2018

Conclusion Of Mechine Learning Of Kaggle

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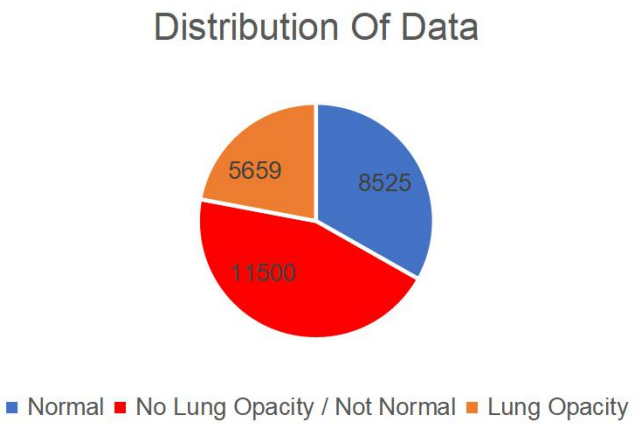
Succinct Introduce Competition

- Competition platform：Kaggle
- Sponsor Institution：RSNA（Radiological Society of North America）
- Data Furnish Institution：NIH（National Institutes of Health Clinical Center）
- Total Fund：$30,000
  - First：$12,000
  - Second：$7,000
  - Third：$4,000
  - Fourth to Tenth：Each $1,000
- Total Joined Teams：1445



Final Rank

- The Comptetition Max Score is : 0.26
- Our Max Score is : 0.181
- The Max Rank Of us is : 160 th
- The Gross teams are : 1445
- The percentage of us is :Top 11%

Processing

1 Initial Dilemma

2 Frame Of Model

3 Deficient Of Model

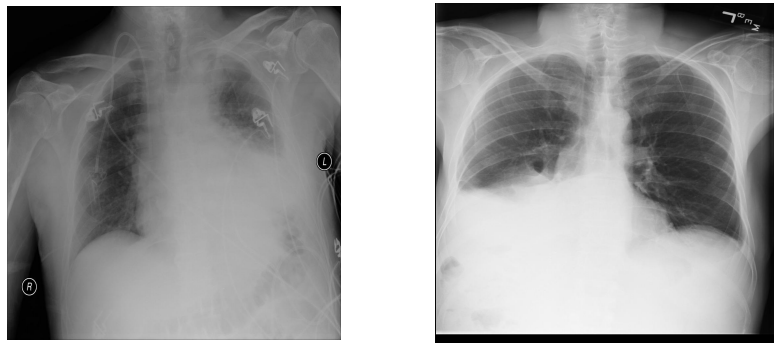
4 ResNeXt-FPN Frame

ONE

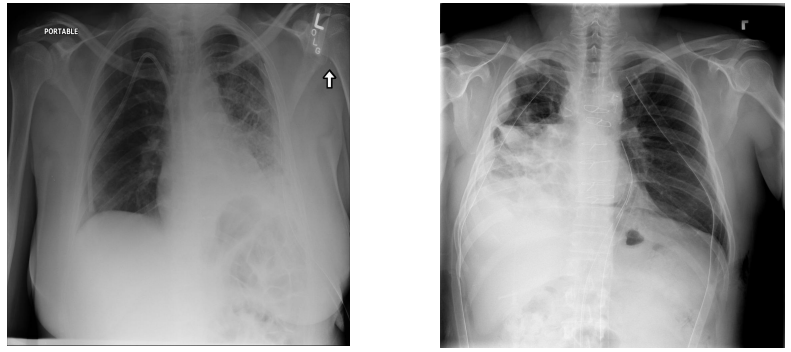
Initial Dilemma

Initial Dilemma

- At the begining of the competition,i have used the single model Mask-rcnn to detect the Lung Opacity area in the X-ray image . However , the final result of the single model was not excellent . There were numerous false positive samples in it . I have extrapolated the reason of the outcome . The conclusion of my is because of the similarity of the X-ray images in different classes . With the observation of my eyes ， i can not discern the **Lung Opacity** patient and the **Not normal but not Lung Opacity** patient .
- So ,with the conclusion that i have proposed , i thought we must use the multiple model to oppressive the false positive in the samples which will be used in the final detection model .In the theory ， it can pronounced suppress the false positive.



