Sorting algorithm visualization : Heap Sort

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An algorithm like Heap sort can be understood easily by visualizing. In this article, a program that visualizes the Heap 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).
- Heapify the array to perform sorting.
- After Heapify, large bars are at the beginning followed by smaller bars.
- 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 Heap Sort visualization, that Heap Sort is very fast compared to other sorting algorithms like Insertion sort or Selection sort and similar in speed with Merge sort.

Examples:

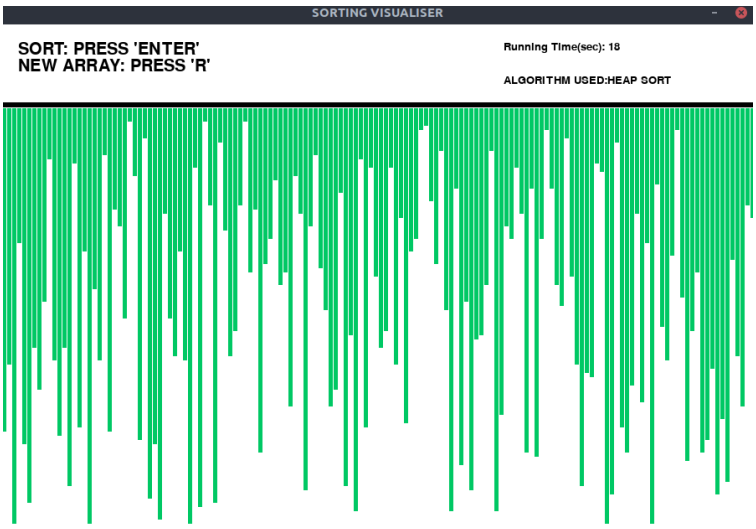
Input:

Press “Enter” key to Perform Visualization.

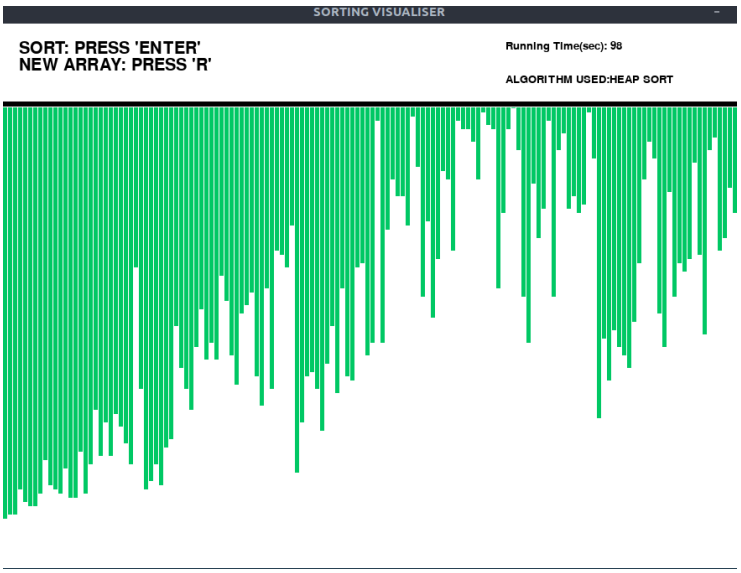
Press “R” key to generate new array.

Output:

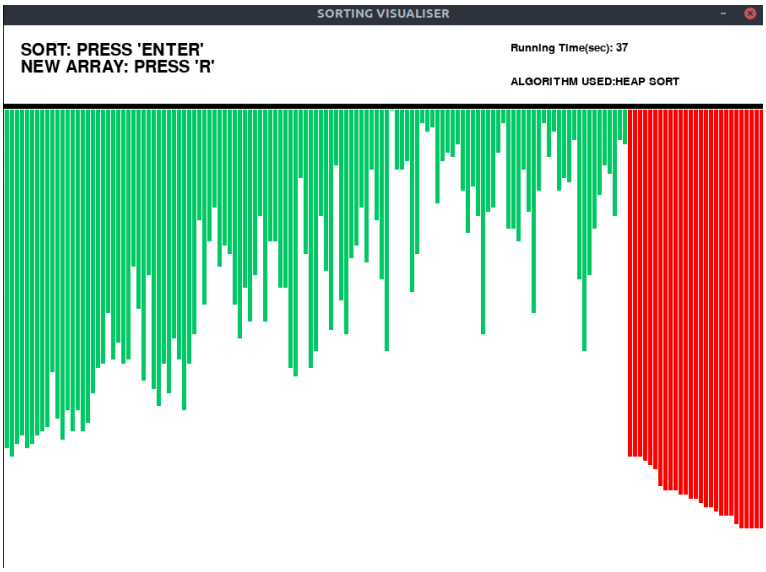
Initial:



