IMAGENET
ILSVRC 2015 CLS-LOC.

Multi-Class AttentionNet.

D. Yoo[1], K. Paeng[1], S. Park[1], S. Hwang[2], H. E. Kim[2], J. Lee[2],
M. Jang[2], A. S. Paek[2], K. K. Kim[1], S. D. Kim[1], I. S. Kweon[1].
[1]KAIST, [2]Lunit Inc.

Lunit KAIST

State-of-the-art methods for object localization.

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1) Box-regression with a CNN.

[Szegedy et al., NIPS'13],

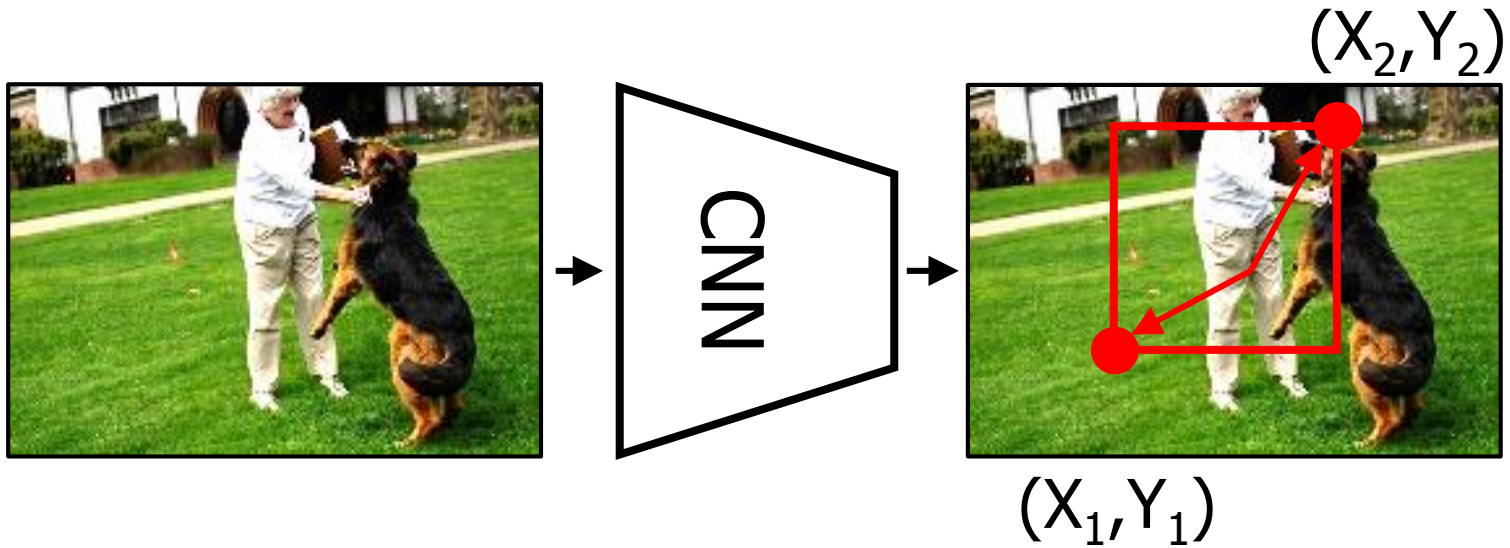
DeepMultiBox [Erhan et al., CVPR'14],
OverFeat [Sermanet et al., ICLR'14],

…

State-of-the-art methods for object localization.

1) Box-regression with a CNN.

(–) Direct mapping from an image to an exact bounding box is relatively difficult for a CNN.



State-of-the-art methods for object localization.

2) Region proposal + classifier.

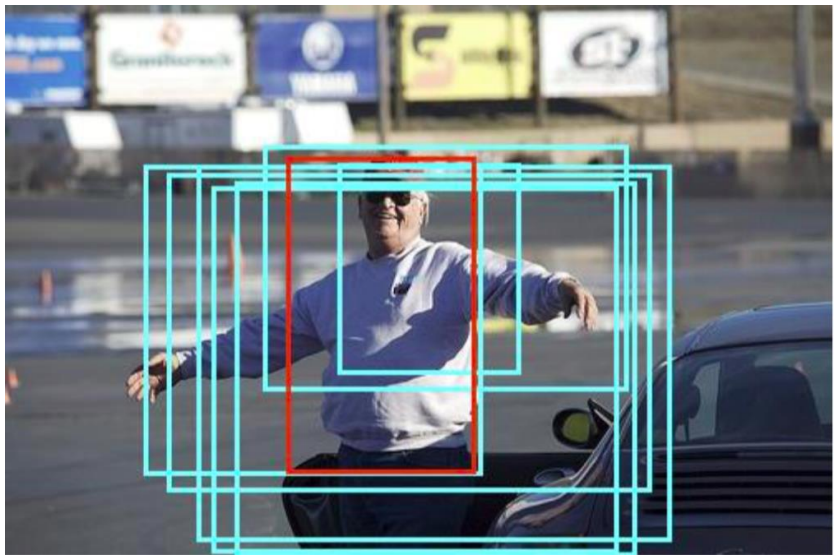
R-CNN [Gkioxari et al., CVPR'14],
Fast R-CNN [Gkioxari, ICCV'15],
Faster R-CNN [Ren et al., NIPS'15],
DeepMultiBox [Erhan et al., CVPR'14],

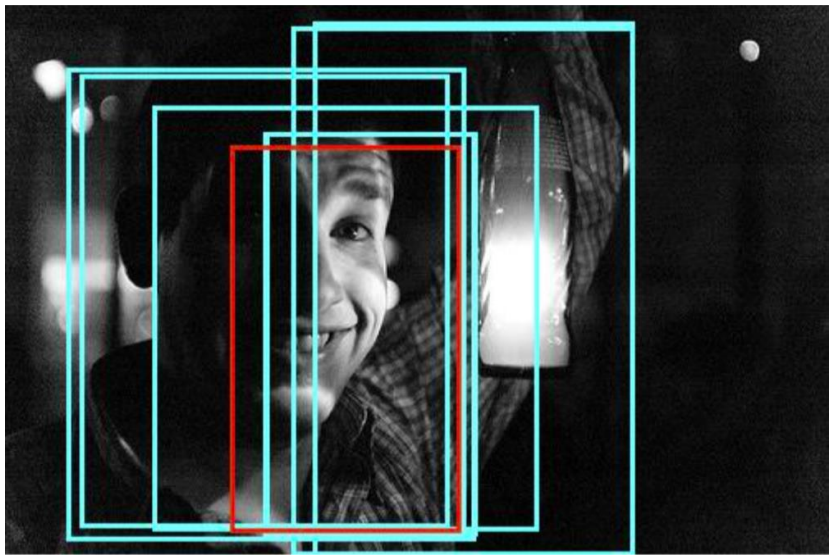
...

State-of-the-art methods for object localization.

2) Region proposal + classifier.

(–) Prone to focus on discriminative part (e.g. face) rather than entire object (e.g. human body).





Idea:
Ensemble of weak directions.

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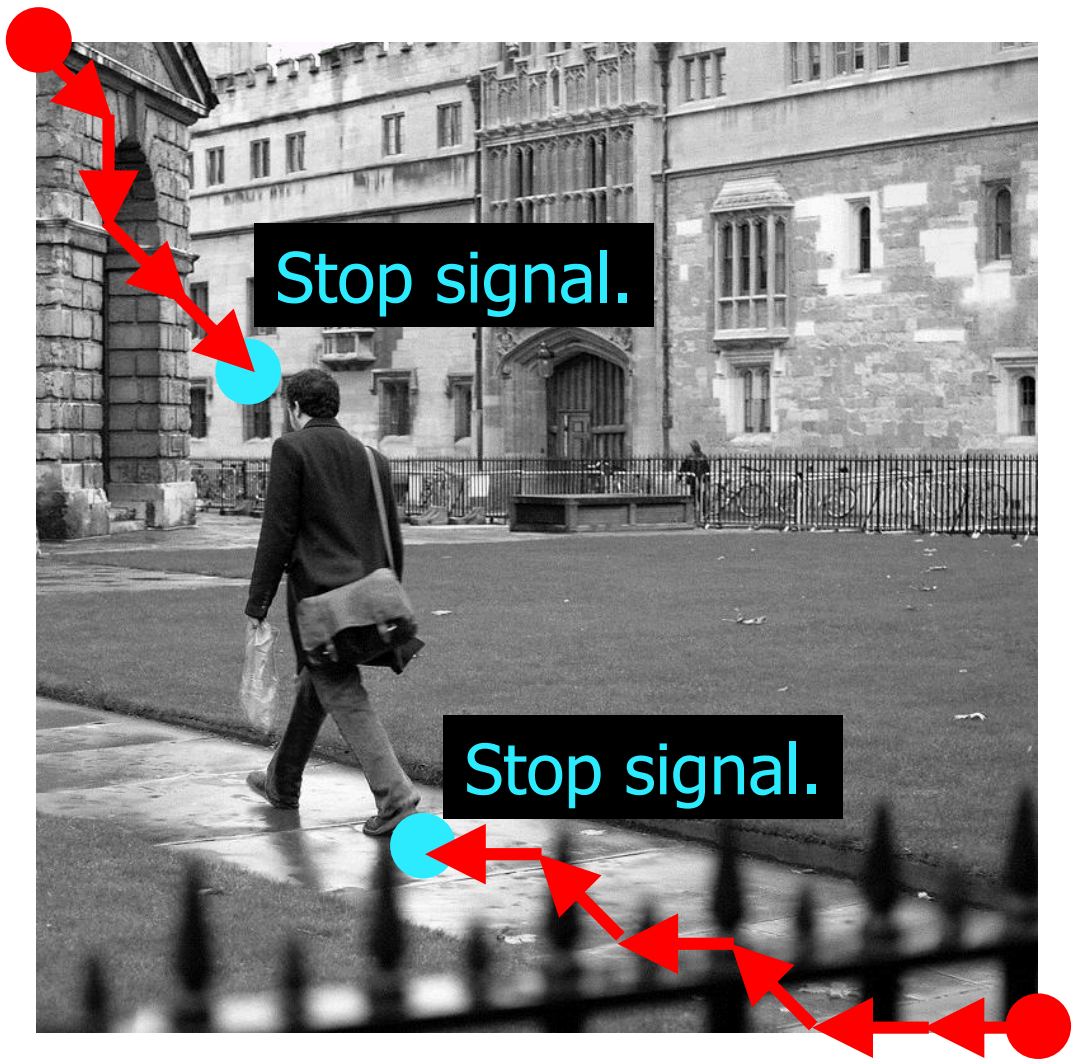