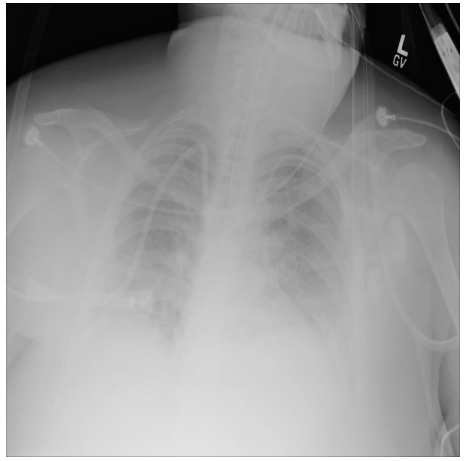
Not Normal Not Lung Opacity



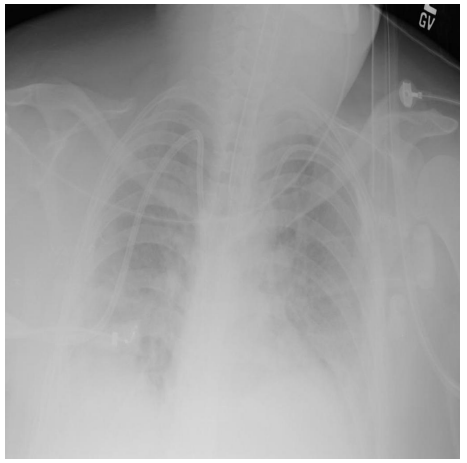
Lung Opacity

Initial Dilemma

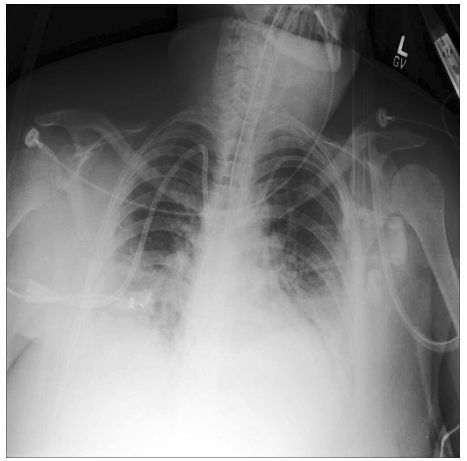
- The second of dilemma at the begining is the deficient of X-ray image . With the over exposure , It is so vague in one image that can not distinguish the margin of the lung .
- So , for surmount the plight, We have tried numerous image trans , like **Gamma trans , Liner trans** at all . At the end , the **histogram equalization** is the final trans that we have choised.
- And this is one of our data augmentation method .The others augmentation have displaied at the side of the screen.



