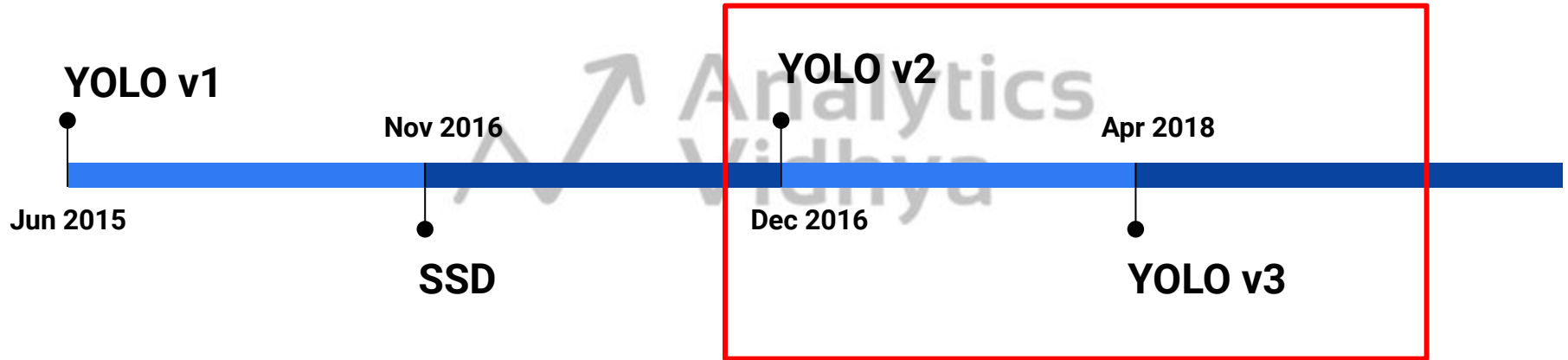


Improvements on YOLO

YOLO v2 & YOLO v3

Improvements on YOLO



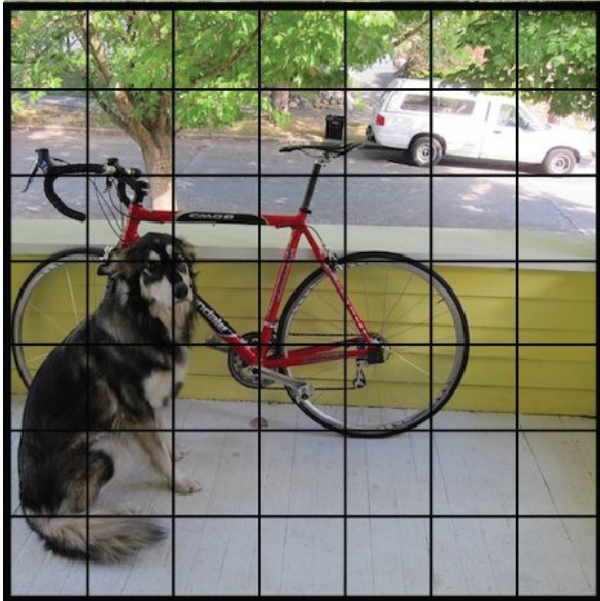
What is new in YOLO v2 ?

- **Better detection of smaller objects:** Divides the image into 13 x 13 grid cells



What is new in YOLO v2 ?

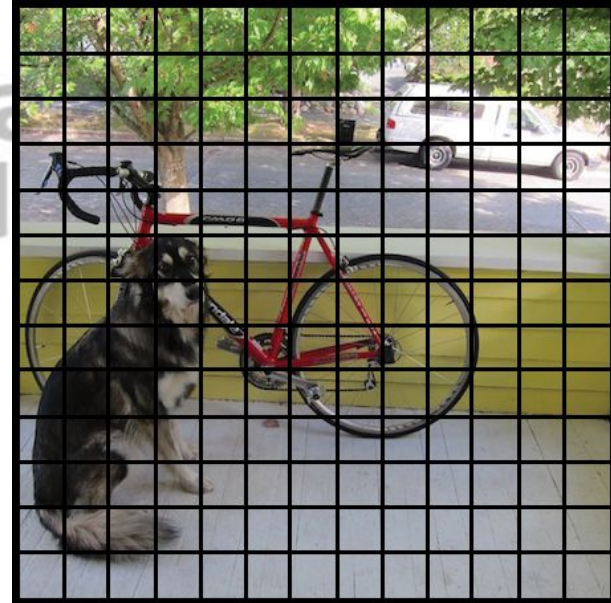
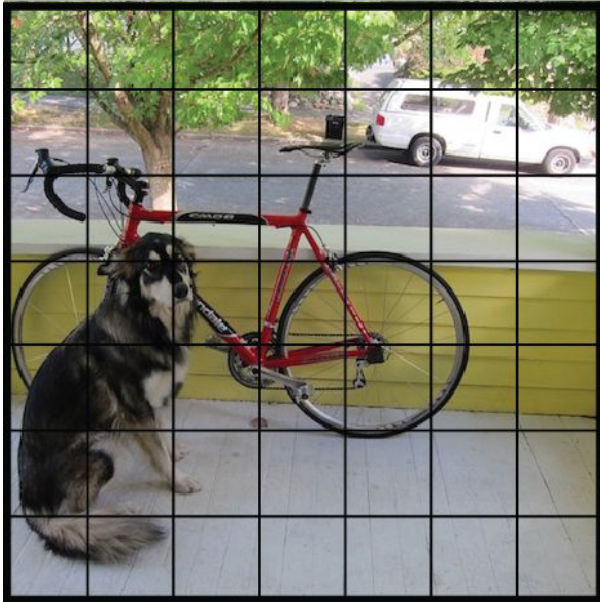
- **Better detection of smaller objects:** Divides the image into 13 x 13 grid cells



Analytics
Vidhya

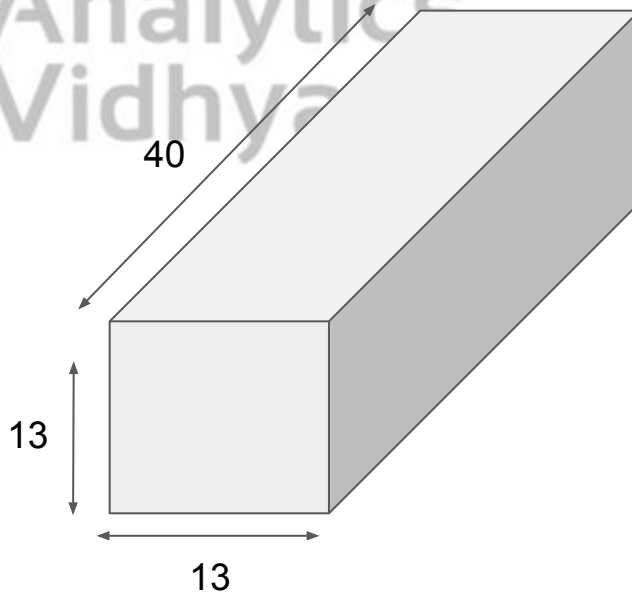
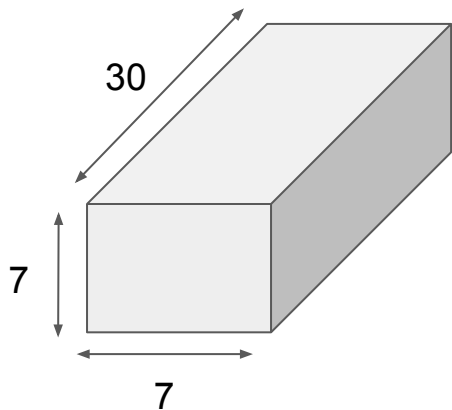
What is new in YOLO v2 ?