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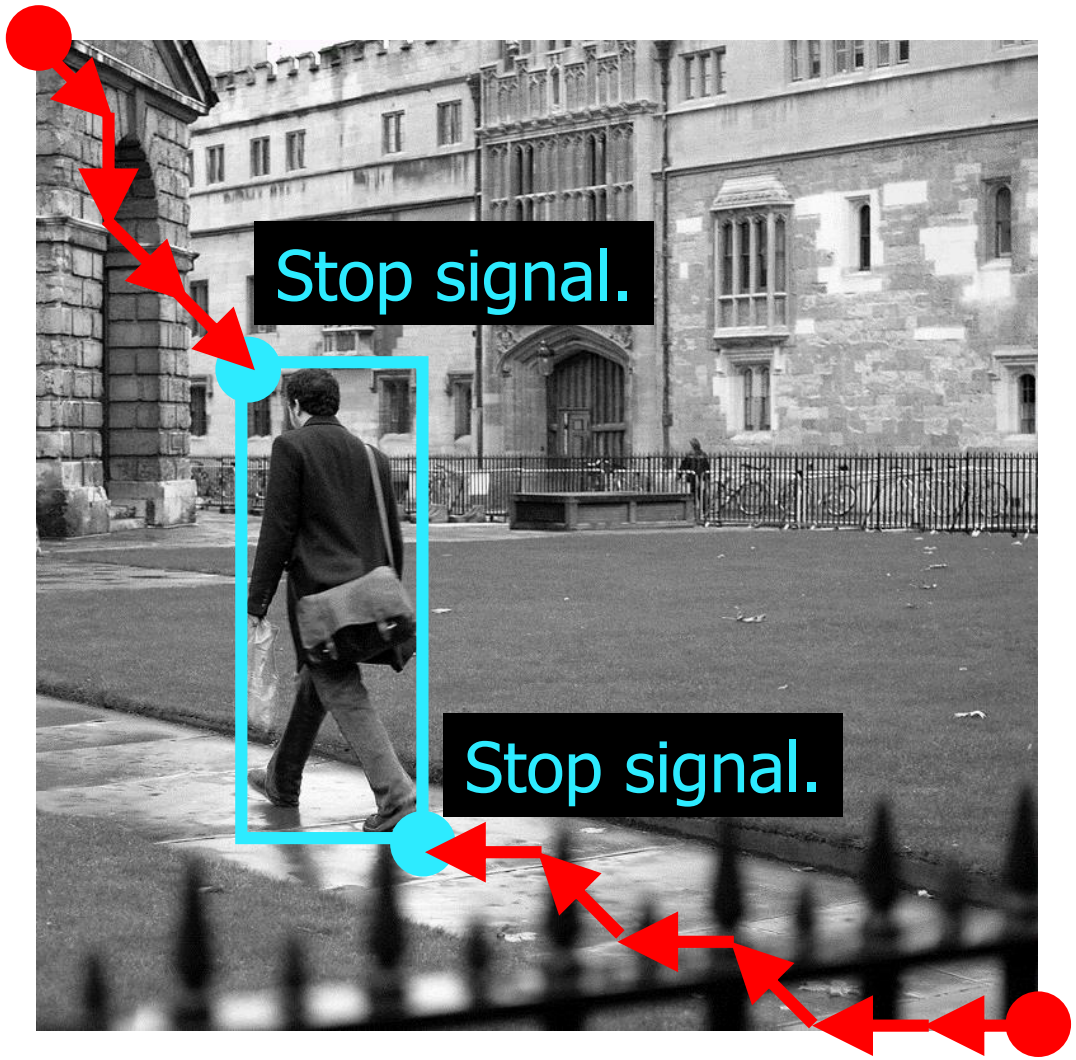

Model:

Model:

(CNN regression model)

Model:

Rather than CNN regression model,

we use *CNN classification* model.

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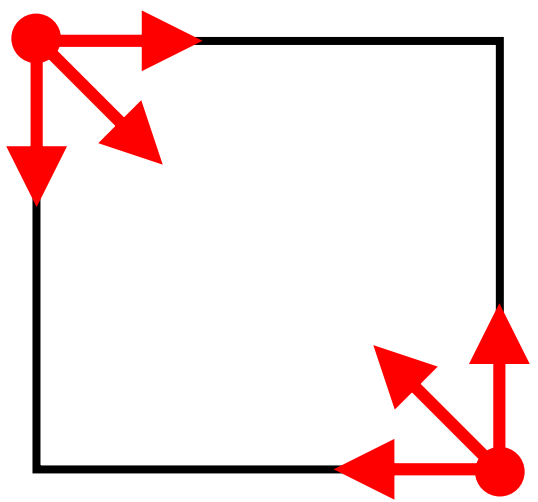
we use *CNN classification* model.

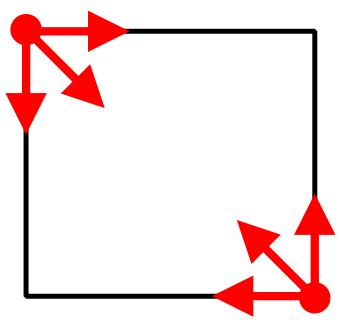
Define weak directions:
fixed length, and quantized.



Strength to the previous methods.

Box-regression:
(−) Relatively
difficult for a CNN.

Weak direction:
(+) Relatively
easy for a CNN.



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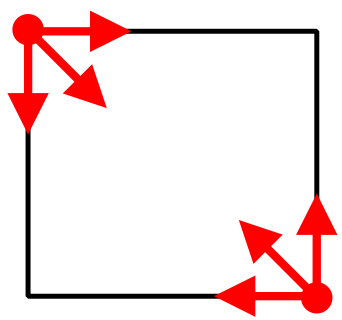
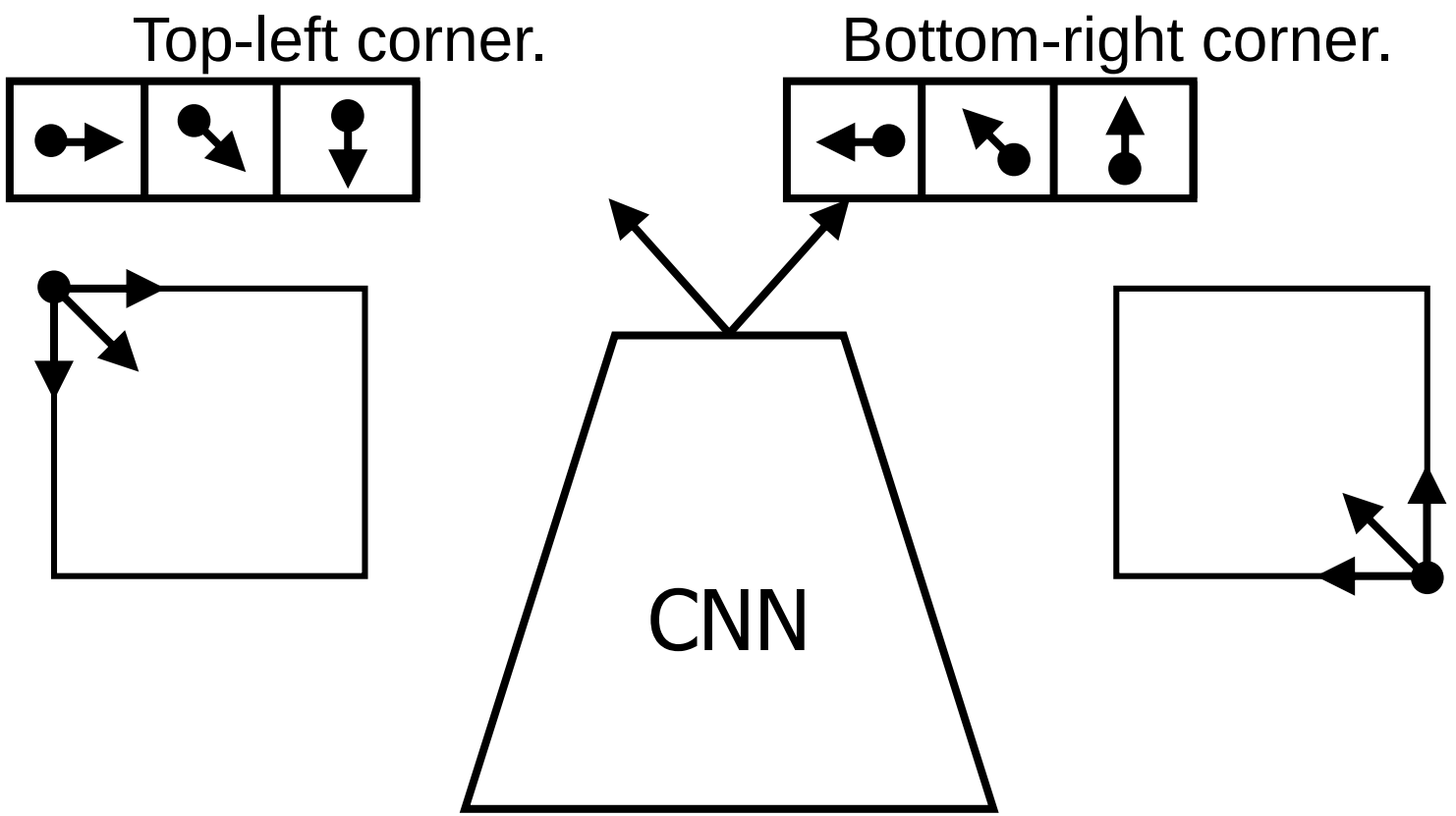


R-CNN:
(−) Focuses on distinctive parts.

↓

Stop signal:
(+) Supervision of clear terminal point.

AttentionNet:
Two layers for each corner.



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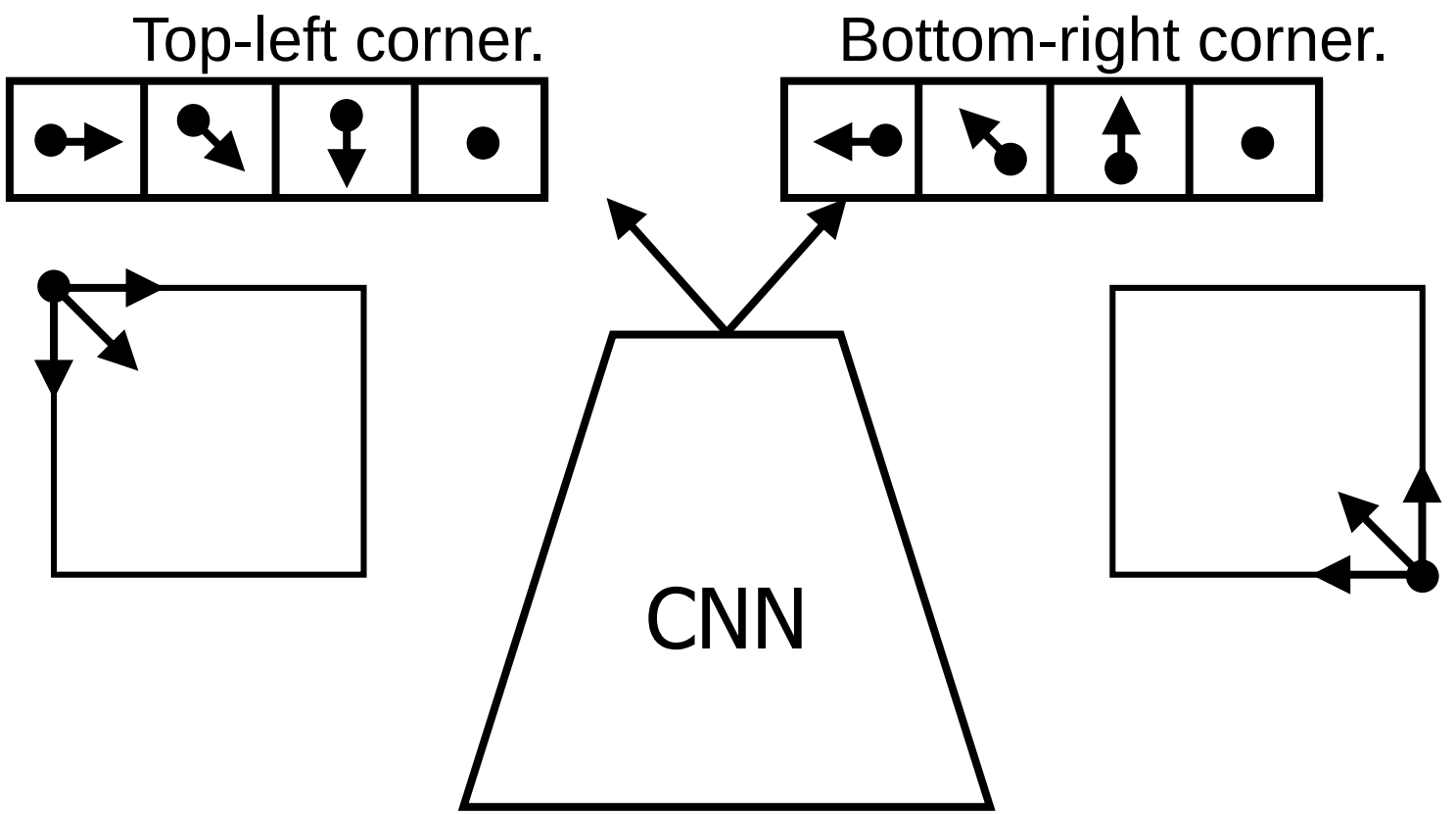

