



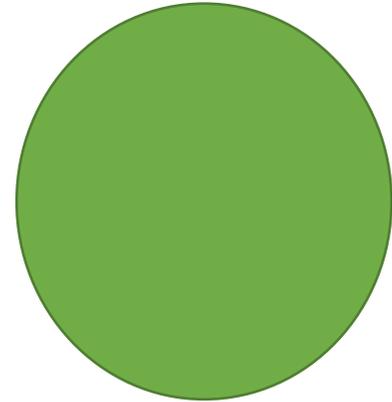
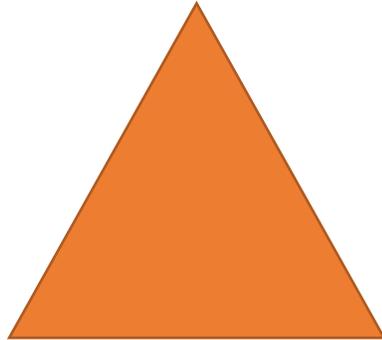
UNIVERSITY OF
SOUTH FLORIDA

Learning useful representations of inputs, without labels

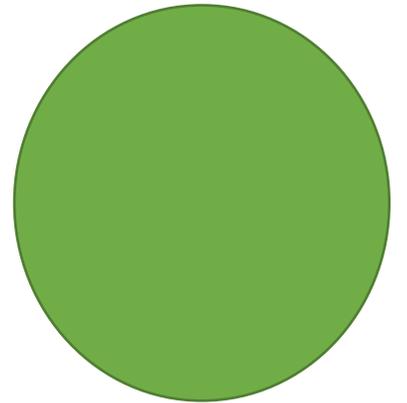
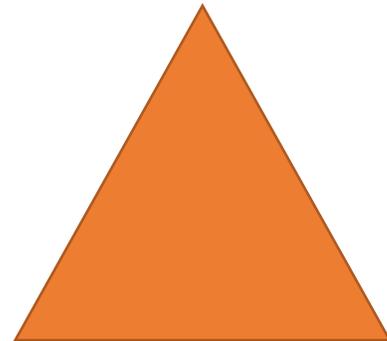
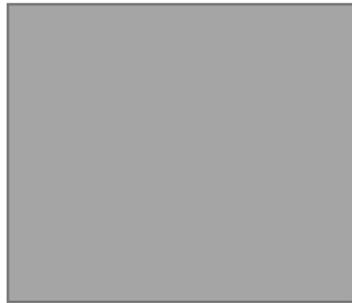
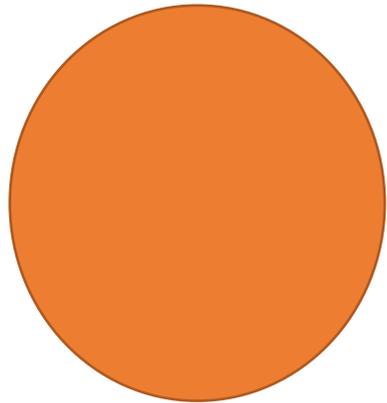
by

Ramy Mounir

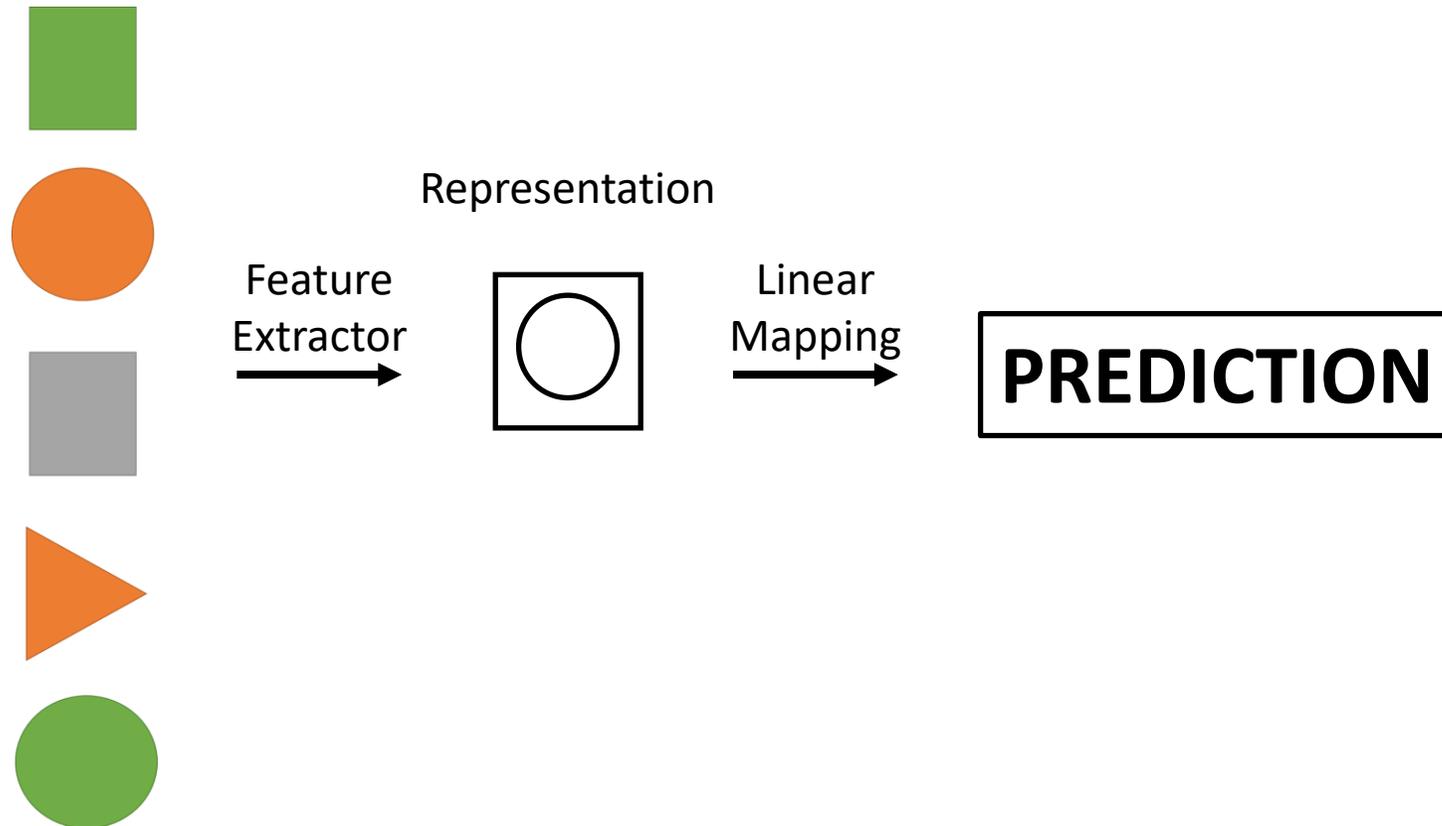
What is a Representation?



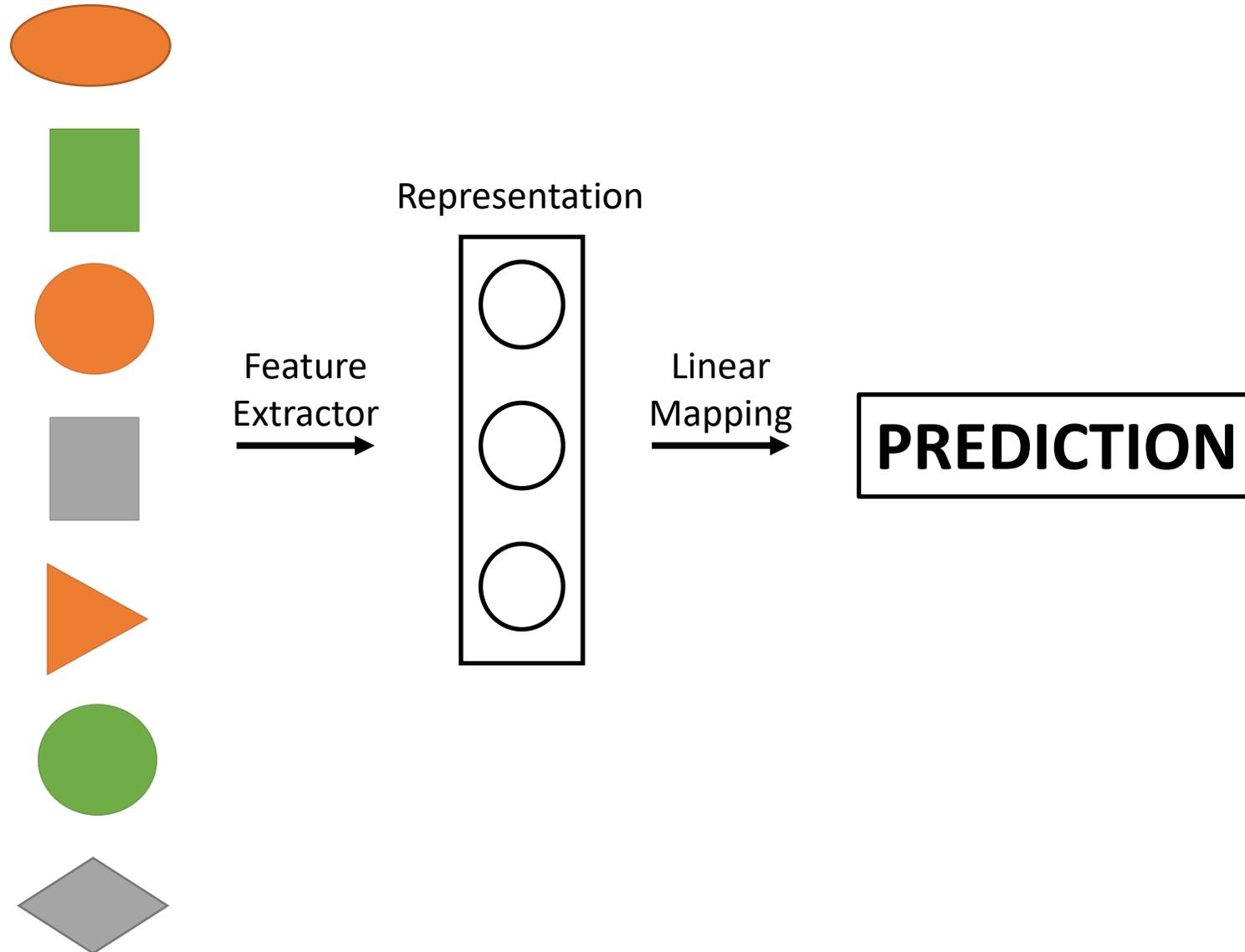
What is a Representation?



