Sorting algorithm visualization : Insertion Sort

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An algorithm like Insertion Sort can be understood easily by visualizing. In this article, a program that visualizes the Insertion Sort Algorithm has been implemented.

The Graphical User Interface(GUI) is implemented in python using pygame library.

Approach:

- Generate random array and fill the pygame window with bars. Bars are straight vertical lines, which represents array elements.
- Set all bars to green color (unsorted).
- Use **pygame.time.delay()** to slow down the algorithm, so that we can see the sorting process.
- Implement a timer to see how the algorithm performs.
- The actions are performed using ‘pygame.event.get()’ method, which stores all the events which user performs, such as start, reset.
- Blue color is used to highlight bars that are involved in sorting at a particular time.
- Orange color highlights the bars sorted.

Observations:

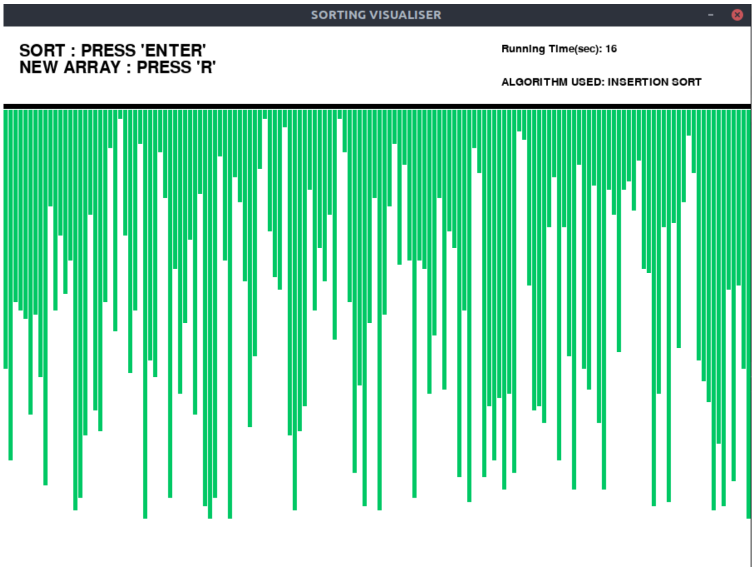
We can clearly see from the Insertion Sort visualization, that insertion Sort is very slow compared to other sorting algorithms like Mergesort or Quicksort.

Examples:

> ***Input:***
> *Press “Enter” key to Perform Visualization.*
> *Press “R” key to generate new array.*

Output:

Initial:

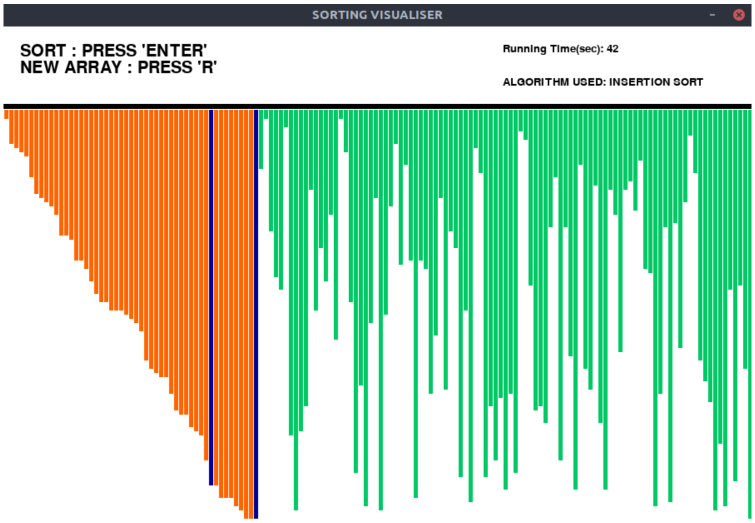


SORT : PRESS 'ENTER'
NEW ARRAY : PRESS 'R'

Running Time(sec): 16

ALGORITHM USED: INSERTION SORT

Sorting:

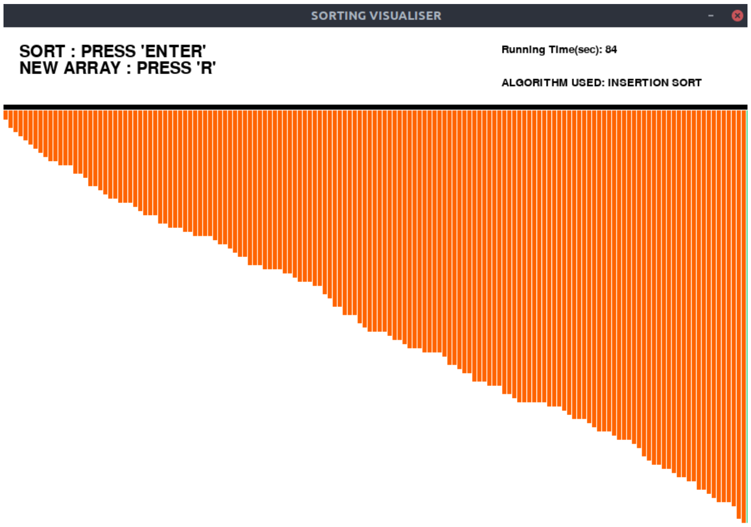


SORT : PRESS 'ENTER'
NEW ARRAY : PRESS 'R'

Running Time(sec): 42

ALGORITHM USED: INSERTION SORT

Final:



SORT : PRESS 'ENTER'
NEW ARRAY : PRESS 'R'

Running Time(sec): 84

ALGORITHM USED: INSERTION SORT

Please make sure to install the pygame library before running the below program.
Below is the implementation of the above visualizer:

Python3

```
# Python implementation of the
# Sorting visualiser: Insertion Sort

# Imports
import pygame
import random
import time
pygame.font.init()
startTime = time.time()
# Total window
screen = pygame.display.set_mode(
                        (900, 650)
                    )

# Title and Icon
pygame.display.set_caption(
            "SORTING VISUALISER"
            )

# Uncomment below lines for setting
# up the icon for the visuliser
# img = pygame.image.load('sorticon.png')
# pygame.display.set_icon(img)

# Boolean variable to run
# the program in while loop
run = True

# Window size and some initials
width = 900
length = 600
array =[0]*151
arr_clr =[(0, 204, 102)]*151
clr_ind = 0
clr =[(0, 204, 102), (255, 0, 0), \
       (0, 0, 153), (255, 102, 0)]
fnt = pygame.font.SysFont("comicsans", 30)
fnt1 = pygame.font.SysFont("comicsans", 20)

# Function to generate new Array
def generate_arr():
    for i in range(1, 151):
        arr_clr[i]= clr[0]
        array[i]= random.randrange(1, 100)

# Initially generate a array
generate_arr()

# Function to refill the
# updates on the window
def refill():
    screen.fill((255, 255, 255))
    draw()
    pygame.display.update()
    pygame.time.delay(10)

# Sorting Algorithm: Insertion sort
def insertionSort(array):

    for i in range(1, len(array)):
        pygame.event.pump()
        refill()
        key = array[i]
        arr_clr[i]= clr[2]
        j = i-1
        while j>= 0 and key<array[j]:
            arr_clr[j]= clr[2]
            array[j + 1]= array[j]
            refill()
            arr_clr[j]= clr[3]
            j = j-1
        array[j + 1]= key
        refill()
        arr_clr[i]= clr[0]

# Function to Draw the array values
def draw():
    # Text should be rendered
    txt = fnt.render("SORT: PRESS 'ENTER'", \
                                1, (0, 0, 0))
    # Position where text is placed
    screen.blit(txt, (20, 20))
    txt1 = fnt.render("NEW ARRAY: PRESS 'R'", \
                                1, (0, 0, 0))
    screen.blit(txt1, (20, 40))
    txt2 = fnt1.render("ALGORITHM USED:"\
           "INSERTION SORT", 1, (0, 0, 0))
    screen.blit(txt2, (600, 60))
    text3 = fnt1.render("Running Time(sec): "+\
            str(int(time.time() - startTime)), \
                                  1, (0, 0, 0))
    screen.blit(text3, (600, 20))
    element_width =(width-150)//150
    boundry_arr = 900 / 150
    boundry_grp = 550 / 100
    pygame.draw.line(screen, (0, 0, 0), (0, 95), \
                                  (900, 95), 6)

    # Drawing the array values as lines
    for i in range(1, 151):
        pygame.draw.line(screen, arr_clr[i], \
                   (boundry_arr * i-3, 100), \
                   (boundry_arr * i-3, \
     array[i]*boundry_grp + 100), element_width)

# Program should be run
# continuously to keep the window open
while run:
    # background
    screen.fill((255, 255, 255))

    # Event handler stores all event
    for event in pygame.event.get():

        # If we click Close button in window
        if event.type == pygame.QUIT:
            run = False
        if event.type == pygame.KEYDOWN:
            if event.key == pygame.K_r:
                generate_arr()
            if event.key == pygame.K_RETURN:
                insertionSort(array)
    draw()
    pygame.display.update()

pygame.quit()
```

Output:

00:00 01:09

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