Q3

June 1, 2020

[1]:
```
%%javascript
IPython.OutputArea.prototype._should_scroll = function(lines) {
    return false;
}
```

<IPython.core.display.Javascript object>

[2]:
```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import cv2
from IPython.core.display import display, HTML
display(HTML("<style>.container { width:100% !important; }</style>"))
```

<IPython.core.display.HTML object>

0.0.1 1.) Image Resize to 10, 30, 50%

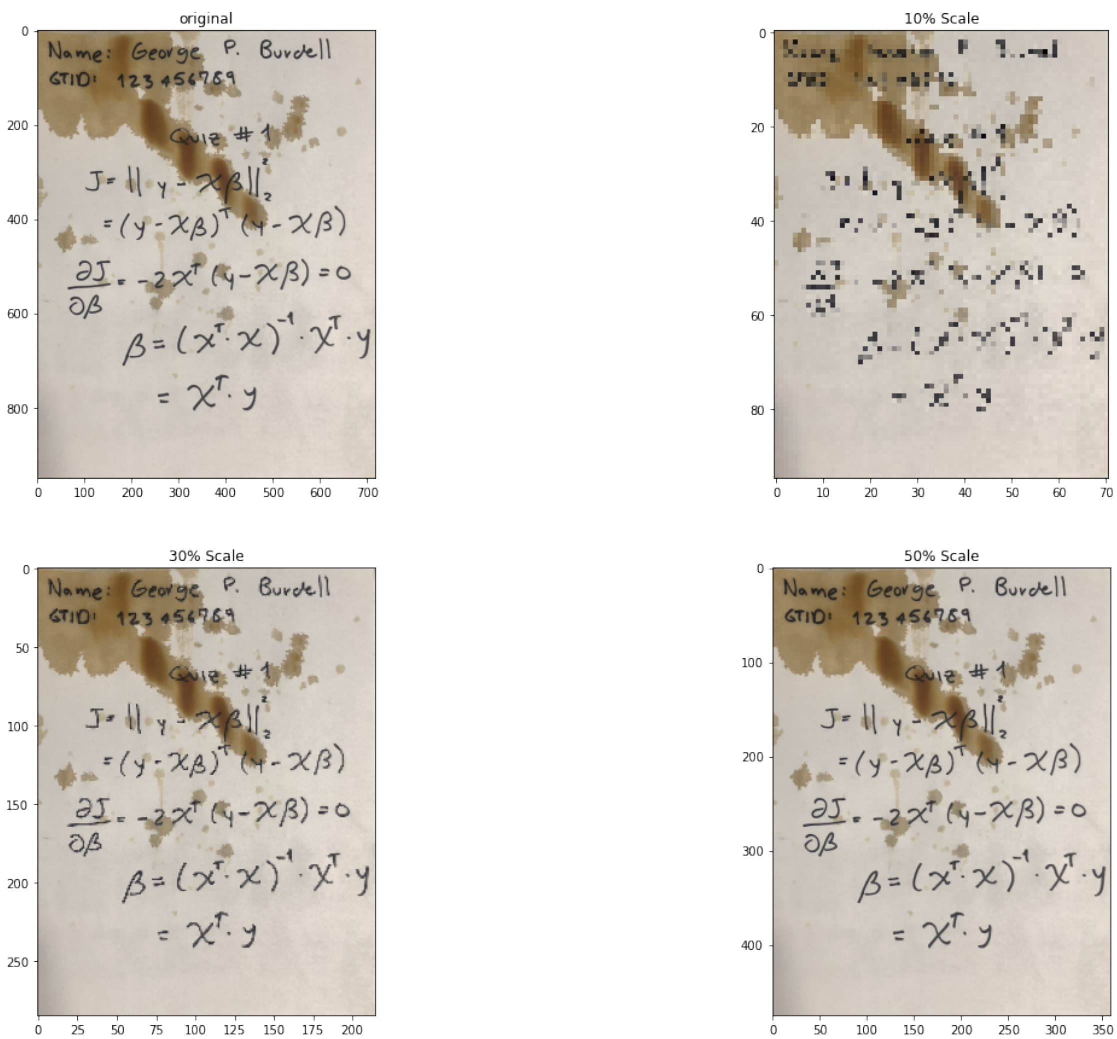
[3]:
```
img = plt.imread('Quiz.png')
```

[4]:
```
def resize(img, percent):
    h = int(img.shape[0] * percent)
    w = int(img.shape[1] * percent)

    return cv2.resize(img, (w,h))
```

[5]:
```
img10 = resize(img, 0.1)
img30 = resize(img, 0.3)
img50 = resize(img, 0.5)
```

[6]:
```
plt.subplots(nrows=2,ncols=2, figsize=(20,15))

plt.subplot(221)
```

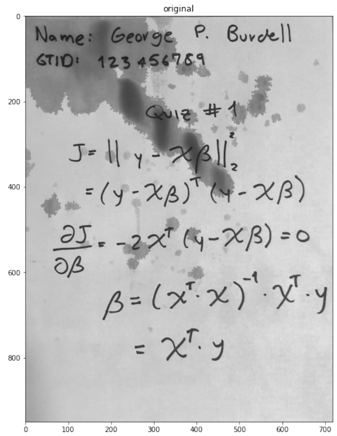
```
plt.imshow(img)
plt.title('original')

plt.subplot(222)
plt.imshow(img10)
plt.title('10% Scale')

plt.subplot(223)
plt.imshow(img30)
plt.title('30% Scale')

plt.subplot(224)
plt.imshow(img50)
plt.title('50% Scale')

plt.show()
```