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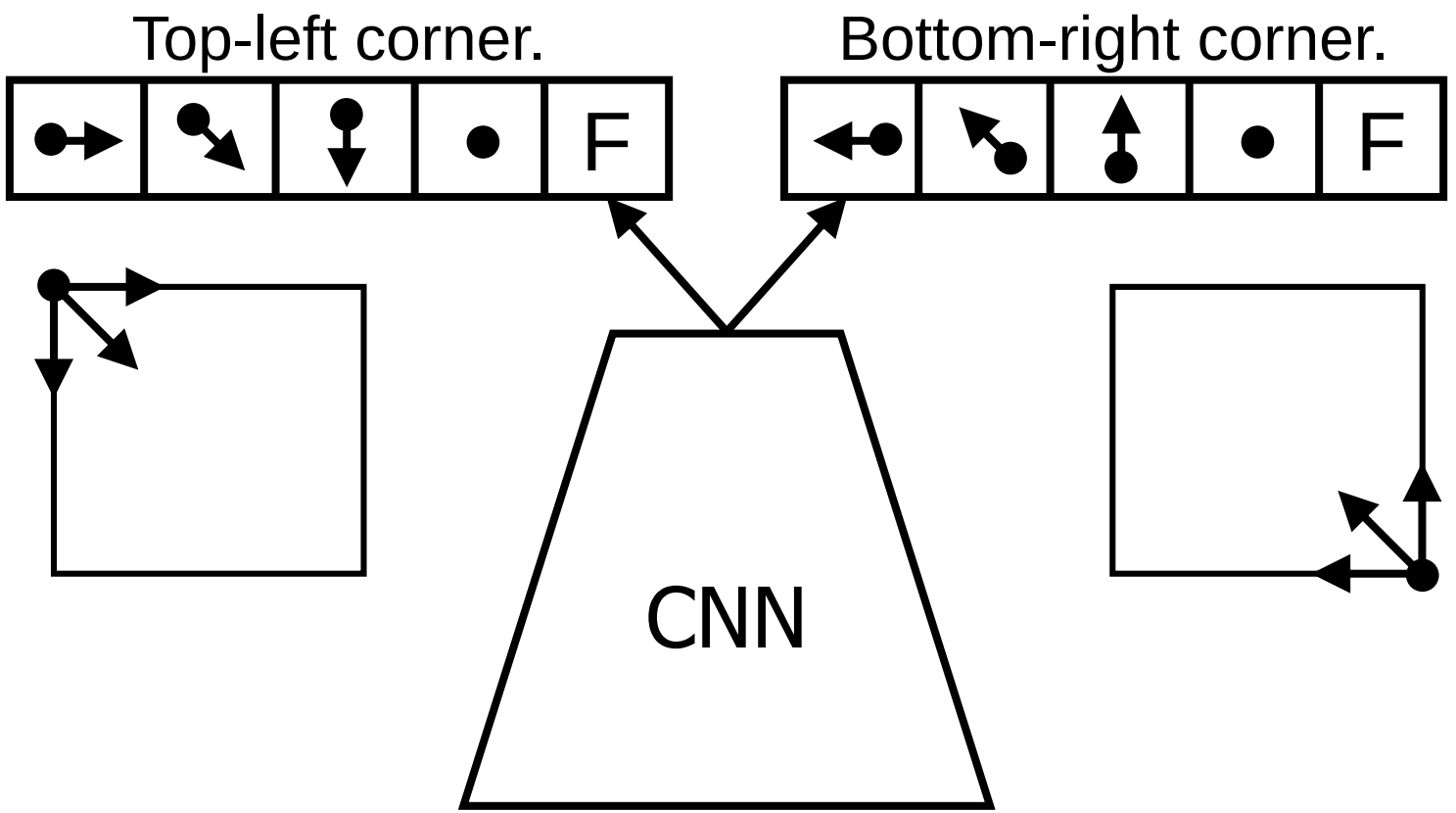

AttentionNet: iterative classification.

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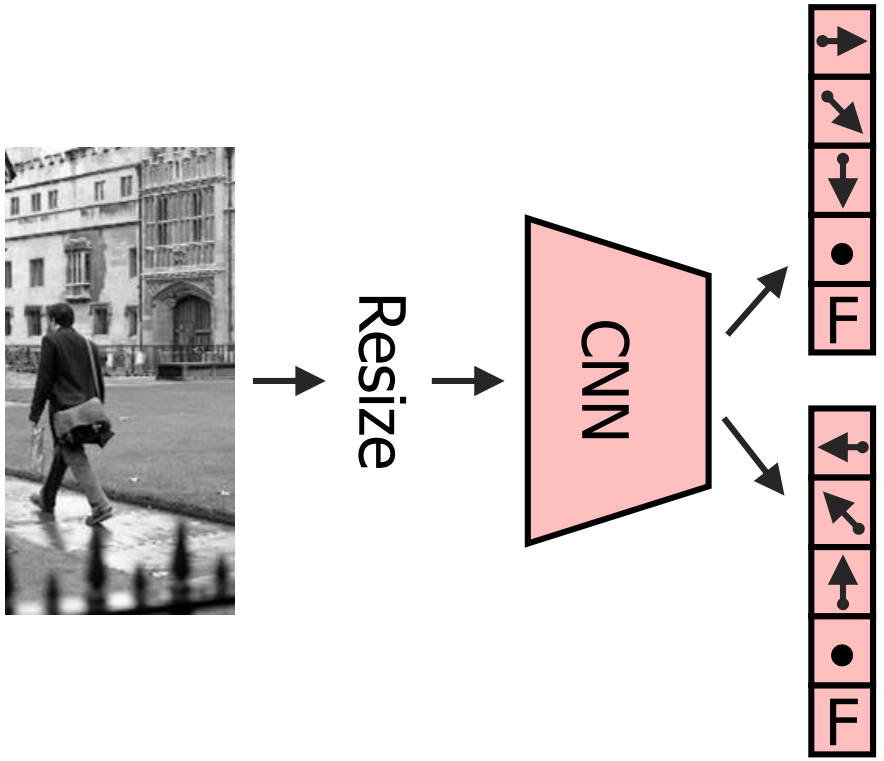

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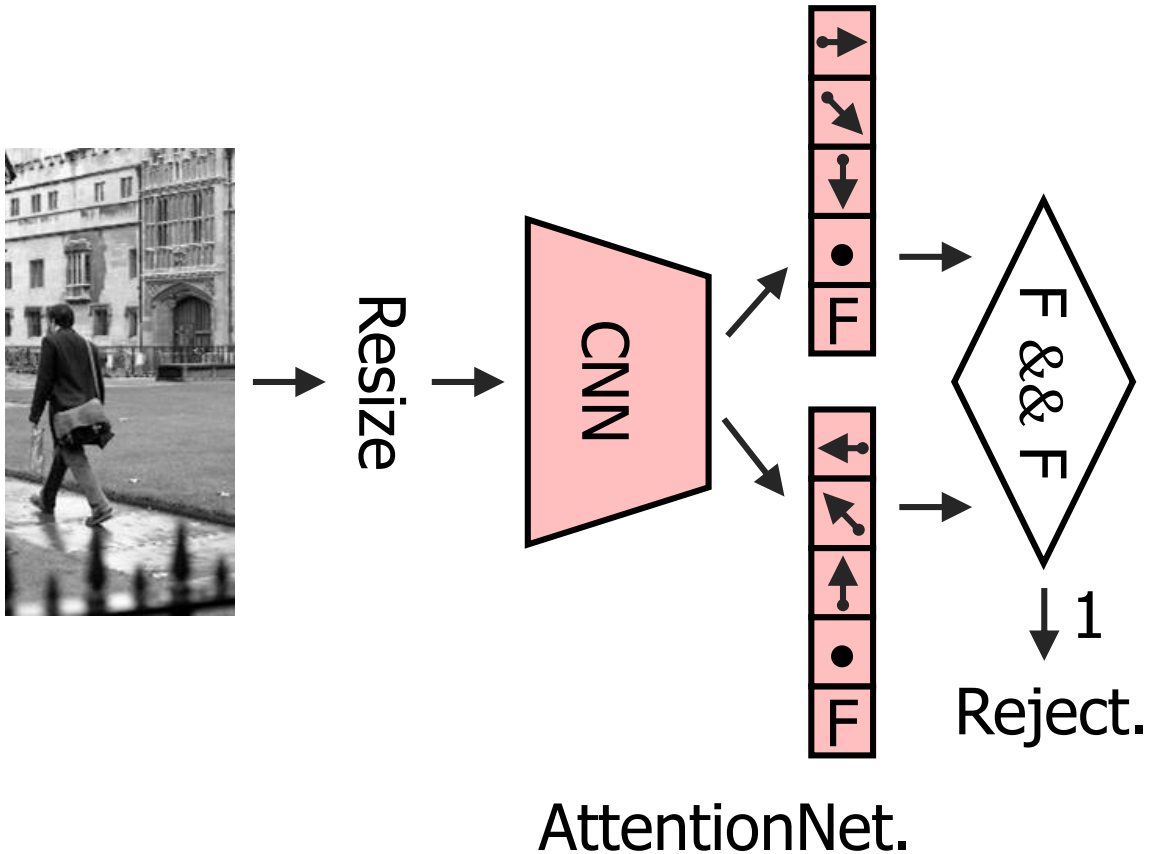

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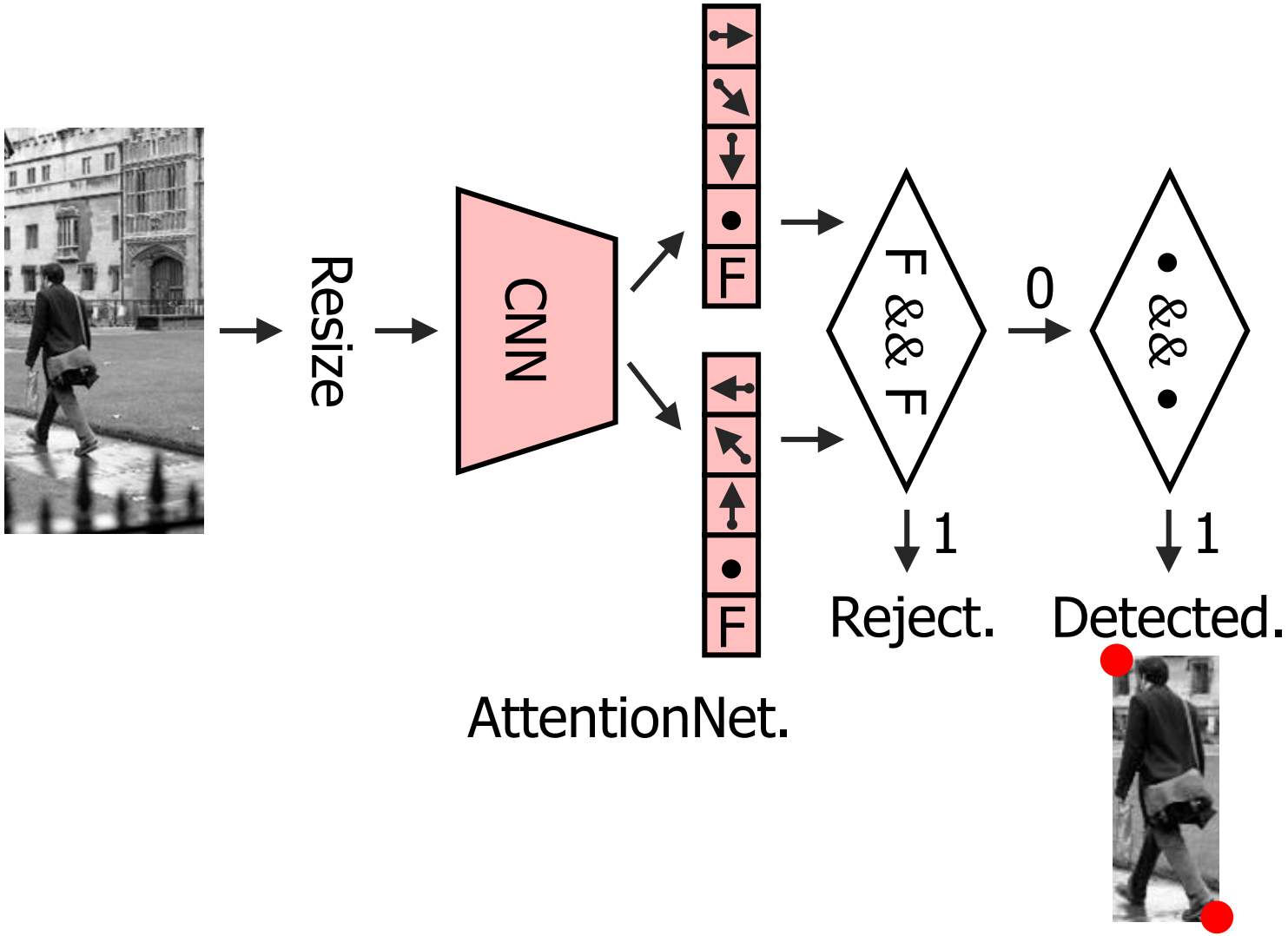