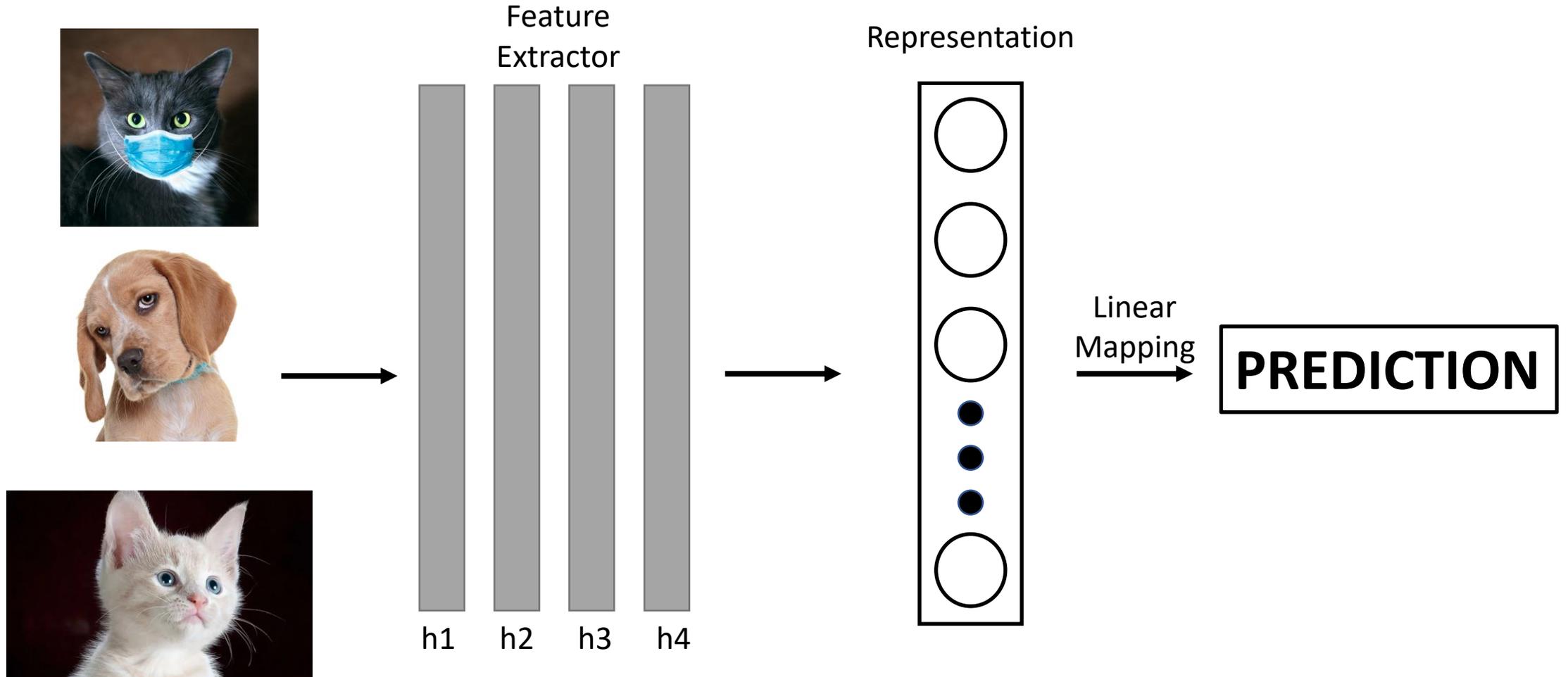
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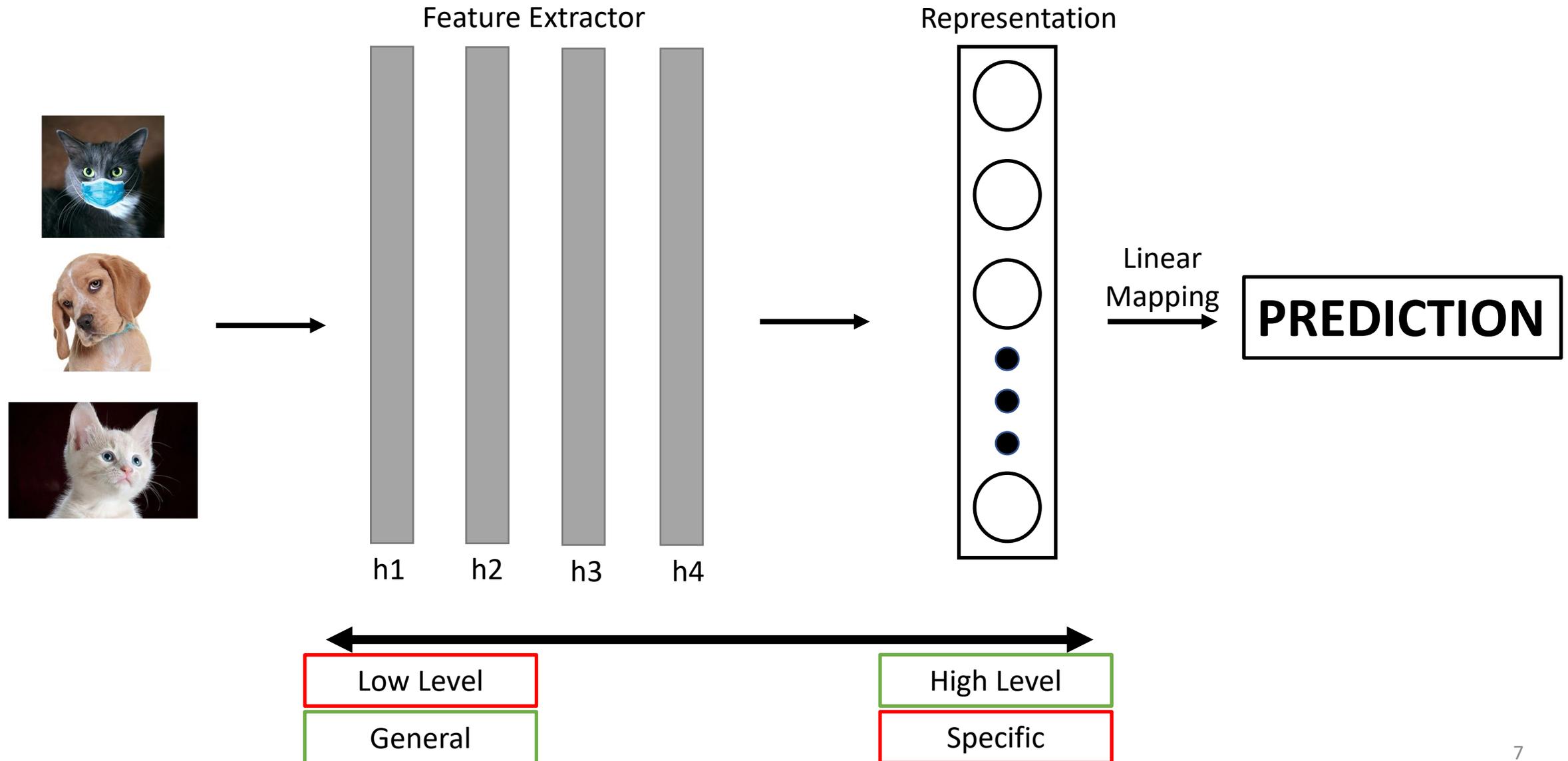
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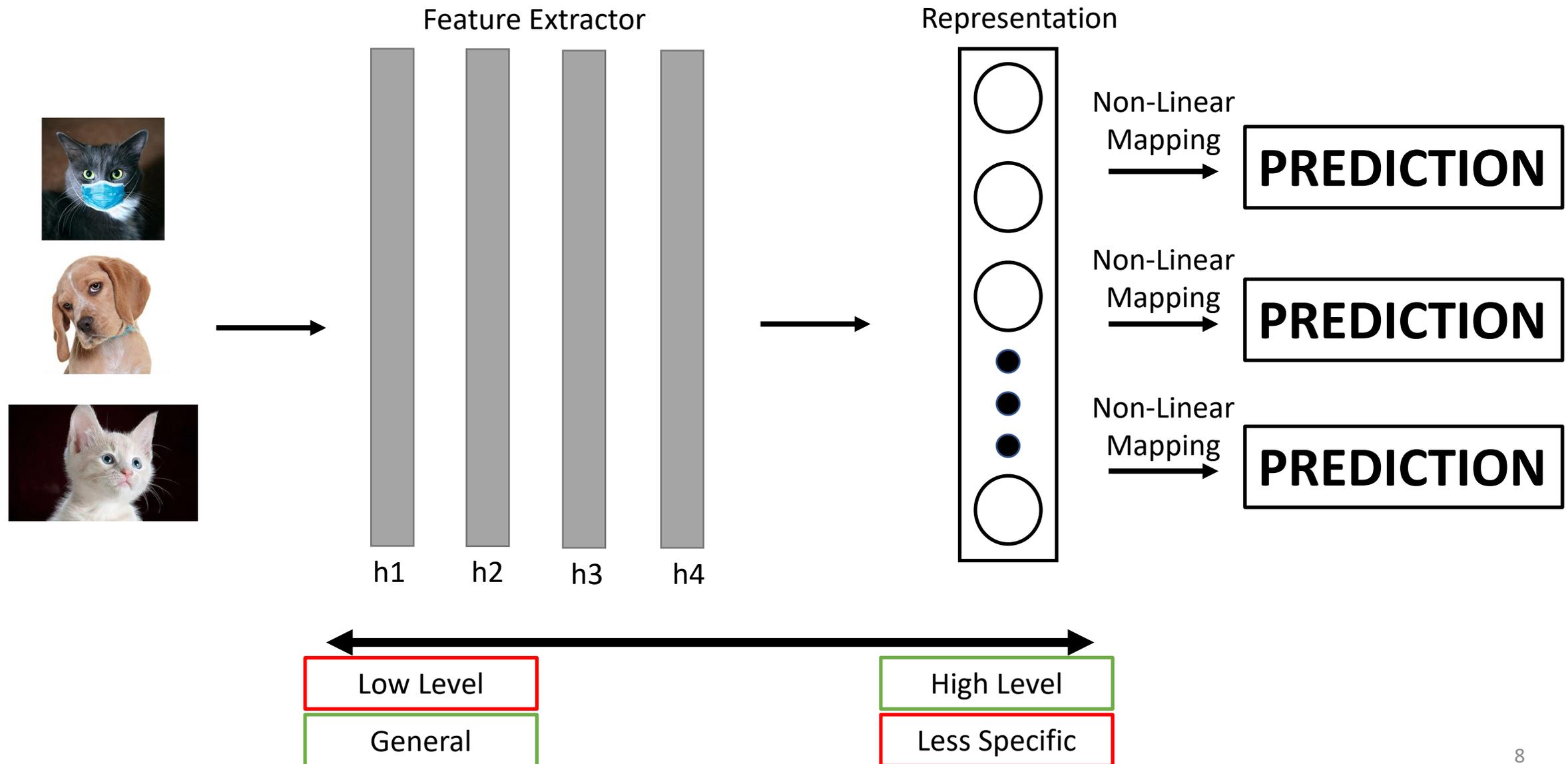
What is a Representation?



