Importing Libraries

```
# Import libraries
!pip install pdf2image
!apt install poppler-utils
!apt install libtesseract-dev
!sudo apt install tesseract-ocr
!pip install pytesseract==0.3.9
!pip install tesseract

!pip install Pillow
from PIL import Image
import pytesseract
from pdf2image import convert_from_path
import cv2
import sys
import os
import csv
import numpy as np
from google.colab.patches import cv2_imshow

pytesseract.pytesseract.tesseract_cmd = r'/usr/bin/tesseract'

# Adding custom options for tesseract
# OCR Engine Mode(oem) is set to Legacy and LSTM
custom_config = r'--oem 3 --psm 6'

# Mount Google Drive
```

```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Requirement already satisfied: pdf2image in /usr/local/lib/python3.10/dist-packages (1.17.0)
Requirement already satisfied: pillow in /usr/local/lib/python3.10/dist-packages (from pdf2ima
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
poppler-utils is already the newest version (22.02.0-2ubuntu0.5).
0 upgraded, 0 newly installed, 0 to remove and 49 not upgraded.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
libtesseract-dev is already the newest version (4.1.1-2.1build1).
0 upgraded, 0 newly installed, 0 to remove and 49 not upgraded.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
tesseract-ocr is already the newest version (4.1.1-2.1build1).
0 upgraded, 0 newly installed, 0 to remove and 49 not upgraded.
Requirement already satisfied: pytesseract==0.3.9 in /usr/local/lib/python3.10/dist-packages (
Requirement already satisfied: packaging>=21.3 in /usr/local/lib/python3.10/dist-packages (fro
Requirement already satisfied: Pillow>=8.0.0 in /usr/local/lib/python3.10/dist-packages (from
Requirement already satisfied: tesseract in /usr/local/lib/python3.10/dist-packages (0.1.3)
Requirement already satisfied: Pillow in /usr/local/lib/python3.10/dist-packages (10.4.0)
Drive already mounted at /content/gdrive; to attempt to forcibly remount, call drive.mount("/c
```

Functions

```
#  Some function for use later in code
# Tesseract image to boxes function on a 3 scale mage
```

```
def tessImage2Boxes(img):
    h, w, c = img.shape
    boxes = pytesseract.image_to_boxes(img, config=custom_config)
    for b in boxes.splitlines():
        b = b.split(' ')
        img = cv2.rectangle(img, (int(b[1]), h - int(b[2])), (int(b[3]), h - int(b[4])), (255, 0, 
    cv2_imshow(img)

# Tesseract image to boxes function on a grayscale image
def tessImage2Boxes_gray(img):
    h, w = img.shape
    boxes = pytesseract.image_to_boxes(img, config=custom_config)
    for b in boxes.splitlines():
        b = b.split(' ')
        img = cv2.rectangle(img, (int(b[1]), h - int(b[2])), (int(b[3]), h - int(b[4])), (255, 0, 
    cv2_imshow(img)

# Function to write jpg and text file to the
def imageToStringTextFile(imgToWrite, newFileBase, theFile):
    #print("file to write :", newFileBase + ".jpg", ", Image shape :", imgToWrite.shape)
    # get file details
    head, tail = os.path.split(theFile)
    #print("head :", head, "tail: ", tail)
    newFileName = head + "/" + newFileBase + tail[17:19]
    print("newFileName :", newFileName)

    # Write the output of the technique to a jpg
    cv2.imwrite(newFileName + ".jpg", imgToWrite)

    # Use tesseract to convert image to string - it extracts the text from the image and saves as 
    text = str(((pytesseract.image_to_string(imgToWrite, lang='eng', config=custom_config))))
    text = text.replace('-\n\n', '')
```

```
    # # Finally, write the processed text to the file.
    with open(newFileName+".txt", 'w') as writefile:
        writefile.write(text + "\n")
```

Retrieve Files Setup

```
# File Pathname to indicate where to get of file - use google drive
afile = ('/content/gdrive/MyDrive/ComputerVision/Week 5 BOM 2')

# Read the BOM jpg here
aImg = cv2.imread(afile + '/RedactedIsometric5.jpg')
cv2_imshow(aImg)
```