Original Image
3d63ab2e-862a-4f11-82d3-b9f561e8ecec



Reorganized Image



Original After Trans Image
3d63ab2e-862a-4f11-82d3-b9f561e8ecec

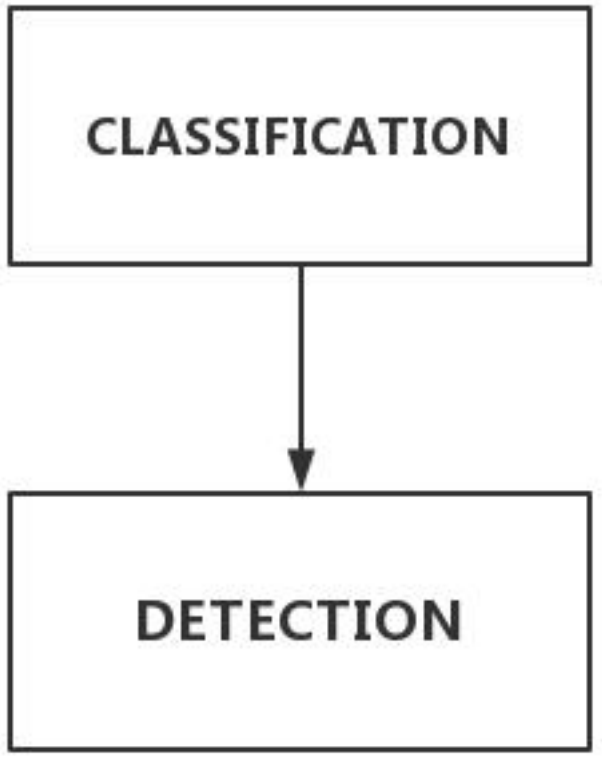
Reorganized Image After Trans

TWO

Frame Of Model

Frame Of Model

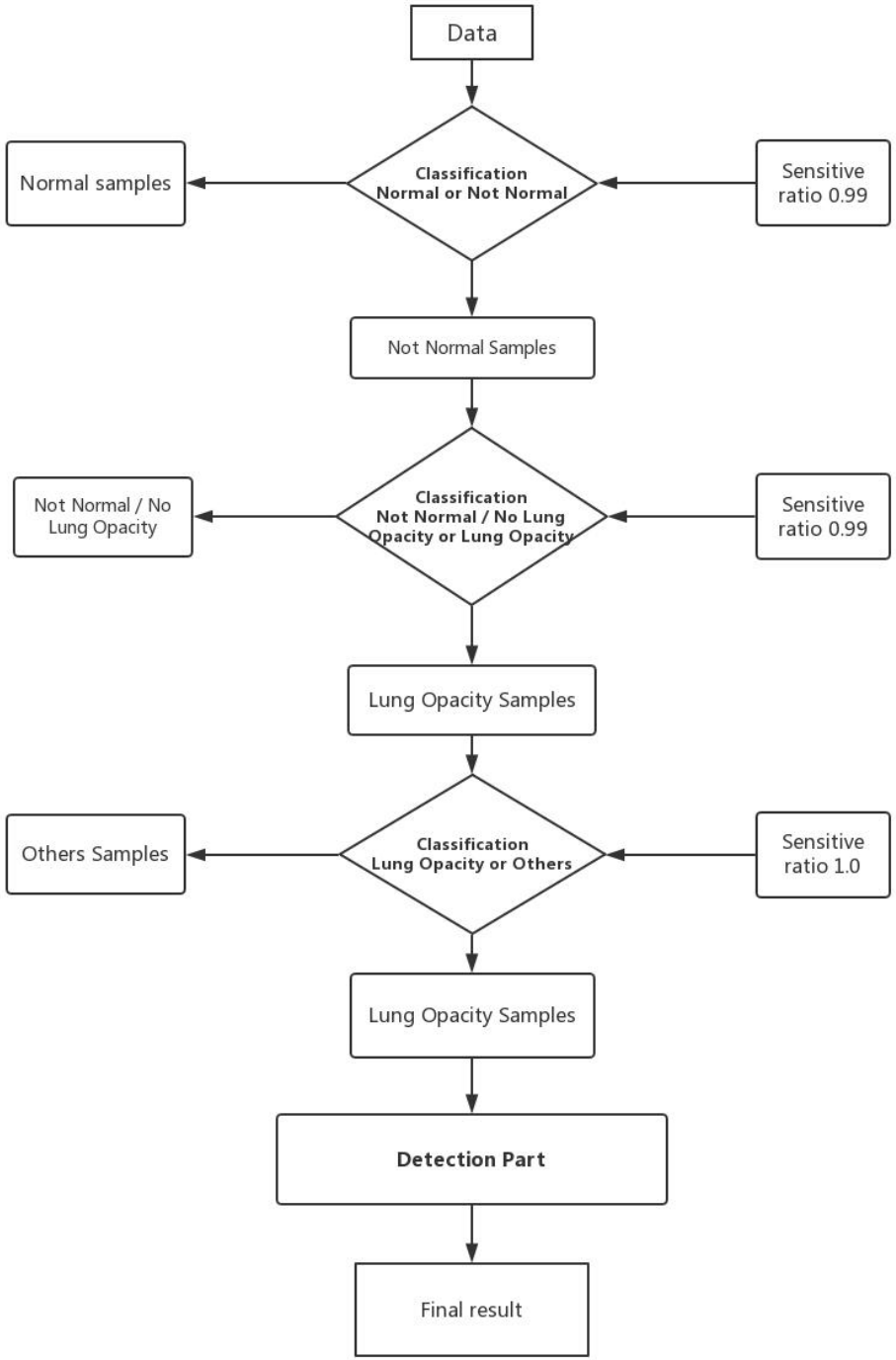
- For solve the plight that we have encountered at the first part ,i proposed the model which has two steps , **classification and detection** .
- There is three labels in data set , **Normal** , **Not Normal / No Lung Opacity** , **Lung Opacity** . Our terminal purpose is to exclude more negtive samples and guaranteeing all Lung Opacity samples are all in the samples which will be detected .
- Detection will be used to detect the samples which have the Lung Opacity label .