- **Better detection of smaller objects:** Divides the image into 13×13 grid cells



What is new in YOLO v2 ?

- **Better detection of smaller objects:** Divides the image into 13×13 grid cells
- **Anchor boxes:** Different Anchor Boxes are used based on the dataset



What is new in YOLO v2 ?

- **Better detection of smaller objects:** Divides the image into 13×13 grid cells
- **Anchor boxes:** Different Anchor Boxes are used based on the dataset
- **Multiscale Training:** Pretrained on Imagenet images of multiple scales such as

224 x 224 then 448 x 448

YOLO v2 - Architectural Changes



YOLO v2 - Architectural Changes

- Batch normalization added after Convolutional Layers



YOLO v2 - Architectural Changes

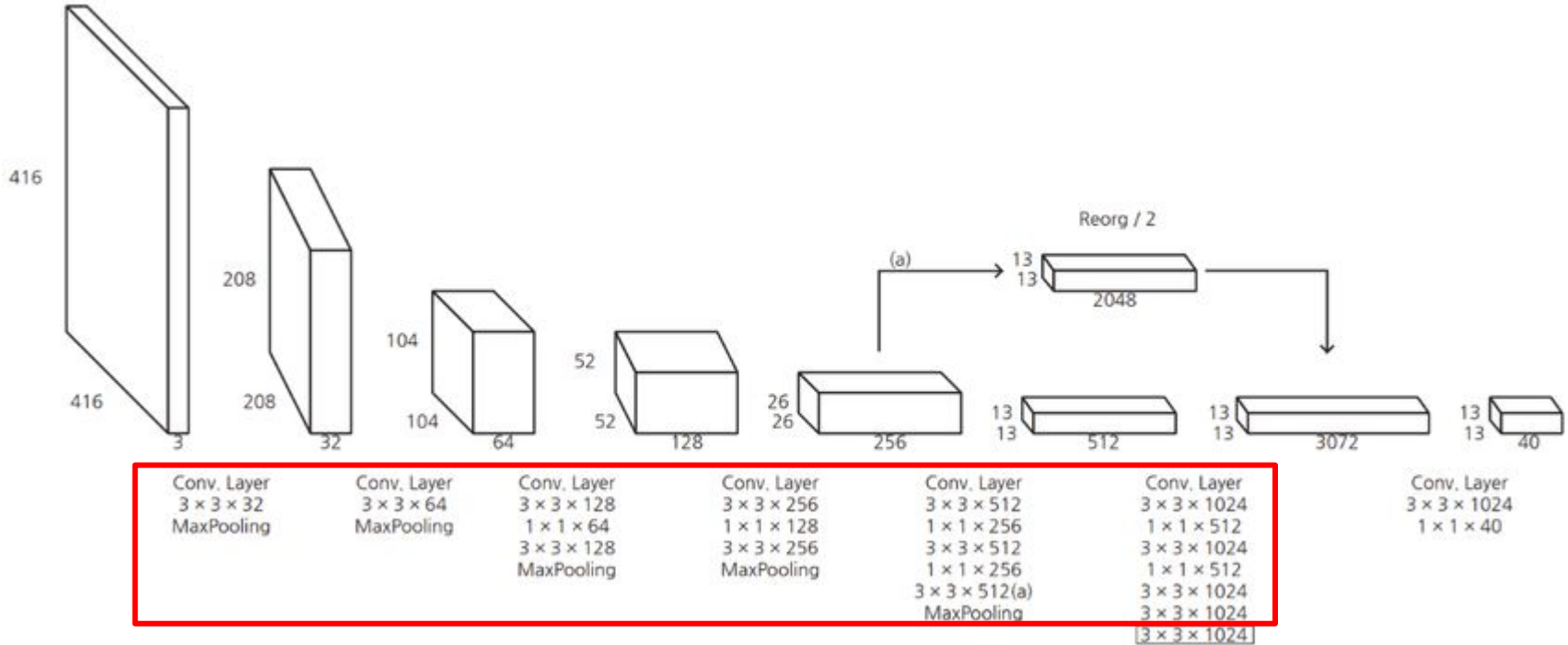
- Batch normalization added after Convolutional Layers
- YOLO v2 uses Darknet 19 architecture