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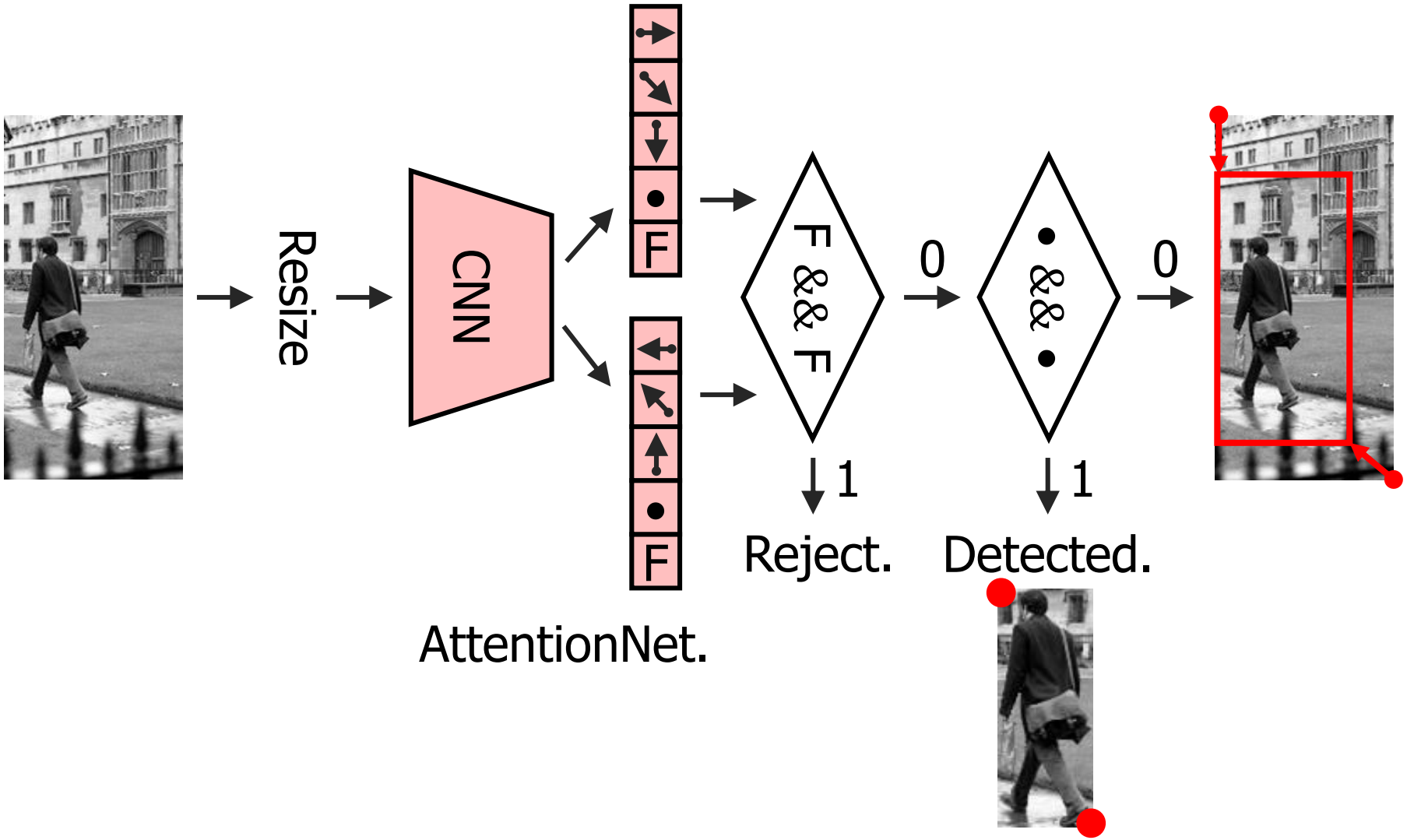

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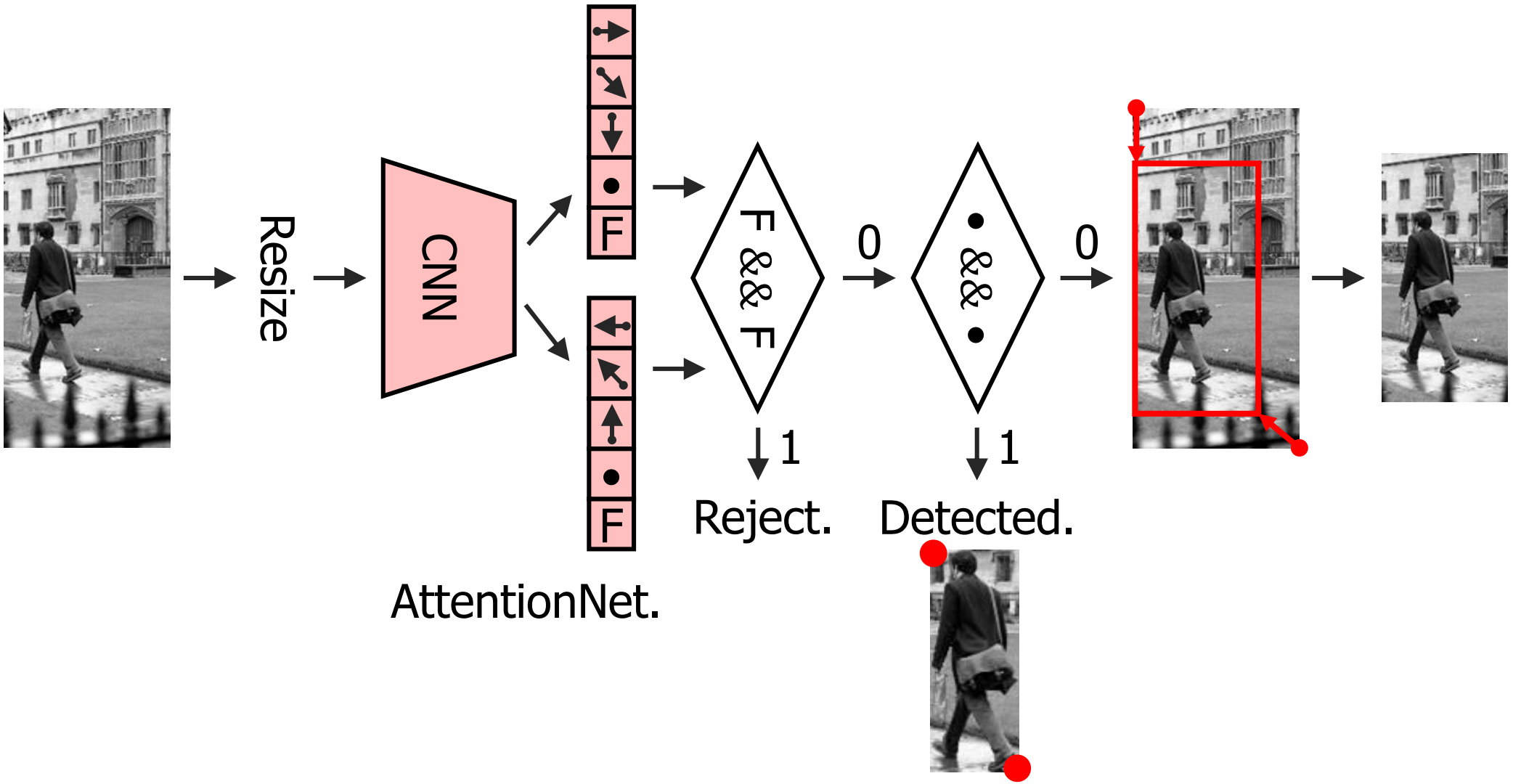

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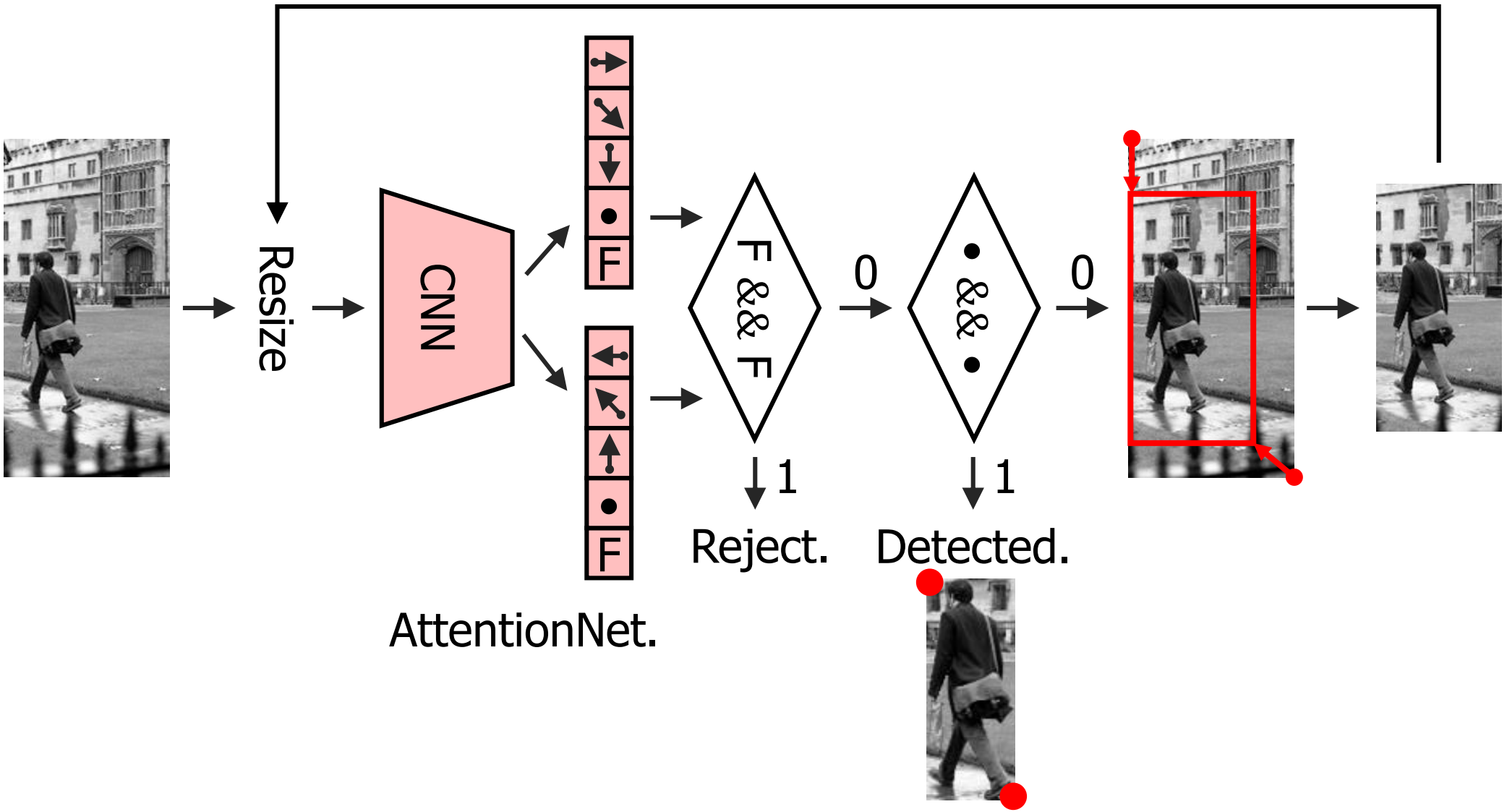

