ROC and AUC example

Emily Miller

Reference

Fawcett, T. (2006). An introduction to ROC analysis. *Pattern recognition letters*, *27*(8), 861-874.

9 dogs, each on
a rolling platform
behind a screen

4 tennis balls

Each tennis ball is
held by a dog; each
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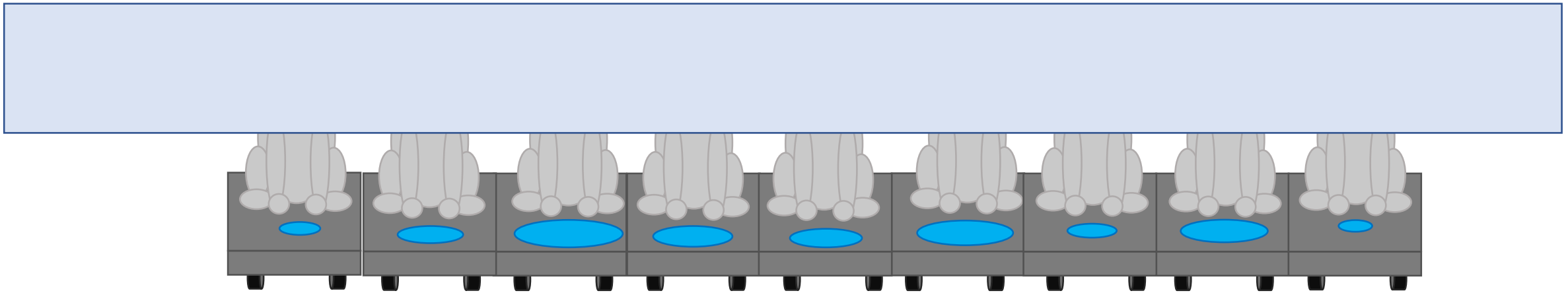

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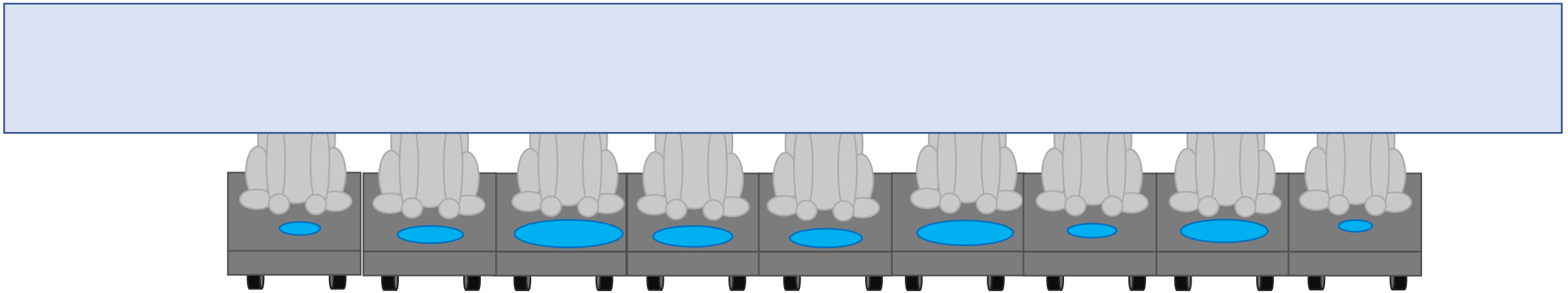
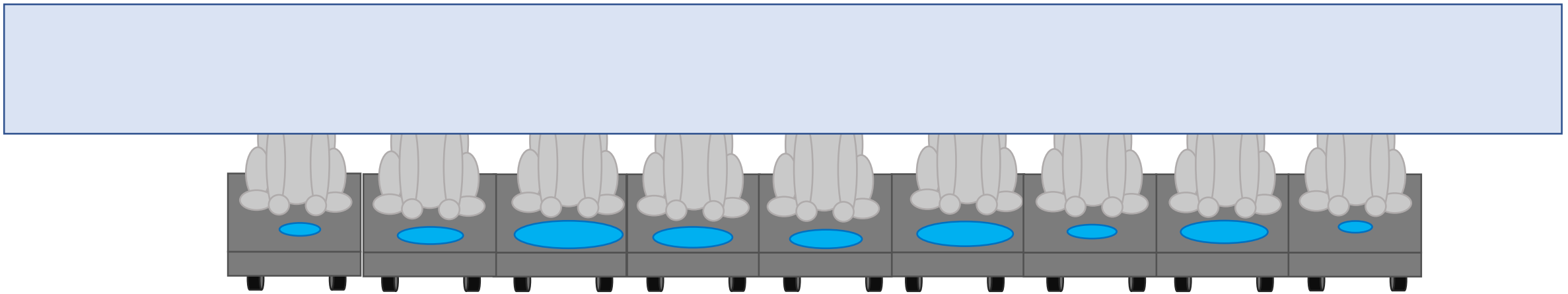
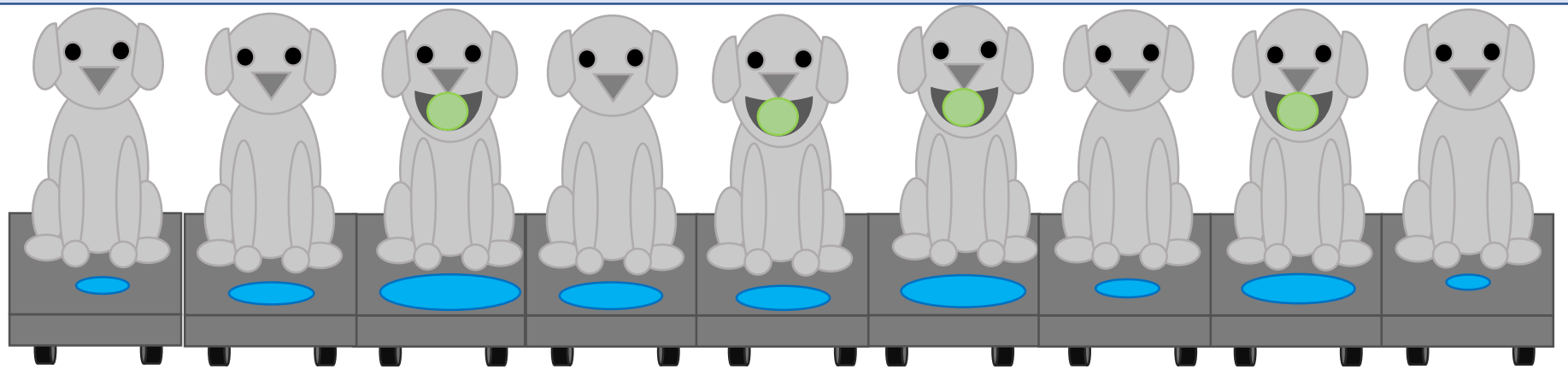
Let’s consider two models that predict which dogs are holding tennis balls.



Model 1

We suppose that the farther a dog is now sitting to the left, the more likely that dog is to have a tennis ball.

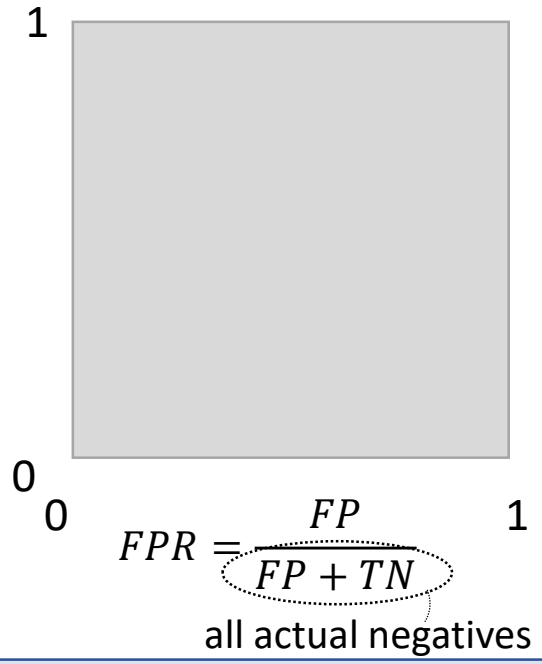




What fraction of the dogs <u>with</u> tennis balls we've included in the set of dogs we've predicted to have tennis balls.

$$TPR = \frac{TP}{TP + FN}$$

all actual positives



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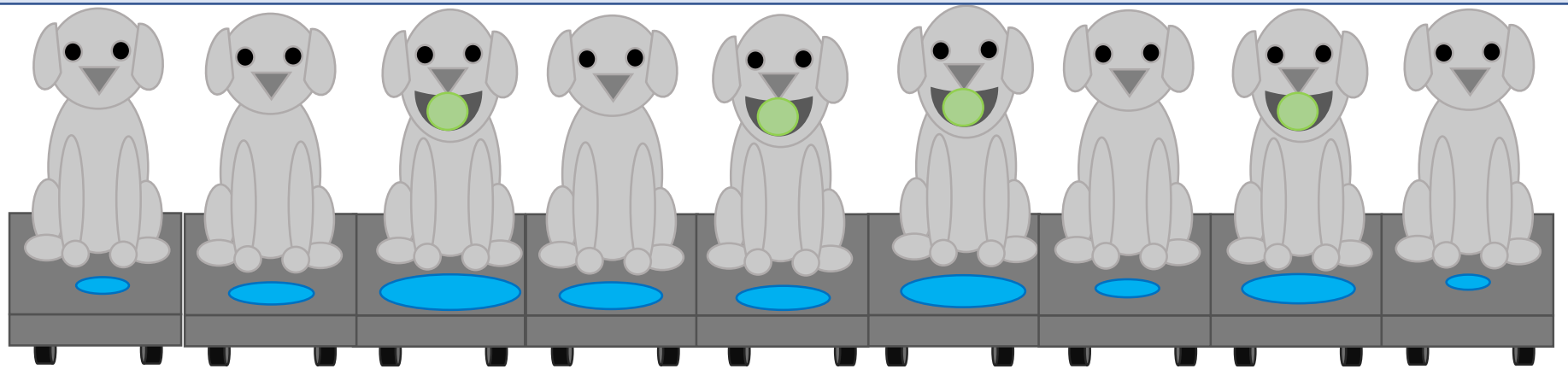