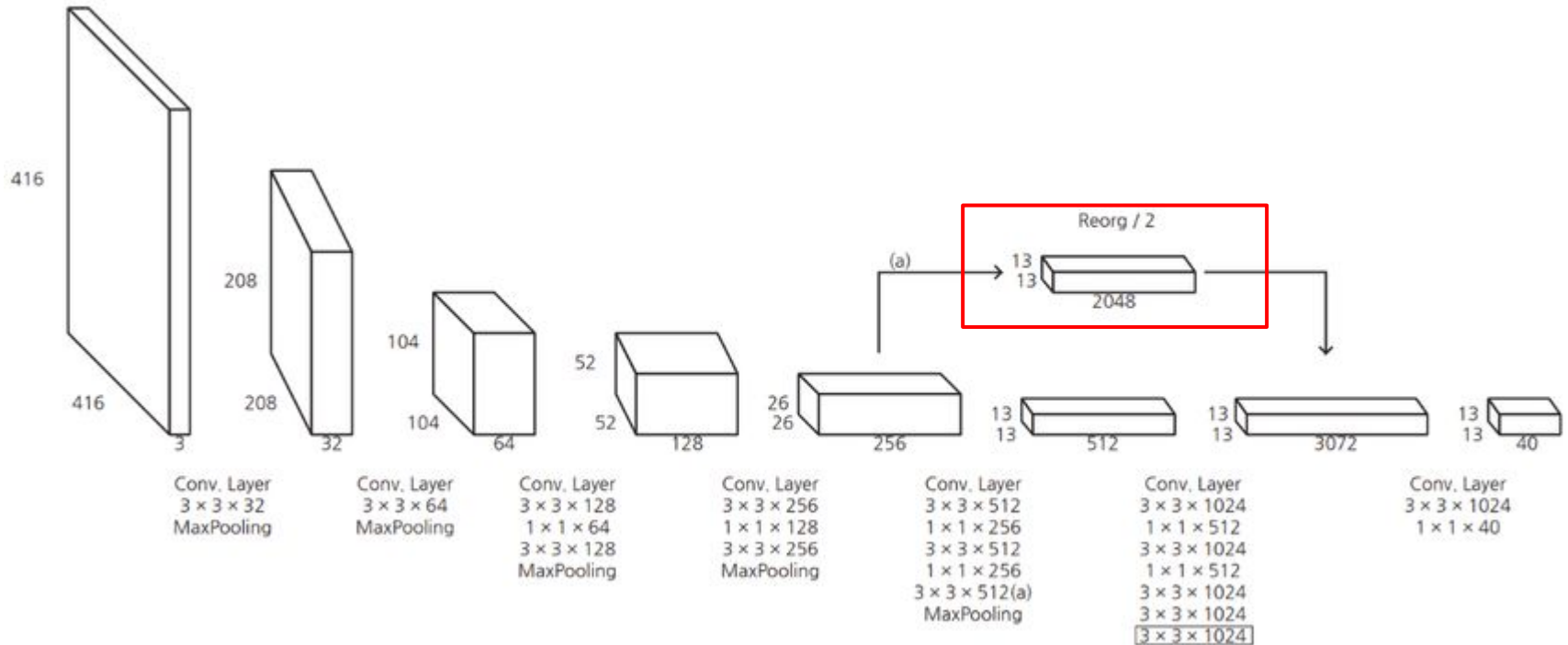
YOLO v2 - Darknet19 Architecture

Type	Filters	Size/Stride	Output
Convolutional	32	3×3	224×224
Maxpool		$2 \times 2/2$	112×112
Convolutional	64	3×3	112×112
Maxpool		$2 \times 2/2$	56×56
Convolutional	128	3×3	56×56
Convolutional	64	1×1	56×56
Convolutional	128	3×3	56×56
Maxpool		$2 \times 2/2$	28×28
Convolutional	256	3×3	28×28
Convolutional	128	1×1	28×28
Convolutional	256	3×3	28×28
Maxpool		$2 \times 2/2$	14×14
Convolutional	512	3×3	14×14
Convolutional	256	1×1	14×14
Convolutional	512	3×3	14×14
Convolutional	256	1×1	14×14
Convolutional	512	3×3	14×14
Maxpool		$2 \times 2/2$	7×7
Convolutional	1024	3×3	7×7
Convolutional	512	1×1	7×7
Convolutional	1024	3×3	7×7
Convolutional	512	1×1	7×7
Convolutional	1024	3×3	7×7
Convolutional	1000	1×1	7×7
Avgpool		Global	1000
Softmax			