How to extract good features?

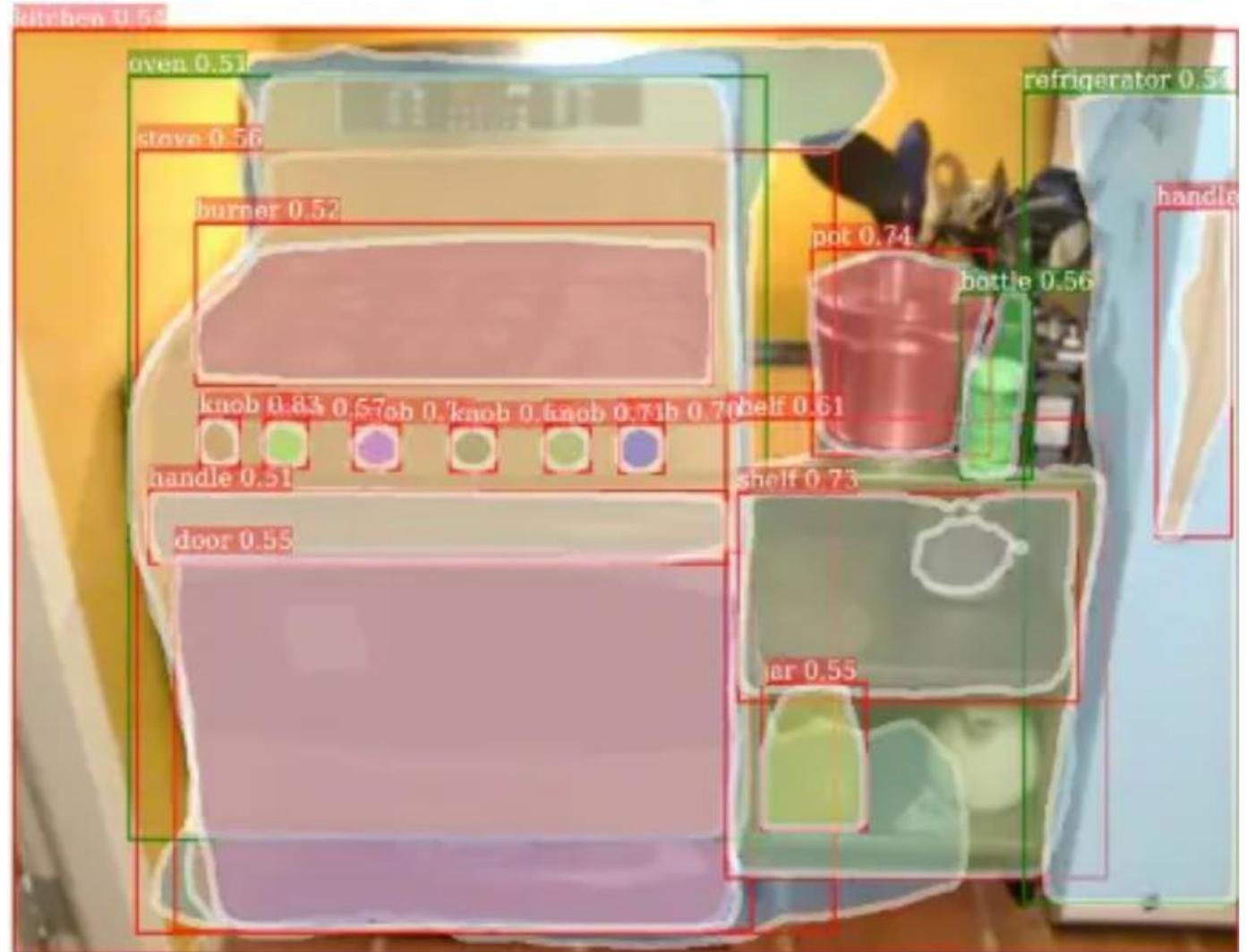


How to extract better features?



What avoid supervision?

- Labels are expensive.



What avoid supervision?

- Labels are expensive.
- *Labels are inaccurate*

| | MNIST | CIFAR-10 | CIFAR-100 | Caltech-256 | ImageNet | QuickDraw |
|---------------|---|--|--|---|---|--|
| correctable |  given: 5 corrected: 3 |  given: cat corrected: frog |  given: lobster corrected: crab |  given: ewer corrected: teapot |  given: white stork corrected: black stork |  given: tiger corrected: eye |
| multi-label | (N/A) | (N/A) |  given: hamster also: cup |  given: fried egg also: frying pan |  given: mantis also: fence |  given: hat also: flying saucer |
| neither |  given: 6 alt: 1 |  given: deer alt: bird |  given: rose alt: apple |  given: porcupine alt: hot tub |  given: polar bear alt: elephant |  given: pineapple alt: raccoon |
| non-agreement |  given: 4 alt: 9 |  given: deer alt: frog |  given: spider alt: cockroach |  given: minotaur alt: coin |  given: eel alt: flatworm |  given: bandage alt: roller coaster |

What avoid supervision?