Frame Of Model (Classification)

- The task of classification has **three** steps .
- **ONE** : Use classification to discern the **Normal** and **Not Normal** samples .The samples **Not Normal** contain Not Normal / No Lung Opacity and Lung Opacity label samples .Training samples contain all labels in the data set （Training samples : 24650 , validate samples :1034）.For guaranteeing the Lung Opacity samples are all included in the next step , i modulated the **sensitive ratio to 0.99** .
- **TWO** : Use the classification to discern the samples which label is **Not Normal .** To distinguish the Not Normal / No Lung Opacity and Lung Opacity samples . Training samples (Training samples : 16368 , validate samples :892) only contain labels of Not Normal / No Lung Opacity and Lung Opacity .(**Sensitive ratio is 0.99**).
- **THREE** : For excluding more negtive samples in the label of **Lung Opacity** (There are numerous negtive samples in the label of Lung Opacity , because the sensitive of the above double classification are 0.99!), I design the final classification. Use the classification to discern the negtive samples which are in the label of **Lung Opacity** .Training samples （Training samples : 24650 , validate samples :1034） contain all labels in the data set .(**Sensitive ratio is 1.0)**

Classification work flow



Frame Of Model (Classification)

- All the classification are based on the model of **ResNet 50** or **ResNet 75**.The First Classification is based on the **ResNet 50** , because it is more simple than the next two model . The second and third classification is based on **ResNet 75** , its are more complex than the First model .
- For imporving the accuracy of each steps , i use the **combination trick** . In each step , the classification unites with four different subclassification with different accuracy . And the final result combines the distinct four result .
- In each subclassification , the accuracy will effect the weight of this subclassification. The sum of weights of all subclassification is 1.0 .

```
TP is  606
TP_FN is  704
TP / TP_FN  0.8607954545454546
TN is  305
TN_FP is  330
TN / TN_FP  0.9242424242424242
ACC is  0.8924242424242425
```

Normal or Not Normal Accuracy (First Step)

```
TP is  139
TP_FN is  198
TP / TP_FN  0.702020202020202
TN is  549
TN_FP is  694
TN / TN_FP  0.7910662824207493
ACC is  0.7449494949494949
```

Not Normal / No Lung Opacity or Lung Opacity Accuracy(Second Step)

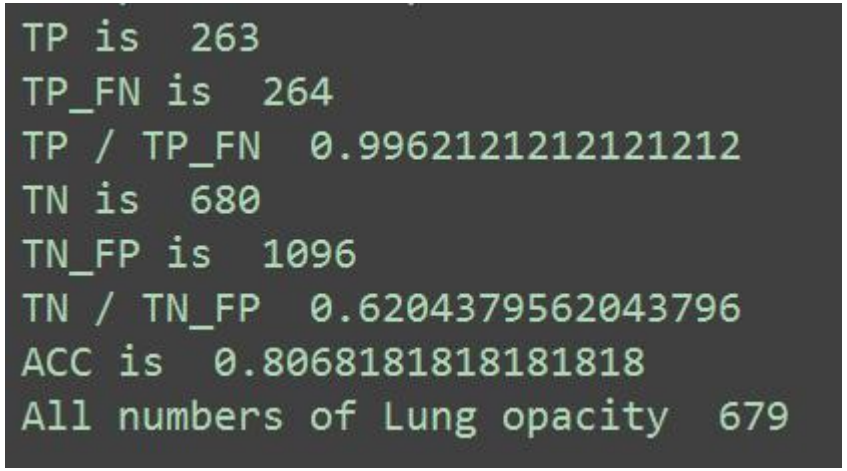
Combination Final Classification.

```
TP is  496
TP_FN is  530
TP / TP_FN  0.9358490566037736
TN is  532
TN_FP is  637
TN / TN_FP  0.8351648351648352
ACC is  0.8849056603773585
```

Lung Opacity or Others Accuracy(Third Step)

Frame Of Model (Classification)

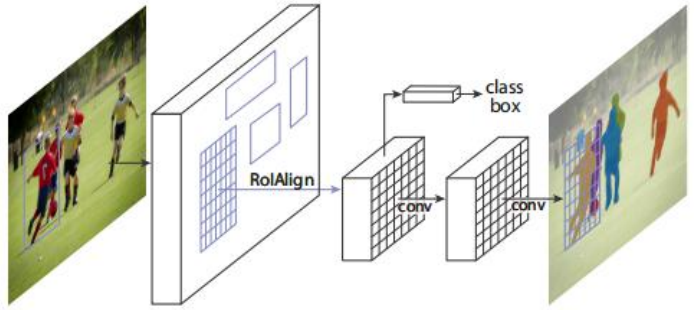
- For **validating** the final result of the classification , i random select 1167 samples in the data set to attest the efficiency of the classification.
- The final result has displaied on the side of the screen . The **sensitive ratio is 0.996**. At this condition , the classification can remove **0.62** negtive samples in this data set .