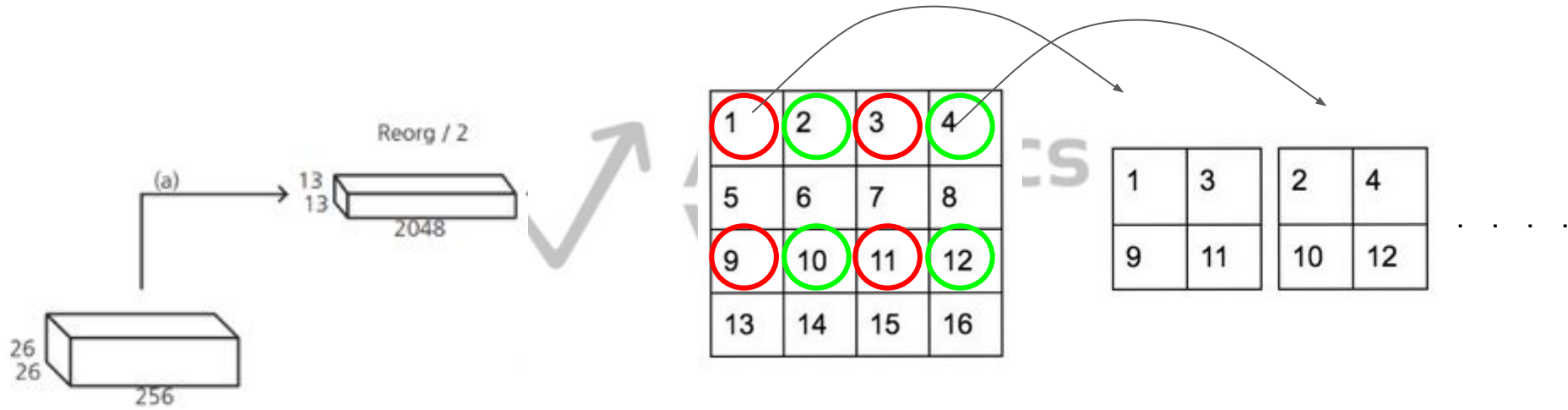
YOLO v2 - Architectural Changes



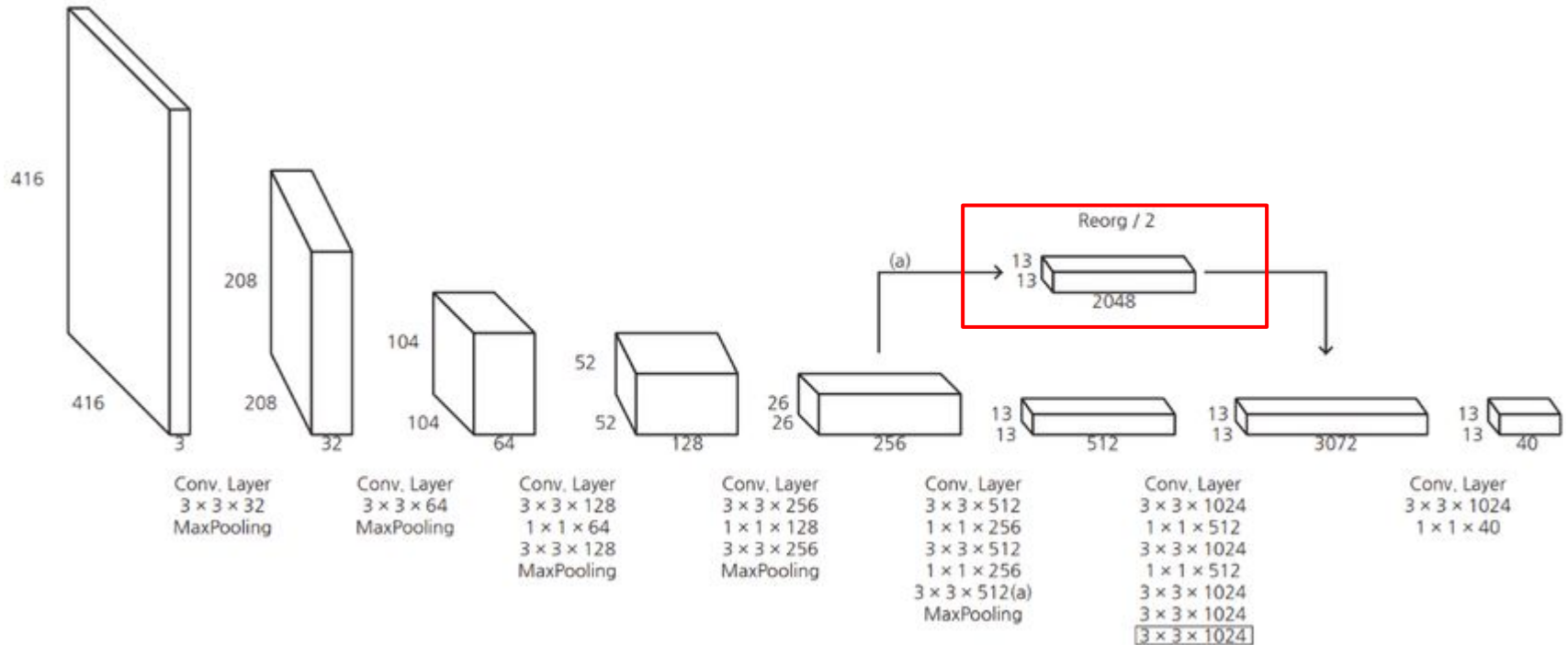
YOLO v2 - Architectural Changes



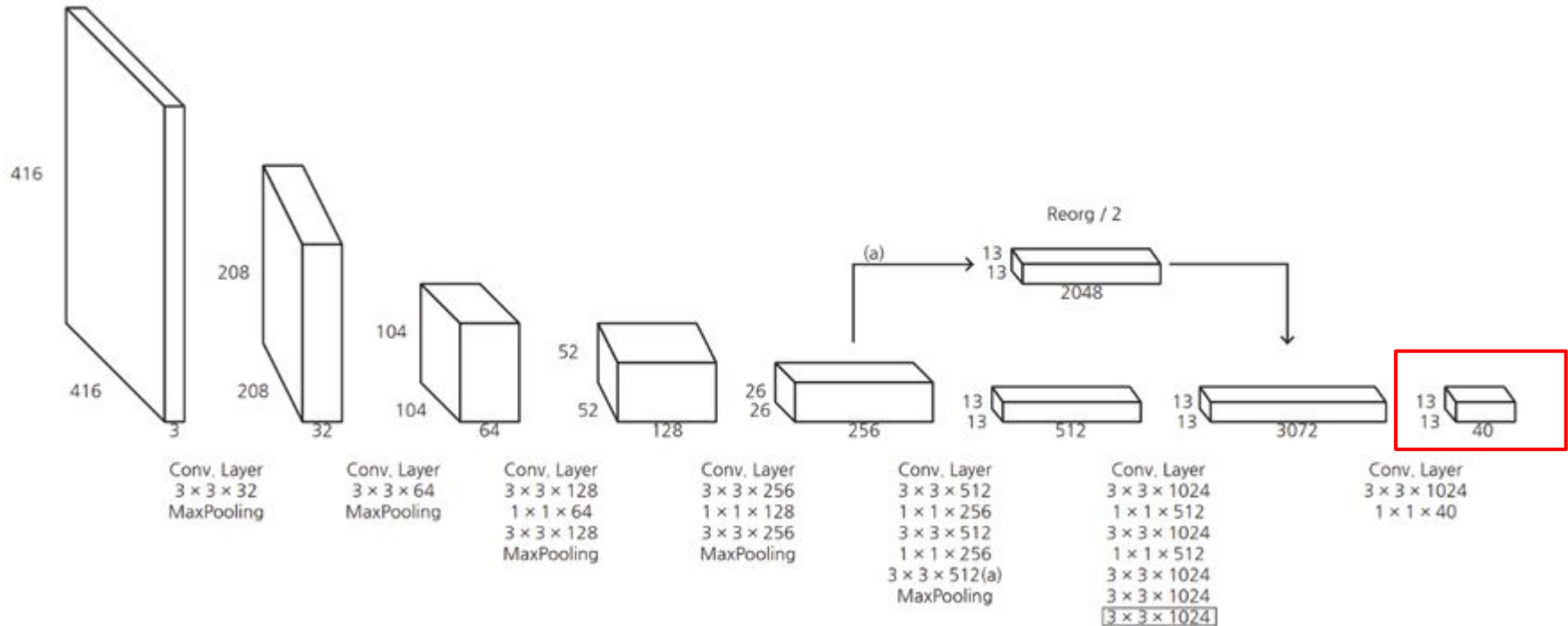
YOLO v2 - Architectural Changes



YOLO v2 - Architectural Changes



YOLO v2 - Architectural Changes

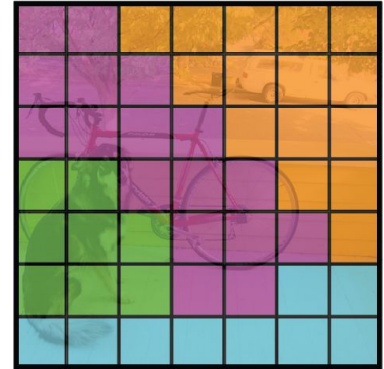


YOLO v3



What is new in YOLO v3 ?

- YOLOv3 uses multi-label classification



What is new in YOLO v3 ?

- YOLOv3 uses multi-label classification



What is new in YOLO v3 ?

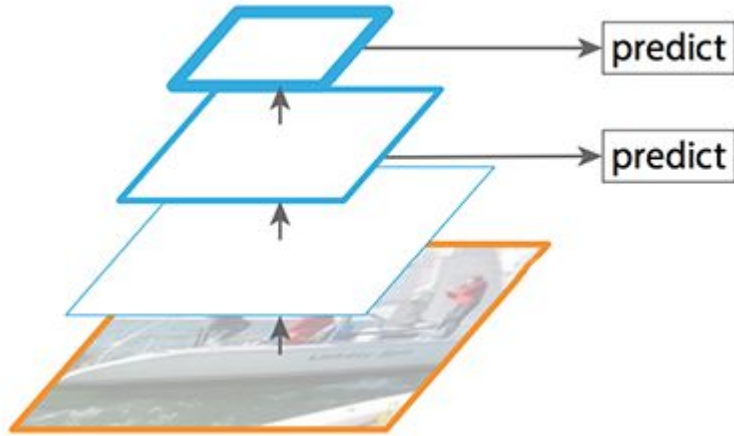
- YOLOv3 uses multi-label classification
- Logistic Classifiers for each class



What is new in YOLO v3 ?