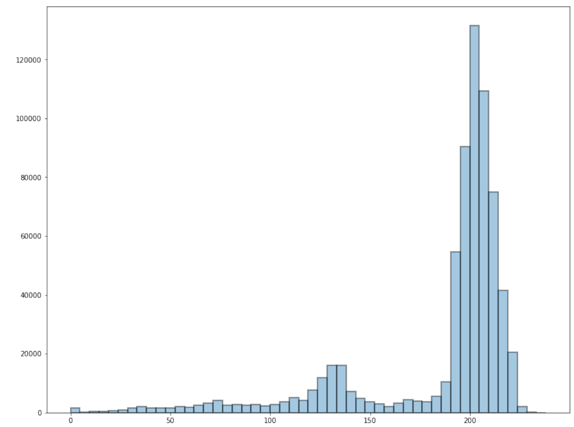


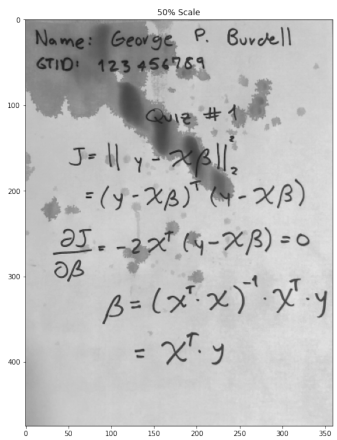
0.0.2 2.) Convert to grayscale

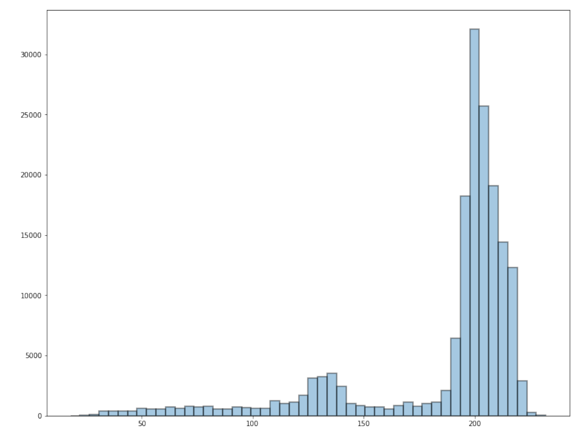
[7]:
```
gray = (cv2.cvtColor(img, cv2.COLOR_RGB2GRAY) * 255).astype('int32')
gray10 = (cv2.cvtColor(img10, cv2.COLOR_RGB2GRAY) * 255).astype('int32')
gray30 = (cv2.cvtColor(img30, cv2.COLOR_RGB2GRAY) * 255).astype('int32')
gray50 = (cv2.cvtColor(img50, cv2.COLOR_RGB2GRAY) * 255).astype('int32')
```

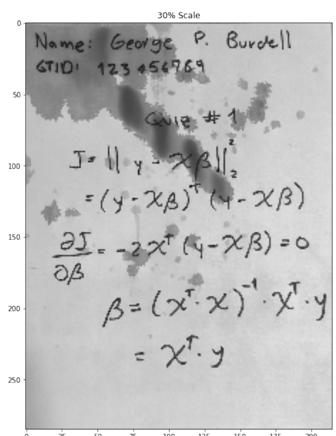
[8]:
```
plt.subplots(nrows=4,ncols=2, figsize=(30,50))

plt.subplot(421)
plt.imshow(gray, cmap='gray', vmin=0, vmax=255)
plt.title('original')

plt.subplot(422)
sns.distplot(gray.reshape(-1),kde=False,hist_kws=dict(edgecolor="k",␣
↪linewidth=2))

plt.subplot(423)
plt.imshow(gray50, cmap='gray', vmin=0, vmax=255)
plt.title('50% Scale')


plt.subplot(424)
sns.distplot(gray50.reshape(-1),kde=False,hist_kws=dict(edgecolor="k",␣
↪linewidth=2))


plt.subplot(425)
plt.imshow(gray30, cmap='gray', vmin=0, vmax=255)
plt.title('30% Scale')

plt.subplot(426)
sns.distplot(gray30.reshape(-1),kde=False, hist_kws=dict(edgecolor="k",␣
↪linewidth=2))

plt.subplot(427)
plt.imshow(gray10, cmap='gray', vmin=0, vmax=255)
plt.title('10% Scale')

plt.subplot(428)
sns.distplot(gray10.reshape(-1),kde=False,hist_kws=dict(edgecolor="k",␣
↪linewidth=2))

plt.show()
```