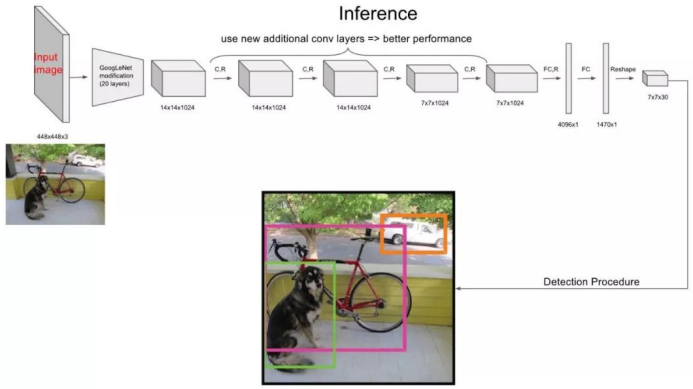
Holistic classification ratio of sensitive and Specificity

Frame Of Model (Detection)

- We have test two detection model , Mask-rcnn and Yolo3 .
- In this competition , the model of Mask-rcnn performed weaker than the Yolo3 . But in the theory , Mask-rcnn should perform more robust and accuracy than the model of Yolo3.
- The most essential question is that we can not train a fantastic weights of Mask-rcnn .Not matter what we have done , forllowing the training steps in the thesis or training model with all losses.
- The detection model of Yolo3 performs better than the Mask-rcnn in the validate data set .So , we choised Yolo3 finally .