- YOLOv3 uses multi-label classification
- Logistic Classifiers for each class
- Predicts boxes at 3 different scales (uses FPN)

Feature Pyramid Network



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Image Pyramid Network (SSD)

Feature Pyramid Network

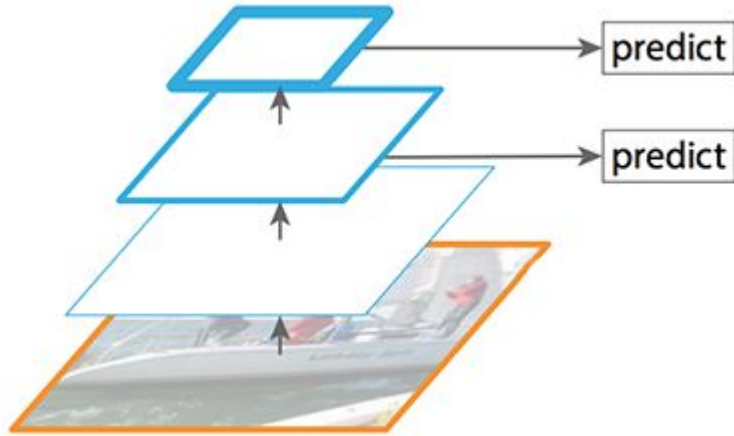
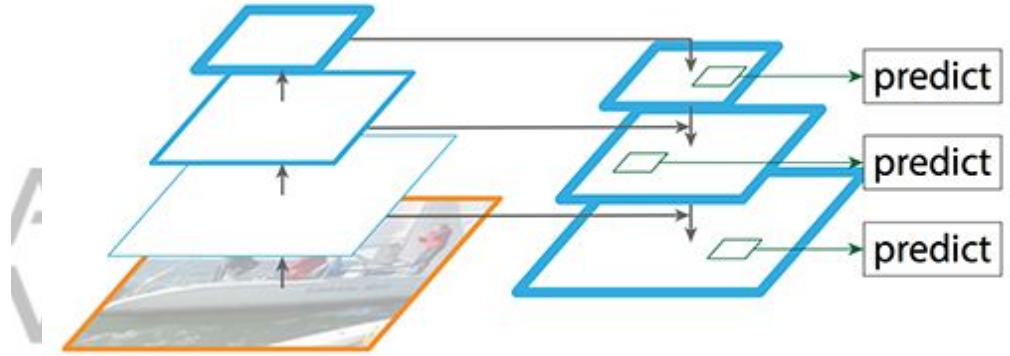
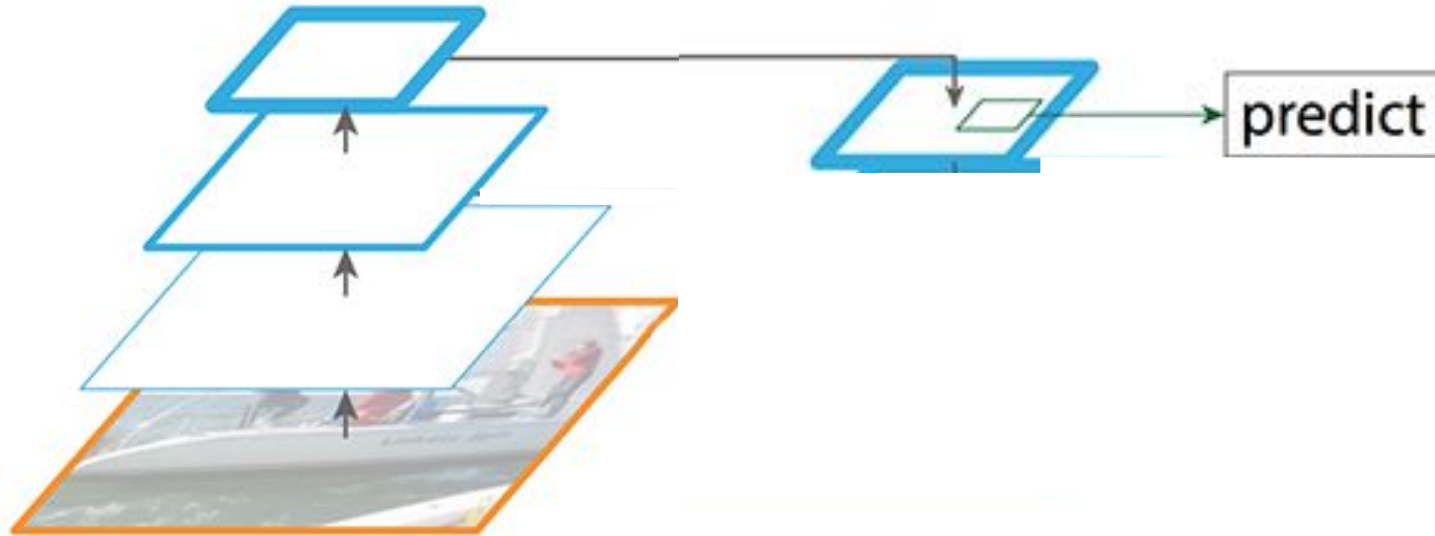


Image Pyramid Network (SSD)

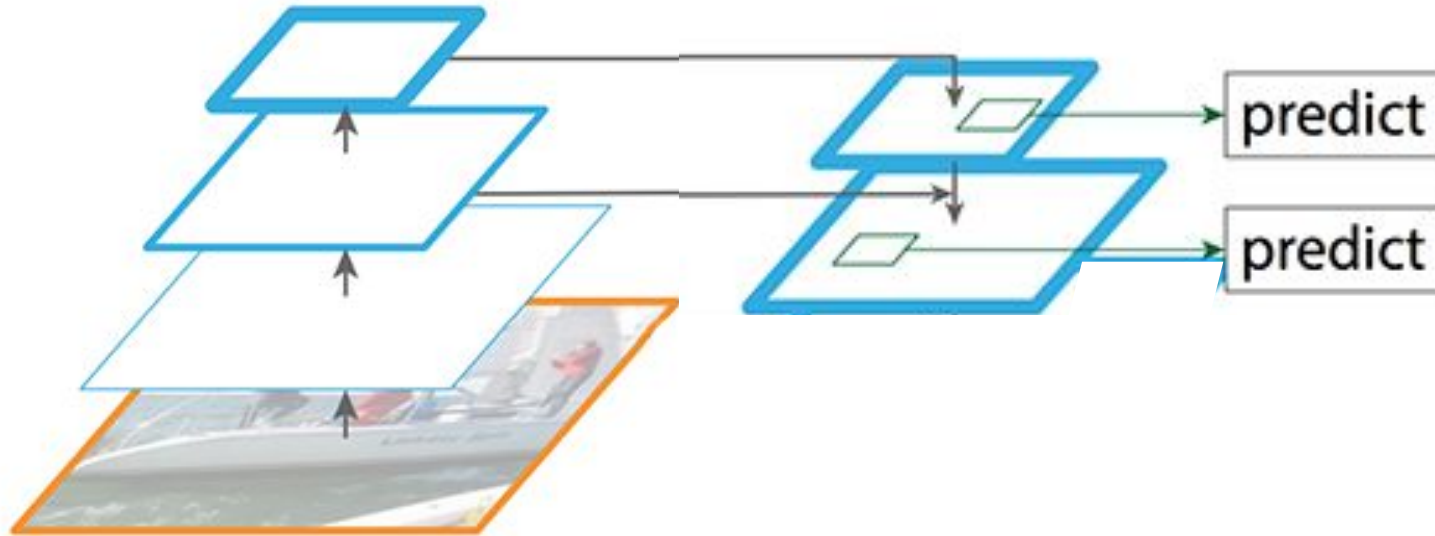


Feature Pyramid Network (YOLO v3)

