

```
!sudo apt install tesseract-ocr -y
!pip install pytesseract opencv-python ipywidgets
```

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Requirement already satisfied: setuptools>=18.5 in /usr/local/lib/python3.11/dist-packages (from ipython>=4.0.0->ipywidgets) (75.2.0)
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  Downloading jedi-0.19.2-py2.py3-none-any.whl.metadata (22 kB)
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Downloading pytesseract-0.3.13-py3-none-any.whl (14 kB)
Downloading jedi-0.19.2-py2.py3-none-any.whl (1.6 MB)
1.6/1.6 MB 17.5 MB/s eta 0:00:00
Installing collected packages: pytesseract, jedi
Successfully installed jedi-0.19.2 pytesseract-0.3.13
```

```
import cv2
import numpy as np
import pytesseract
import matplotlib.pyplot as plt
from google.colab.patches import cv2_imshow
from google.colab import files
import ipywidgets as widgets
from IPython.display import display, clear_output

# Set Tesseract path for Colab
pytesseract.pytesseract.tesseract_cmd = "/usr/bin/tesseract"

uploaded_image_path = None

# === IMAGE PROCESSING ===
def preprocess_image(image_path):
    image = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
    image = cv2.resize(image, (450, 450))
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    blurred = cv2.GaussianBlur(image, (5, 5), 0)
    threshold = cv2.adaptiveThreshold(
        blurred, 255, cv2.ADAPTIVE_THRESH_GAUSSIAN_C,
        cv2.THRESH_BINARY_INV, 11, 2
    )
    return threshold

# === GRID EXTRACTION ===
def extract_sudoku_grid(image):
    grid = np.zeros((9, 9), dtype=int)
    h, w = image.shape
    cell_h, cell_w = h // 9, w // 9

    for i in range(9):
        for j in range(9):
            y1, y2 = i * cell_h, (i + 1) * cell_h
            x1, x2 = j * cell_w, (j + 1) * cell_w
            cell = image[y1:y2, x1:x2]

            cell = cv2.resize(cell, (100, 100))
            cell = cv2.GaussianBlur(cell, (3, 3), 0)
            _, cell = cv2.threshold(cell, 128, 255, cv2.THRESH_BINARY | cv2.THRESH_OTSU)
            cell = cell[15:85, 15:85] # crop center

            digit = pytesseract.image_to_string(
                cell, config='--psm 10 --oem 3 -c tesseract_char_whitelist=123456789'
            )
            digit = ''.join(filter(str.isdigit, digit))
            grid[i][j] = int(digit) if digit else 0

    return grid

# === SUDOKU SOLVER ===
def is_valid(board, row, col, num):
    for i in range(9):
        if board[row][i] == num or board[i][col] == num or \
            board[row//3*3 + i//3][col//3*3 + i%3] == num:
            return False
    return True

def solve_sudoku(board):
    for i in range(9):
        for j in range(9):
            if board[i][j] == 0:
                for num in range(1, 10):
                    if is_valid(board, i, j, num):
                        board[i][j] = num
                        if solve_sudoku(board):
                            return True
                        board[i][j] = 0
                return False
    return True

# === DISPLAY ===
def display_grid(grid, title):
    print(f"\n{title}:")
    for row in grid:
        print(" ".join(str(num) if num != 0 else "." for num in row))

# === UI ===
def on_upload_change(change):
    global uploaded_image_path
    uploaded_file = list(change['new'].values())[0]
    uploaded_image_path = "/content/uploaded_sudoku.png"
    with open(uploaded_image_path, 'wb') as f:
        f.write(uploaded_file['content'])
    print("\n Image uploaded!")
    image = cv2.imread(uploaded_image_path)
    cv2.imshow(image)

def on_solve_clicked(b):
    clear_output()
    display(select_input, upload_button, solve_button)

    if select_input.value == "Manual":
        grid = [
            [5, 3, 0, 0, 7, 0, 0, 0, 0],

```

```

        [6, 0, 0, 1, 9, 5, 0, 0, 0],
        [0, 9, 8, 0, 0, 0, 0, 6, 0],
        [8, 0, 0, 0, 6, 0, 0, 0, 3],
        [4, 0, 0, 8, 0, 3, 0, 0, 1],
        [7, 0, 0, 0, 2, 0, 0, 0, 6],
        [0, 6, 0, 0, 0, 0, 2, 8, 0],
        [0, 0, 0, 4, 1, 9, 0, 0, 5],
        [0, 0, 0, 0, 8, 0, 0, 7, 9],
    ]
    display_grid(grid, "Manual Input")
    if solve_sudoku(grid):
        display_grid(grid, "Solved Sudoku")
    else:
        print("Could not solve the Sudoku.")

elif select_input.value == "Upload" and uploaded_image_path:
    processed = preprocess_image(uploaded_image_path)
    cv2_imshow(processed)

    grid = extract_sudoku_grid(processed)
    display_grid(grid, "Extracted Grid")

    if solve_sudoku(grid):
        display_grid(grid, "Solved Sudoku")
    else:
        print(" Could not solve the Sudoku.")
else:
    print("Please upload an image first!")

# Widgets
select_input = widgets Dropdown(options=["Manual", "Upload"], description='Mode:')
upload_button = widgets.FileUpload(accept='image/*', multiple=False)
solve_button = widgets.Button(description="Solve Sudoku")

upload_button.observe(on_upload_change, names='value')
solve_button.on_click(on_solve_clicked)

display(select_input, upload_button, solve_button)

```

Mode:

Upload (0)

Solve Sudoku

Manual Input:

```

5 3 . . 7 . . .
6 . . 1 9 5 . . .
. 9 8 . . . 6 .
8 . . 6 . . . 3
4 . . 8 . 3 . . 1
7 . . 2 . . . 6
. 6 . . . 2 8 .
. . . 4 1 9 . . 5
. . . . 8 . . 7 9

```

Solved Sudoku:

```

5 3 4 6 7 8 9 1 2
6 7 2 1 9 5 3 4 8
1 9 8 3 4 2 5 6 7
8 5 9 7 6 1 4 2 3
4 2 6 8 5 3 7 9 1
7 1 3 9 2 4 8 5 6
9 6 1 5 3 7 2 8 4
2 8 7 4 1 9 6 3 5
3 4 5 2 8 6 1 7 9

```