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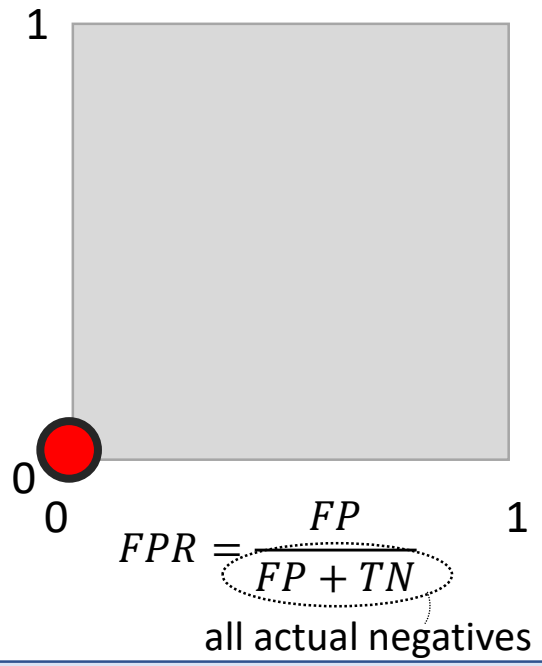

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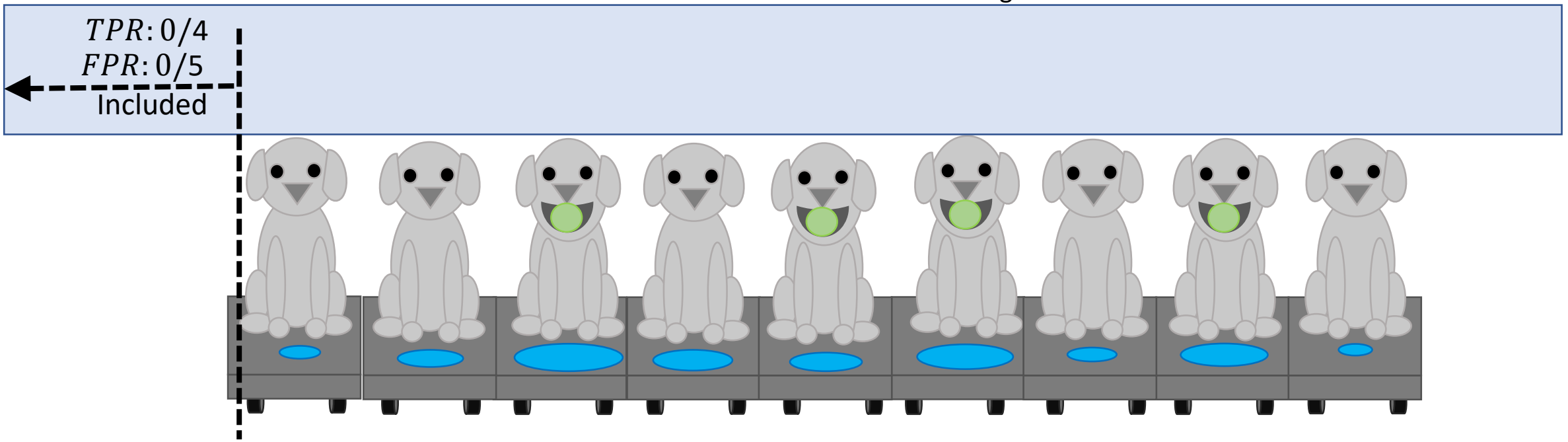

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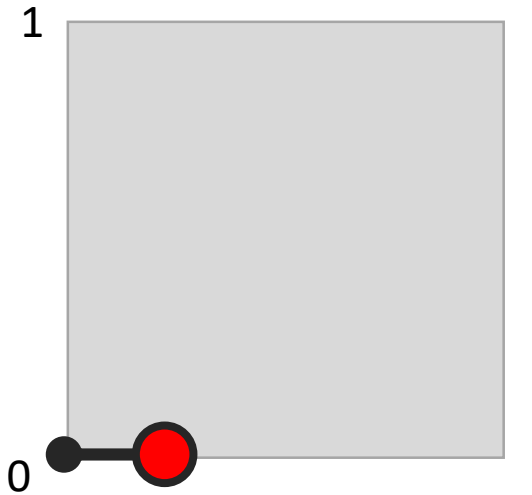

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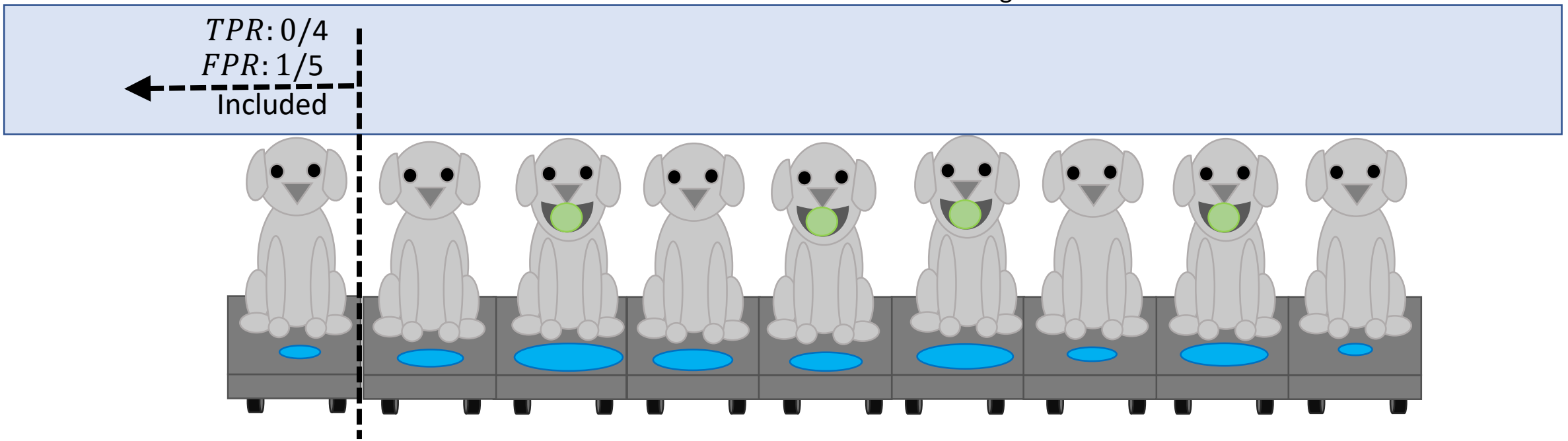

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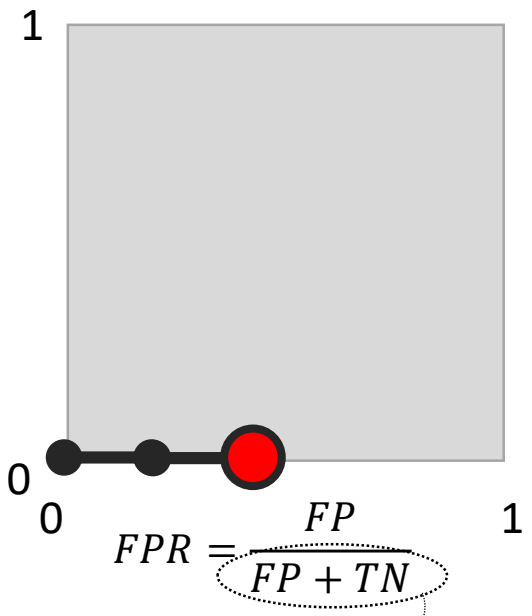

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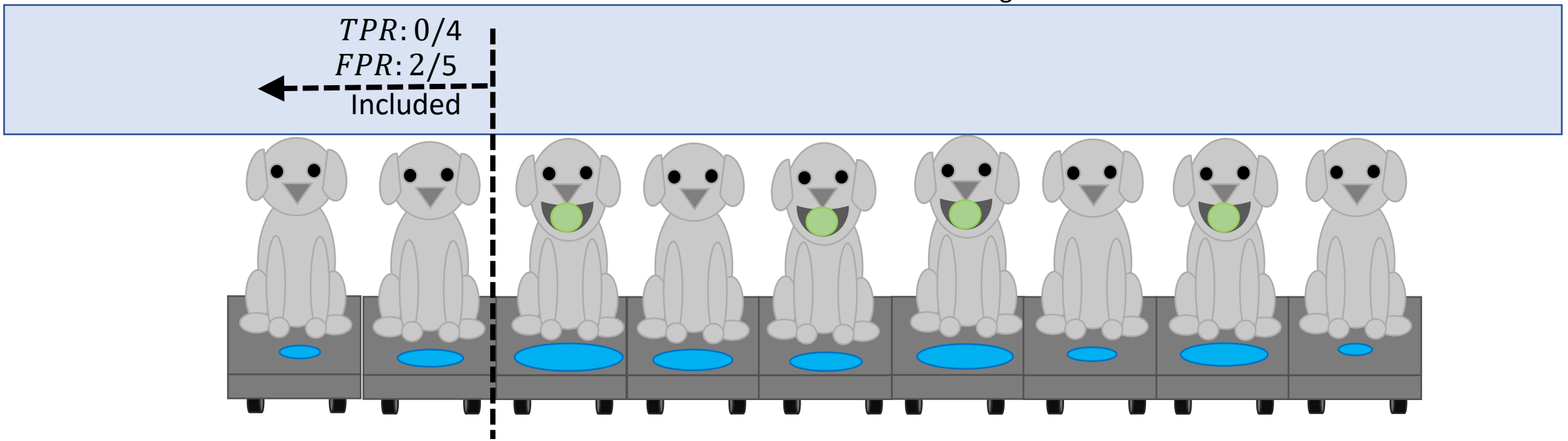

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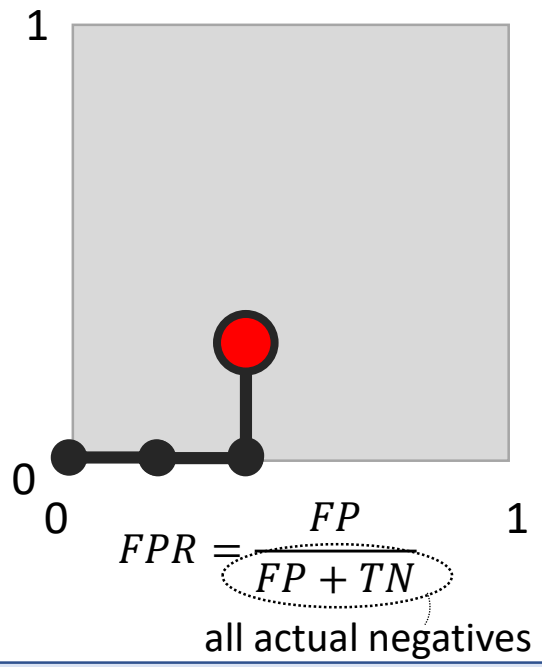

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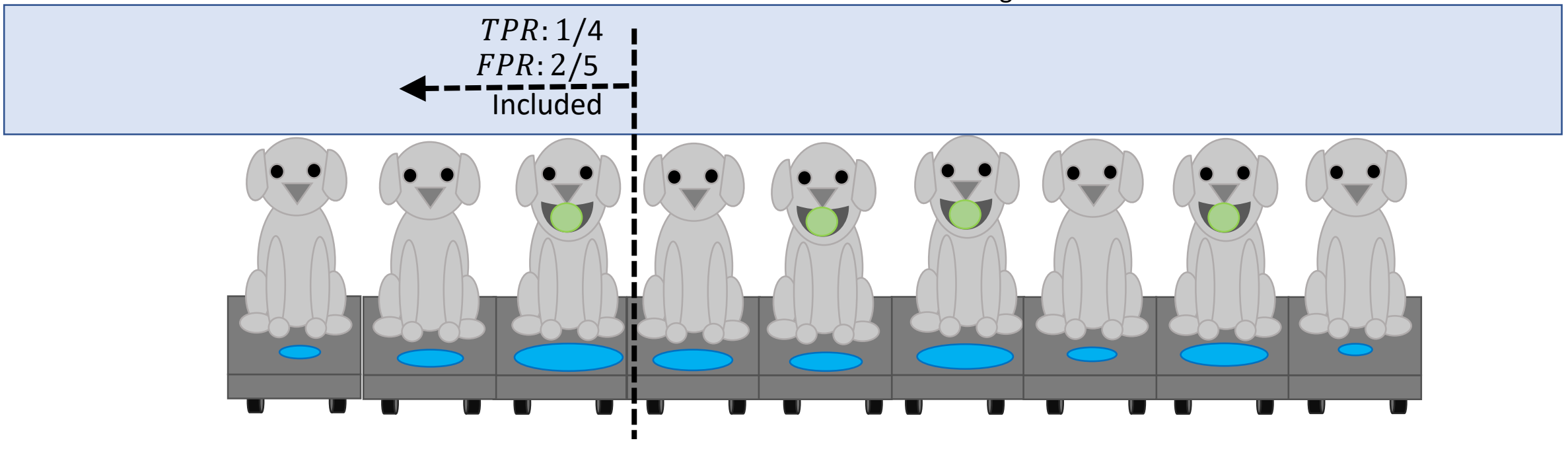

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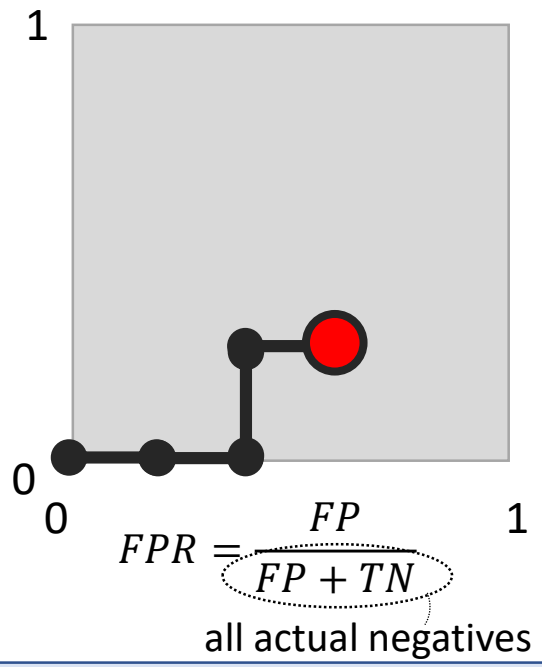

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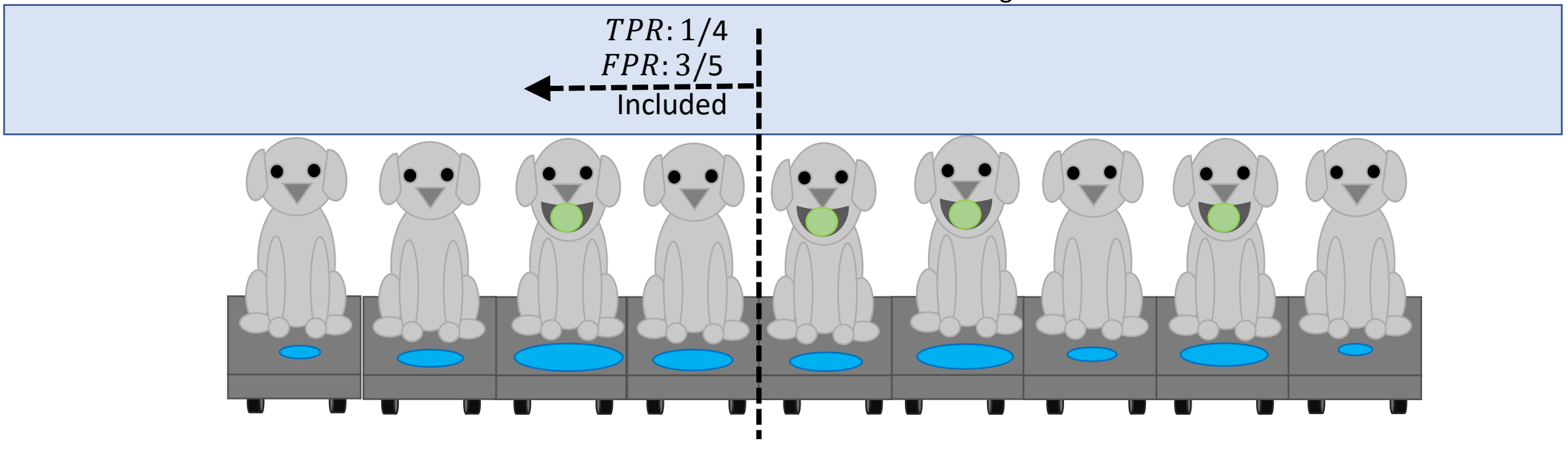

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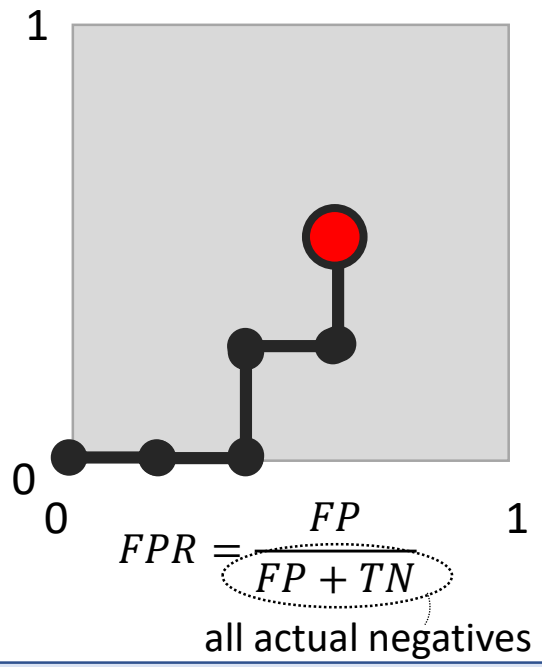

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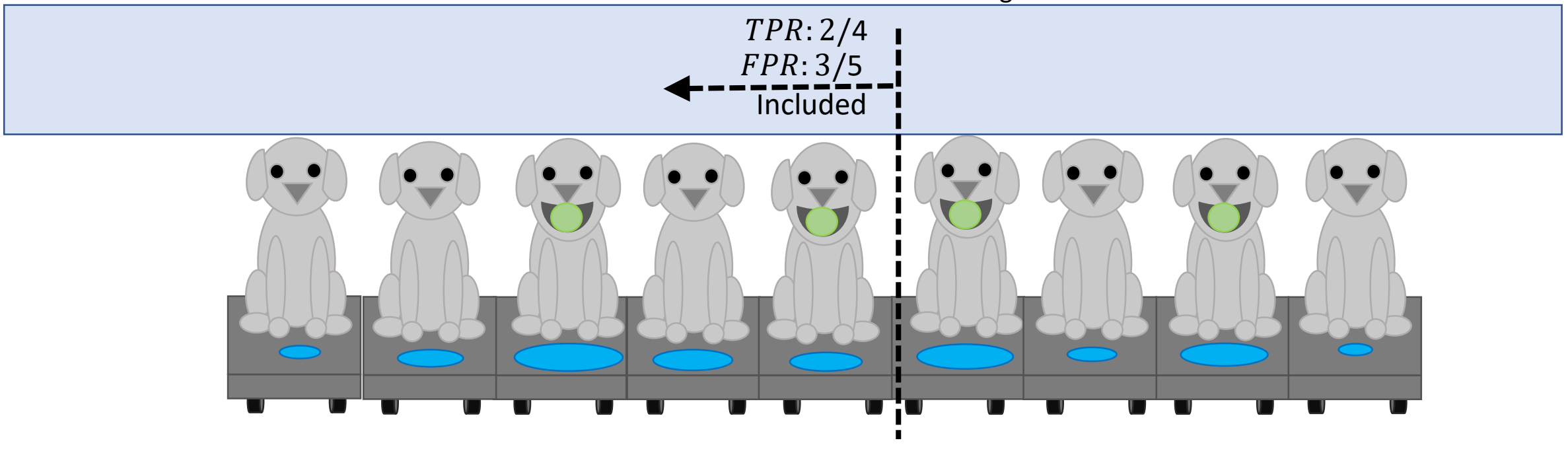

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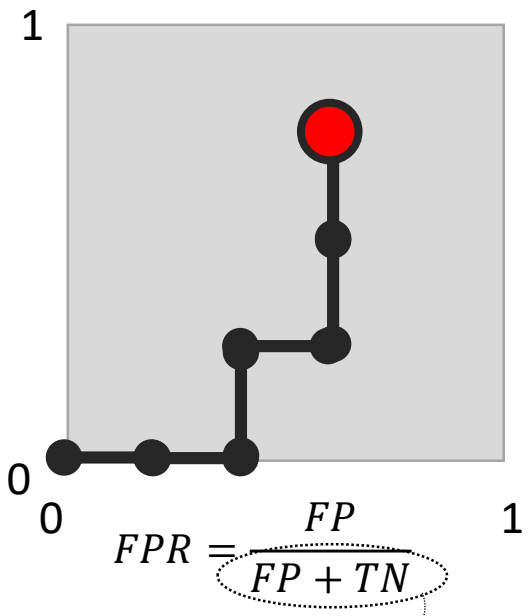

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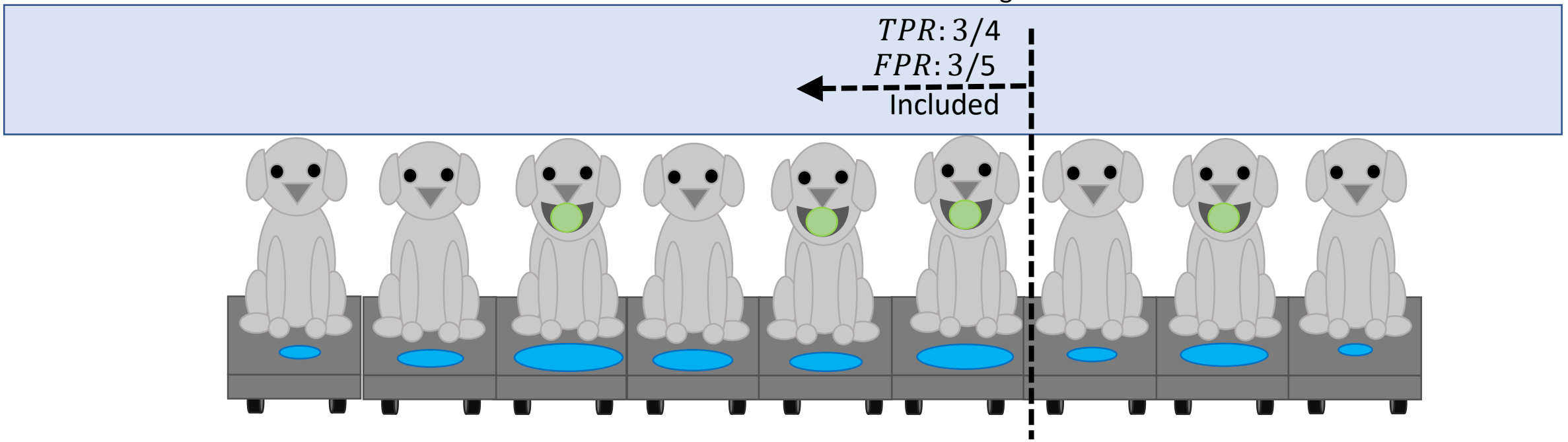

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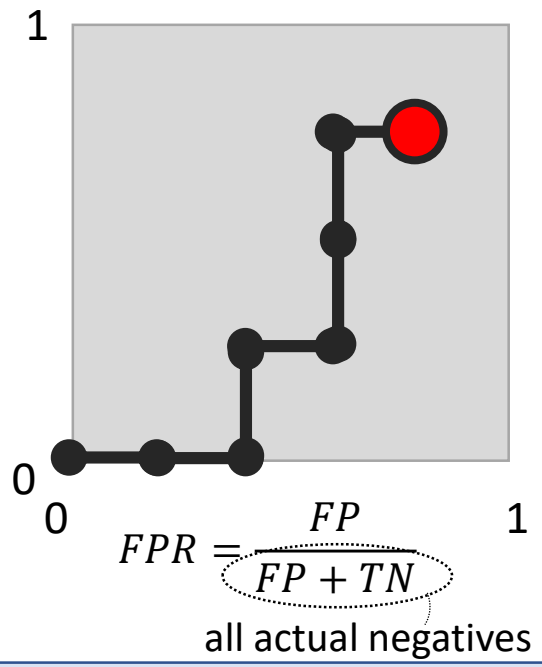

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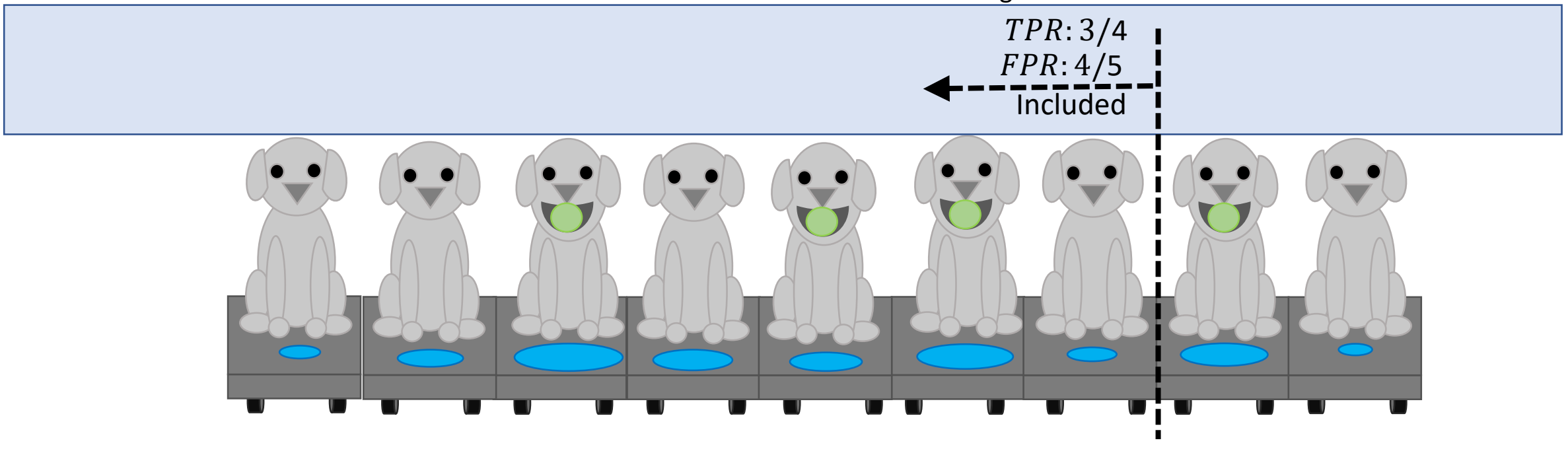

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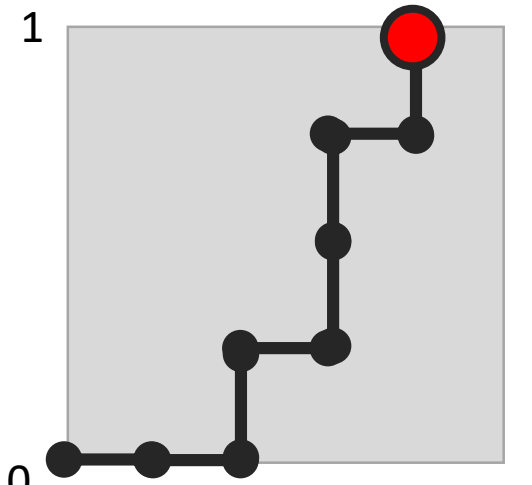

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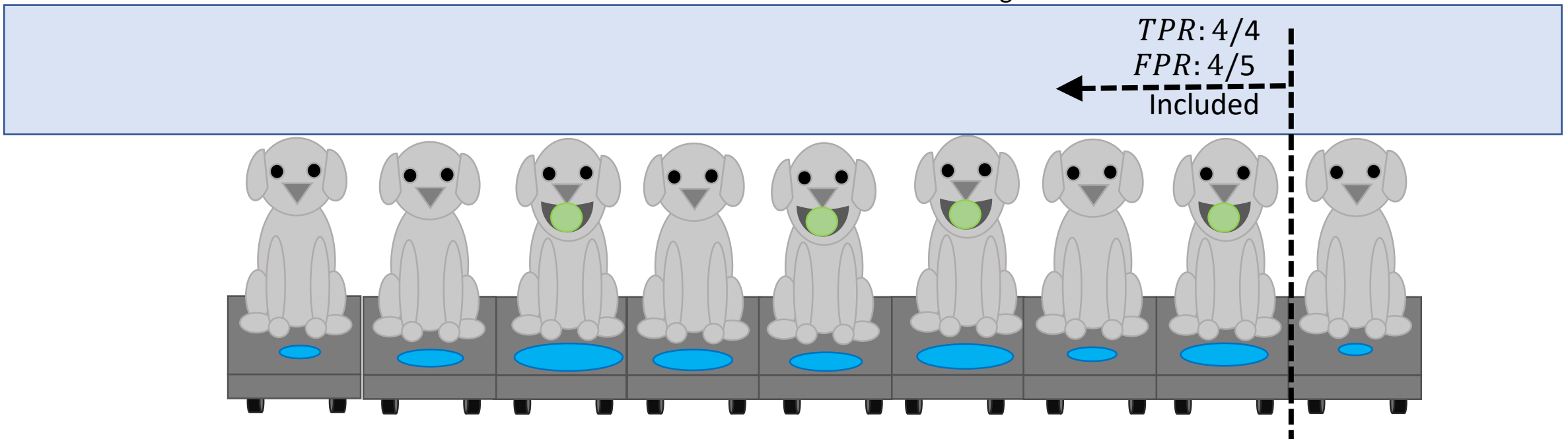

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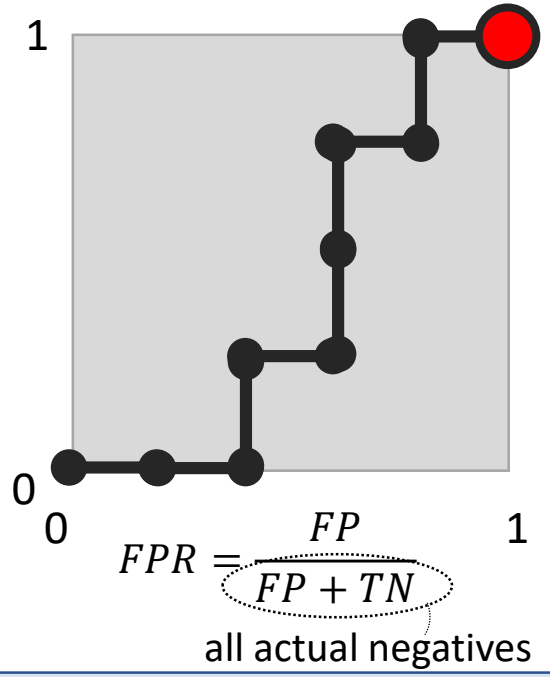

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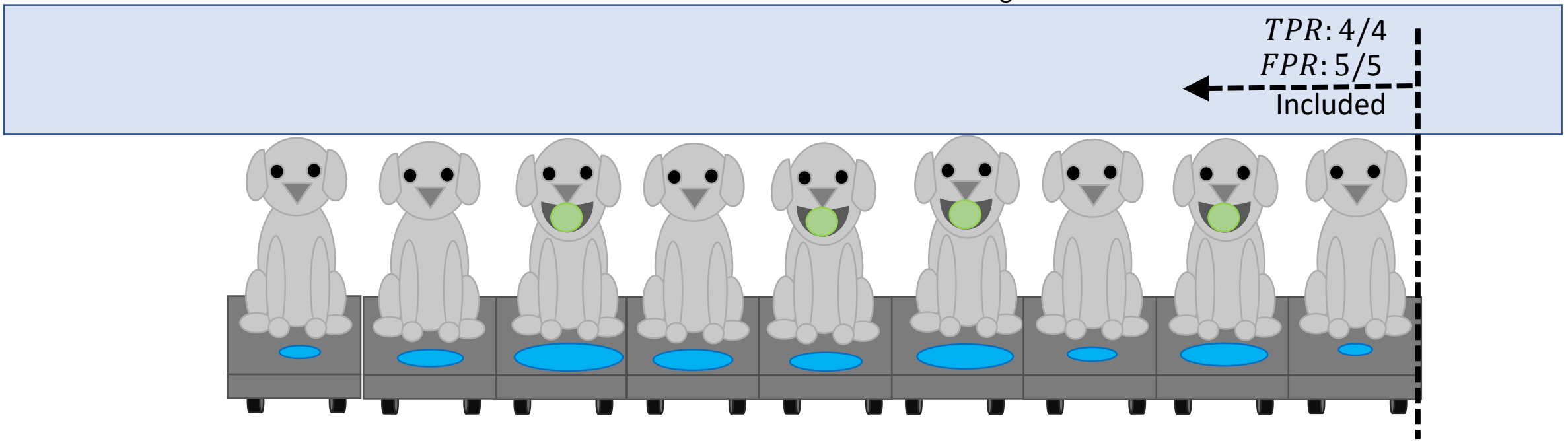

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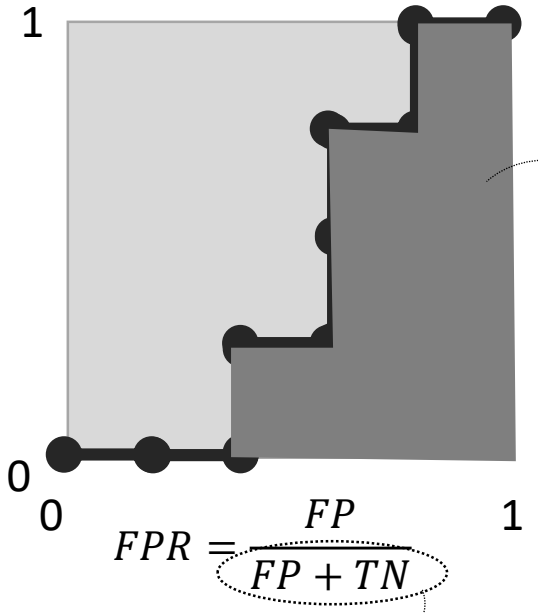
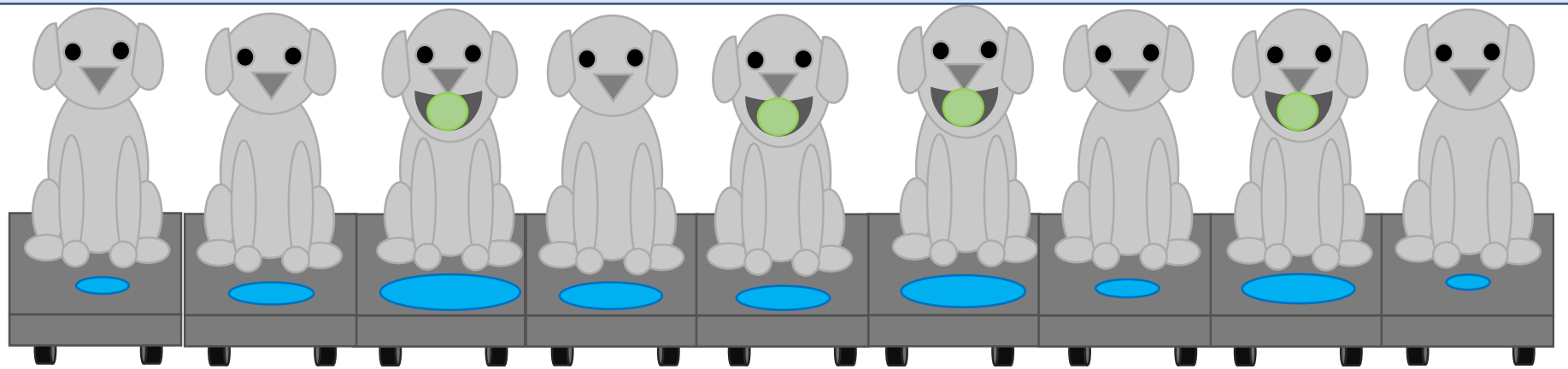
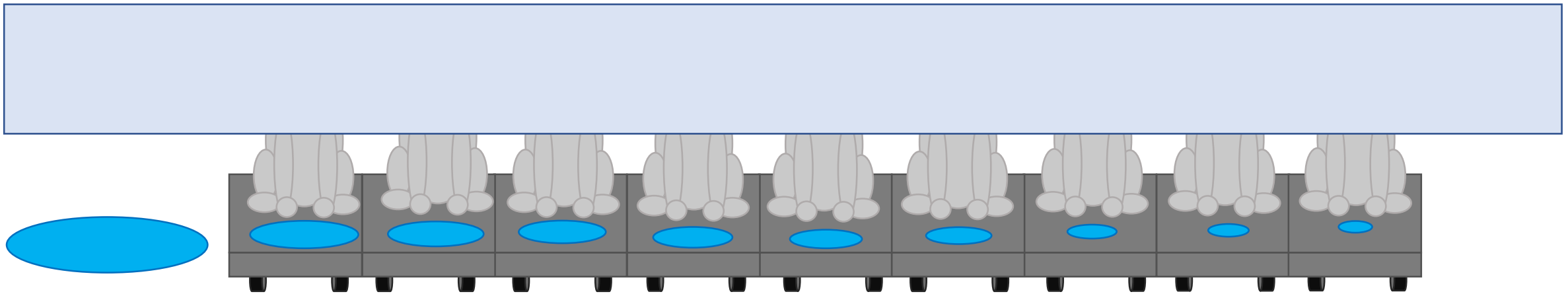


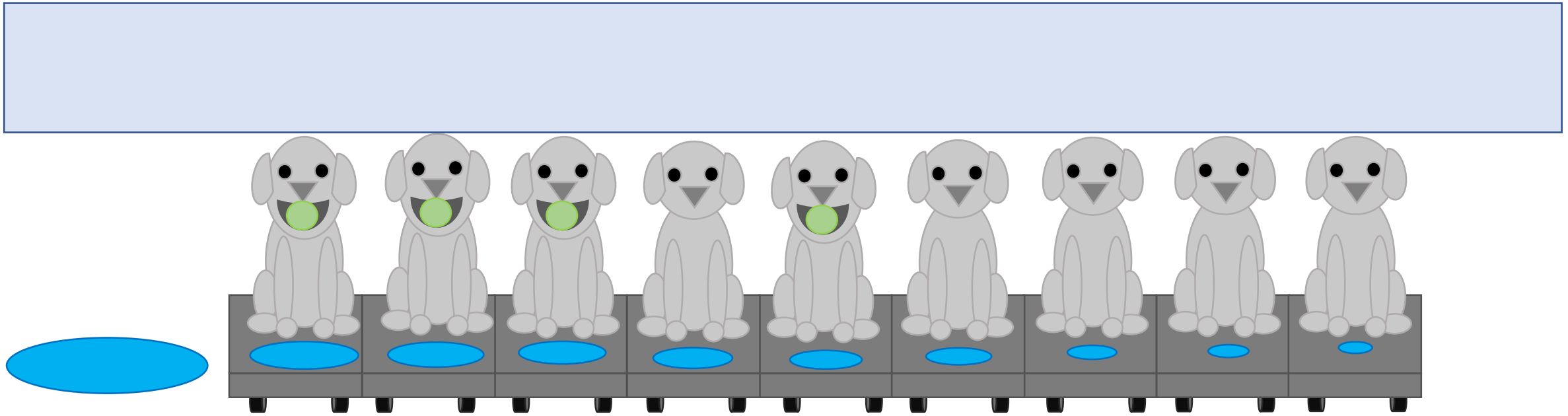
$$AUC = 8 * \left(\frac{1}{5} * \frac{1}{4}\right)$$
$$= 0.40$$



Model 2

We suppose that the more a dog has drooled,
the more likely that dog is to have a tennis ball.





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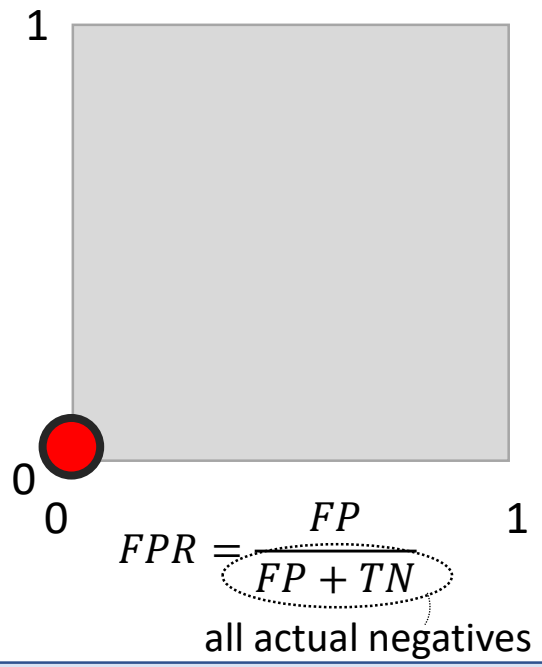

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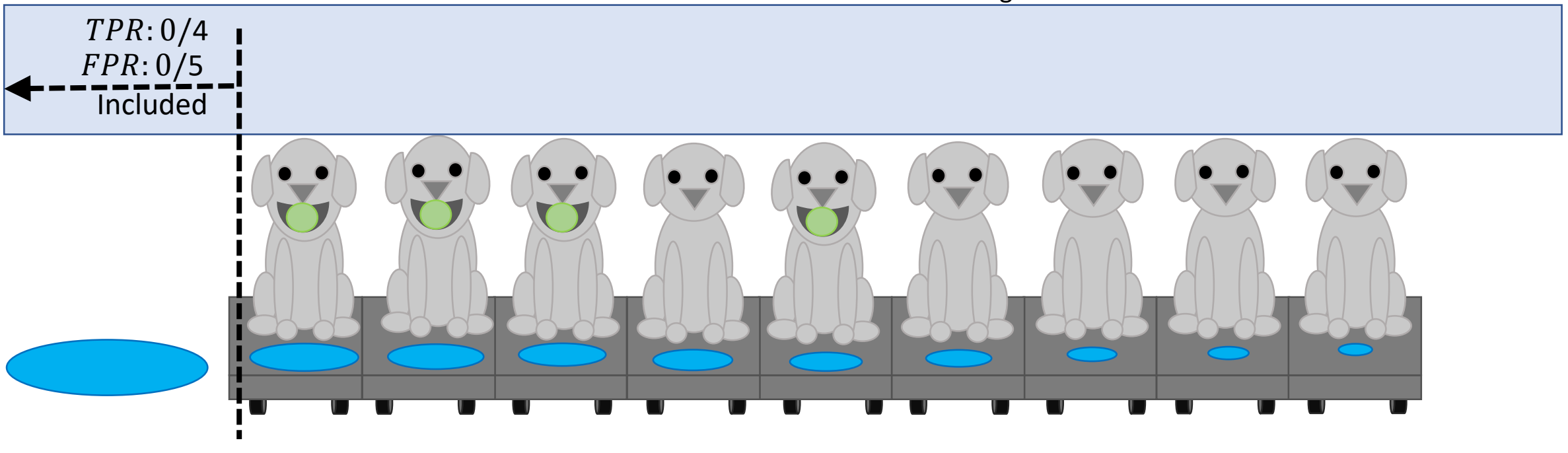

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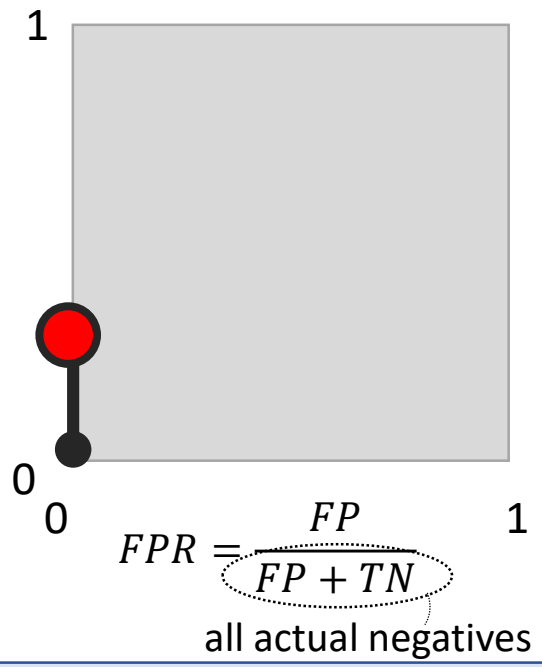

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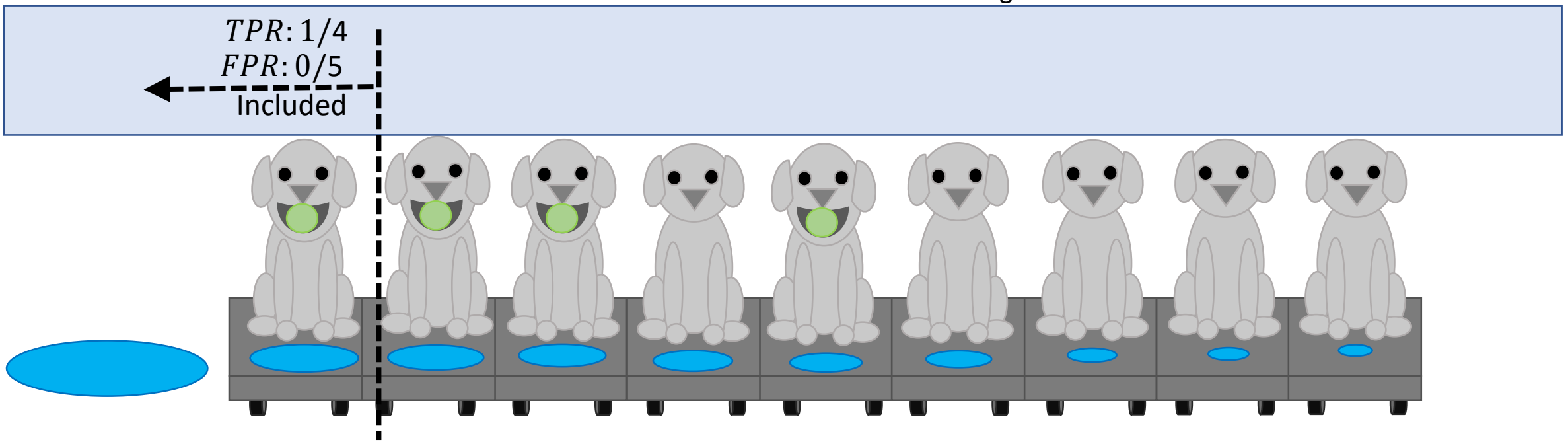

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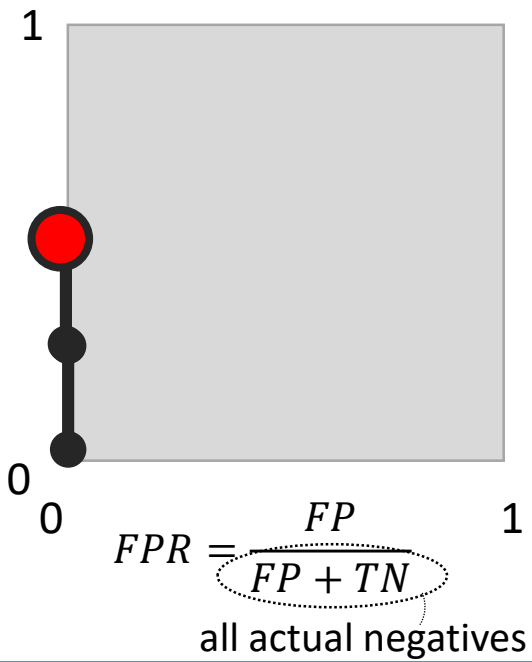

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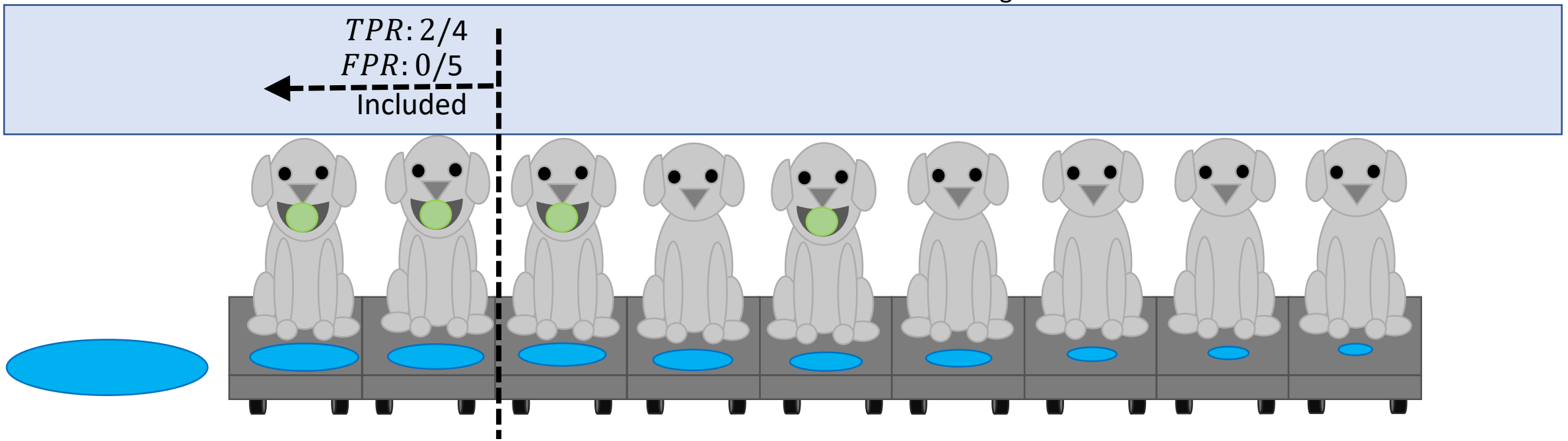

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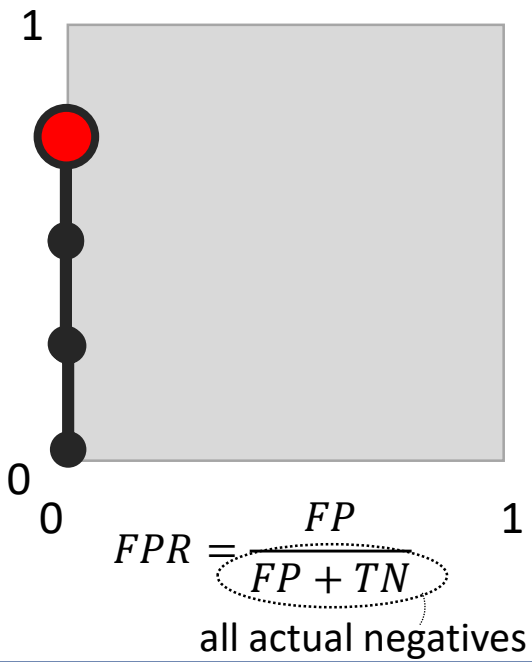

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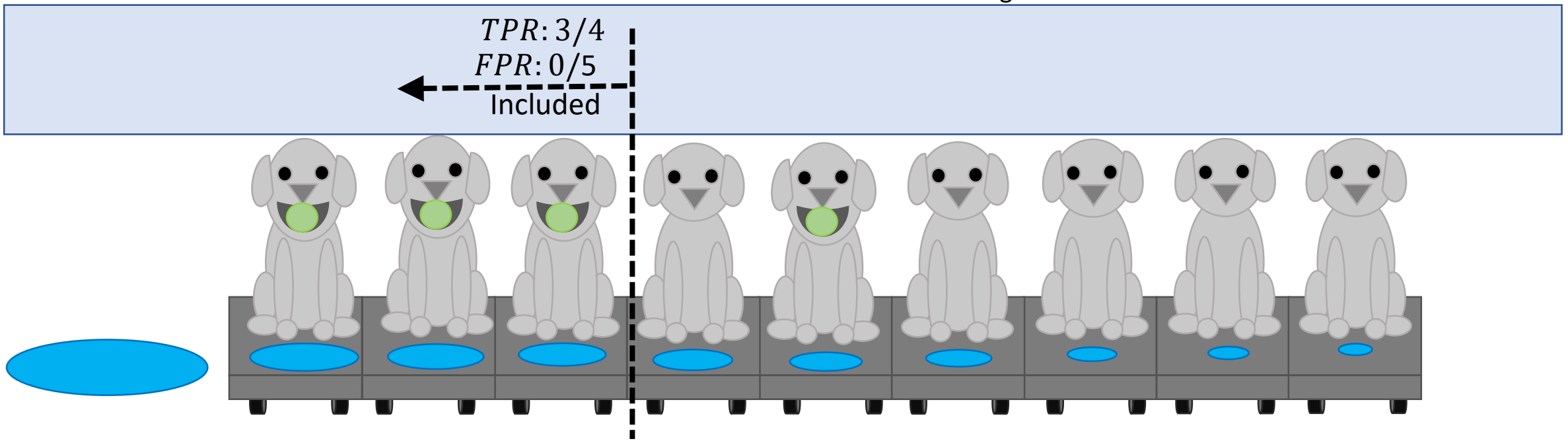

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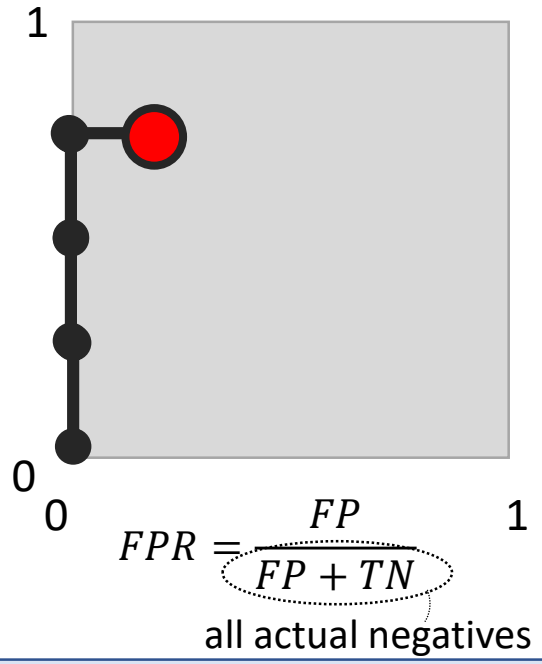

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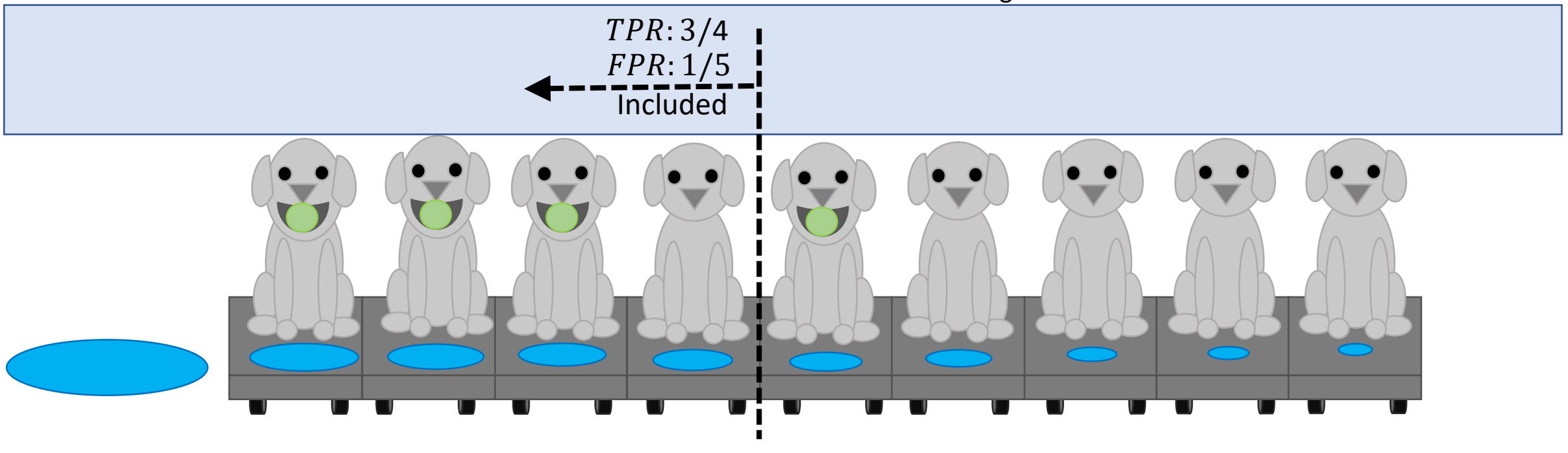

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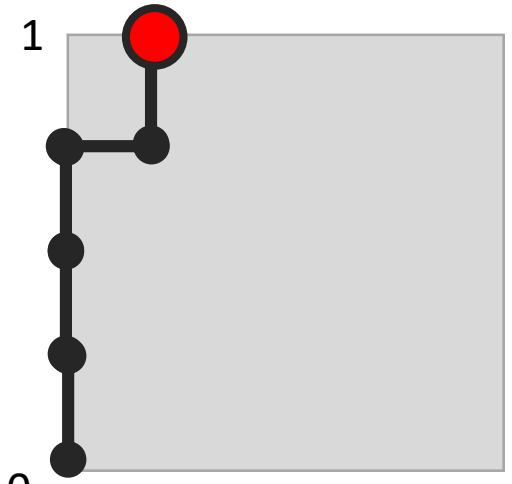

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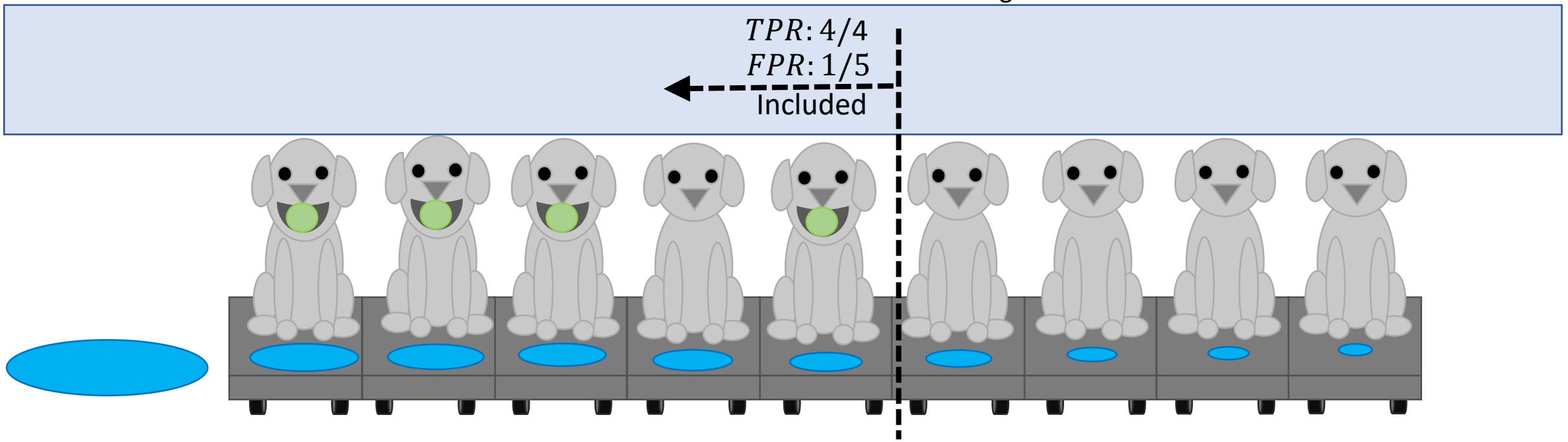

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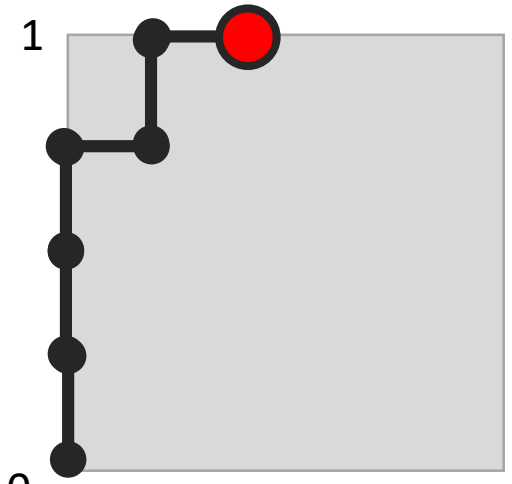

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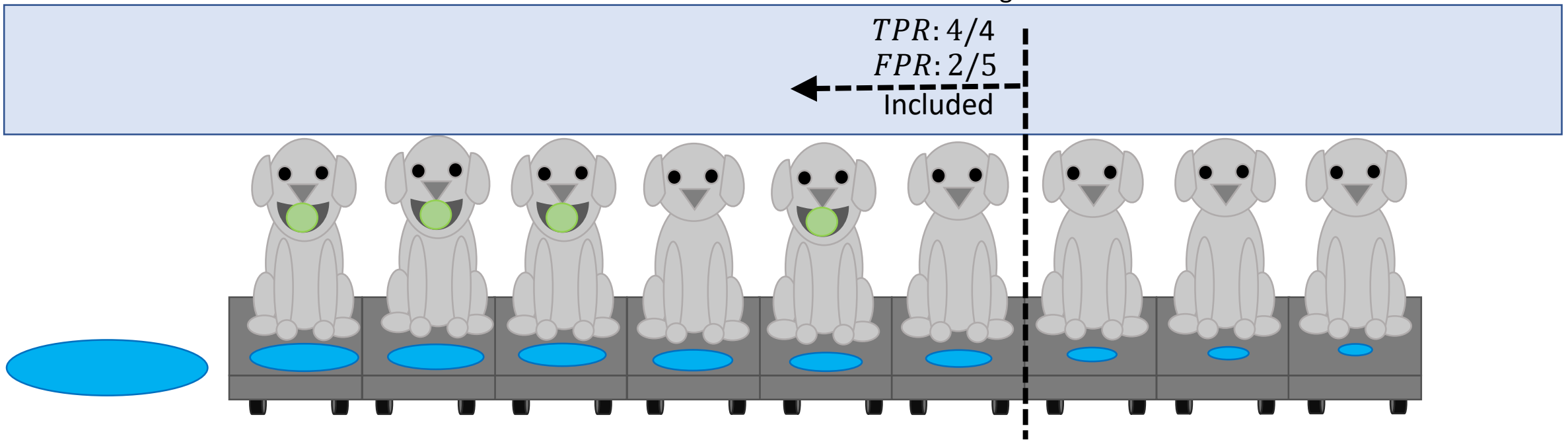

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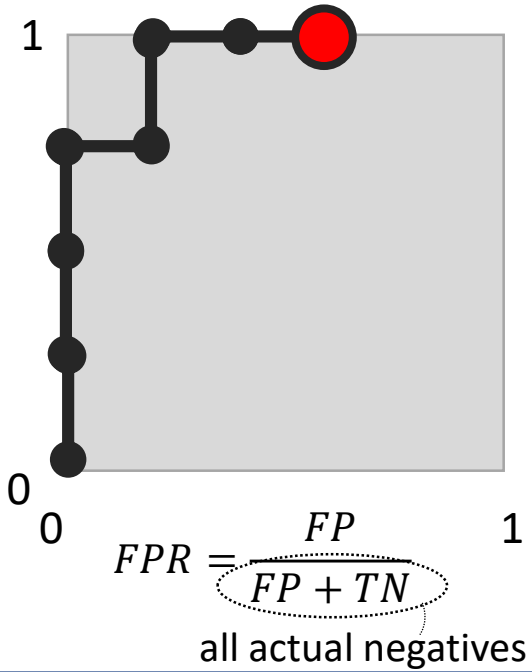
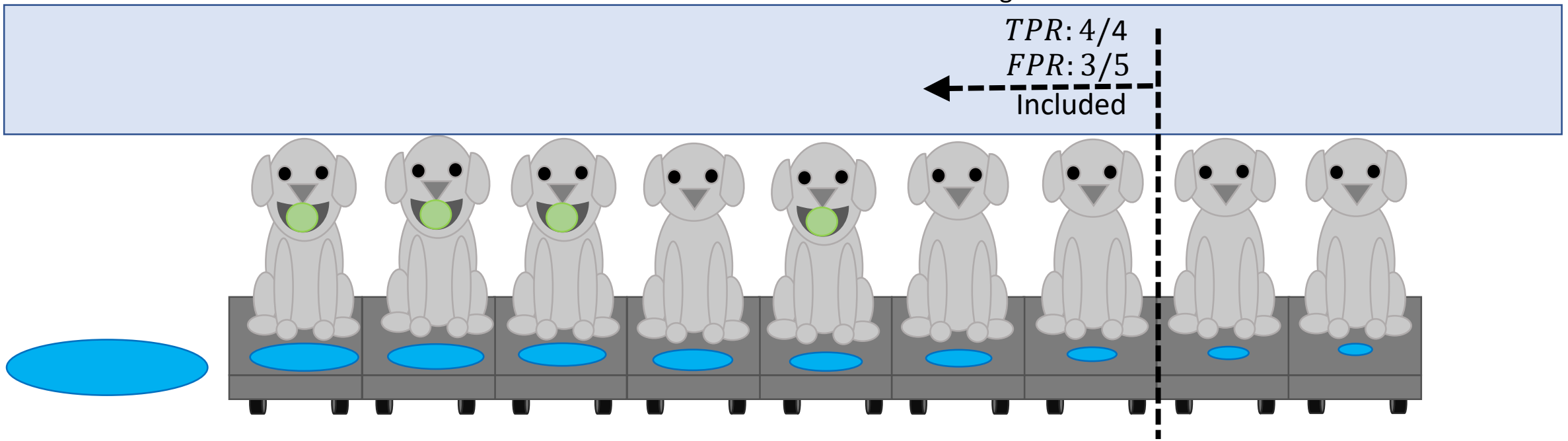
all actual positives



$$FPR = \frac{FP}{FP + TN}$$

all actual negatives

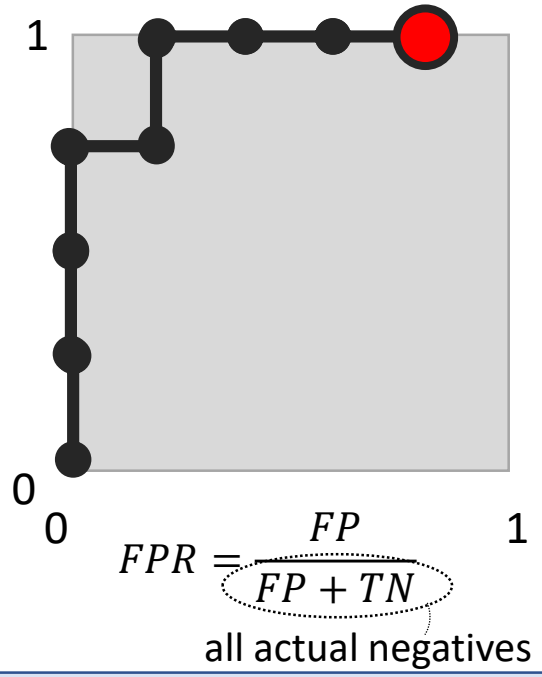
What fraction of the dogs <u>without</u> tennis balls we've included in the set of dogs we've predicted to have tennis balls.



What fraction of the dogs <u>with</u> tennis balls we've included in the set of dogs we've predicted to have tennis balls.

$$TPR = \frac{TP}{TP + FN}$$

all actual positives



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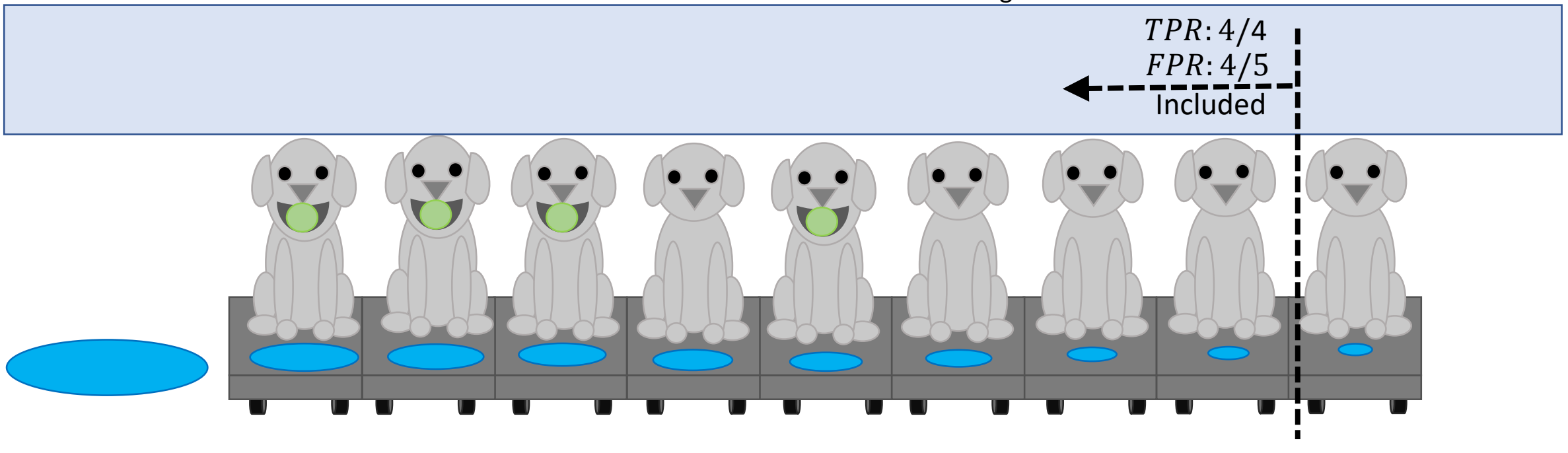

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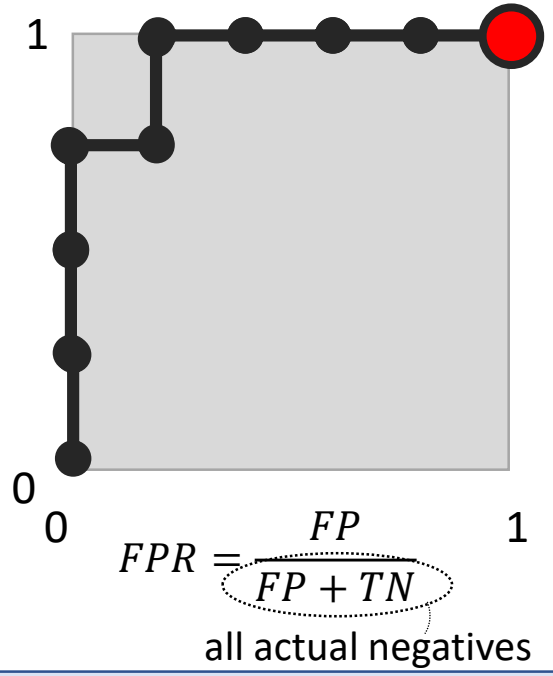
all actual positives



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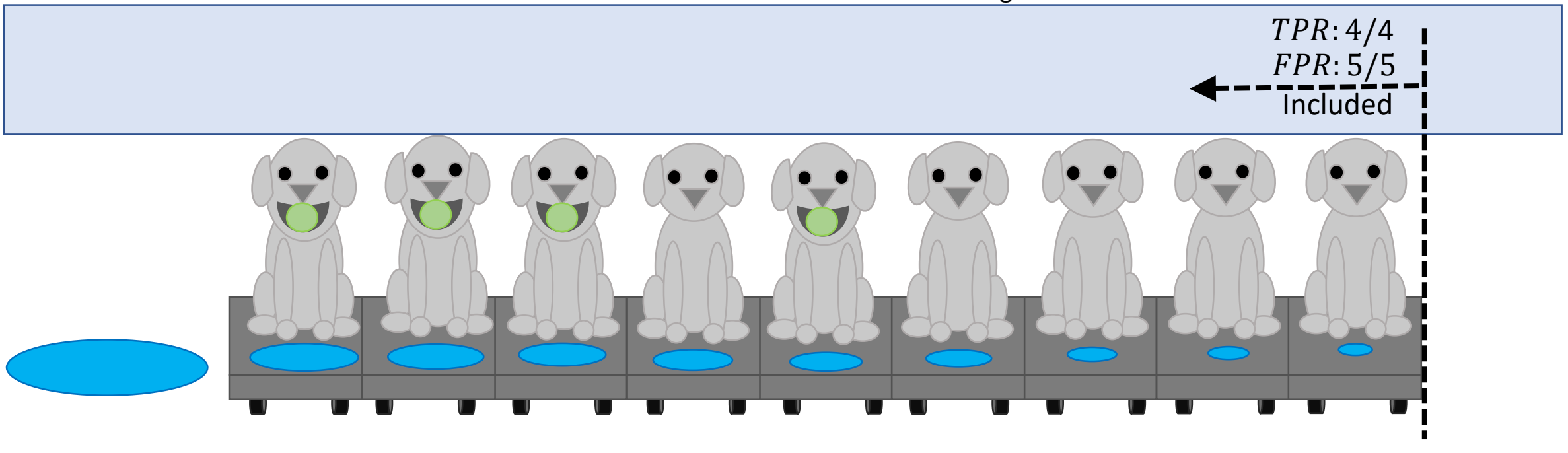
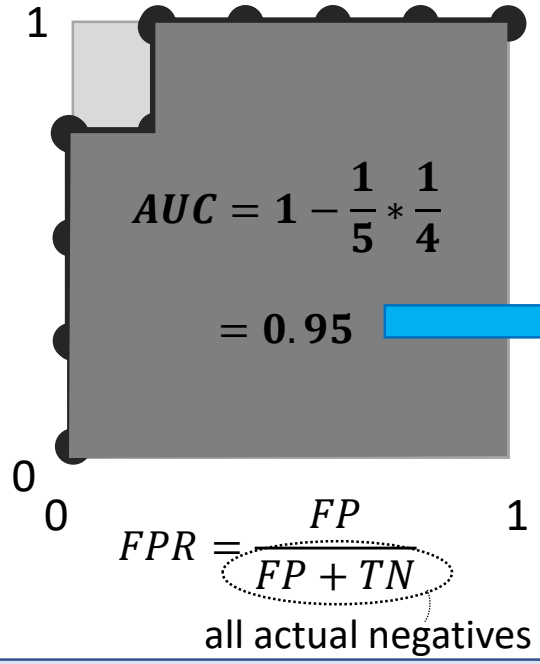


$$TPR = \frac{TP}{TP + FN}$$

all actual positives



Model 1's AUC: 0.40
Model 2's AUC: 0.95

Drool pool size is a much better classifier here.