Extract Region of Interest

```
aImg.shape
```

```
# Define the region of interest - ensure this is as accurate as possible
# Coordinates obtained from MS Paint

# File Pathname to indicate where to get of file - use google drive
afile = ('/content/gdrive/MyDrive/ComputerVision/Week 5 BOM 2')

# Read the BOM jpg here
aImg = cv2.imread(afile + '/RedactedIsometric5.jpg')
# cv2_imshow(aImg)
```

```
# I had an error here finding ROI. After several attempts I managed to get a decent result.
# The x and y values needed to be offset by minus one. Solutioin found online.
height, width, _ = aImg.shape

row_start = max(0, min(206, height - 1))
row_end = max(0, min(2841, height))
col_start = max(0, min(5519, width - 1))
col_end = max(0, min(7975, width))

aImg = aImg[row_start:row_end, col_start:col_end]

# Call Function to write jpg and text file
imageToStringTextFile(aImg, "BOM_ROI_5", afile)
# cv2_imshow(aImg)

# Use tesseract to display image of boxes surrounding the text found. Good visual display to see ho
# This can be commented out as it doesn't always need to run
# tessImage2Boxes(aImg)
```

```
newFileName : /content/gdrive/MyDrive/ComputerVision/BOM_ROI_5
```

Convert To GrayScale

```
img1grayscale = aImg.copy()
# Convert to grayscale
img1grayscale = cv2.cvtColor(img1grayscale,cv2.COLOR_BGR2GRAY)
```

Binary Threshold

```
# Using Simple threshold to improve the ratio rate significantly across all images
# Highest final ratio achieved with Binary ToZero as follows.
ret, imgBin = cv2.threshold(img1grayscale,127,255,cv2.THRESH_TOZERO)

# Call Function to write jpg and text file
imageToStringTextFile(imgBin, "BOM_BIN_5", afile)

# Use tesseract to display image of boxes surrounding the text found. Good visual display to see ho
# This can be commented out as it doesn't always need to run
tessImage2Boxes_gray(imgBin)
```

newFileName : /content/gdrive/MyDrive/ComputerVision/BOM_BIN_5

	ITEM	SIZE	BILL OF MATERIAL	QTY
JACKET	1	2"	Pipe, Carbon Steel, Seamless, ASTM A106 Gr.B, Sch 40	3.0M
	2	2"	Elbow 90 Deg, SR, Butt Weld, Carbon Steel, A234 WPB, Sch 40	2
	3	½"	Weldolet, Butt Weld, Carbon Steel, FRG ASTM A105, Sch 40	3
	4	½"	Pipe, Carbon Steel, Seamless, ASTM A106 Gr.B, Sch 40	0.5M
	5	½"	Weldneck Flange, 300#. RF, Carbon Steel, ASTM A105 ASME B16.5	4
	6	½"	Elbow 90 Deg, LR, Butt Weld, Carbon Steel, A234 WPB, Sch 40	3
CORE	7	1"	Pipe, Carbon Steel, Seamless, ASTM A106 Gr.C, Sch 160	3.0M
	8	1"	Elbow 90 Deg, LR, Butt Weld, Carbon Steel, A234 WPC, Sch 160	2

HUBS	9	1.1/2"	Grayloc Hub, 1.1/2" GR7, A350-LF2 c/w Clamp (AISI 4140), Seal Ring (AISI 630 NACE, MOS2 Coated), Studs & Nuts	3
	10	1"	Grayloc Hub, 1" GR7, A350-LF2 c/w Clamp (AISI 4140), Seal Ring (AISI 630 NACE, MOS2 Coated), Studs & Nuts	1

Erosion

```
# Inverse Threshold used since Erosion works better with a dark background.
ret, imgBinInv = cv2.threshold(img1grayscale,127,255,cv2.THRESH_BINARY_INV)

# create kernel
kernel = np.ones((3,3),np.uint8)

# Apply erosion to the image
# Spend time finding the correct balance of variables(kernel, iterations)
imgErode = cv2.erode(imgBinInv,kernel,iterations = 1) # inversethresh used here (imgBin) as erosio
#cv2_imshow(imgErode)

# Function to write jpg and text file
imageToStringTextFile(imgErode, "BOM_ERO_5", afile)

# Use tesseract to display image of boxes surrounding the text found. Good visual display to see h
# This can be commented out as it doesn't always need to run
# tessImage2Boxes_gray(imgErode)
```

```
newFileName : /content/gdrive/MyDrive/ComputerVision/BOM_ERO_5
```

Contouring - Horizontal and Vertical lines

```
# # making a copy of the image here as findContours might make changes to original image
imgContour = img1grayscale.copy()

# # Image has to be be in grayscal for the morphologyEx operations to work
#gray = cv2.cvtColor(imgContour, cv2.COLOR_BGR2GRAY)
```