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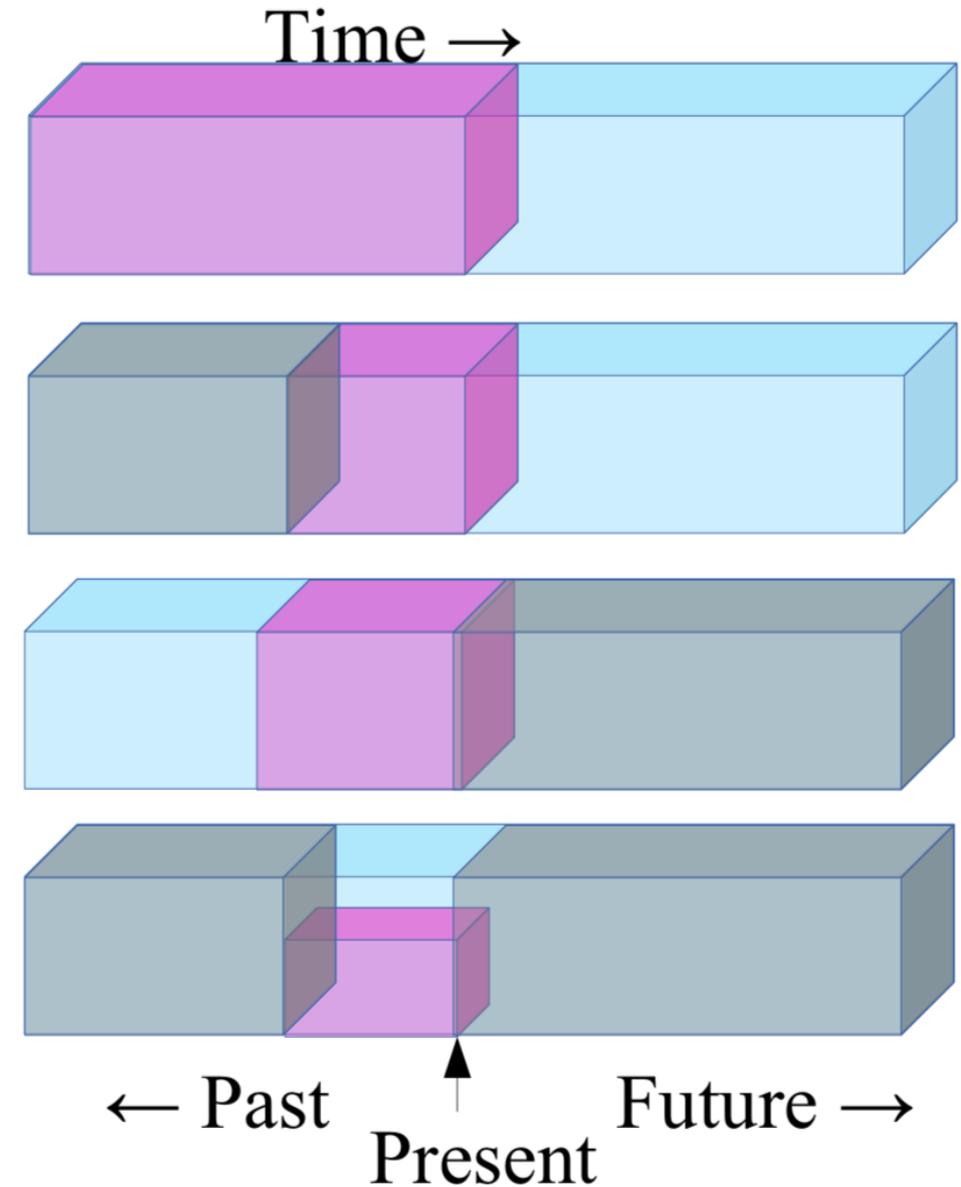
| NO LABEL | LABELD "IPOD" | LABELD "LIBRARY" | LABELD "PIZZA" | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|-----------------------|------------------|----------------|-------|---------|----|-------|----|-------|----|---------|----|--|-----------------------|--------|------|--------|---------|----|-------|----|-------|----|---------|-------|---|-----------------------|--------|------|-------|---------|--------|-------|----|-------|----|---------|----|--|-----------------------|--------|------|----|---------|----|-------|--------|-------|----|---------|-------|
|  <table border="1"> <tr><td>Granny Smith</td><td>85.61%</td></tr> <tr><td>iPod</td><td>0.42%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | Granny Smith | 85.61% | iPod | 0.42% | library | 0% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>Granny Smith</td><td>0.13%</td></tr> <tr><td>iPod</td><td>99.68%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | Granny Smith | 0.13% | iPod | 99.68% | library | 0% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>Granny Smith</td><td>1.14%</td></tr> <tr><td>iPod</td><td>0.08%</td></tr> <tr><td>library</td><td>90.53%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | Granny Smith | 1.14% | iPod | 0.08% | library | 90.53% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>Granny Smith</td><td>0.89%</td></tr> <tr><td>iPod</td><td>0%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>65.35%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | Granny Smith | 0.89% | iPod | 0% | library | 0% | pizza | 65.35% | rifle | 0% | toaster | 0% |
| Granny Smith | 85.61% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0.42% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Granny Smith | 0.13% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 99.68% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Granny Smith | 1.14% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0.08% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 90.53% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Granny Smith | 0.89% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 65.35% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| laptop computer | 15.98% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| laptop computer | 4.03% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 78.2% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| laptop computer | 37.6% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 5.24% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| laptop computer | 18.89% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 59.3% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| coffee mug | 61.71% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| coffee mug | 2.97% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 95.43% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| coffee mug | 2.13% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 80.77% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| coffee mug | 55.42% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 26.39% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0.04% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  <table border="1"> <tr><td>rotary dial telephone</td><td>98.33%</td></tr> <tr><td>iPod</td><td>0%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | rotary dial telephone | 98.33% | iPod | 0% | library | 0% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>rotary dial telephone</td><td>47.93%</td></tr> <tr><td>iPod</td><td>25.65%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0.04%</td></tr> </table> | rotary dial telephone | 47.93% | iPod | 25.65% | library | 0% | pizza | 0% | rifle | 0% | toaster | 0.04% |  <table border="1"> <tr><td>rotary dial telephone</td><td>80.94%</td></tr> <tr><td>iPod</td><td>0%</td></tr> <tr><td>library</td><td>9.68%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | rotary dial telephone | 80.94% | iPod | 0% | library | 9.68% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>rotary dial telephone</td><td>81.12%</td></tr> <tr><td>iPod</td><td>0%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>3.48%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0.03%</td></tr> </table> | rotary dial telephone | 81.12% | iPod | 0% | library | 0% | pizza | 3.48% | rifle | 0% | toaster | 0.03% |
| rotary dial telephone | 98.33% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rotary dial telephone | 47.93% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 25.65% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0.04% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rotary dial telephone | 80.94% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 9.68% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rotary dial telephone | 81.12% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 3.48% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0.03% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  <table border="1"> <tr><td>plant pot</td><td>50.58%</td></tr> <tr><td>iPod</td><td>0%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | plant pot | 50.58% | iPod | 0% | library | 0% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>plant pot</td><td>4.99%</td></tr> <tr><td>iPod</td><td>93.5%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | plant pot | 4.99% | iPod | 93.5% | library | 0% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>plant pot</td><td>19%</td></tr> <tr><td>iPod</td><td>0%</td></tr> <tr><td>library</td><td>42.07%</td></tr> <tr><td>pizza</td><td>0%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | plant pot | 19% | iPod | 0% | library | 42.07% | pizza | 0% | rifle | 0% | toaster | 0% |  <table border="1"> <tr><td>plant pot</td><td>12.63%</td></tr> <tr><td>iPod</td><td>0%</td></tr> <tr><td>library</td><td>0%</td></tr> <tr><td>pizza</td><td>50.17%</td></tr> <tr><td>rifle</td><td>0%</td></tr> <tr><td>toaster</td><td>0%</td></tr> </table> | plant pot | 12.63% | iPod | 0% | library | 0% | pizza | 50.17% | rifle | 0% | toaster | 0% |
| plant pot | 50.58% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| plant pot | 4.99% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 93.5% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| plant pot | 19% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 42.07% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| plant pot | 12.63% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iPod | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| library | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pizza | 50.17% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| rifle | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| toaster | 0% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

What avoid supervision?