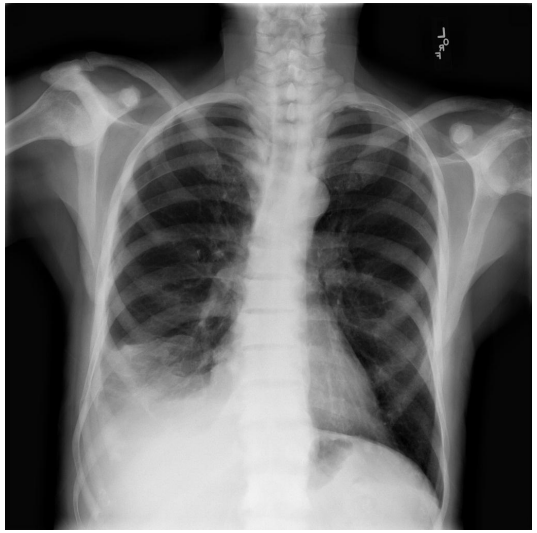


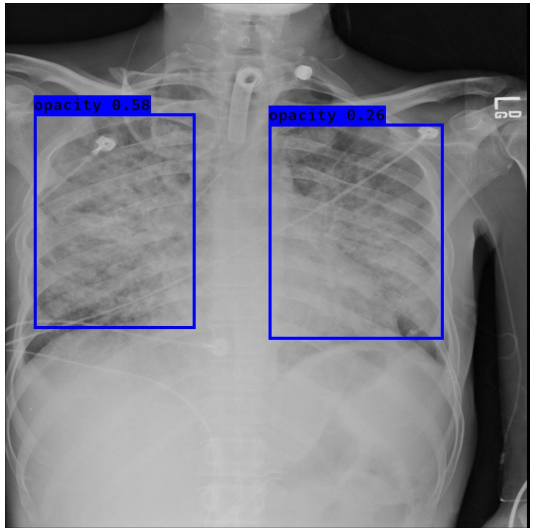
Mask-rcnn

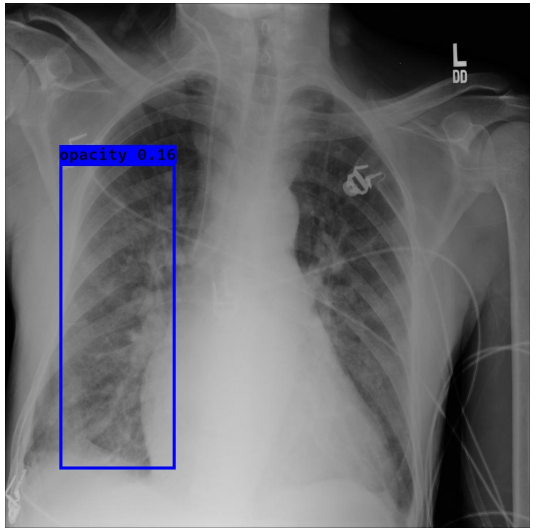


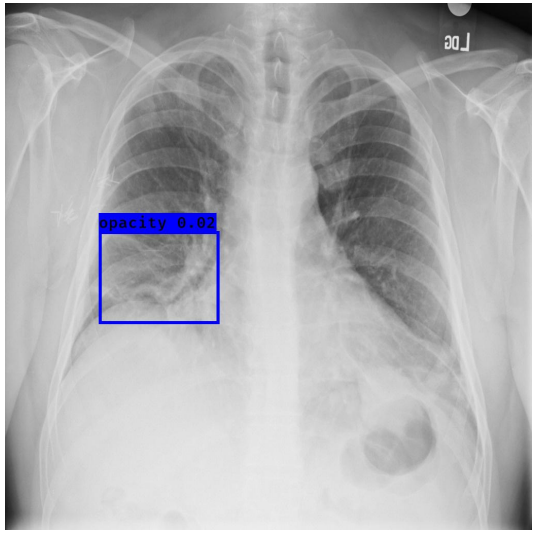
Yolo-V3

Frame Of Model (Result Display)









THREE

Deficient Of Model

Deficient Of Model

- **ONE** : The original format of the data set is DCM . it contains many useful information in this file , like gender , age , view position ,and so on . However , we have ommited those useful information and postulated all Lung Opacity images have the **same distribution** . So this many deter our to raise accuracy .
- **TWO** : We can not training a excellent weights for detection model .In the validate set , the detection model performed well , but in the test set , it performed worse than the validate set . it always ommits or detects error .
- **THREE** : I have googled some information with the Lung Opacity . In some way , doctor can not decree one patient who has Lung Opacity or not only through the image of X-ray . There are also another check , like Blood examination , CT scan at al.For this reason , it may thwart our to improve the accuracy of detection .

FOUR

ResNeXt-FPN Frame

ResNeXt-FPN Frame(Frame Work)

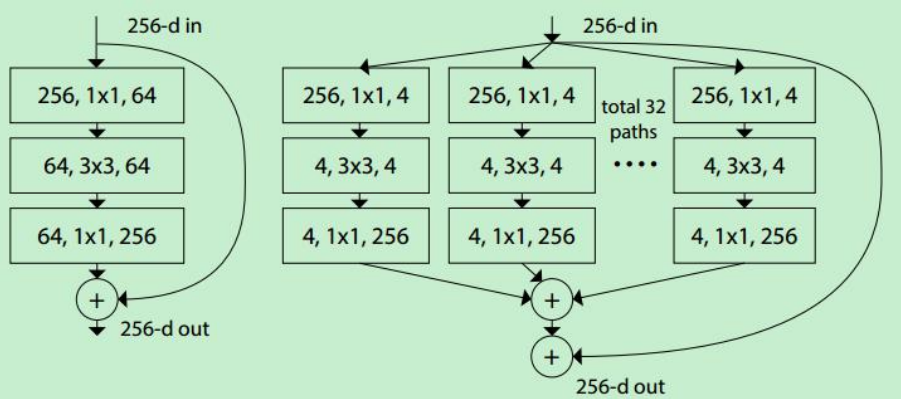


Figure 1. **Left**: A block of ResNet [14]. **Right**: A block of ResNeXt with cardinality = 32, with roughly the same complexity. A layer is shown as (# in channels, filter size, # out channels).