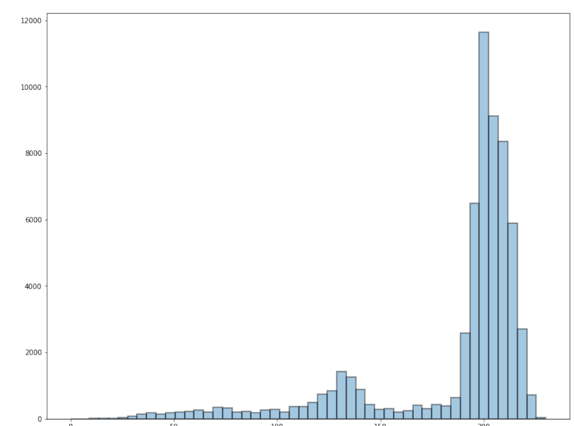

original
Name: George P. Burdell
GTID: 123456789
Quiz # 1

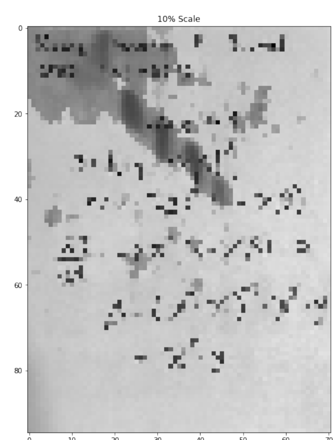


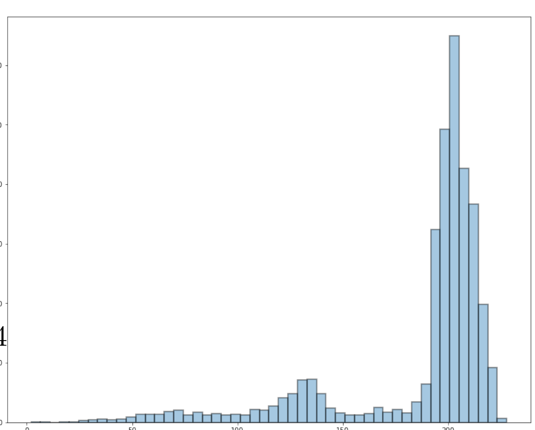

50% Scale




30% Scale




10% Scale



0.0.3 Image Selection

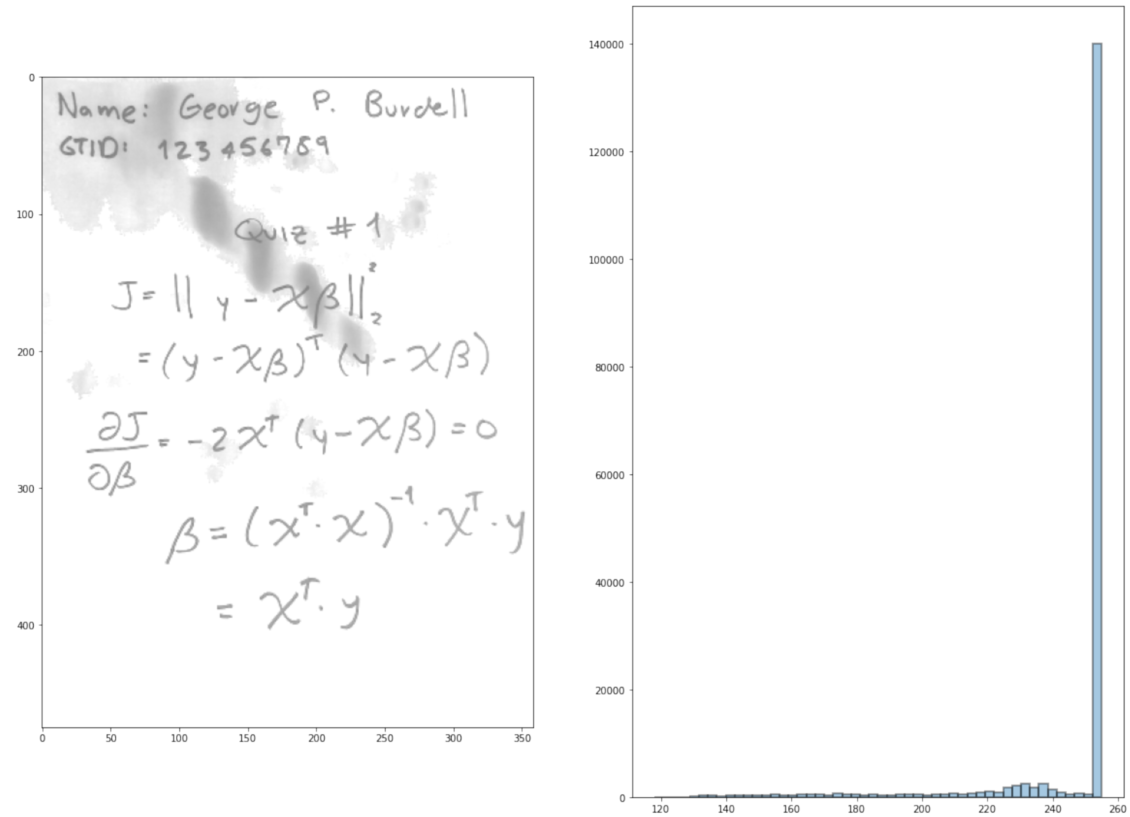
The 50% image looks to be the best candidate. It reduces the original image from > 6 million pixels to approx 1.7 million pixels while maintaining sufficient resolution. The 30% and 10% appear to be too grainy, and probably will begin to lose informational structure as transformations are later applied

0.0.4 3.) Pixel Shifting

[9]:
```
def pixelshift(image, s):
    img = image.copy()
    img += s
    img[img>255] = 255
    img[img<0] = 0
    return img
```

[10]:
```
shift = pixelshift(gray50, 100)
```

[11]:
```
plt.subplots(nrows=1, ncols=2, figsize=(20,15))
plt.subplot(121)
plt.imshow(shift, cmap='gray', vmin=0, vmax=255)

plt.subplot(122)
sns.distplot(shift.reshape(-1),kde=False,hist_kws=dict(edgecolor="k",␣
 ↪linewidth=2))

plt.show()
```