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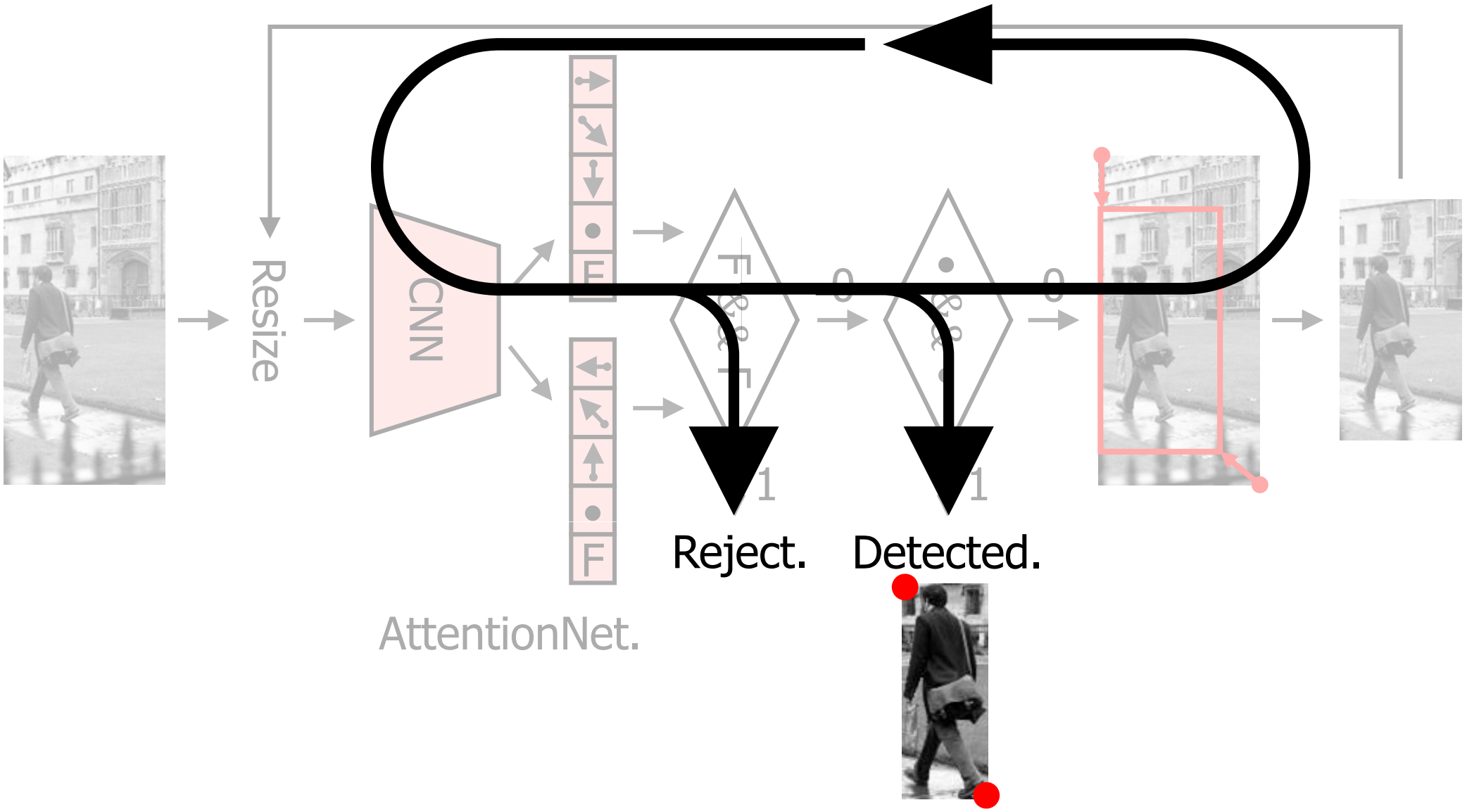


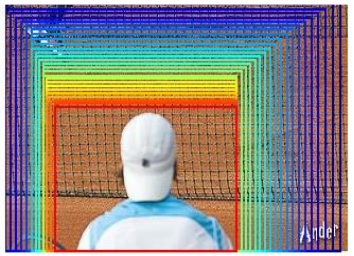
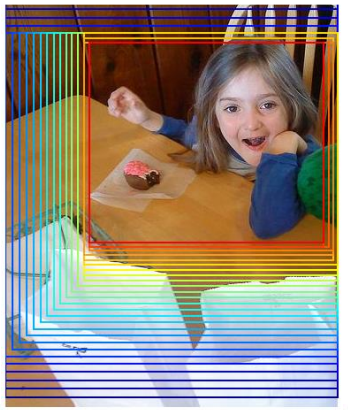

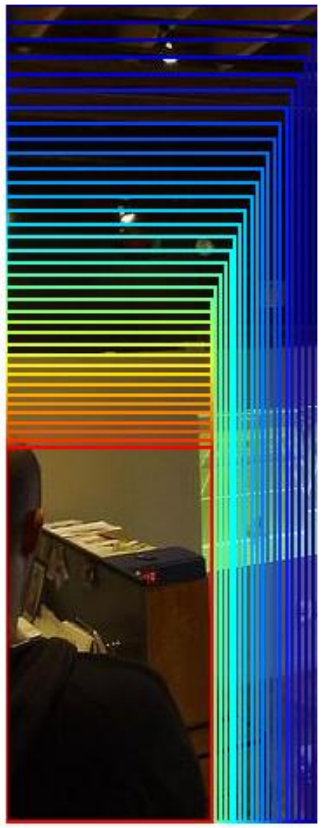
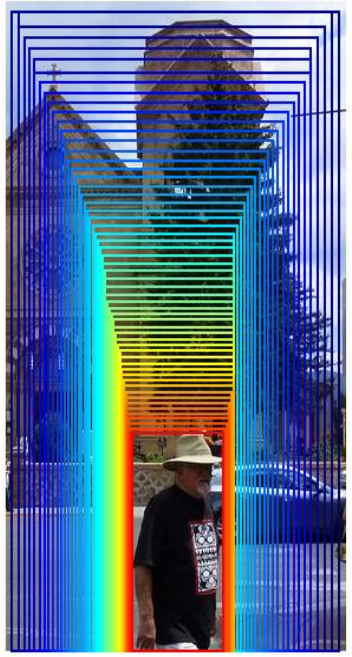

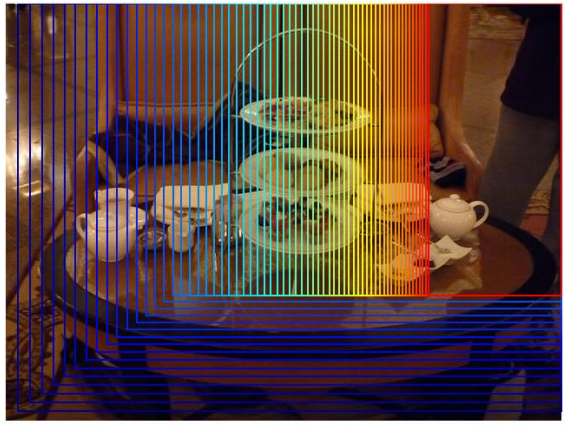
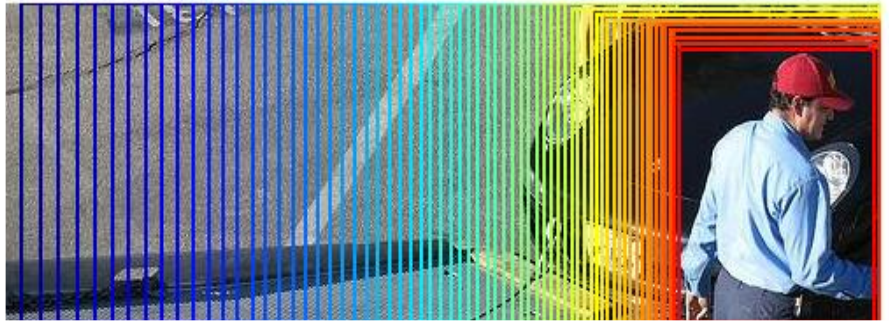
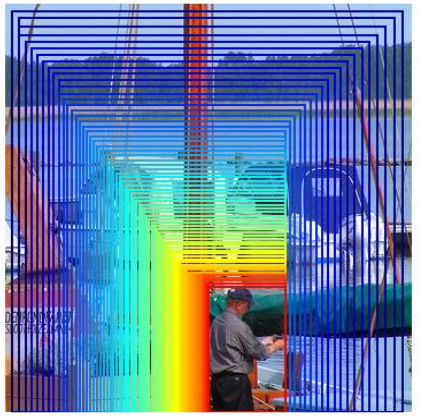


AttentionNet: Aggregating Weak Directions for Accurate Object Detection

Human detection examples on PASCAL VOC 2007

Initial box proposal:

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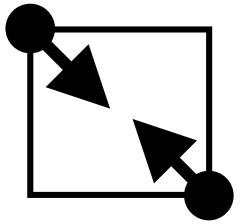
Boxes satisfying  .

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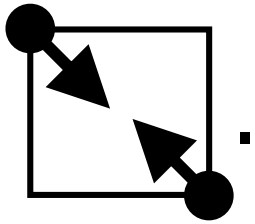
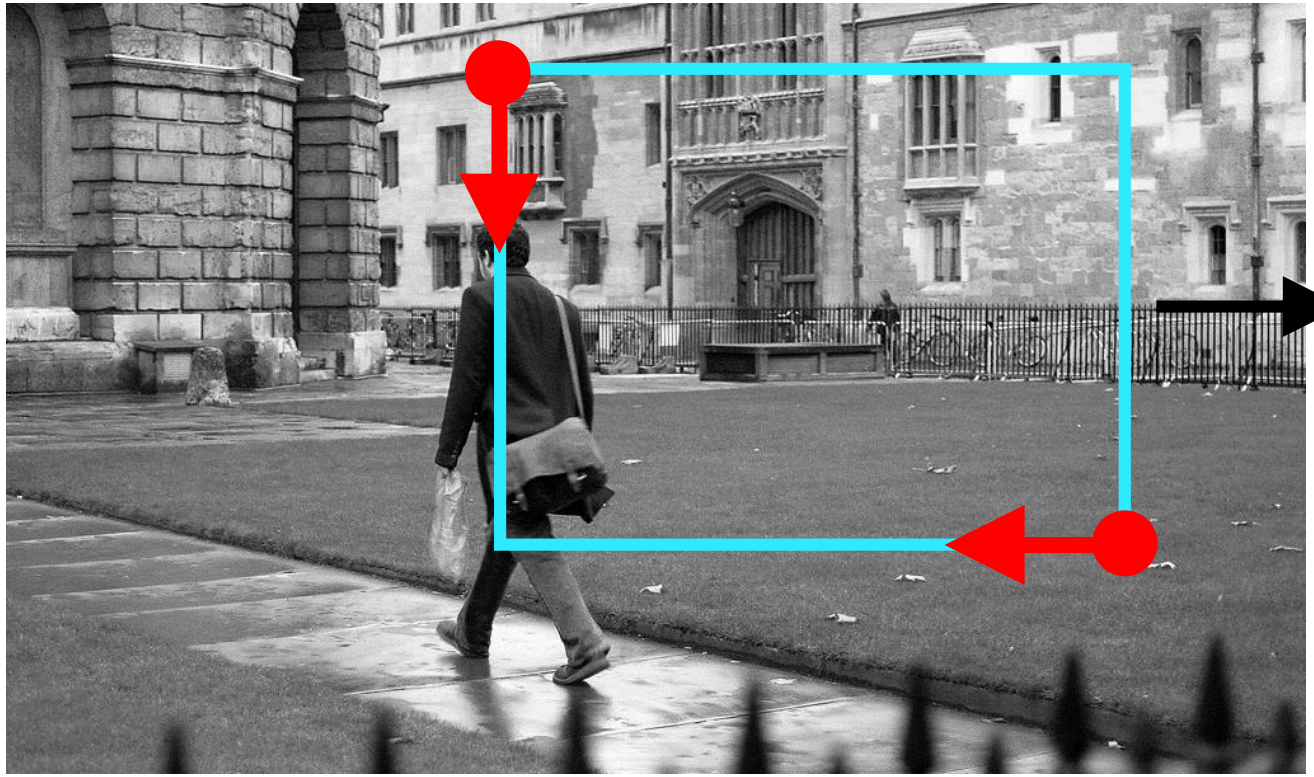
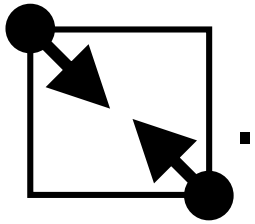
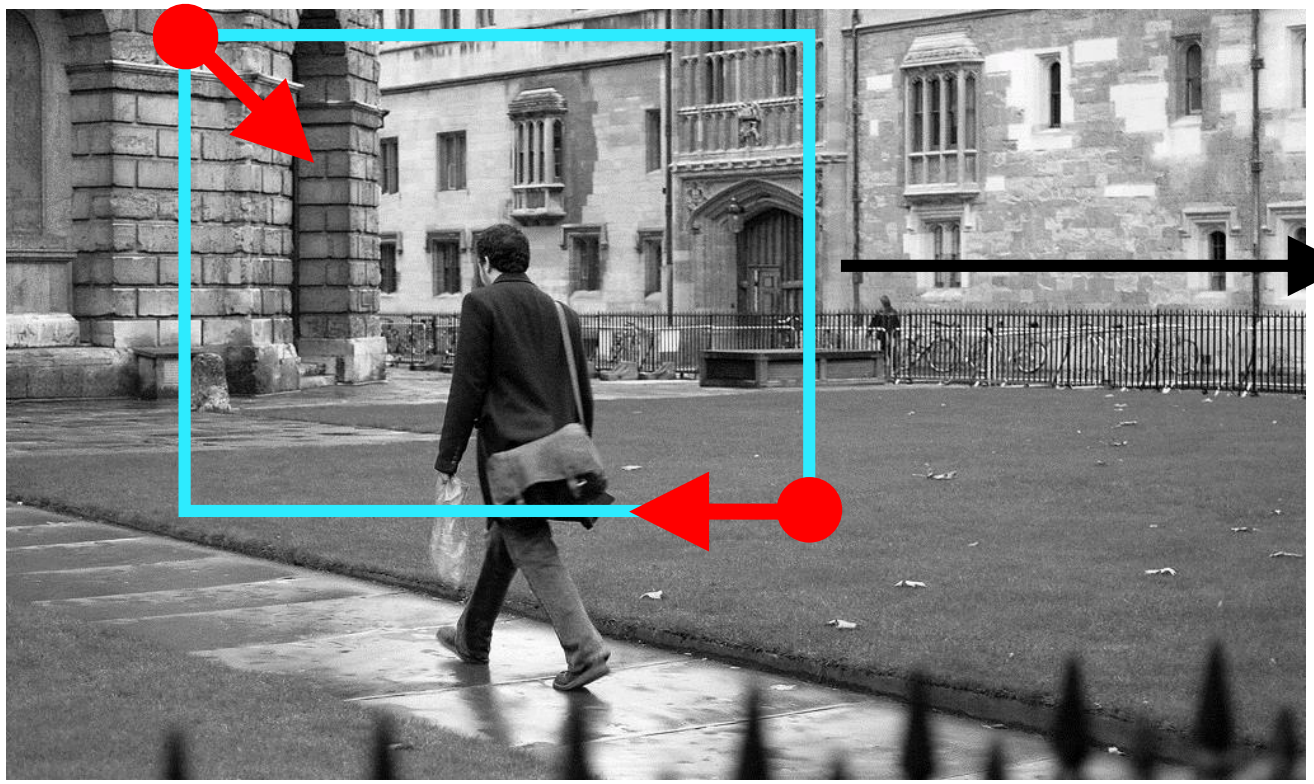
Boxes satisfying  .