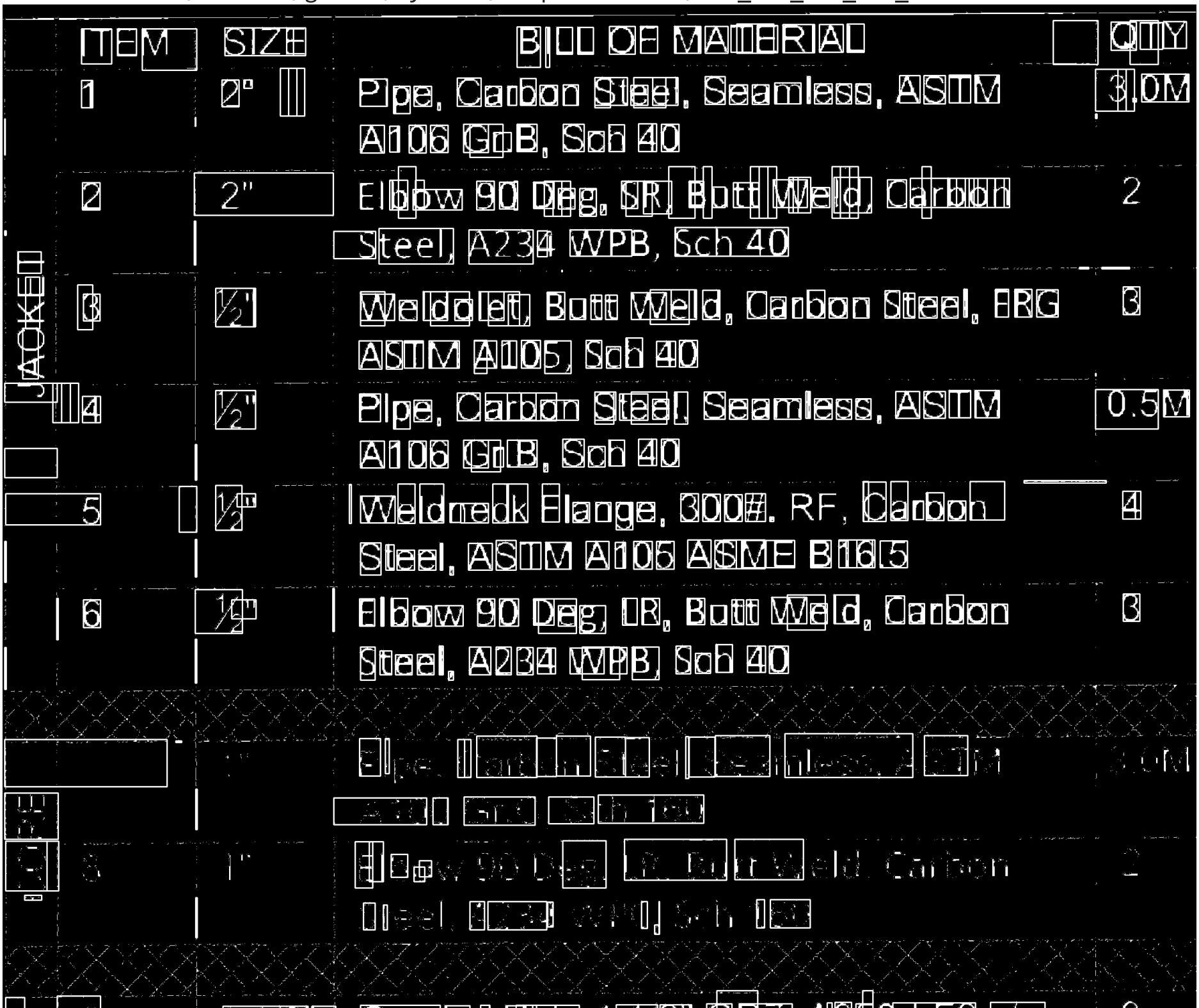
```
ret, thresh = cv2.threshold(imgContour,127,255,cv2.THRESH_BINARY)

# Horizontal Kernel code here: a horizontal kernel will help to detect all the horizontal line fro
horizontal_kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (3,2) ) # This kernel yielded best r
detect_horizontal = cv2.morphologyEx(thresh, cv2.MORPH_OPEN, horizontal_kernel, iterations=1) # 1 
cnts = cv2.findContours(detect_horizontal, cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
# If third column value is NOT equal to -1 than its internal contouring
cnts = cnts[0] if len(cnts) == 2 else cnts[1]
for c in cnts:
  # Draw the contour
  cv2.drawContours(imgContour, [c], -1, (0,0,0), 1) # Values change to fix fully white image

# Vertical Kernel code here : A verticle kernel which will detect all the verticle lines from the 
vertical_kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (2,3)) # This kernel yeilded best resu
detect_vertical = cv2.morphologyEx(thresh, cv2.MORPH_OPEN, vertical_kernel, iterations=2) # 2 iter
cnts = cv2.findContours(detect_vertical, cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
# If third column value is NOT equal to -1 than its internal contouring
cnts = cnts[0] if len(cnts) == 2 else cnts[1]
for c in cnts:
  # Draw the contour
  cv2.drawContours(imgContour, [c], -1, (0,0,0), 1) # Values change to fix fully white image

# Function to write jpg and text file
imageToStringTextFile(imgContour, "BOM_HOR_VER_5", afile)

# Use tesseract to display image of boxes surrounding the text found
#tessImage2Boxes_gray(imgContour)
```