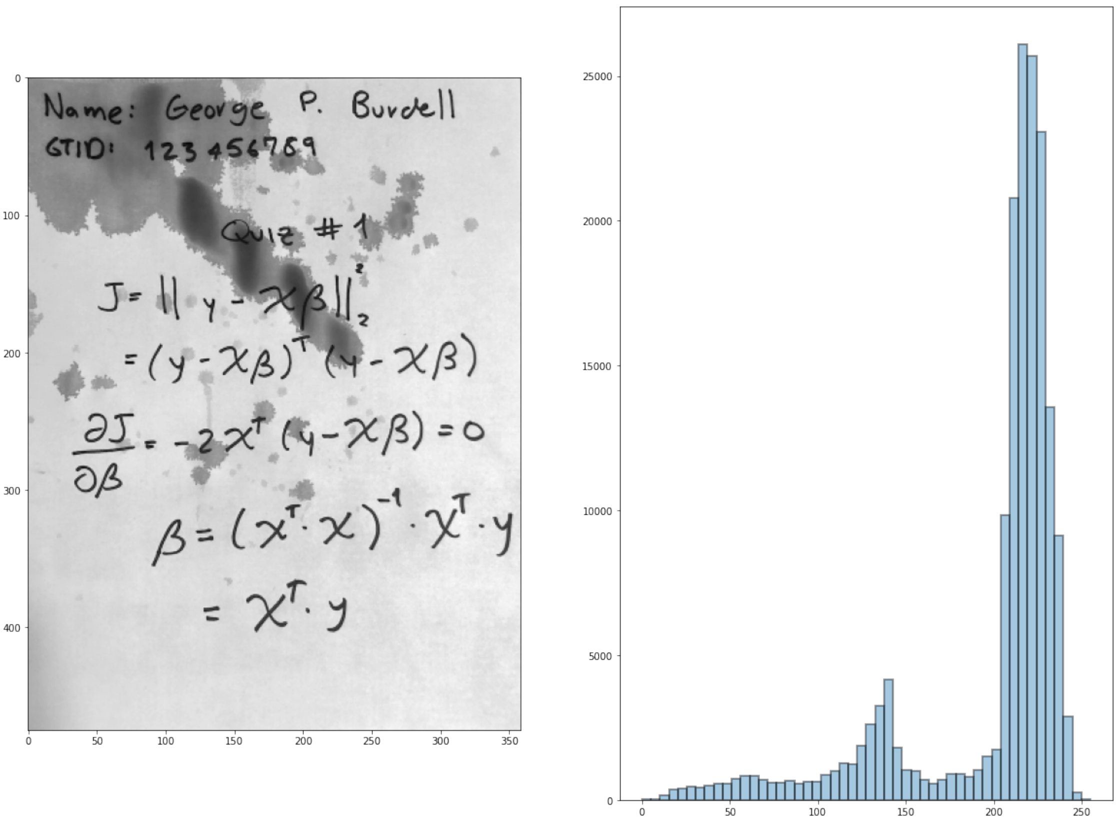
0.0.5 4.) Histogram Stretching

[12]:
```python
def stretch(image):

    img = image.copy()
    pmin = np.min(img)

    #max pixel intensity
    pmax = np.max(img)

    #lambda
    lam = 255

    #hist stretching function
    s = lambda x: ((x - pmin) / (pmax - pmin)) * lam


    return s(img).astype(int)
```

[13]:
```python
img_stretch = stretch(gray50)
```

[14]:

```
plt.subplots(nrows=1, ncols=2, figsize=(20,15))
plt.subplot(121)
plt.imshow(img_stretch, cmap='gray', vmin=0, vmax=255)

plt.subplot(122)
sns.distplot(img_stretch.reshape(-1),kde=False,hist_kws=dict(edgecolor="k", linewidth=2))

plt.show()
```



0.0.6 5.) Linear (negative image)

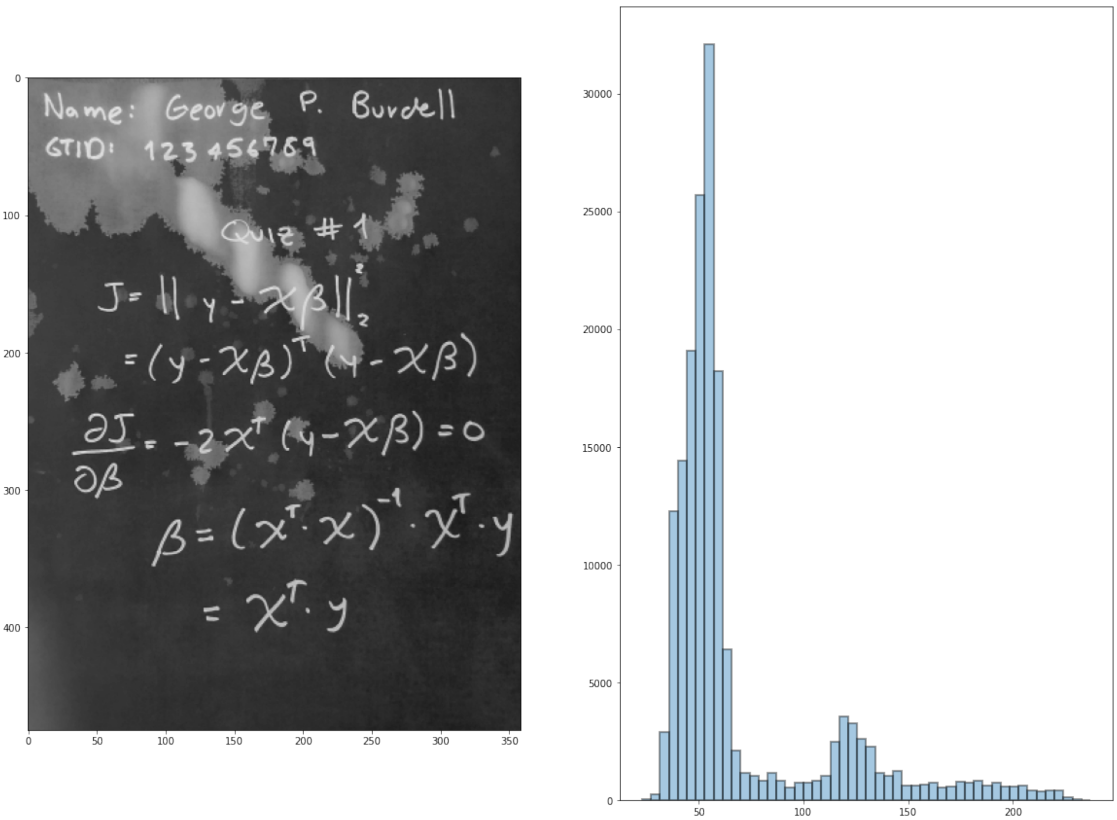
[15]:

```
def linear(image):
    img = image.copy()
    lin = lambda x: (256 - 1) - x

    return lin(img).astype(int)
```