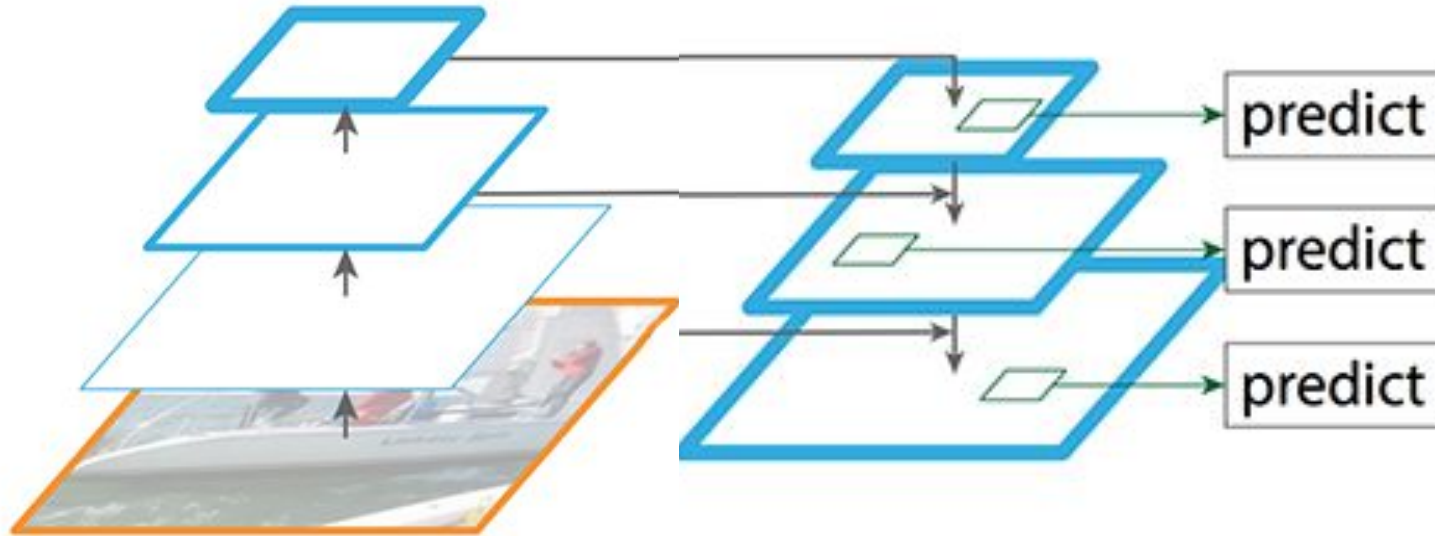
Feature Pyramid Network



Feature Pyramid Network



Feature Pyramid Network



YOLO v3 - Architectural Changes

- Uses Darknet-53 Architecture



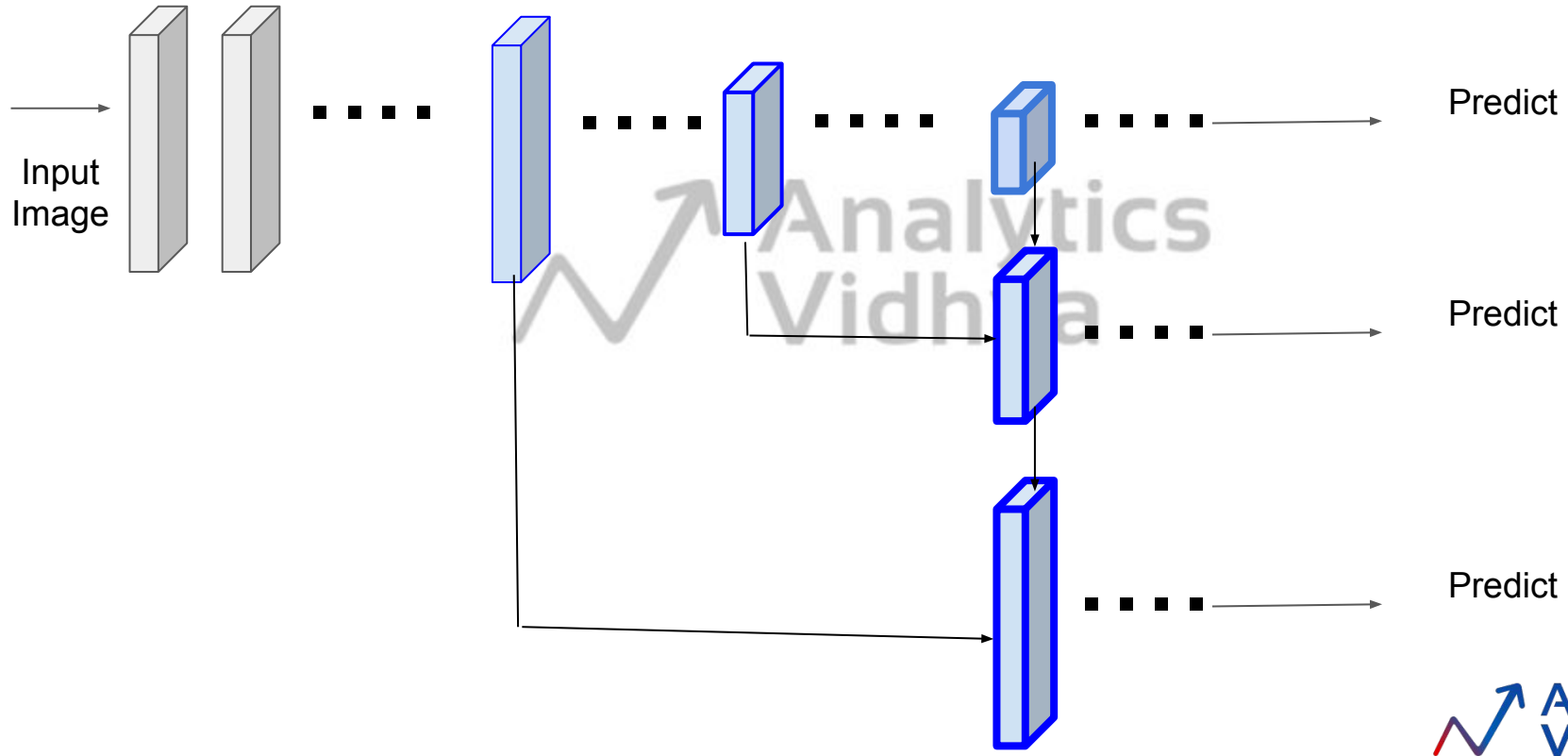
YOLO v3 - Darknet-53 Architecture

	Type	Filters	Size	Output
	Convolutional	32	3×3	256×256
	Convolutional	64	$3 \times 3 / 2$	128×128
1x	Convolutional	32	1×1	128×128
	Convolutional	64	3×3	
	Residual			
	Residual			
	Convolutional	128	$3 \times 3 / 2$	64×64
2x	Convolutional	64	1×1	64×64
	Convolutional	128	3×3	
	Residual			
	Residual			