Rejected.

Initial box proposal:

Boxes satisfying  .



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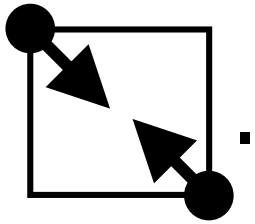
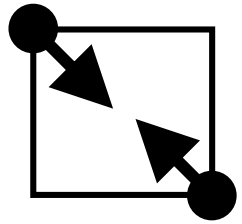
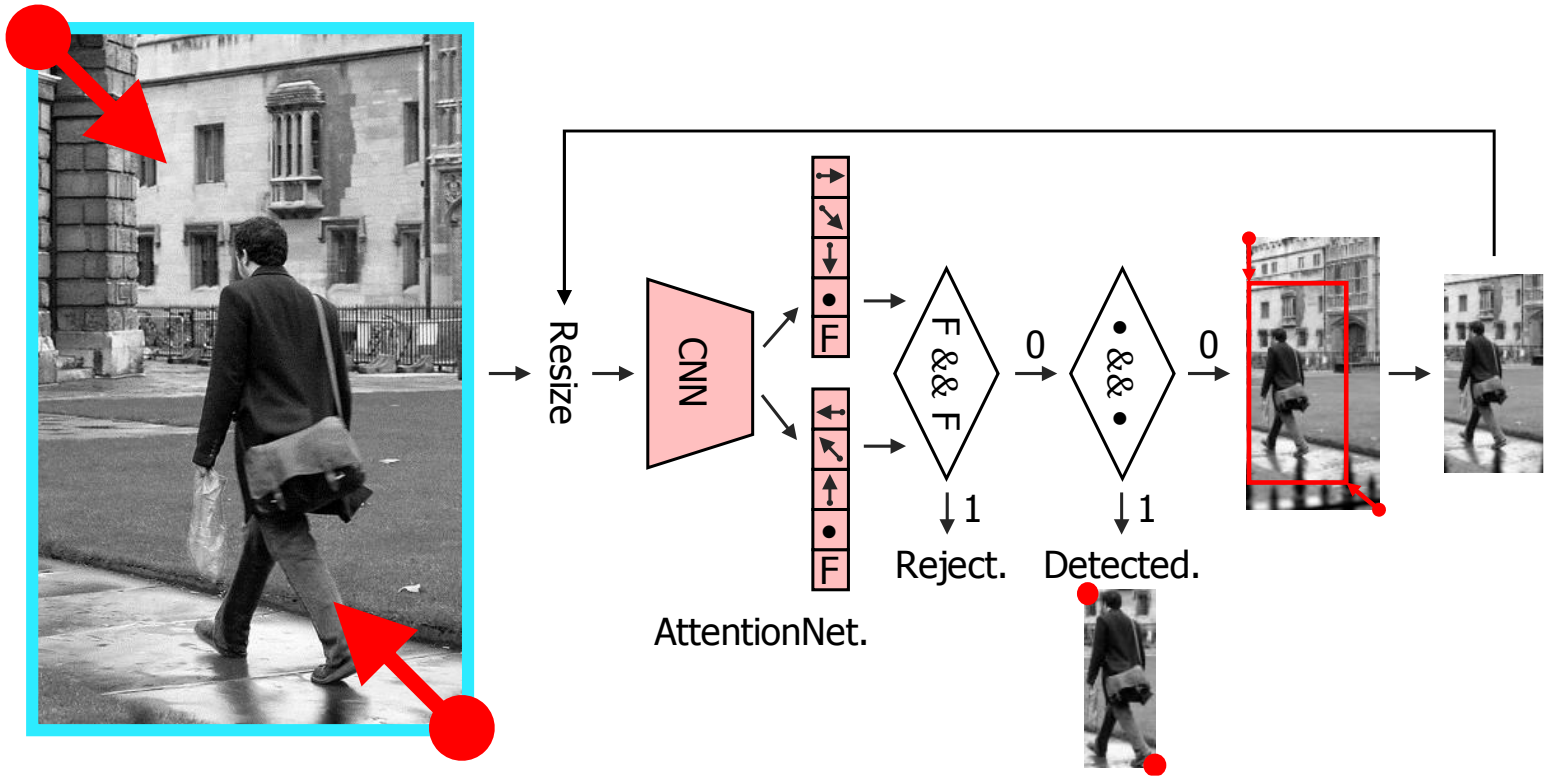
Initial box proposal:

Boxes satisfying  .

Continue.

Initial box proposal:

Boxes satisfying  .



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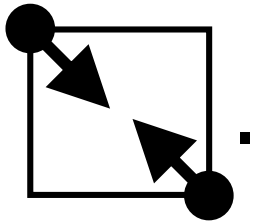
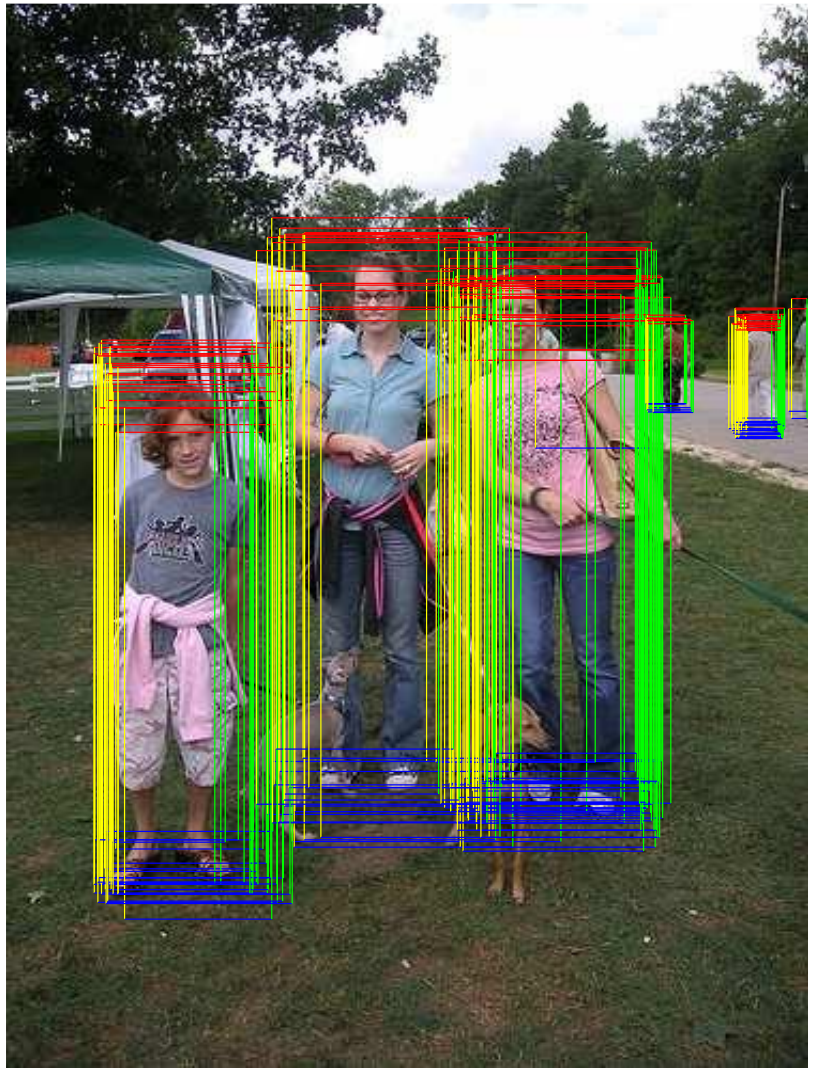
Boxes satisfying  .

Multi-{scale, aspect ratio} sliding window search using ***fully-convolutional network***.

Initial detection and refinement.