[16]:

```
lin_img = linear(gray50)
```

[17]:
```
plt.subplots(nrows=1, ncols=2, figsize=(20,15))
plt.subplot(121)
plt.imshow(lin_img, cmap='gray', vmin=0, vmax=255)

plt.subplot(122)
sns.distplot(lin_img.reshape(-1),kde=False,hist_kws=dict(edgecolor="k",␣
↪linewidth=2))

plt.show()
```

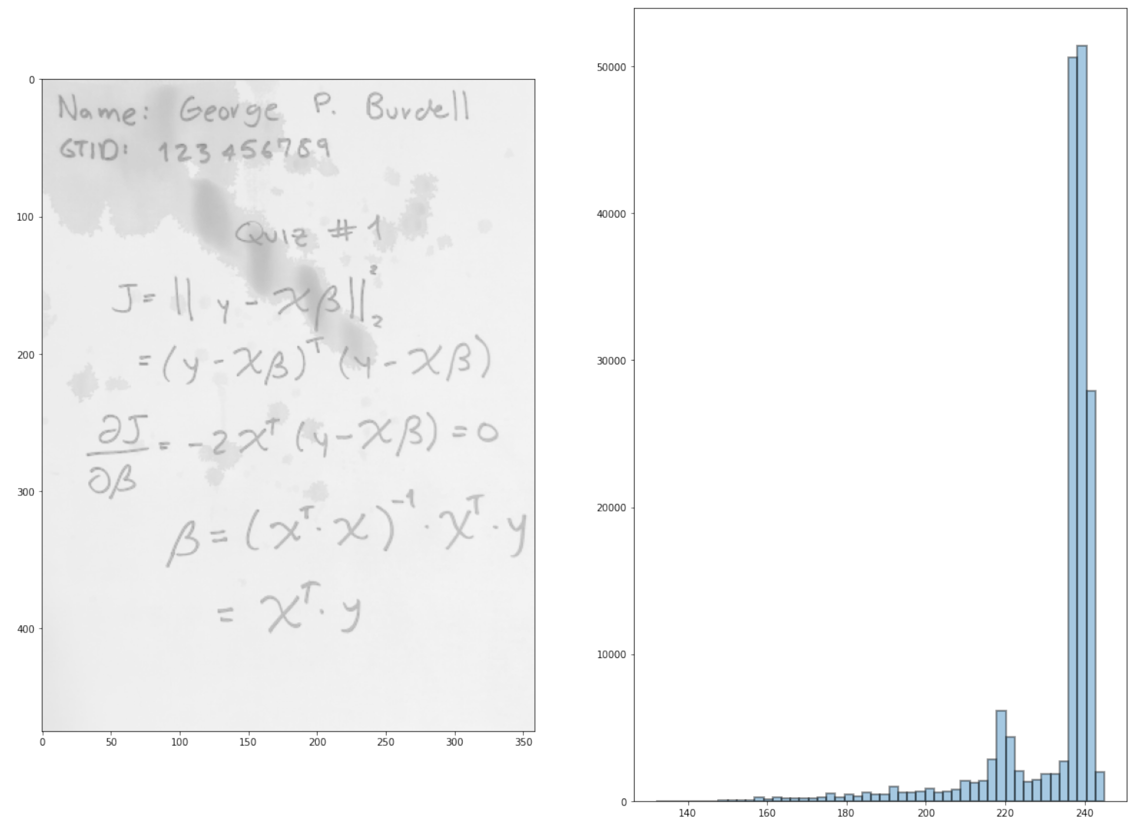


0.0.7 6.) logarthimic transformation

[18]:
```
def log(image):
    img = image.copy()
    c=45

    logpix = lambda x: c * np.log(x + 1)

    return logpix(img).astype(int)
```

[19]:
```python
log_img = log(gray50)
```

[20]:
```python
plt.subplots(nrows=1, ncols=2, figsize=(20,15))
plt.subplot(121)
plt.imshow(log_img, cmap='gray', vmin=0, vmax=255)

plt.subplot(122)
sns.distplot(log_img.reshape(-1),kde=False,hist_kws=dict(edgecolor="k",␣
↪linewidth=2))

plt.show()
```