- Labels are expensive.
- *Labels are inaccurate*
- *Labels encourage tailored and task-dependent features*
 - *e.g., Using human detector for tracking*

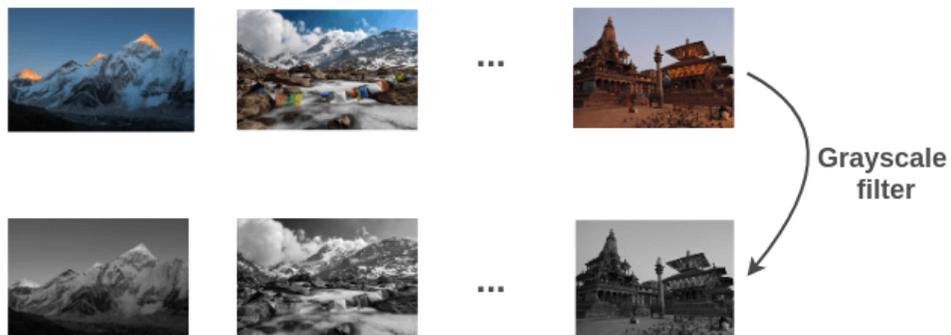
Self Supervised Representation Learning

- Past predicts the future
- Recent past predicts future
- Present predicts the past
- Visible predicts occluded



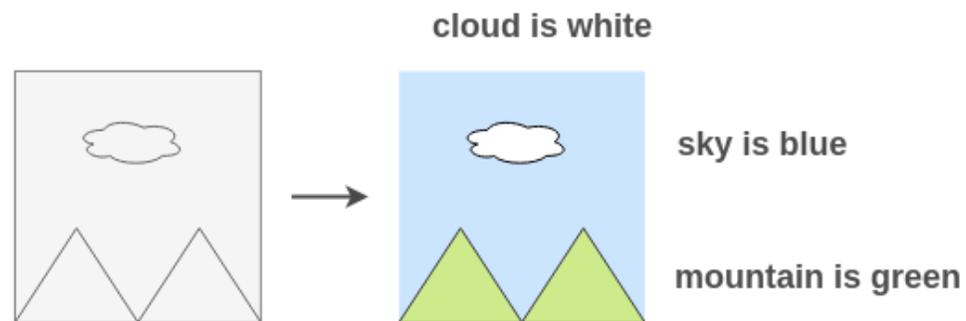
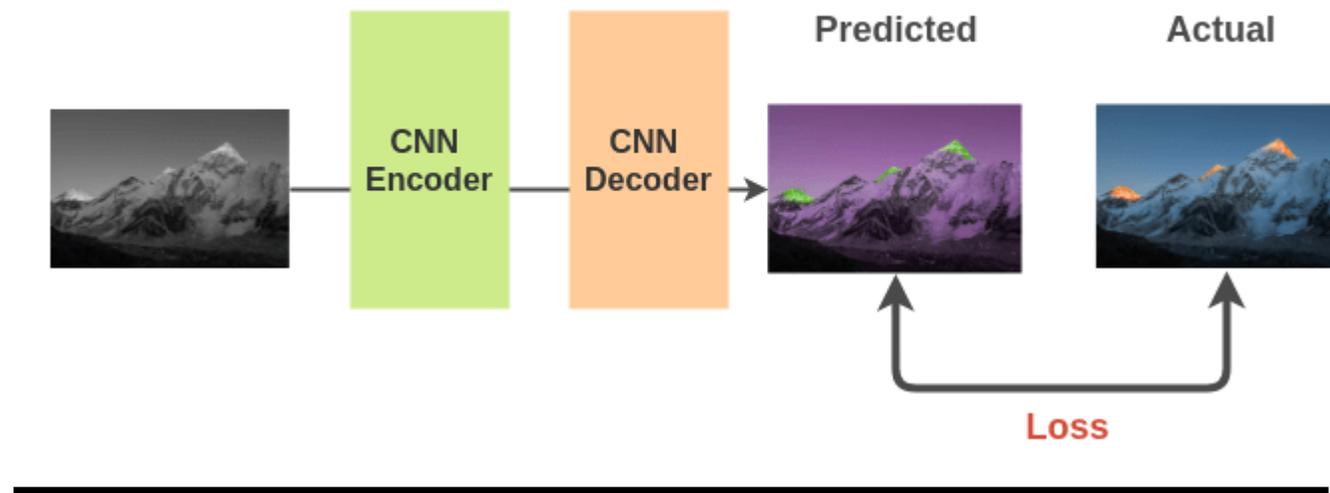
Self Supervised Representation Learning

Training Data Generation for Image Colorization



<https://amitnss.com/2020/02/illustrated-self-supervised-learning/>

Image Colorization

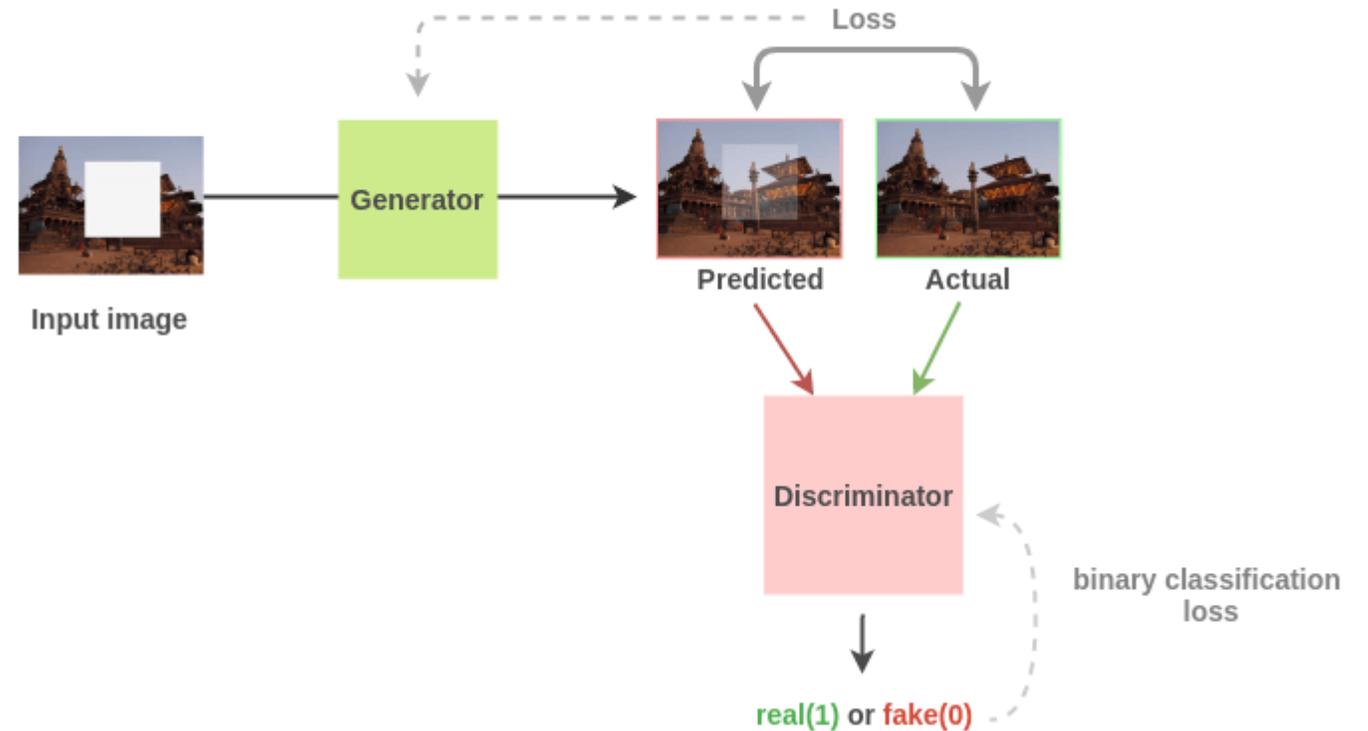


Self Supervised Representation Learning

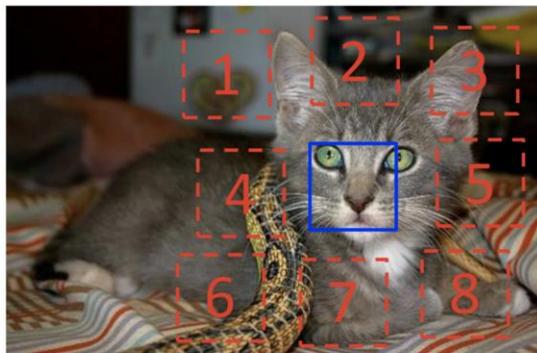
Image Inpainting Data Generation



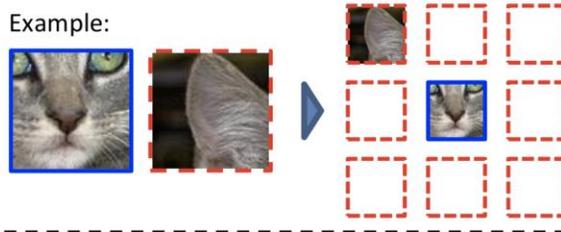
Image Inpainting



Self Supervised Representation Learning



Example:



Question 1:

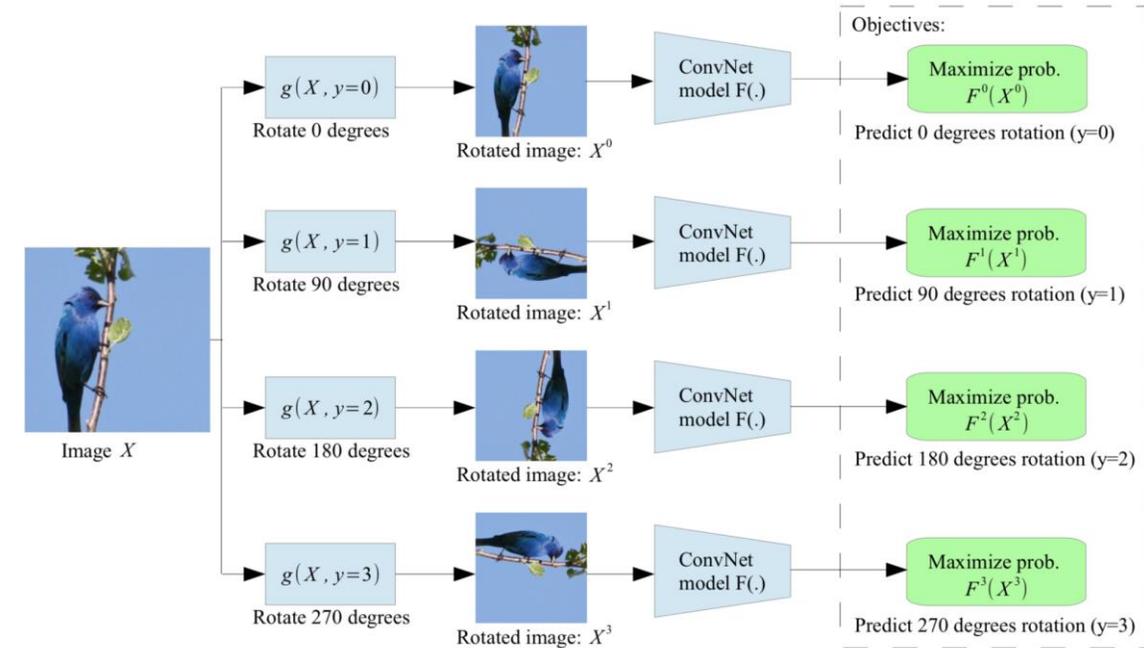


Question 2:



$$X = \left(\begin{array}{c} \text{cat face} \\ \text{cat ear} \end{array} \right); Y = 3$$

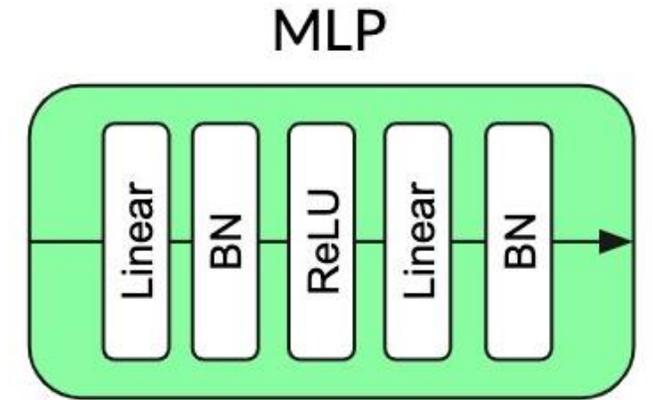
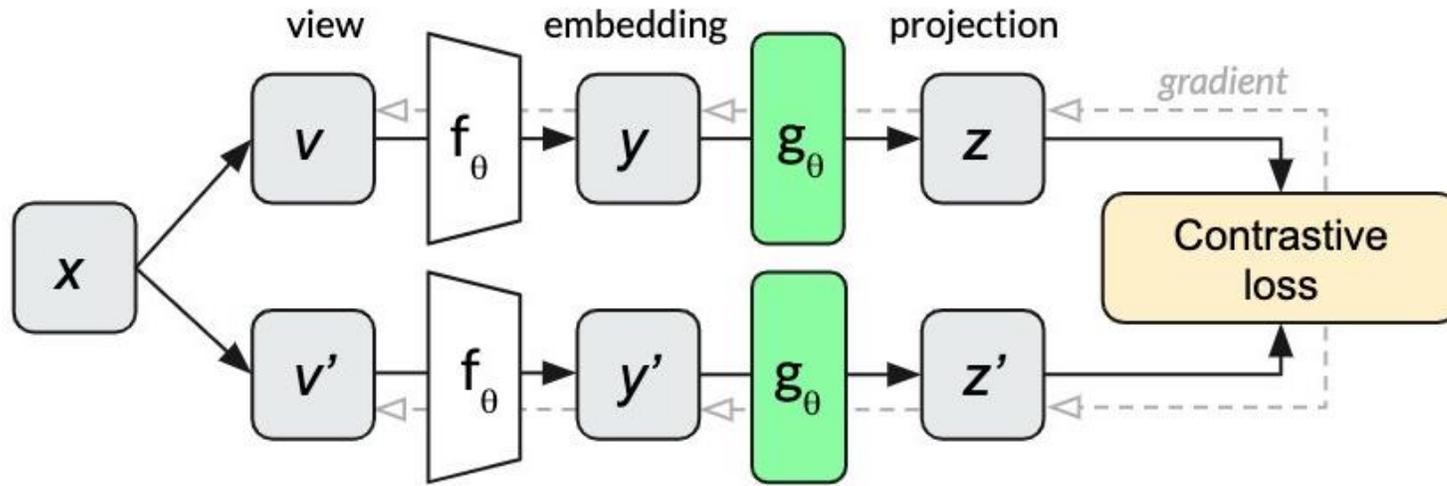
Doersch, Carl, Abhinav Gupta, and Alexei A. Efros. "Unsupervised visual representation learning by context prediction." Proceedings of the IEEE international conference on computer vision. 2015.



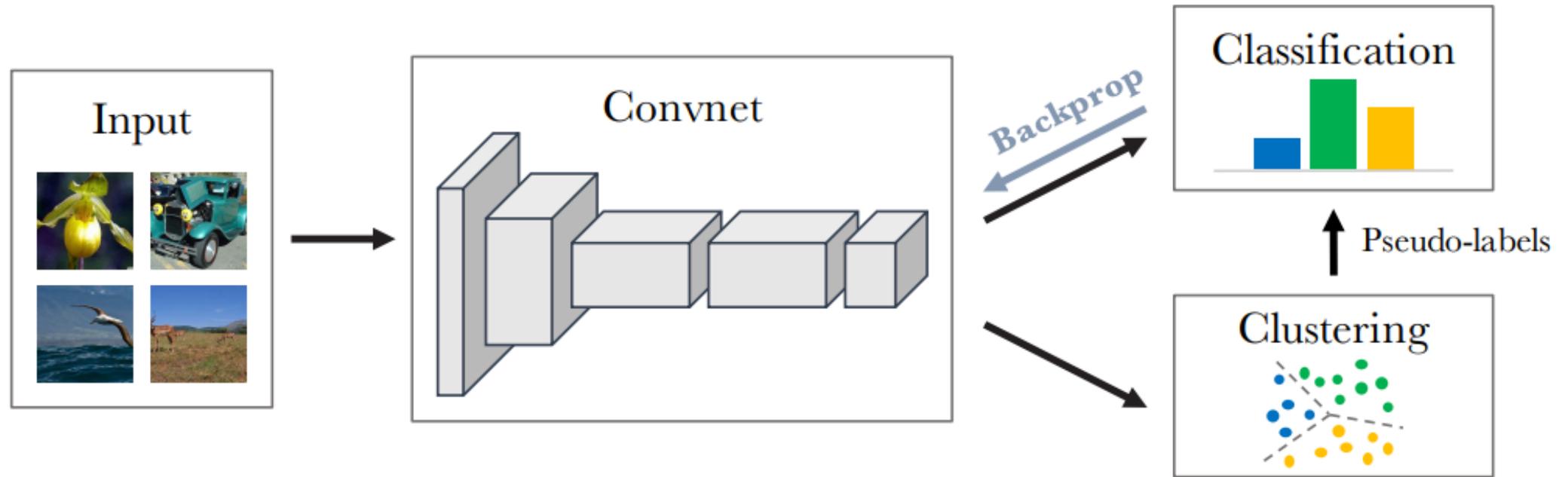
Gidaris, Spyros, Praveer Singh, and Nikos Komodakis. "Unsupervised representation learning by predicting image rotations." arXiv preprint arXiv:1803.07728 (2018).

Contrastive approaches

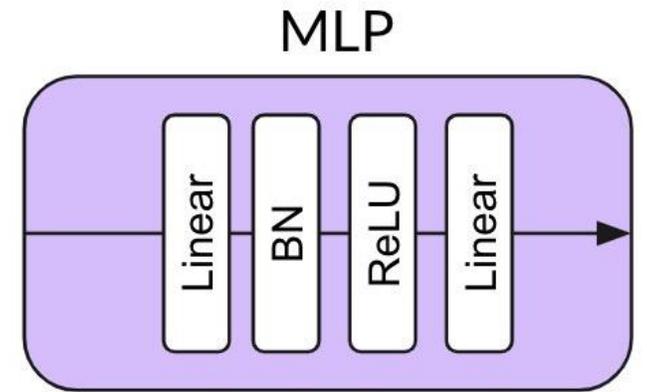
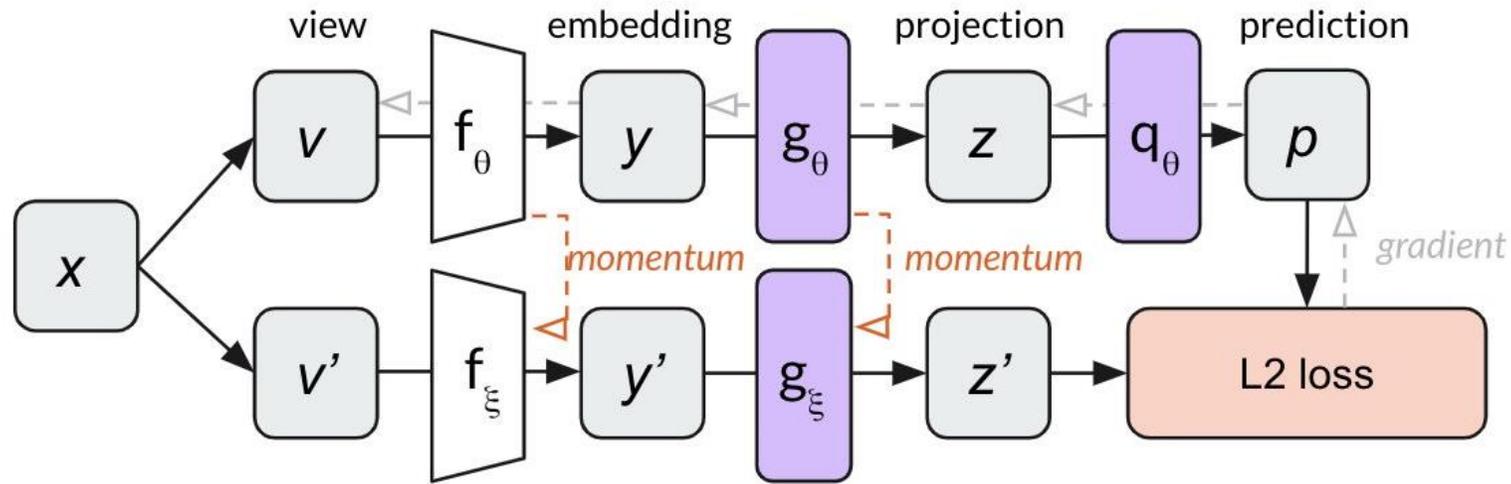
Contrastive approaches - SimCLR