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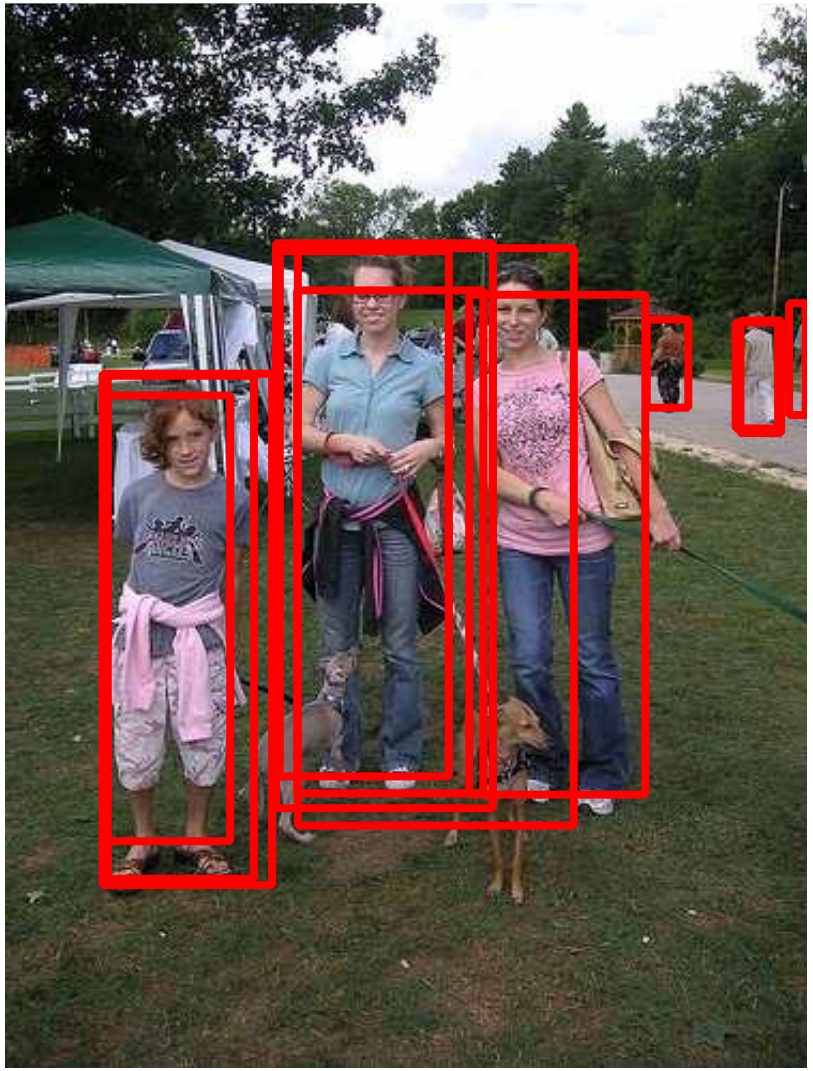

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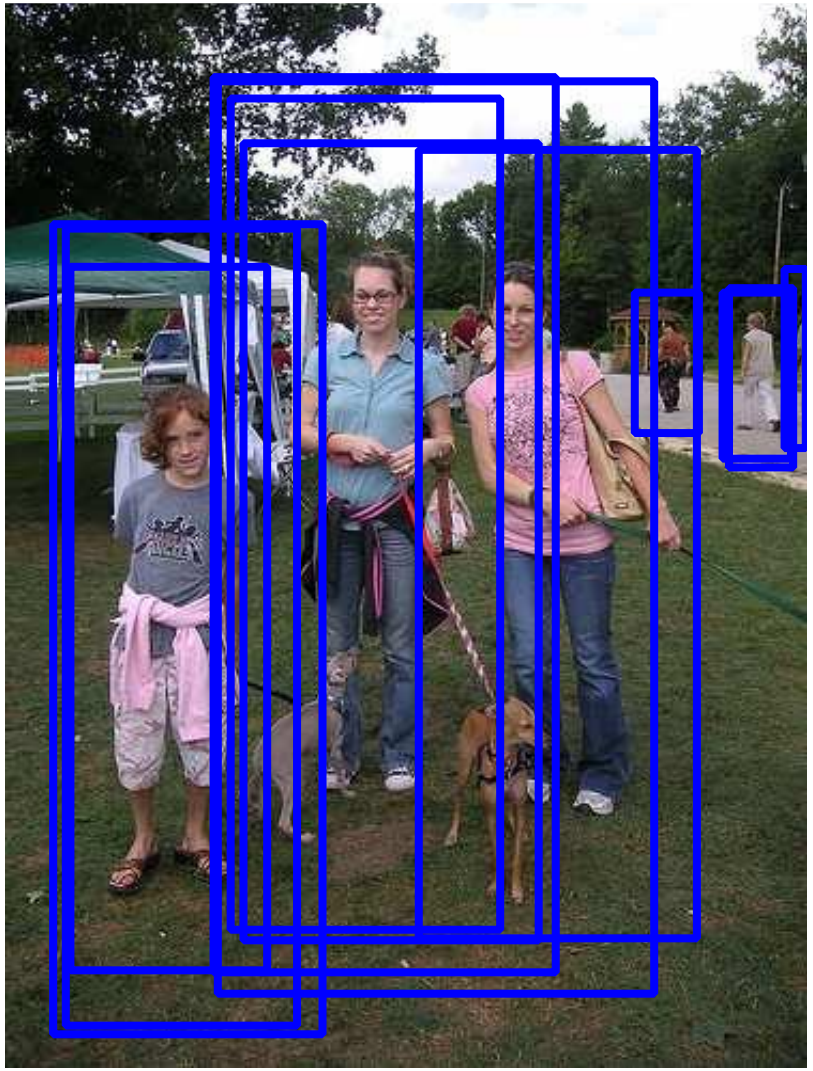

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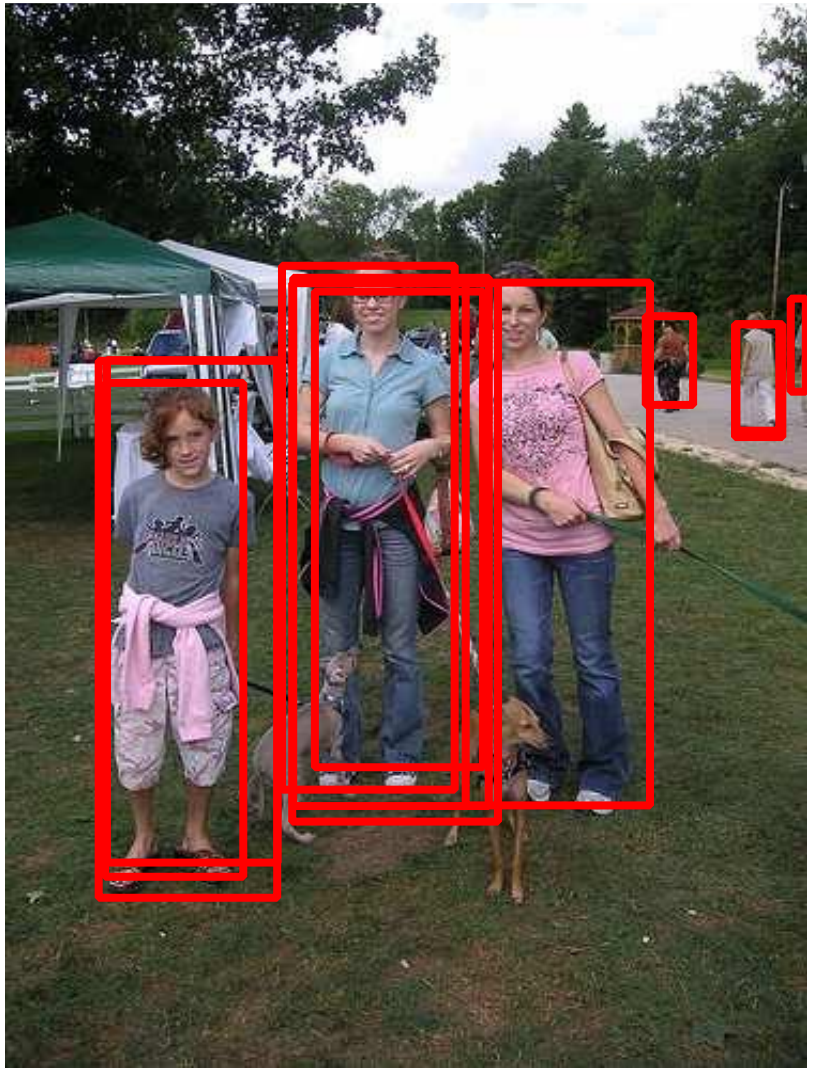

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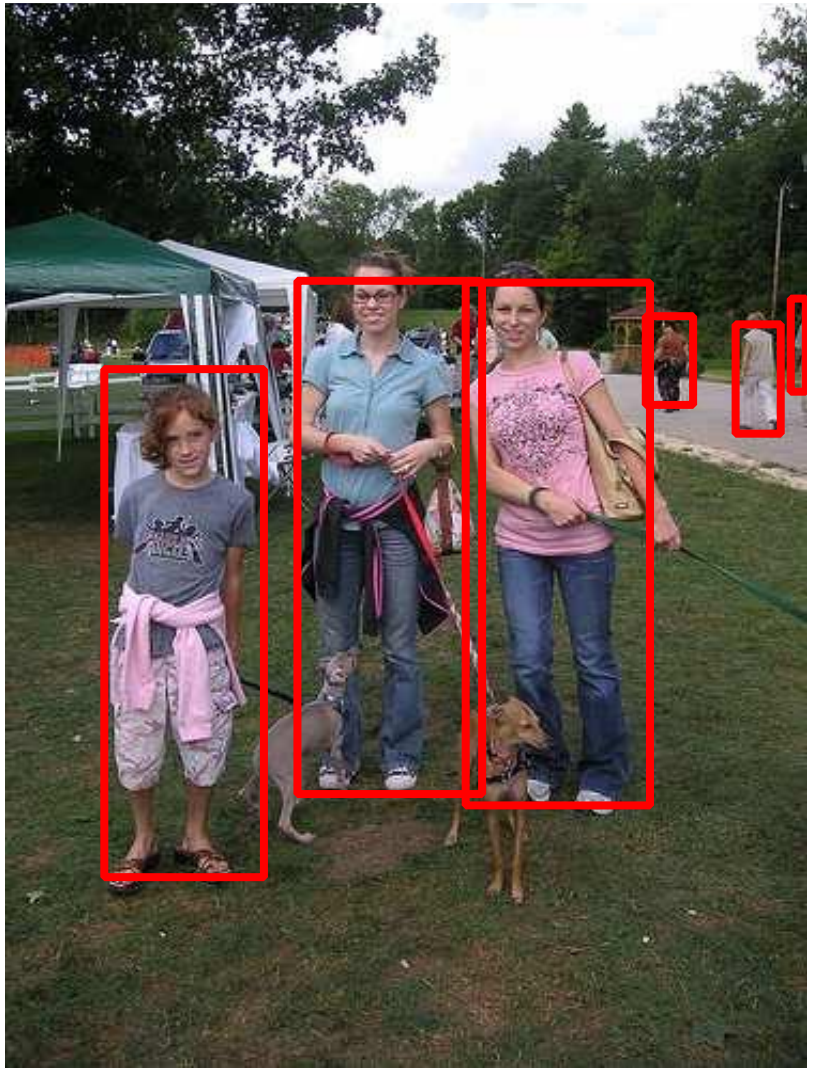
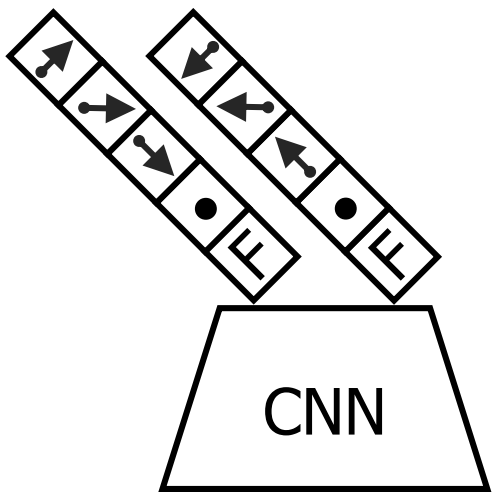


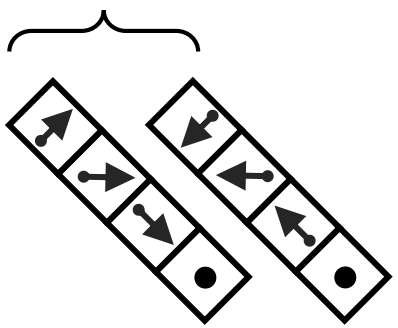
Extension to multiple classes.



AttentionNet.

Extension to multiple classes.

Class 1.



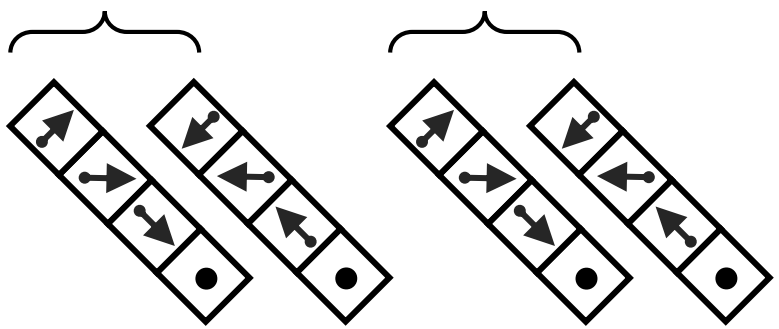
CNN

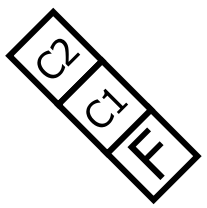
AttentionNet.

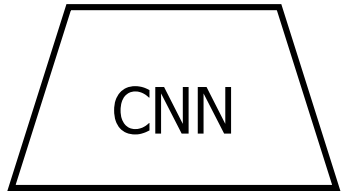
Extension to multiple classes.