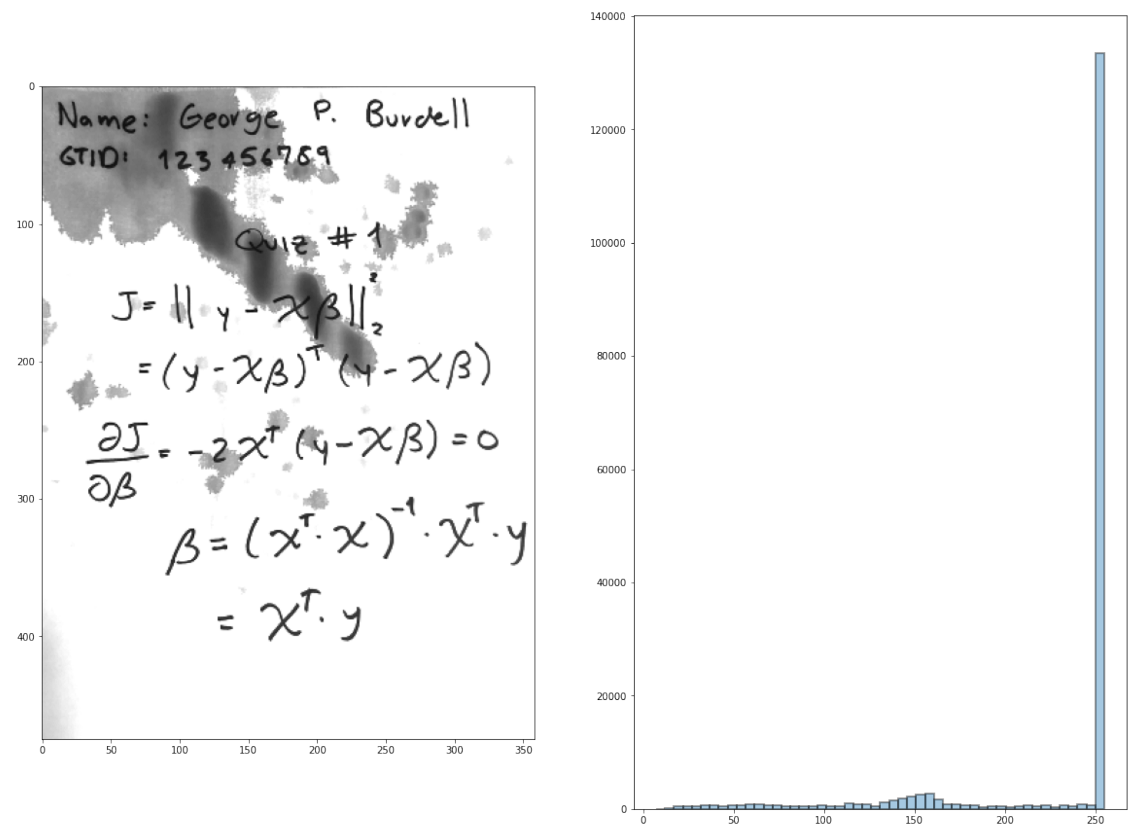
0.0.8 7.) Power Function Transformation

[21]:
```python
def power(image):
    img = image.copy()
    c=0.1
    gam = 1.5

    powpix = lambda x: c * x**gam
```

```
    img = powpix(img).astype(int)

    img[img > 255] = 255

    return img
```

[22]:
```
pow_img = power(gray50)
```

[23]:
```
plt.subplots(nrows=1, ncols=2, figsize=(20,15))
plt.subplot(121)
plt.imshow(pow_img, cmap='gray', vmin=0, vmax=255)

plt.subplot(122)
sns.distplot(pow_img.reshape(-1),kde=False,hist_kws=dict(edgecolor="k",␣
 ↪linewidth=2))

plt.show()
```



0.0.9 8.) Black and White

[24]:
```
def bnw(image, thresh):
    img = image.copy()
    img[img <= thresh] = 0
    img[img > thresh] = 1

    return img
```