Erosion and Contouring

```
# apply contouring to the eroded image

# # making a copy of the image here as findContours might make changes to original image
result = imgErode.copy()
# # Image has to be be in grayscal for the morphologyEx operations to work
# gray =
ret, thresh = cv2.threshold(result,127,255,cv2.THRESH_BINARY)

# Horizontal Kernel
# These values will not give the best result - you are expected to explore different values
# This kernel yeilded best result, trial and error
horizontal_kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (3,2) )
horizontal_mask = cv2.morphologyEx(thresh, cv2.MORPH_OPEN, horizontal_kernel, iterations=1)
cnts = cv2.findContours(horizontal_mask, cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
cnts = cnts[0] if len(cnts) == 2 else cnts[1]
for c in cnts:
  cv2.drawContours(result, [c], -1, (0,0,0), 1)

# Vertical Kernel
# These values will not give the best result - you are expected to explore different values
# This kernel yeilded best result, trial and error
vertical_kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (2,3))
detect_vertical = cv2.morphologyEx(thresh, cv2.MORPH_OPEN, vertical_kernel, iterations=1)
cnts = cv2.findContours(detect_vertical, cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
cnts = cnts[0] if len(cnts) == 2 else cnts[1]
for c in cnts:
  cv2.drawContours(result, [c], -1, (0,0,0), 1)

# Function to write jpg and text file
imageToStringTextFile(result, "BOM_ERO_HOR_VER_5", afile)
```

```
# Use tesseract to display image of boxes surrounding the text found
tessImage2Boxes_gray(result)
```

newFileName : /content/gdrive/MyDrive/ComputerVision/BOM_ERO_HOR_VER_5



RUBS	9	1.1/2"	Grayloc Hub, 1.1/2" GR7, A350-LF2 c/w Clamp (AISI 4140), Seal Ring (AISI 630 NACE, MOS2 Coated), Studs & Nuts	3
	10	1"	Grayloc Hub, 1" GR7, A350-LF2 c/w Clamp (AISI 4140), Seal Ring (AISI 630 NACE, MOS2 Coated), Studs & Nuts	1

Contouring and then Erosion you are here

```
kernel = np.ones((2,2),np.uint8)

imgContour2 = imgContour.copy()

contErode =  cv2.erode(imgContour2,kernel,iterations = 2)

# Function to write jpg and text file
imageToStringTextFile(contErode, "BOM_HOR_VER_ERO_5", afile)

# Use tesseract to display image of boxes surrounding the text found. Good visual display to see ho
# This can be commented out as it doesn't always need to run
#tessImage2Boxes_gray(contErode)
```

```
newFileName : /content/gdrive/MyDrive/ComputerVision/BOM_HOR_VER_ERO_5
```

Blurring

```
imgBlur = cv2.imread(afile + '/RedactedIsometric5.jpg')

imgBlur = imgBlur[219:1507, 5849:8036]

#Highest end number attained with median blur
imgBlur = cv2.medianBlur(imgBlur,3) # Changed to diff (oddnumbered) parameters. 3=best

# Function to write jpg and text file
imageToStringTextFile(imgBlur, "BOM_BLUR_5", afile)
```

```
# Use tesseract to display image of boxes surrounding the text found. Good visual display to see
# This can be commented out as it doesn't always need to run
```