	Convolutional	256	$3 \times 3 / 2$	32×32
8x	Convolutional	128	1×1	32×32
	Convolutional	256	3×3	
	Residual			
	Residual			
	Convolutional	512	$3 \times 3 / 2$	16×16
8x	Convolutional	256	1×1	16×16
	Convolutional	512	3×3	
	Residual			
	Residual			
	Convolutional	1024	$3 \times 3 / 2$	8×8
4x	Convolutional	512	1×1	8×8
	Convolutional	1024	3×3	
	Residual			
	Residual			
	Avgpool		Global	
	Connected		1000	
	Softmax			

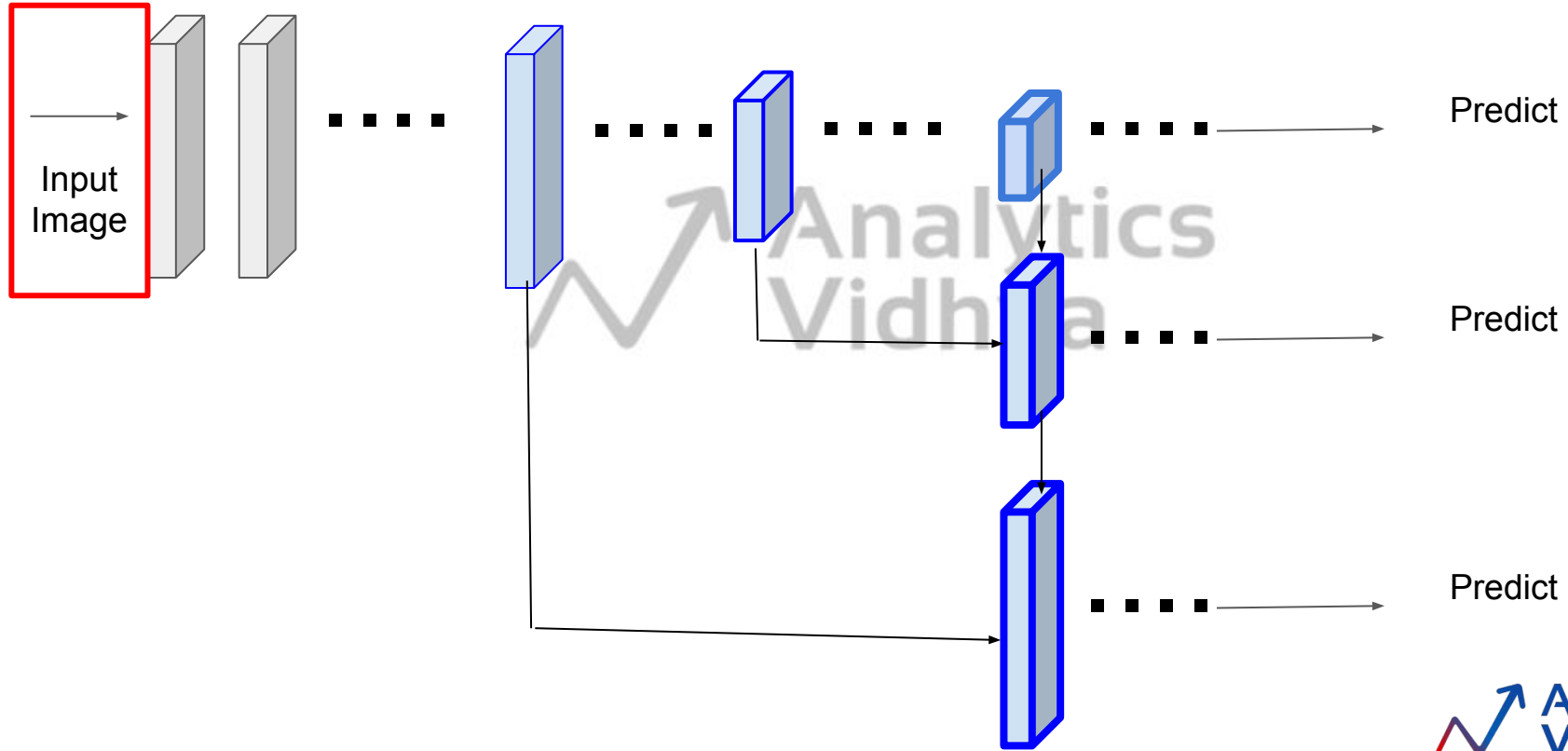
YOLO v3 - Architectural Changes

- Uses Darknet-53 Architecture
- 106 layer fully convolutional underlying architecture