0.0.10 linear image to black and white

[25]:
```
lin_bw = bnw(lin_img, 183)
```

0.0.11 power image to black and white

[26]:
```
pow_bw = bnw(pow_img, 61)
```

0.0.12 logarithmic image to black and white

[27]:
```
log_bw = bnw(log_img, 193)
```

0.0.13 histogram stretch to black and white

[28]:
```
stretch_bw = bnw(img_stretch, 65)
```

0.0.14 Pixel shift to black and white

[29]:
```
shift_bw = bnw(shift, 173)
```

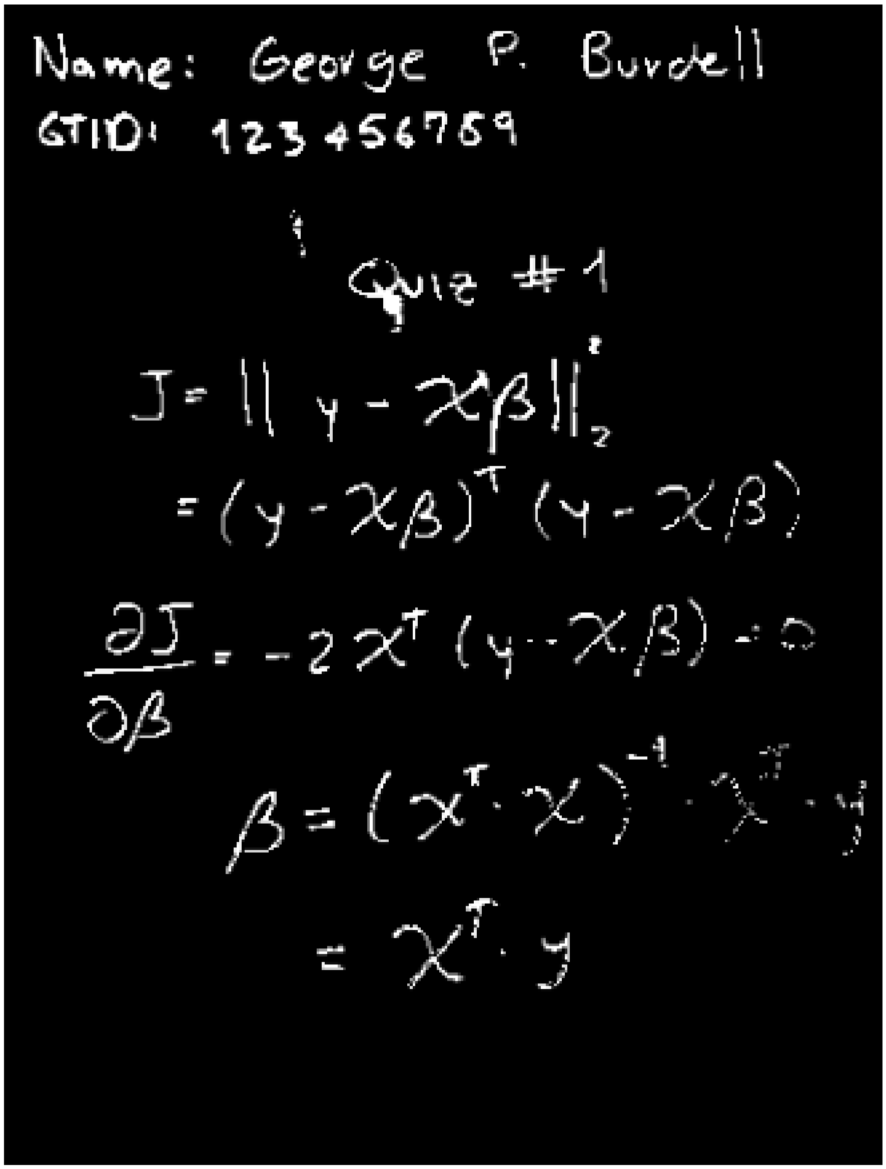
0.0.15 All results

[30]:
```
results = [lin_bw, pow_bw, log_bw, stretch_bw, shift_bw]
titles = ['linear transform', 'power transform', 'log transform', 'histogram␣
↪stretch', 'pixel shift']
```

[31]:
```
for i in range(len(results)):
    plt.figure(figsize=(15,8))
    plt.imshow(results[i], cmap='gray')
    plt.axis('off')
```

```
    plt.title(titles[i])
    plt.show()
```

linear transform



power transform

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Quiz #1

$$J = \| y - X\beta \|_2^2$$

$$= (y - X\beta)^T (y - X\beta)$$

$$\frac{\partial J}{\partial \beta} = -2X^T (y - X\beta) = 0$$

$$\beta = (X^T \cdot X)^{-1} \cdot X^T \cdot y$$

$$= X^T \cdot y$$

log transform

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Quiz #1

$$J = \| y - X\beta \|_2^2$$

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$$\beta = (X^T \cdot X)^{-1} \cdot X^T \cdot y$$