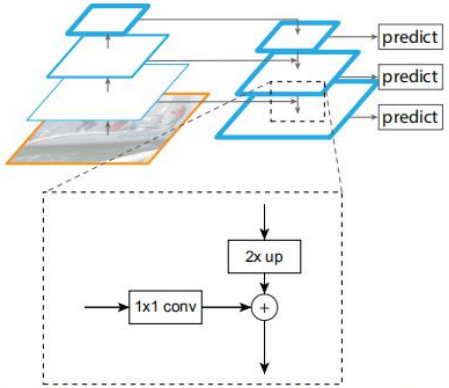
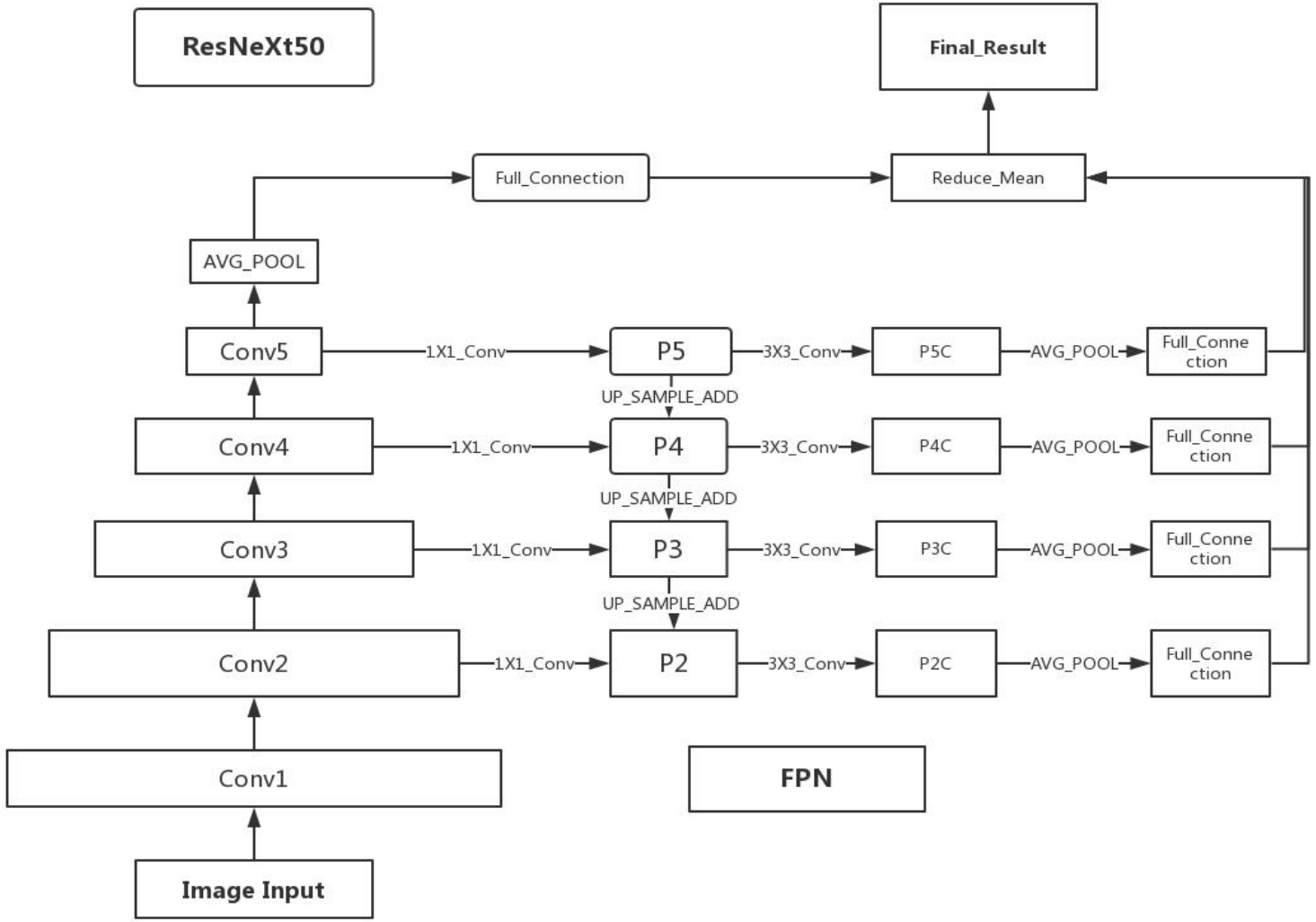
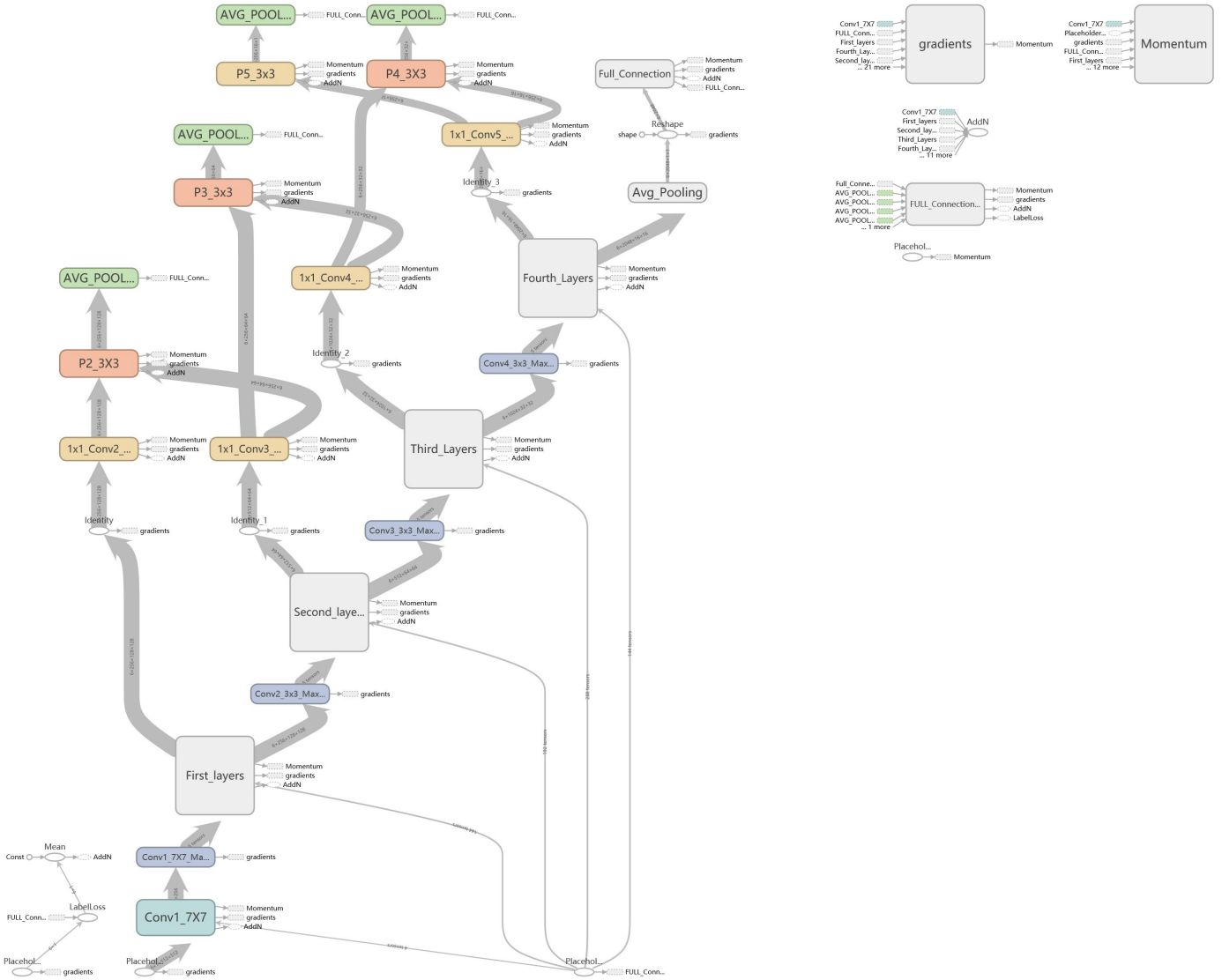