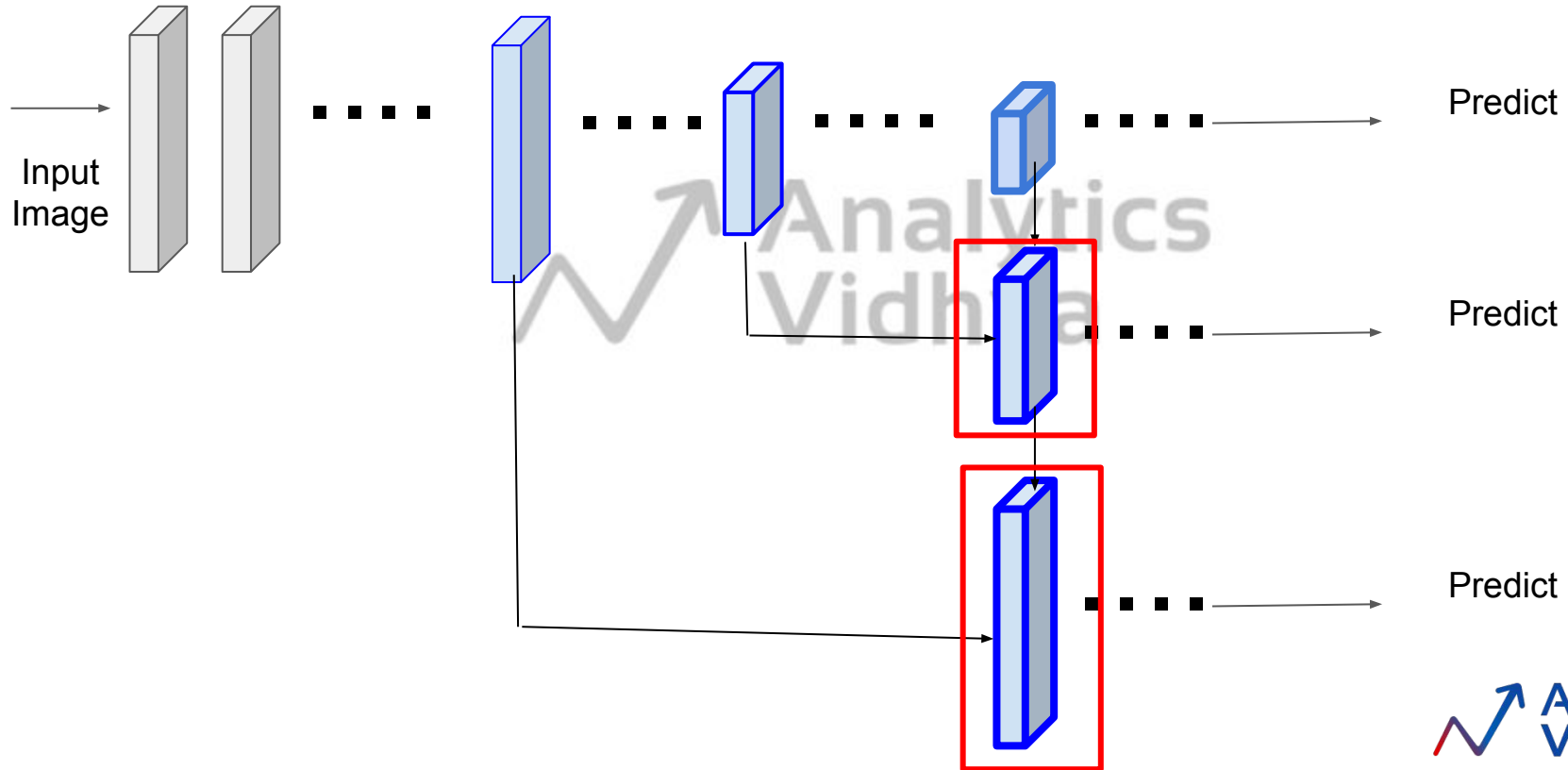
YOLO v3 - Architectural Changes



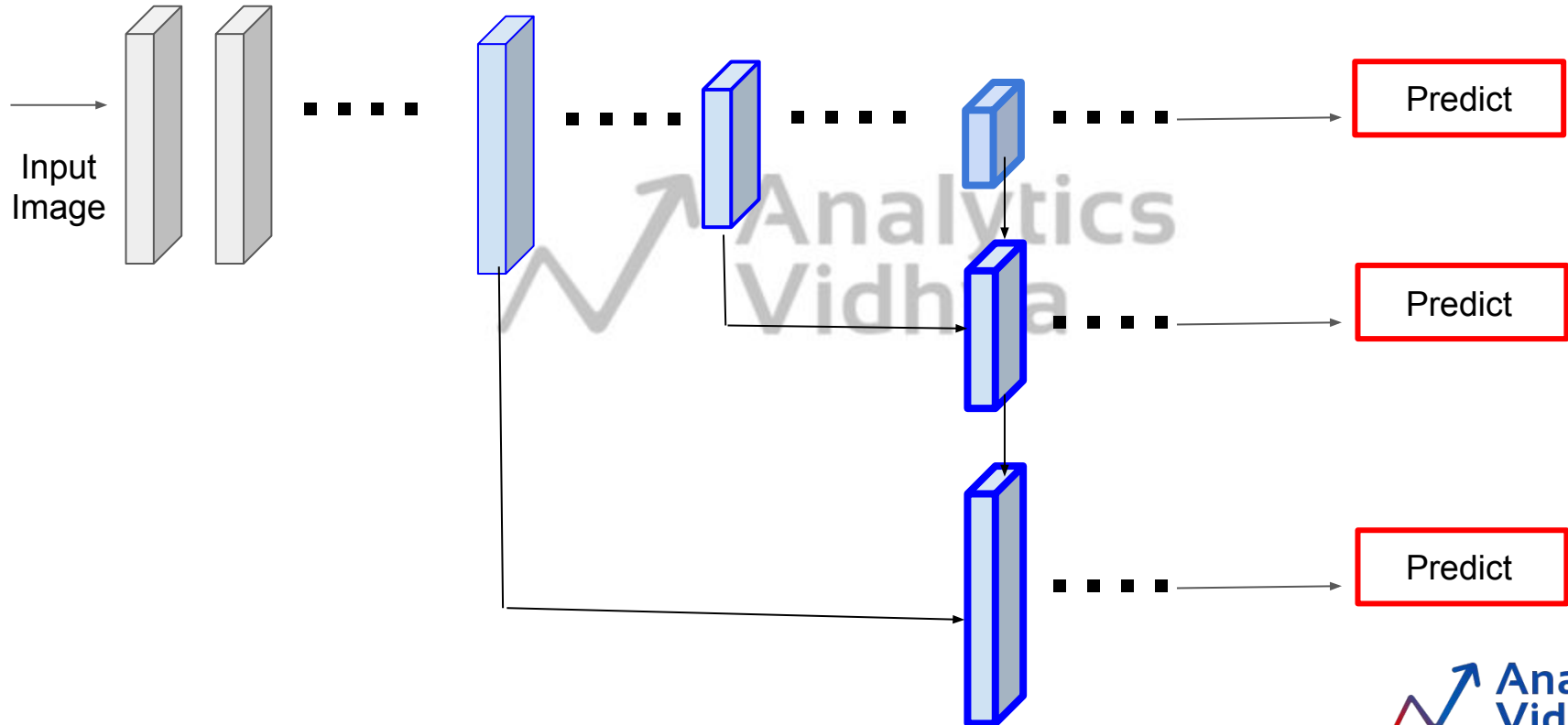
YOLO v3 - Architectural Changes



YOLO v3 - Architectural Changes



YOLO v3 - Architectural Changes



YOLO v3 - Limitations

- Slower than YOLO v2, but more accurate.



YOLO v3 - Limitations

- Slower than YOLO v2, but more accurate.
- Relatively high performance on smaller objects
(than medium and larger size objects)



Thank You