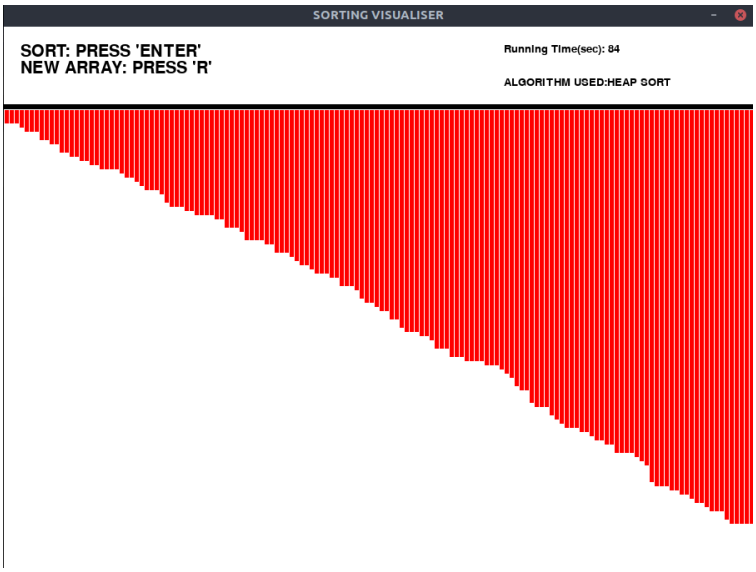
After heapification of array:



Sorting:



Final:



Please make sure to install the pygame library before running the below program.

Below is the implementation of the above visualizer:

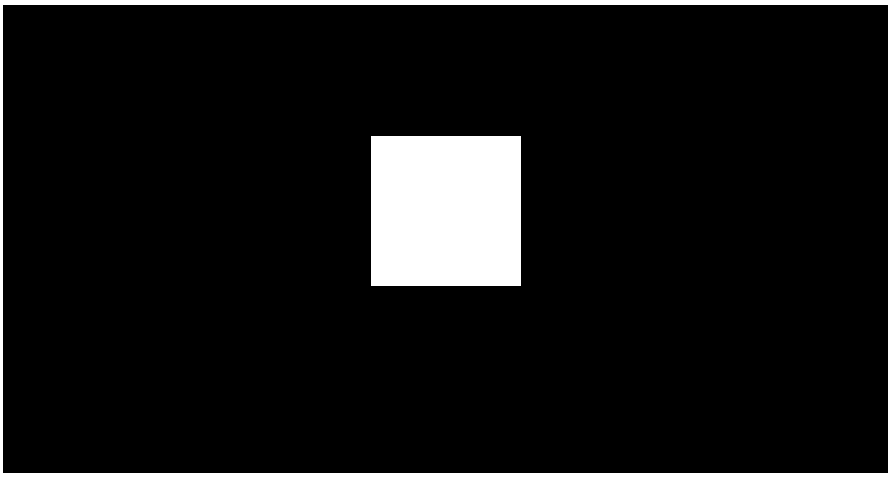
Python3

```
# Python implementation of the
# Sorting visualiser: Heap 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: Heap Sort
    def heapSort(array):
        n = len(array)
        for i in range(n//2-1, -1, -1):
            pygame.event.pump()
            heapify(array, i, n)
        for i in range(n-1, 0, -1):
            array[i], array[0] = array[0], array[i]
            arr_clr[i] = clr[1]
            refill()
            heapify(array, 0, i)


    def heapify(array, root, size):
        left = root * 2 + 1
        right = root * 2 + 2
        largest = root
        if left < size and array[left] > array[largest]:
            largest = left
        if right < size and array[right] > array[largest]:
            largest = right
        if largest != root:
            arr_clr[largest] = clr[2]
            arr_clr[root] = clr[2]
            array[largest],\
            array[root] = array[root],\
            array[largest]
            refill()
            arr_clr[largest] = clr[0]
            arr_clr[root] = clr[0]
            heapify(array, largest, size)
            refill()

    # 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:" +
                           "HEAP 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:
                    heapSort(array)
        draw()
        pygame.display.update()

    pygame.quit()
```



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