Figure 3. A building block illustrating the lateral connection and the top-down pathway, merged by addition.



ResNeXt-FPN Frame(Display)



ResNeXt-FPN Frame(Compare)

- The subclassifications (ResNet75) of Thrid are all training with the same training set as ResNeXt50-FPN.The validate set are also all same .
- As show on the side of the screen.The layers of subclassifications are all deeper than the ResNeXt50-FPN,but accuracy are all lower than ResNeXt50-FPN.And in the exam of mine , the sub path way of the layer of ResNeXt50 is only 4(Because tensorflow can not build so prodigious Graph) , less 8 times than original thesis .

```
TP is  163
TP_FN is  221
TP / TP_FN  0.7375565610859729
TN is  724
TN_FP is  889
TN / TN_FP  0.8143982002249719
ACC is  0.7737556561085973
```

SubClassification of Third Accuracy

```
TP is  213
TP_FN is  221
TP / TP_FN  0.9638009049773756
TN is  575
TN_FP is  889
TN / TN_FP  0.6467941507311586
ACC is  0.8031674208144797
```

SubClassification of Third Accuracy

```
TP  134
TP_FN  146
TN  674
TN_FP  888
TP / TP_FN  0.9178082191780822
TN / TN_FP  0.759009009009009
ACC is  0.8356164383561644
```

ResNeXt50-FPN Accuracy

```
TP is  187
TP_FN is  221
TP / TP_FN  0.8461538461538461
TN is  672
TN_FP is  889
TN / TN_FP  0.7559055118110236
ACC is  0.8009049773755657
```

SubClassification of Third Accuracy

```
TP is  205
TP_FN is  221
TP / TP_FN  0.9276018099547512
TN is  612
TN_FP is  889
TN / TN_FP  0.688413948256468
ACC is  0.8076923076923077
```

SubClassification of Third Accuracy

2018

THANKS

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