. "The teams did a tremendous job putting Orion through its paces in the real environment it will endure as we push the boundary of human exploration in the coming years."

Orion blazed into the morning sky at 7:05 a.m. EST, lifting off from Space Launch Complex 37 at Cape Canaveral Air Force Station in Florida on a United Launch Alliance Delta IV Heavy rocket. The Orion crew module splashed down approximately 4.5 hours later in the Pacific Ocean, 600 miles southwest of San Diego.

During the uncrewed test, Orion traveled twice through the Van Allen belt where it experienced high periods of radiation, and reached an altitude of 3,600 miles above Earth. Orion also hit speeds of 20,000 mph and weathered temperatures approaching 4,000 degrees Fahrenheit as it entered Earth's atmosphere.

Orion will open the space between Earth and Mars for exploration by astronauts. This proving ground will be invaluable for testing capabilities future human Mars missions will need. The spacecraft was tested in space to allow engineers to collect



http://www.nasa.gov/content/nasas-orion-flight-test-and-the-journey-to-mars

Premise tonight: Hurdling towards Mars Landing Site at 200 mph+ with drag shoot deployed!!!

http://lars-lab.jpl.nasa.gov/JPL_Coding_Standard_C.pdf

JPL Institutional Coding Standard for the C Programming Language

[version edited for external distribution: does not include material copyrighted by MIRA Ltd (i.e., LOC-5&6) and material copyrighted by the ISO (i.e., Appendix A)] Cleared for external distribution on 03/04/09, CL#09-0763.

Version: 1.0

Date: March 3, 2009

Over 25,000 lines of Python
Code was used as
testing scripts
in the C-code
dispatched to the Mars Lander.

???

Note: Ask Prof. Reed about the C-code, reported as 500,000 lines.

Professor Reed sez:

"Computer Language Programming is
The Business of Dealing with
Failure!!!"

The "thumbers"!



Rapid Refresher On Python IFs NASA/JPL STANDARDS

Now with this as a backdrop in our program decision making in Python—let's examine some Python Code together.

> Premise tonight: Hurdling towards Mars Landing Site at 200 mph+ with drag shoot deployed!!!

Mars Curiosity: Facts and Information by Elizabeth Howell, Space.com Contributor | March 26, 2015 11:58pm ET

972

f Share

328

Tweet

133

Submit



An artist's concept illustrates what the Mars rover Curiosity will look like on the Red Planet.

Credit: NASA/JPL-Caltech View full size image

The Mars Science Laboratory and its rover centerpiece, Curiosity, is the most ambitious Mars mission vet flown by NASA. The rover's primary mission is to find out if Mars is, or was, suitable for life. Another objective is to learn more about the red planet's environment.

For the latest news about the mission, follow Space.com's Mars Science Lab Coverage.1

Decision Patterns



A) IF this THEN Do S1

Not Extensible

B) IF <u>this</u> THEN Do S1 ELSE Do S2

- More Reliable
- More Extensible
- More Flexible
- Future Focused
- Limits Side-Effects

C) IF <u>this</u> THEN Do S1

ELSE_IF <u>this</u> Do S2

ELSE_IF <u>this</u> Do S3

ELSE_IF <u>this</u> Do S4

ELSE_IF <u>this</u> Do S5

ELSE_IF <u>this</u> Do S5

Finality "otherwise"

IF Pattern 'C'

Choose Decision Pattern 'C'

IF this THEN Do S1

ELSE IF this Do S2

ELSE IF this Do S3

ELSE IF this Do S4

ELSE IF this Do S5

ELSE

Finality "otherwise"

Satisfies NASA/JPL

Choose Decision Pattern 'C' Don't forget the "cascade" effect

Prioritize and check the most important or most likely condition first in order of operations.

```
IF <u>this</u> THEN Do S1

ELSE_IF <u>this</u> Do S2

ELSE_IF <u>this</u> Do S3

ELSE_IF <u>this</u> Do S4

ELSE_IF <u>this</u> Do S5

ELSE_IF <u>this</u> Do S5
```

Finality "otherwise"

```
### Begin Ifs in Python:
##
### Python ifs presented by Professor Reed
### last updated (20-APR-2015)
### for Python 3.4+
### Featured Speaker -- Python User Group -- Apr. 2015
##
##
##import string
                                                   Exact only!
def simplelf(x):
  print("Demo Simple IF Demo*: ")
  if x < 0:
     print("simple if test ran:", x)
     print("x is less than 0")
  print("end of Simple IF Demo*: ")
  print ("*** Doesn't meet NASA/JPL Stds, WHY? ***")
  print()
                        Let's go examine some live code together!
```

So what have we determined so far?

What does the NASA/JPL STDS say about dangling IF logic???

Remember the MARS Polar Lander!!!





Python

Part 2



Pseudo Case/Select Class

Begin Part 2

Pseudo Case/Select Class In Python???

```
IF (x < 0) THEN "x is negative"

ELSE_IF (x == 0) "x equals zero"

ELSE (x > 0)

"x is greater than zero"
```

Why Look at Preferred Decision?

CASE (where x is numeric) OF

X < 0: "x is negative";

X ==0: "x equals zero";

X > 0: "x is greater than zero"

OTHERWISE

"X is something else?"

Pseudo Case/Select Class In Python???

```
IF (x < 0) THEN "x is negative"

ELSE_IF (x == 0)

"x equals zero"

ELSE_IF (x > 0)

"x is greater than zero"

ELSE

"otherwise clause"
```

Expanded & Improved!!!

Pseudo Case/Select Class In Python???

```
# Rewrite of CASE/Switch logic engine
# Updated and corrected by Professor Reed (24-APR-2015).
def case x(x):
  for case in switch(x):
    if case(-1):
      print("[Test case no.1:]")
      print("x is a negative value of: ", x)
      break
    if case(0):
                                                                Exact only!
      print("[Test case no.2: ]")
      print("x is a value of zero: ",x)
      break
    if case(1):
      print("[Test case no.3: ]")
      print("x is a postive value of: ",x)
      break
    if case(): # default, could also just omit condition or 'if True'
      print("default x is something else!")
      print("sometimes called 'otherwise'")
                                                   Once again, let's go examine
      # No need to break here, it'll stop anyway
  print()
                                                   some code!
```

Pseudo Case/Select Class Python???

What NASA/JPL STDS say about this??? Do not use items which of

USE Decision Pattern 'C' We saw earlier together.



Part 3



Using Asserts Properly

Begin Part 3

Making Even Better Decisions Using Asserts Properly

```
==== ERRORS =====
                       ERROR collecting aprdemoAsserts01.py
aprdemoAsserts01.py:90: in <module>
    testMyIfs(x)
aprdemoAsserts01.py:79: in testMyIfs
simpleIf(x) ## first demo -- simple if test
aprdemoAsserts01.py:16: in simpleIf
assert(x < 99)
    assert 101 < 99
                                   Captured stdout
[negative value test1:]
x is: 101
the value of x is: 101
Demo Simple IF Demo*:
x is:. 101
                       ====== 1 error in 0.08 seconds ==
jimsbiggirl@jimsbiggirl-PC /cygdrive/c/users/jimsbiggirl/documents
```

\$ py.test aprdemoAsserts01.py

Making Even Better Decisions Using Asserts Properly

Why Do Assertions at ALL???



Rule 16 (use of assertions)

Assertions shall be used to perform basic sanity checks throughout the code. All functions of more than 10 lines should have at least one assertion. [Power of Ten Rule 5]

Rule 5: The assertion density of the code should average to a minimum of two assertions per function.

Assertions are used to check for anomalous conditions that should never happen in real-life executions.



Assertions must always be side-effect free and should be defined as Boolean tests.

The Power of Ten – Rules for Developing Safety Critical Code
Gerard J. Holzmann
NASA/JPL
Laboratory for Reliable Software

Making Even Better Decisions Using <u>Asserts</u> Properly

Let's Go Examine Some More Python Code with IFs and Asserts!

Making Still Even Better Decisions In Python





- Part 2 Pseudo Case/Select Class
- Part 3 Using Asserts Properly

Making Even Better Decisions Using Asserts Properly

- *Any Questions???
- *Any Ideas???
- *Any Comments???

End of Part 3!

Thanks, Prof. JRR

End of Presentation on Making Better Decisions In Python

###

Thanks again, Prof. JRR

Any Supporting Code and/or notes for this Presentation will be made available on **GitHub**.

Please download **MyTeachBuddy Hybrid Phone App** and be Kind & Generous in your reviews.

Please don't install it and then delete it later, It creates terrible stats on the Mobile App Store Sites.



Other Resources!

GITHUB



https://github.com/profjrr/April-27th-Presentation-to-Python-UG.git

https://github.com/profjrr

Copyright (c) 2013 --ProfJRR Columbus, OH. All Rights Reserved.