Class 1.

Class 2.







Multi-class AttentionNet.

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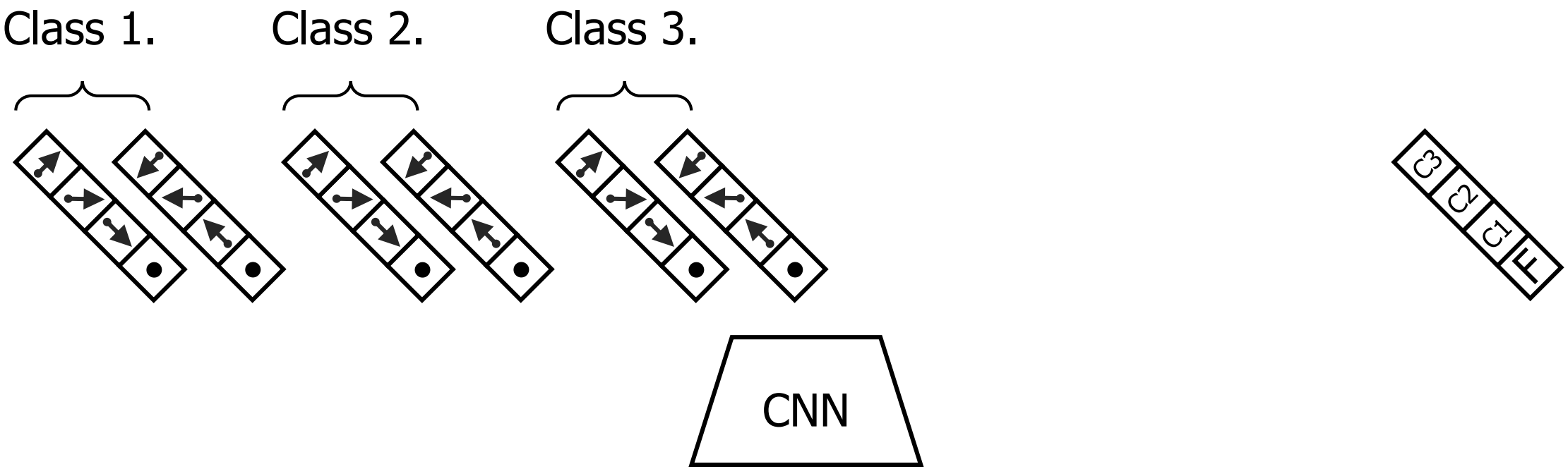

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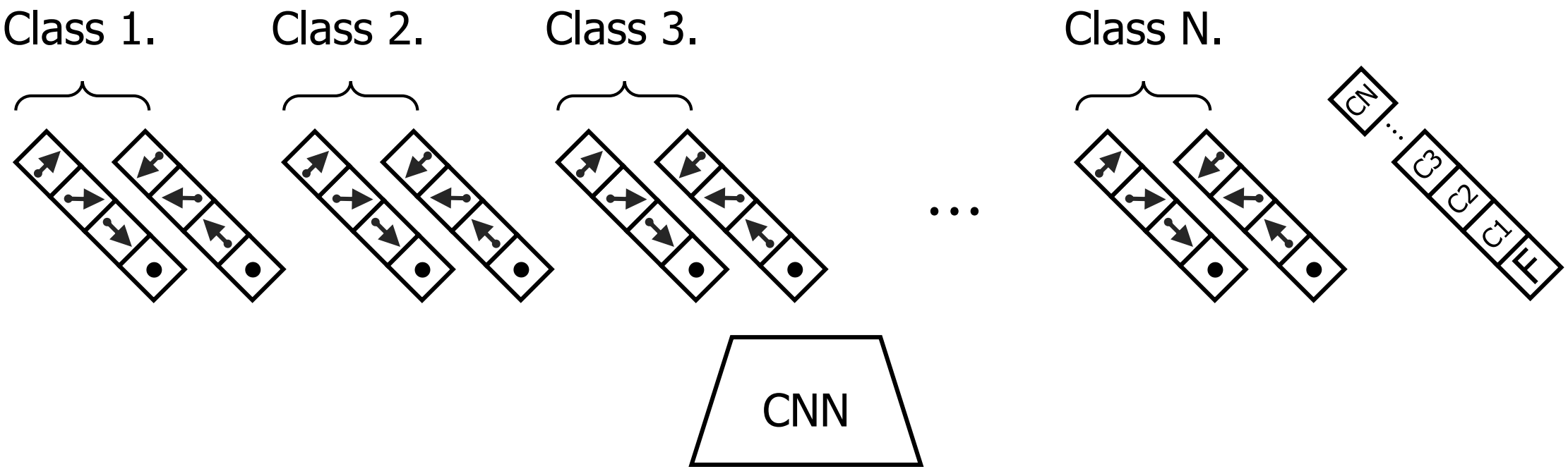
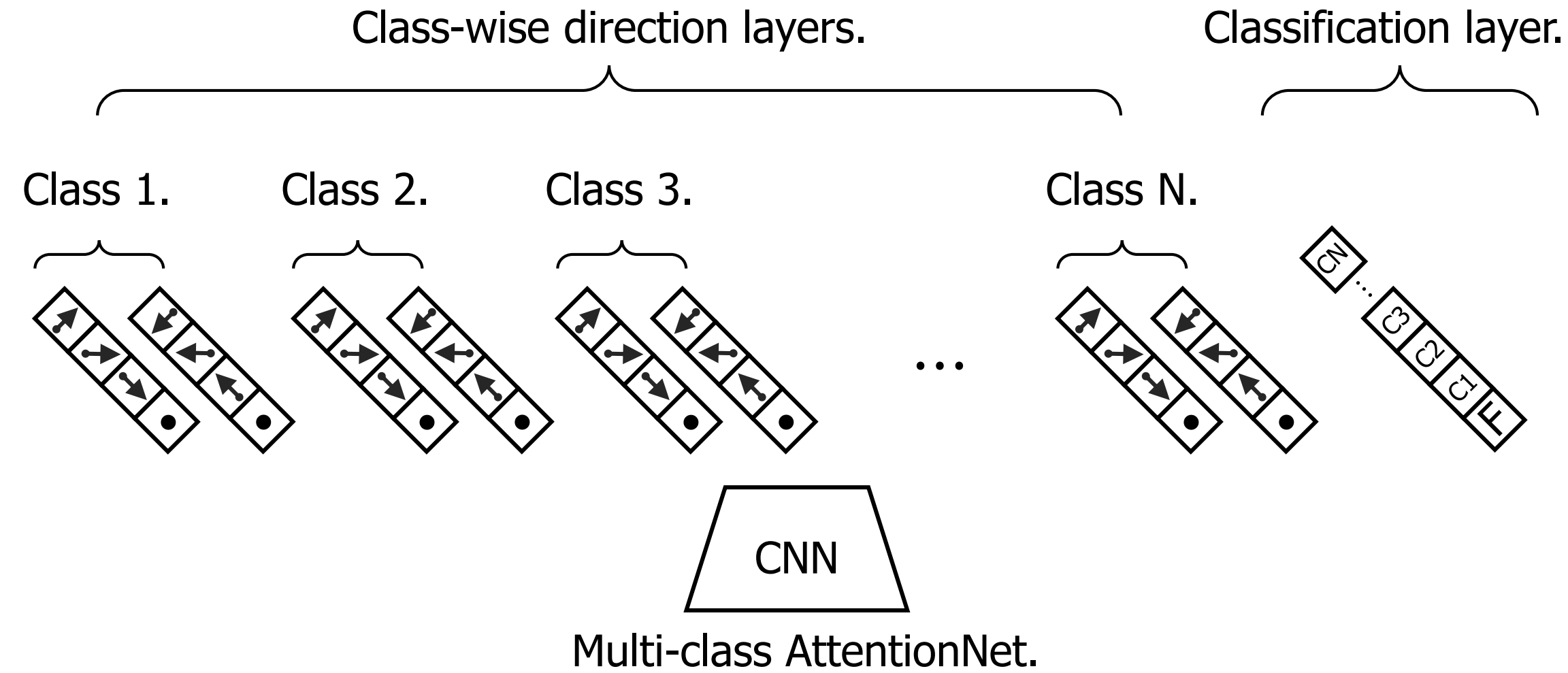


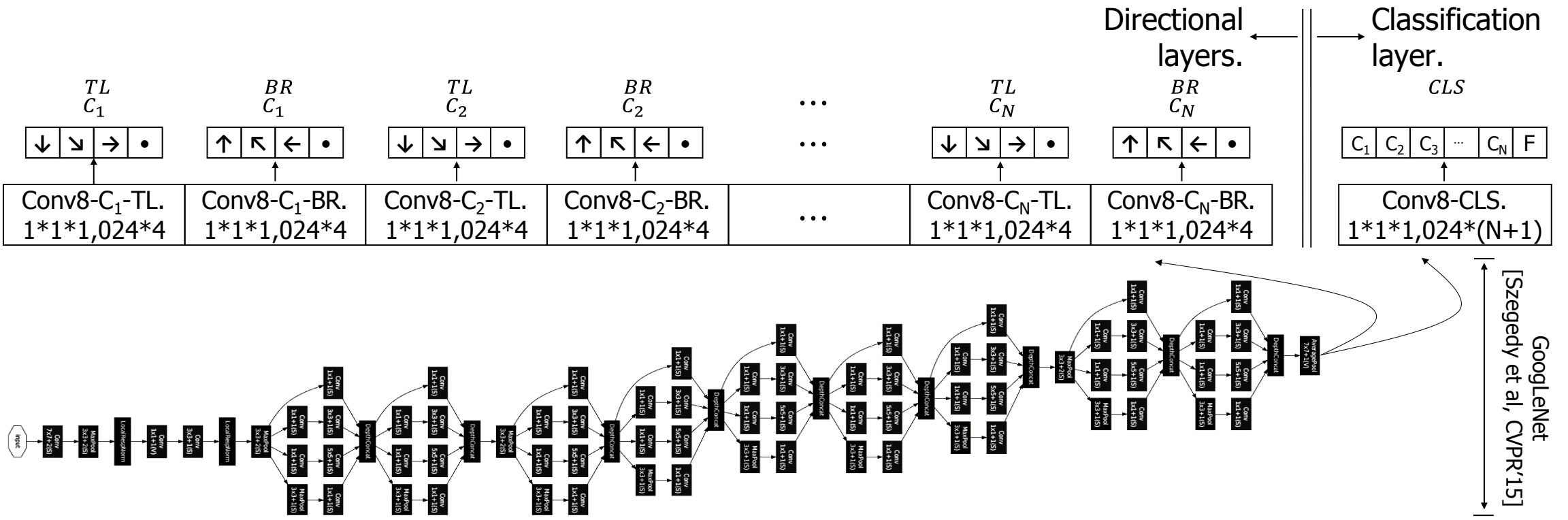
Multi-class AttentionNet.

Extension to multiple classes.



Multi-class AttentionNet.

Final architecture.



Training multi-class AttentionNet.

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- Pre-training.
  - GoogLeNet [Szegedy et al, CVPR'15].
  - ILSVRC-CLS dataset.

Training multi-class AttentionNet.

- Pre-training.
  - GoogLeNet [Szegedy et al, CVPR'15].
  - ILSVRC-CLS dataset.
- Fine-tuning.
  - # epochs: 5.
  - # training region: 22M. (randomly generated.)
  - Learning rate of the classification layer: 0.01.
  - Learning rate of the 2K(=1K+1K) directional layers: 0.01.
  - Learning rate of the layers from conv1 to conv21: 0.001.

Training multi-class AttentionNet.

$$Loss = \underbrace{\frac{1}{3}Loss^{TL} + \frac{1}{3}Loss^{BR}}_{\text{Directional terms.}} + \underbrace{\frac{1}{3}Loss^{CLS}}_{\text{Classification term.}},$$

Training multi-class AttentionNet.

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$$Loss^{CLS} = SoftMaxLoss(y^{CLS}, t^{CLS}).$$

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Given top-5 class predictions,
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Results on validation set.

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Note that we use a SINGLE "Multi-class AttiontionNet".

Related publication:
Donggeun Yoo, Sunggyun Park, Joon-Young Lee, Anthony S. Paek, In So Kweon,
AttentionNet: Aggregating Weak Directions for Accurate Object Detection,
In ICCV, 2015.