Outline

Sequence and Table Generation

Generate the number sequence

$$\frac{2}{1^2+2}, \frac{3}{2^2+2}, \frac{4}{3^2+2}, \frac{5}{4^2+2}, \ldots$$

using Python.

- Using usual for loop with 10 terms
- Using one line for loop with 10 terms
- Define a function which can generated the sequence

Estimate: 15 minutes

Sequence & Table (cont)

Given the series

$$\frac{1}{7^4} - \frac{1}{9^4} + \frac{1}{11^4} - \frac{1}{13^4} + \cdots - \frac{1}{77^4}.$$

Write the sum using sigma notation and translate it to Python command.

- Using usual for loop.
- Define a function which can generated the numerical value of the series.

Estimate: 15 minutes

Sequence & Table (cont)

Find the sum of all integers between 120 to 7000 inclusive which are divisible by 3 or 7.

- Using usual for loop with 10 terms
- Using one line for loop

Estimate: 15 minutes

Sequence & Table (cont)

Produce a usually multiplication for 1 to 15 as a 2D table.

- Using for loop. Ref: `https://stackoverflow.com/questions/20415384/properly-formatted-multiplication-table`
- Using numpy array (are you able to find the right command for this?)

Estimate: 15 minutes

SPM Statistics

SPM statistics are used in real world business and social data analysis. We will investigate how to apply array-based programming and simple for loops to solve SPM statistics problem.
The table in the next slide shows the frequency distribution of the age of 100 scouts in a camping spot.

SPM Statistics

Age (years)	Frequency	Midpoint	Upper Boundary	Cumulative Frequency
0 – 4	0	2	4.5	0
5 – 9	12			
10 – 14	18			
15 – 19	26			
20 – 24	25			
25 – 29	13			
30 – 34	6			

SPM Statistics (cont)

(a) Complete the above table by using Python.
(b) Calculate the estimated mean age, in years, of a scout in the camping spot.
(c) Any scout which is older than 18 years old is considered senior scout. Use Python program instead of ogive to find the percentage of senior scout in the camping spot.

Estimate: 30 minutes

Stem-and-Leaf Plot

Stem-and-Leaf Plot is a good way to obtain an informative visual display of a data set of numbers x_i with at least two digits. The steps for constructing a stem-and-leaf plot are

1. divide each number x_i into two parts: a *stem*, consisting of one or more of the leading digits and a *leaf*, consisting of the remaining digit.
2. List the stem values in a vertical column.
3. Record the leaf for each observation beside its stem.
4. Write the units for stems and leaves on the display.

Stem-and-Leaf Plot (cont)

Stem-and-leaf plot was developed in the 1970s by John Tukey and is not as nice as histogram.

```
12, 127, 28, 42, 39, 113, 42, 18, 44, 118, 44, 37, 113,
124, 37, 48, 127, 36, 29, 31, 125, 139, 131, 115, 105,
132, 104, 123, 35, 113, 122, 42, 117, 119, 58, 109, 23,
105, 63, 27, 44, 105, 99, 41, 128, 121, 116, 125, 32,
61, 37, 127, 29, 113, 121, 58, 114, 126, 53, 114, 96,
25, 109, 7, 31, 141, 46, 13, 27, 43, 117, 116, 27, 7,
68, 40, 31, 115, 124, 42, 128, 52, 71, 118, 117, 38,
27, 106, 33, 117, 116, 111, 40, 119, 47, 105, 57, 122,
109, 124, 115, 43, 120, 43, 27, 27, 18, 28, 48, 125,
107, 114, 34, 133, 45, 120, 30, 127, 31, 116, 146
```

By using Numpy, write a stem-and-leaf plot function in Python. Hint: `https://www.rosettacode.org/wiki/Stem-and-leaf_plot`.

Estimate: 30 minutes

Why $\pi \neq \frac{22}{7}$?

(a) $\pi = \frac{22}{7}$ (b) $\pi \neq \frac{22}{7}$

Which of the statement above is false? I learned to use (a) in Form 1 to Form 3. So is (a) true? Let ask Python to decide which one is correct.