$$= X^T \cdot y$$

histogram stretch

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Quiz #1

$$J = \| y - X\beta \|_2^2$$

$$= (y - X\beta)^T (y - X\beta)$$

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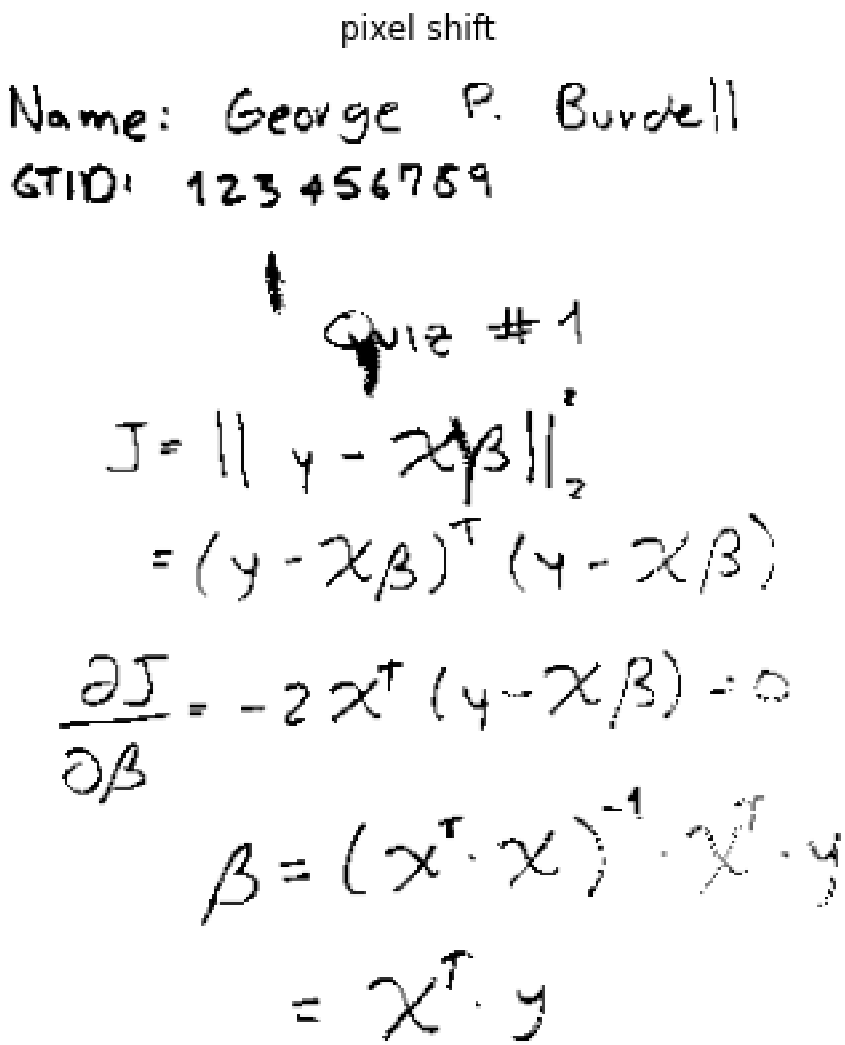
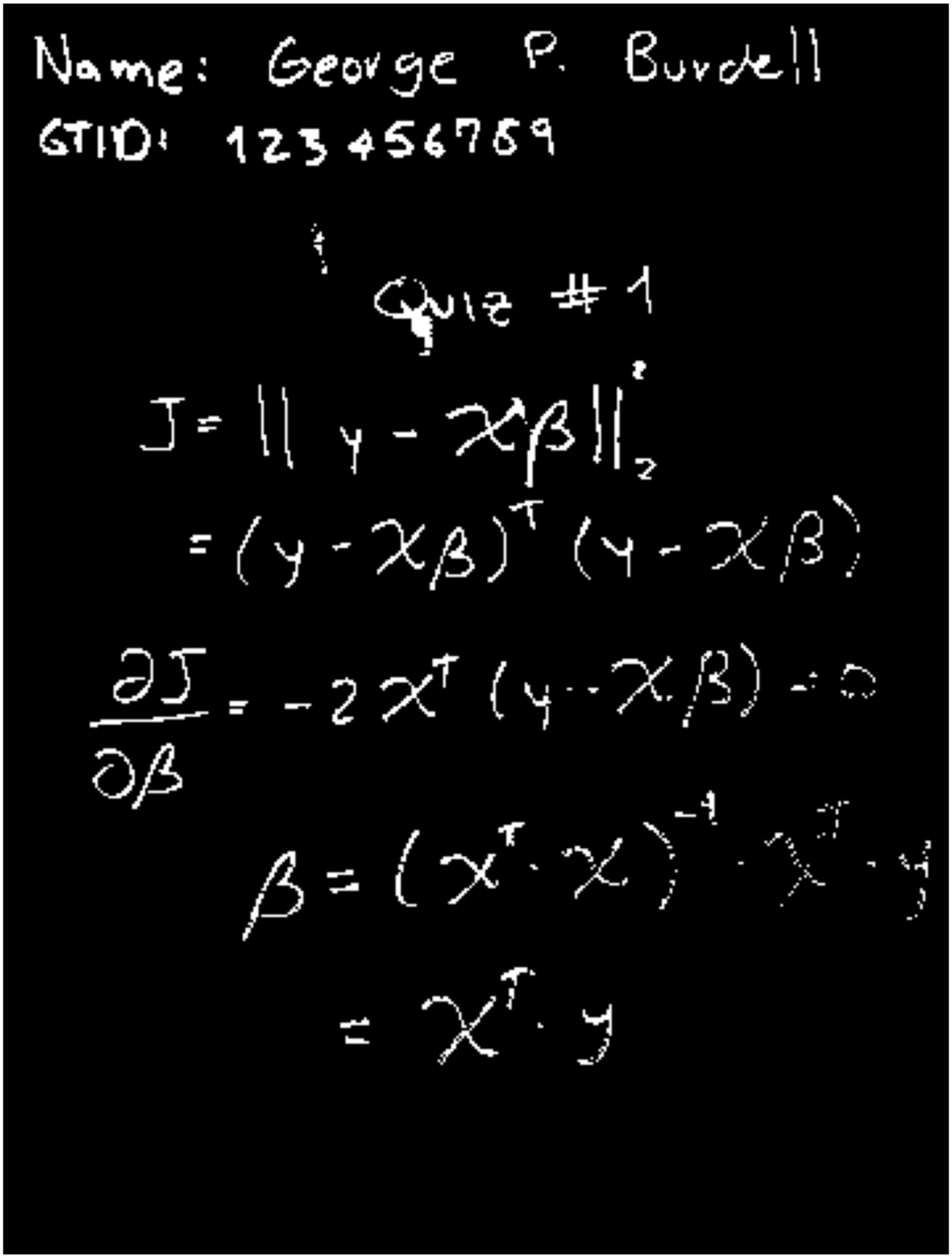
$$= X^T \cdot y$$



1 Winner Winner Chicken Dinner

[32]:
```
plt.figure(figsize=(30,20))
plt.imshow(lin_bw, cmap='gray')
plt.axis('off')
plt.show()
```


Name: George P. Burdell
GTID: 123456789
Quiz #1
$J = \|y - X\beta\|_2^2$
$= (y - X\beta)^T (y - X\beta)$
$\frac{\partial J}{\partial \beta} = -2X^T(y - X\beta) = 0$
$\beta = (X^T \cdot X)^{-1} \cdot X^T \cdot y$
$= X^T \cdot y$

[ ]: