Smith College

Computer Science

CSC352 Spring 2017 Introduction to Interrupts

Week 1

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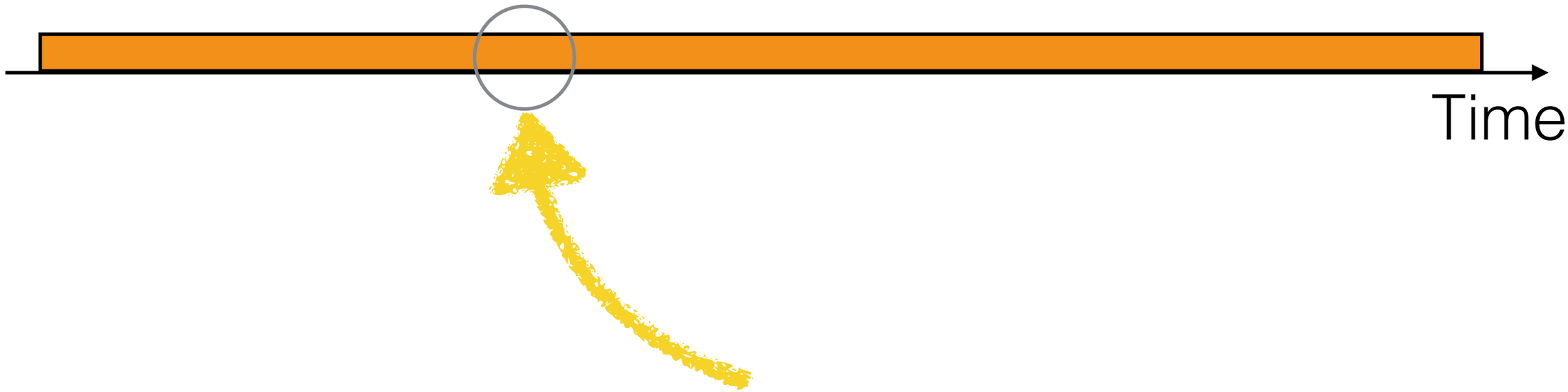
References

- See class page for references:

- http://www.science.smith.edu/dftwiki/index.php/CSC352_Class_Page_2017

Simplified view of Computation



Simplified view of Computation

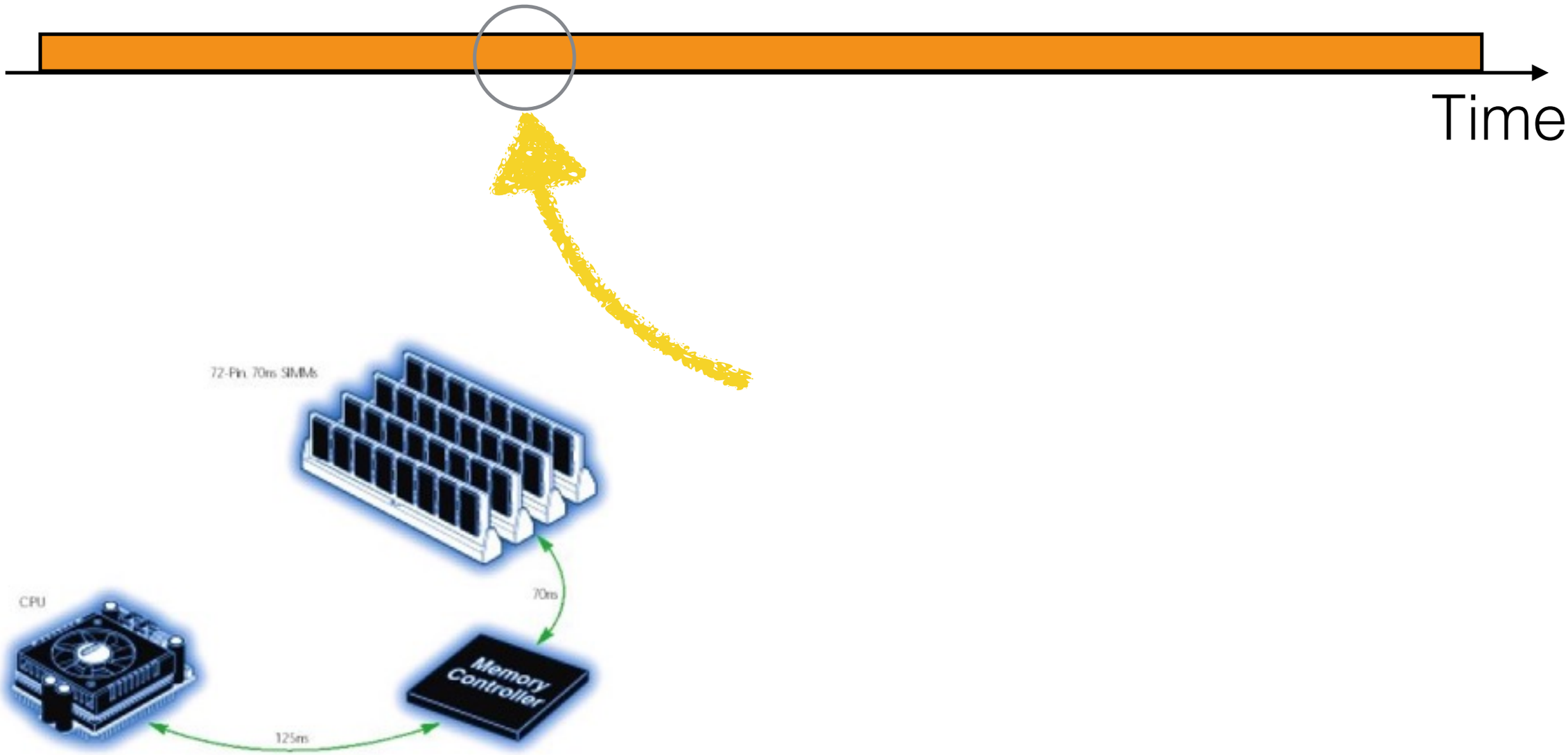


Photo credits: https://technick.net/img/guide_umg/guide_umg_016.jpg

Example Program 1

This is the text for an editor that gets characters from the keyboard, and saves and closes the program on Ctrl-X.

```
...
init();
...
while (true) {
  while (!has_char()) ;
    ch = get_char();
    if (ch == ^X) {
      savefile();
      exit (0);
    } else
    ...
    } else
    if ('z' >= ch && 'a' <= ch) {
      insertChar(ch);
    }
}
```

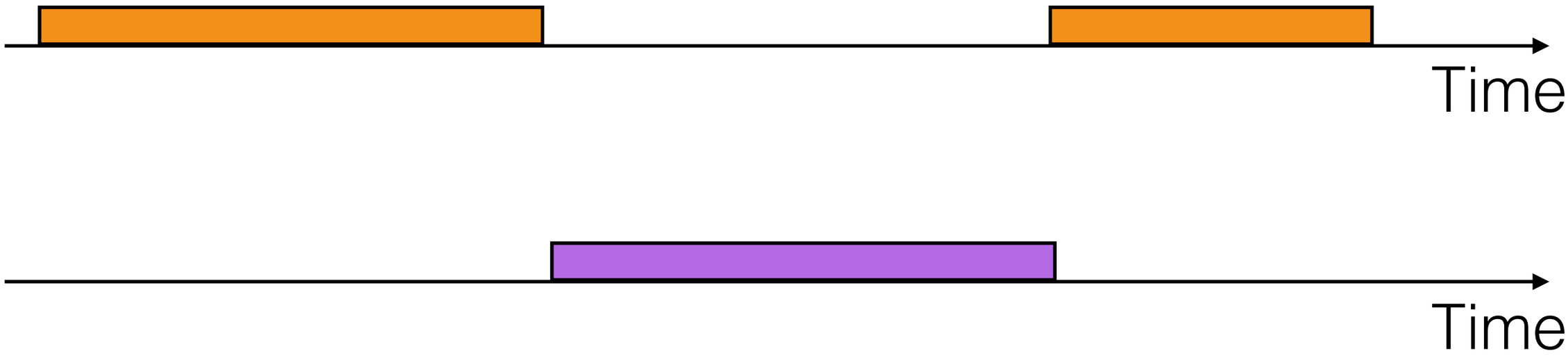
Example Program 2

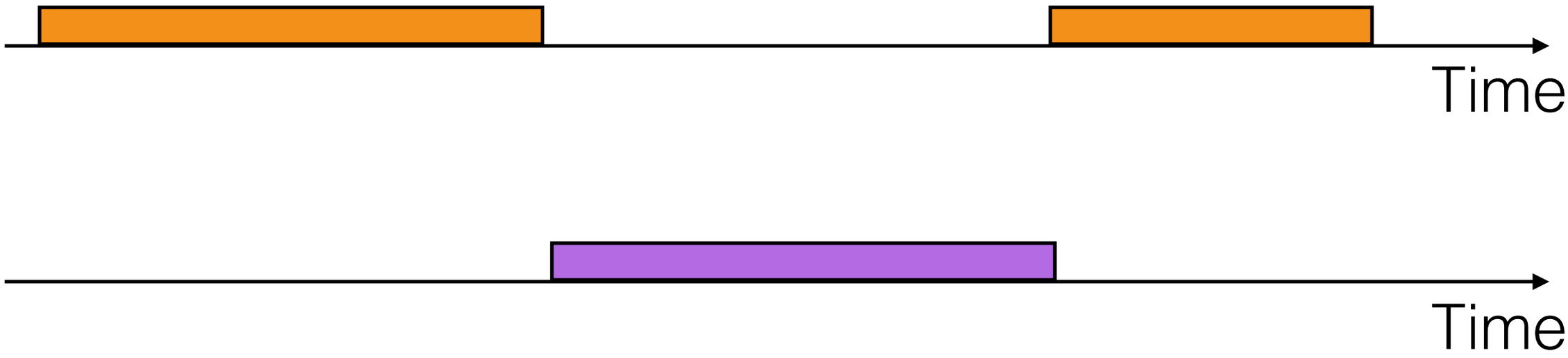
This is the same text for an editor, but more contemporary. What's different?

```
...
CreateWindow();
EnableEvent(WM_CLOSE);
...
void eventOccurred(Event e) {
  switch (e.code) {
    case WM_CLOSE:
       savefile();
       exit(0);
    case 'a'-'z':
       insertChar(e.code);
       break;
    default:
       break;
  }
}
```

The Reality

The Reality



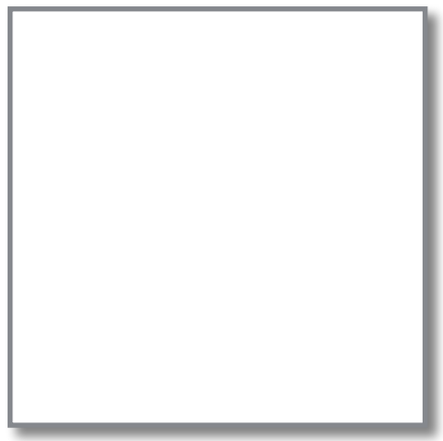

Time
Time

How do Interrupts Work?

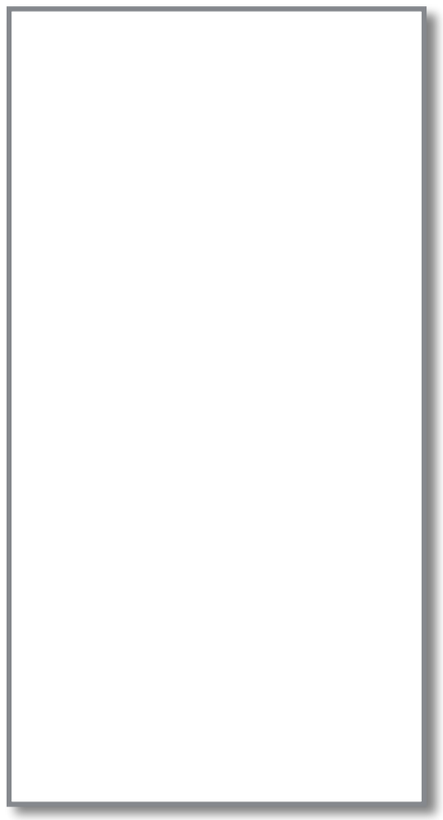
- Hardware
- Processor
- Stack

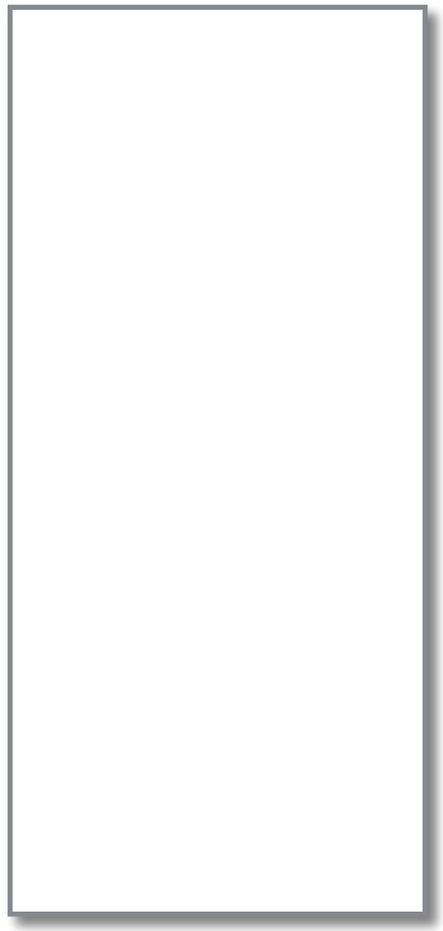
Infrastructure

I/O Controller



Processor

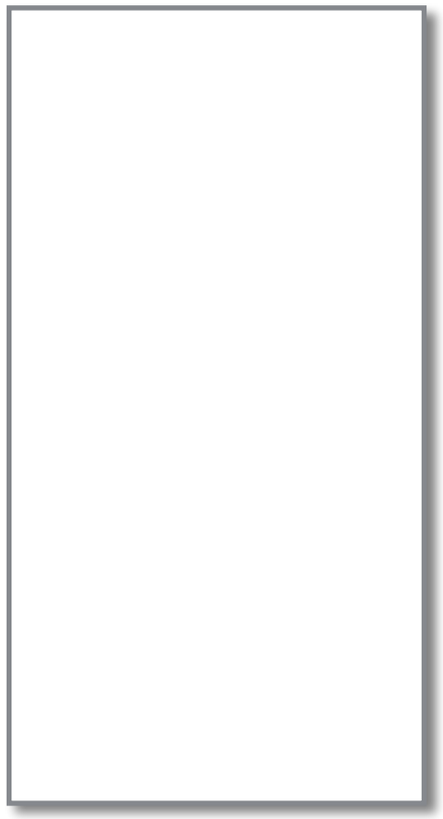




Ram

Infrastructure

Processor



I/O Controllers

Ram

Response to an Interrupt

- At every new instruction:
  - if interrupt pending and interrupts allowed…

How fast?

- How fast is a context switch, approximately?

What's a more accurate graph?

Quantum

- The operating system typically allows programs/ processes to run for a fixed amount of time before another process takes over the processor. How can this be implemented?

That's the root of Parallelism!

Image credits:
http://www.fubiz.net/wp-content/uploads/2015/11/root-8.jpg

Threads
Threading
Multithreading

Process vs Threads

Goals of Multithreading

- Enhance performance
- Increase throughput
- Divide the work into well defined tasks that can be idle waiting for information
- Greater user responsiveness

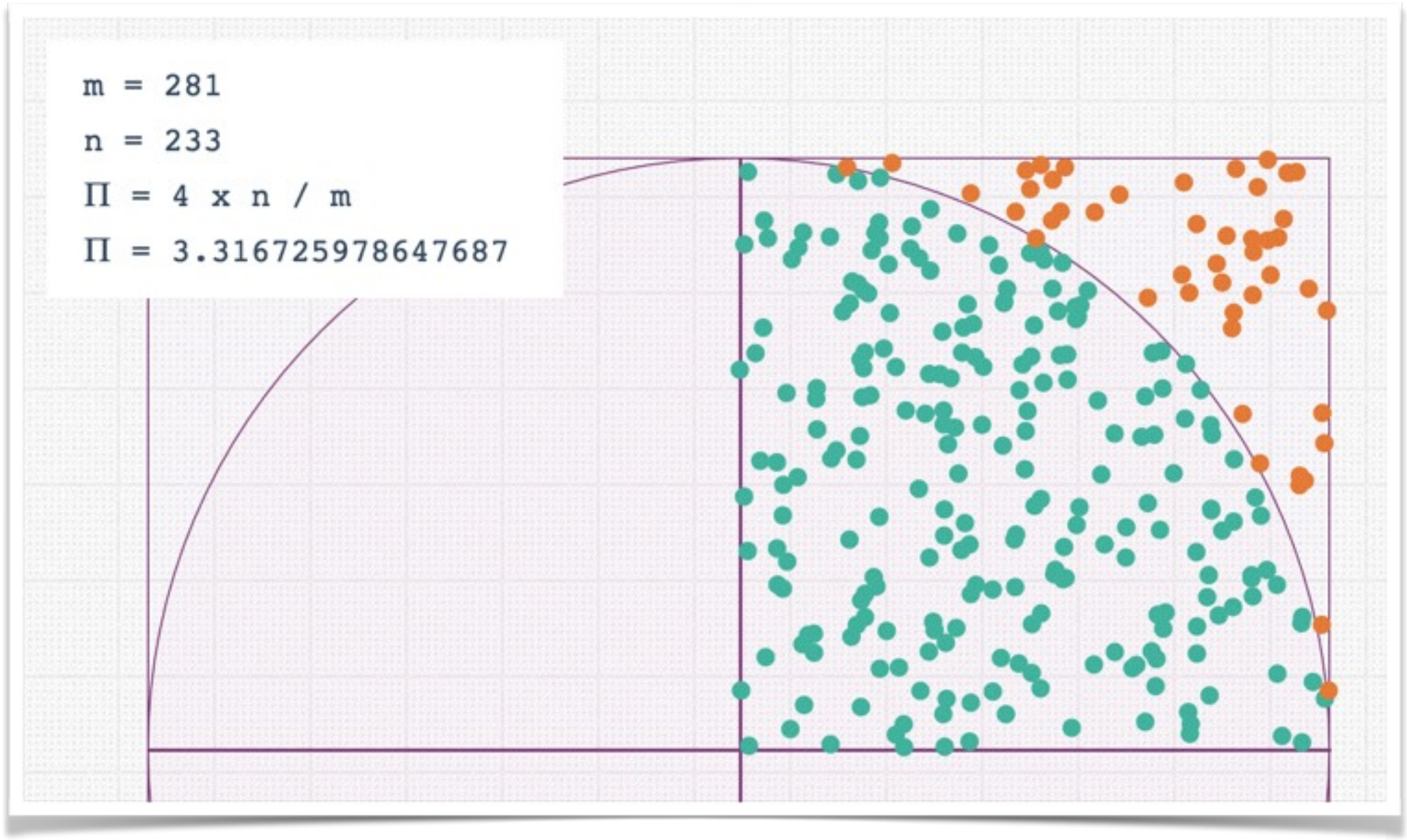
Caveat

- Python supports multithreading, and multiprocessing.
- Python threads CANNOT RUN IN PARALLEL (GIL)
- If parallelism is needed in Python, use the Multiprocessing library
- Discussion: http://stackoverflow.com/questions/3044580/multiprocessing-vs-threading-python

Examples

- Go to class Web page:
  http://www.science.smith.edu/dftwiki/index.php/Python_Multithreading/Multiprocessing_Examples

Monte-Carlo Pi



http://montepie.herokuapp.com/

Python

monteCarloPi.py - /Users/thiebaut/Desktop/Dropbox/352/monteCarloPi.py (3.5.0b1)

```
from __future__ import print_function
from random import random

N = 1000000 # int( input( "> " ) )

inside = 0
for i in range( N ):
    x = random()
    y = random()
    if x*x + y*y < 1:
        inside += 1

    if i > 0 and i%1000 == 0:
        print( "%9d %1.12f" % ( i, 4.0*inside/i ) )

```

Ln: 16 Col: 0

Mini Lab

Write a multiprocessing application in Python that computes an approximation of Pi using the Monte Carlo simulation, and using 10 Processes.