Write and Run Python commands to Determine Which One of the Statements (a) and (b) is True

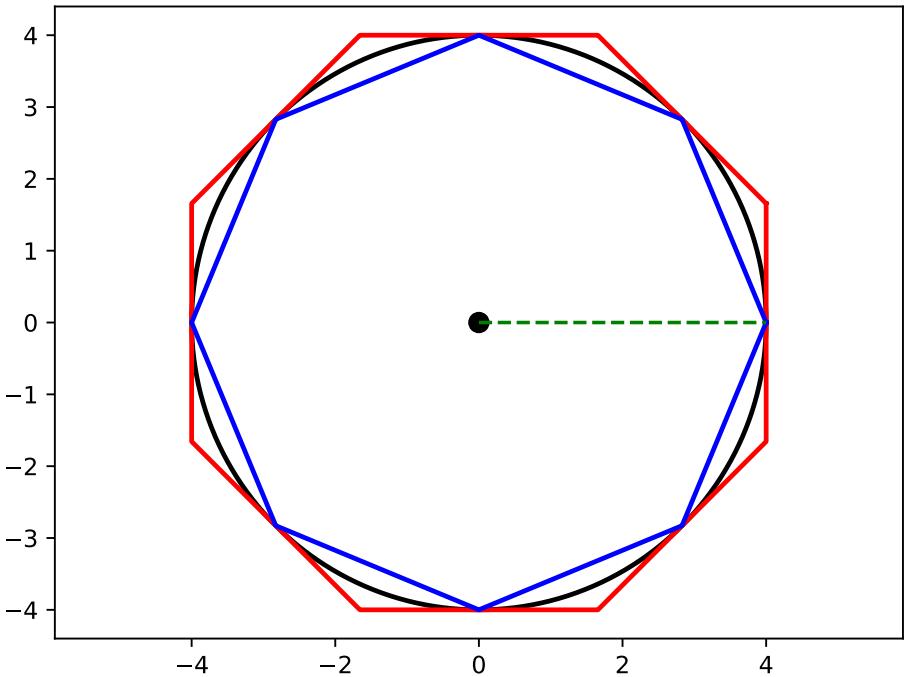
Approximating π using Trigo

What is the "theory" behind π? The value π is defined as the **ratio** of the **circumference** of a circle with respect to the **diameter**. We will use inner and outer regular n-polygon to approximate the circumference and area of a circle of radius r.

Approximating π using Trigo

Use Trigonometry and Python to Approximate π, Circumference and Area

(a) Write a Python script to draw the following diagram (where the circle has a radius 4).



Approximating π using Trigo (cont)

(b) Write a Python script to generate the table of circumferences and areas for the inner and outer polygons where $n = 4, 16, 32, 64, 128, 256, 1024, 2048$ with a **radius of 1**.

Estimate: 1 hour

Outline

Application of Integers

For detecting errors in digital data CRC is used, this is a good technique in detecting the transmission errors. In this technique mainly binary division is applied. In these technique,cyclic redundancy check bits are present which is a sequence of redundant bits,these bits are appended to the end of data unit so that the resulting data unit becomes exactly divisible by a second which is predetermined binary number. At the destination side, the incoming data is divided by the same number, if there is no remainder then assumed that data is correct and it's ready to accept. A remainder indicates that something happen during transition, data unit has been damaged. So this data unit is not accepted.

Application of Integers

Based on https://www.geeksforgeeks.org/cyclic-redundancy-check-python/

Concepts: Cyclic redundancy (application of polynomial algebra), Socket Programming (computer networking)

What is CRC?

CRC or Cyclic Redundancy Check is a method of detecting accidental changes/errors in the communication channel. CRC uses Generator Polynomial which is available on both sender and receiver sides. An example generator polynomial is of the form like $x^3 + 1$. This generator polynomial represents key 1001. Another example is $x^2 + x$. that represents key 110.

Ref: https://en.wikipedia.org/wiki/Cyclic_redundancy_check

Application of Integers (cont)

Scenario: Want to send data “EVN” over Wifi

1. Convert a string (in ASCII encoding) to binary string data.
2. Both sides using the CRC KEY: 1001
3. Code: CRC key length minus 1 $\rightarrow$ 000 appended at end of data.

Estimate: 1 hour