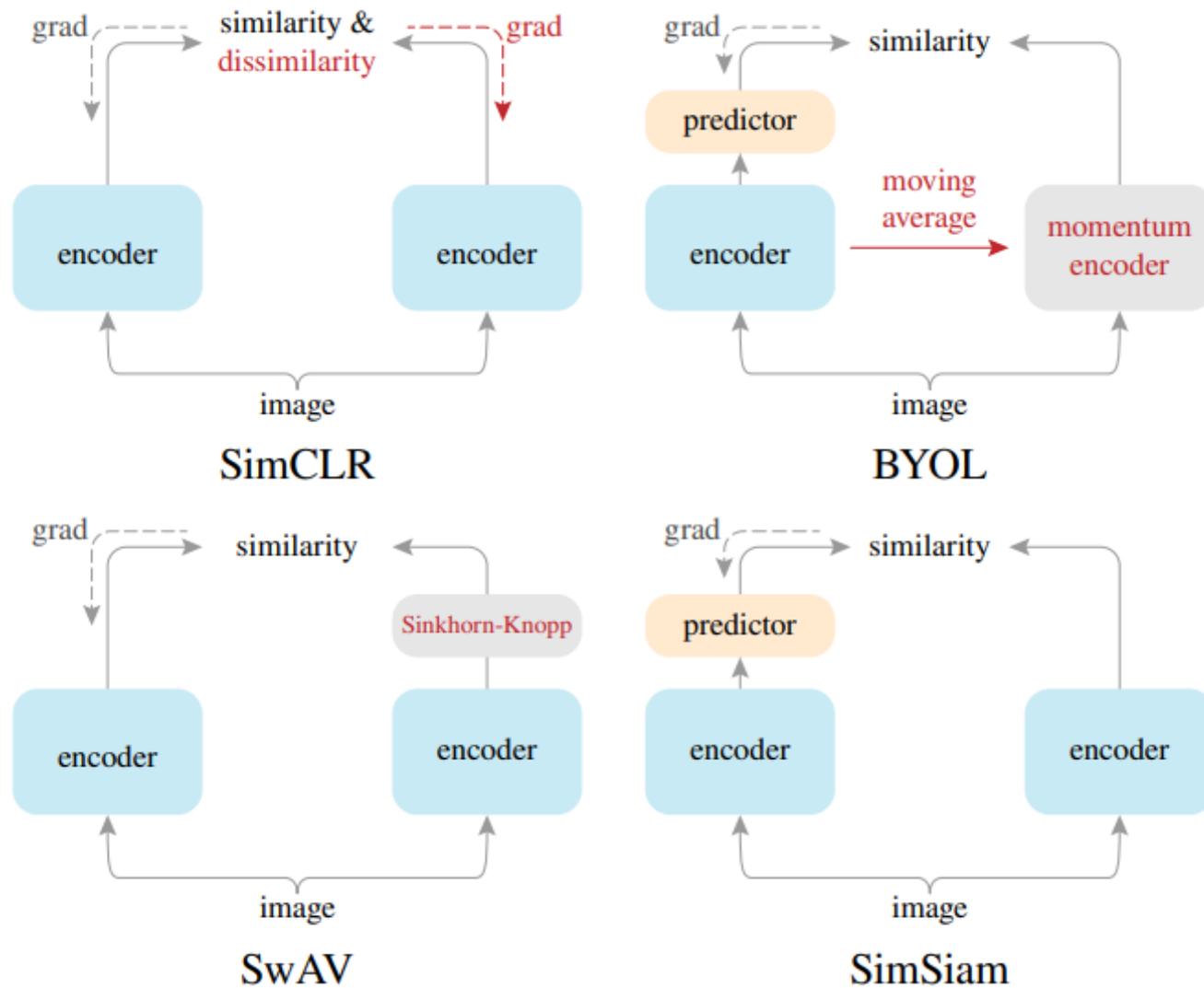
Clustering approaches



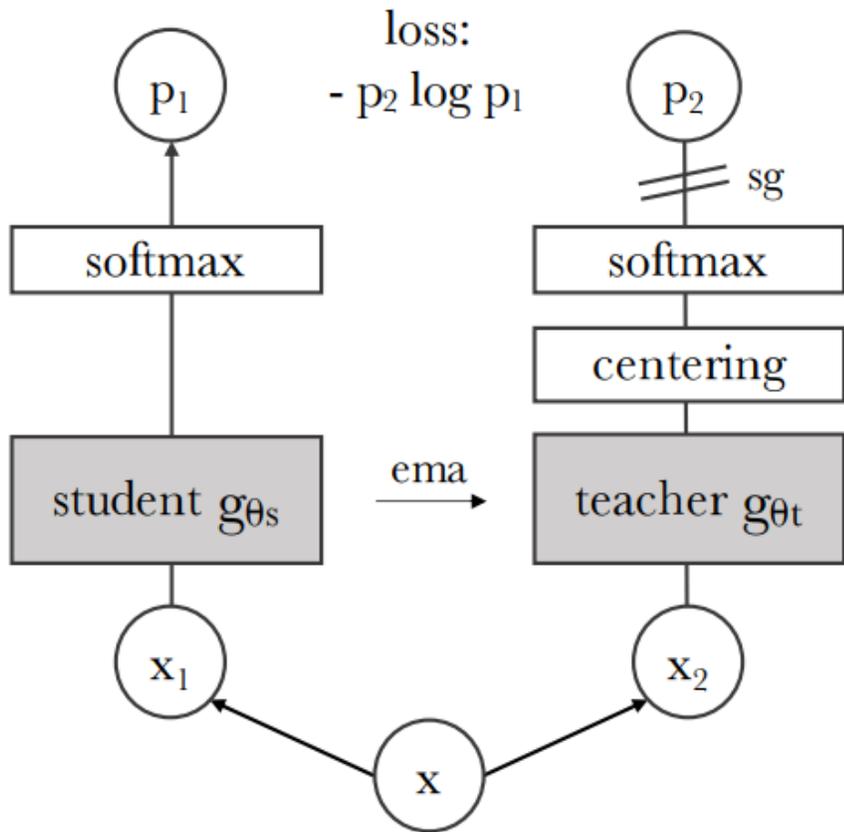
Momentum Encoder - BYOL



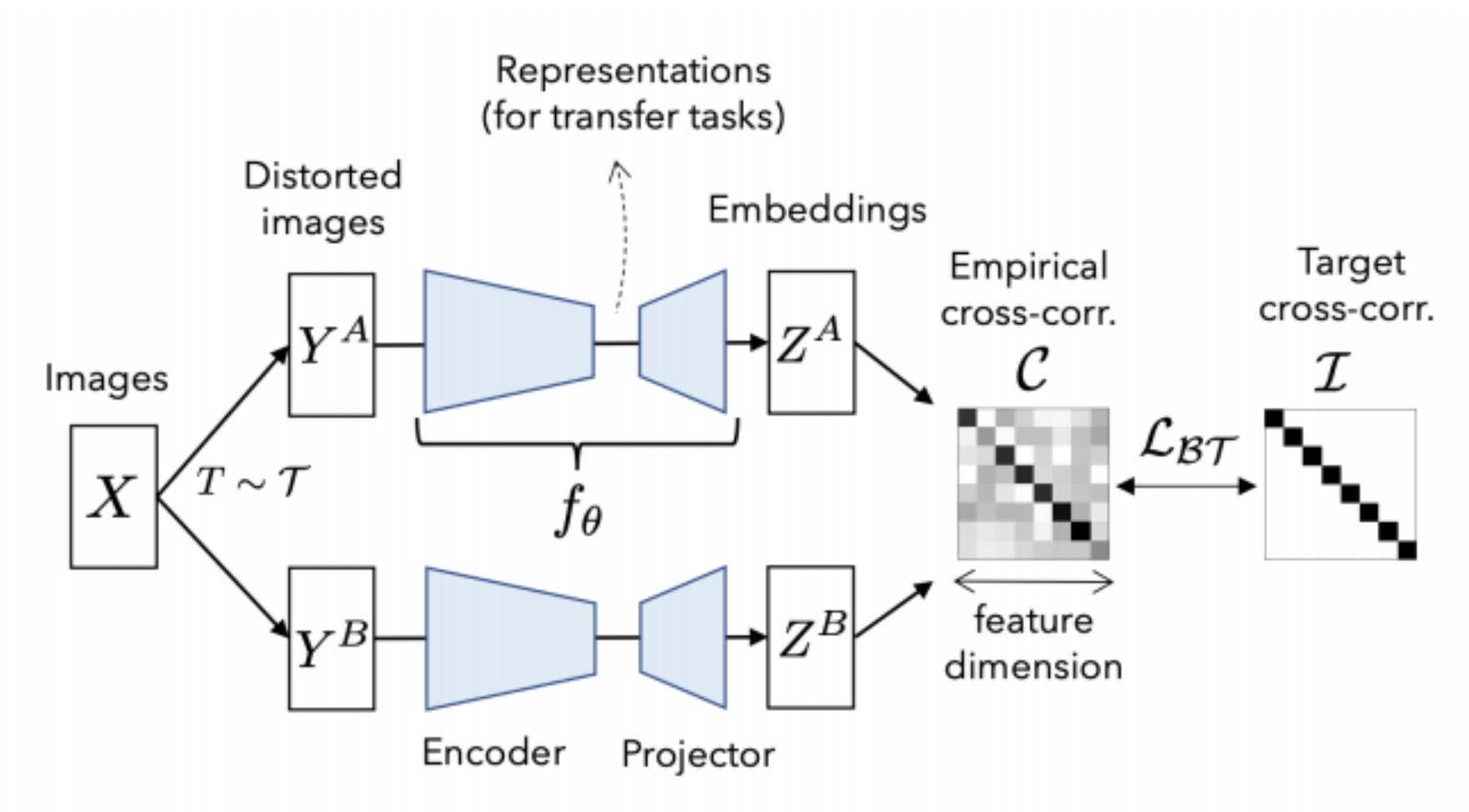
Simple Siamese - SimSiam



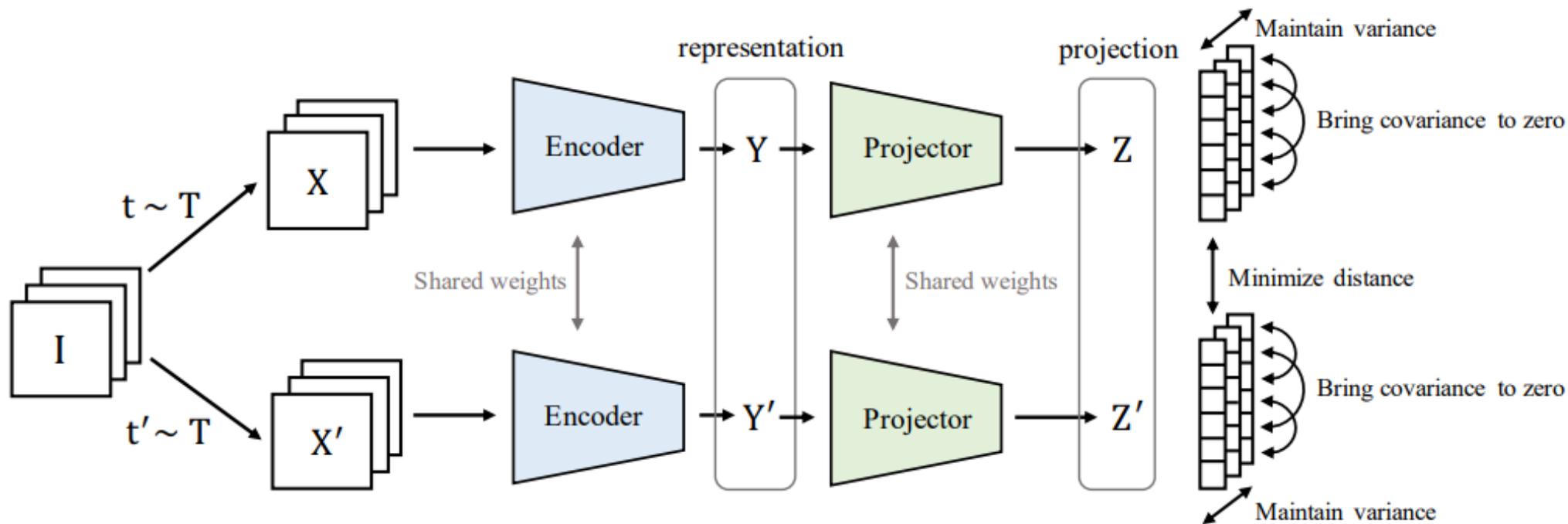
Momentum Encoder - DINO



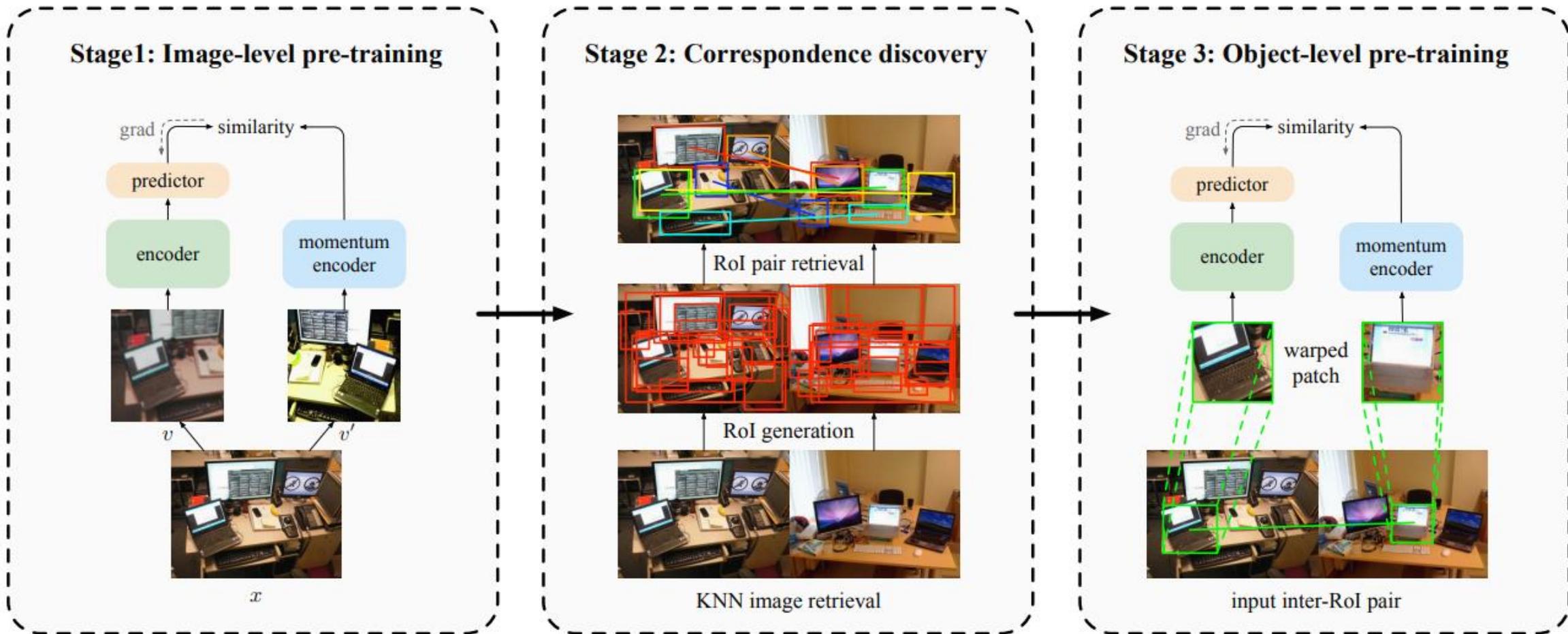
Symmetrical – Barlow Twins



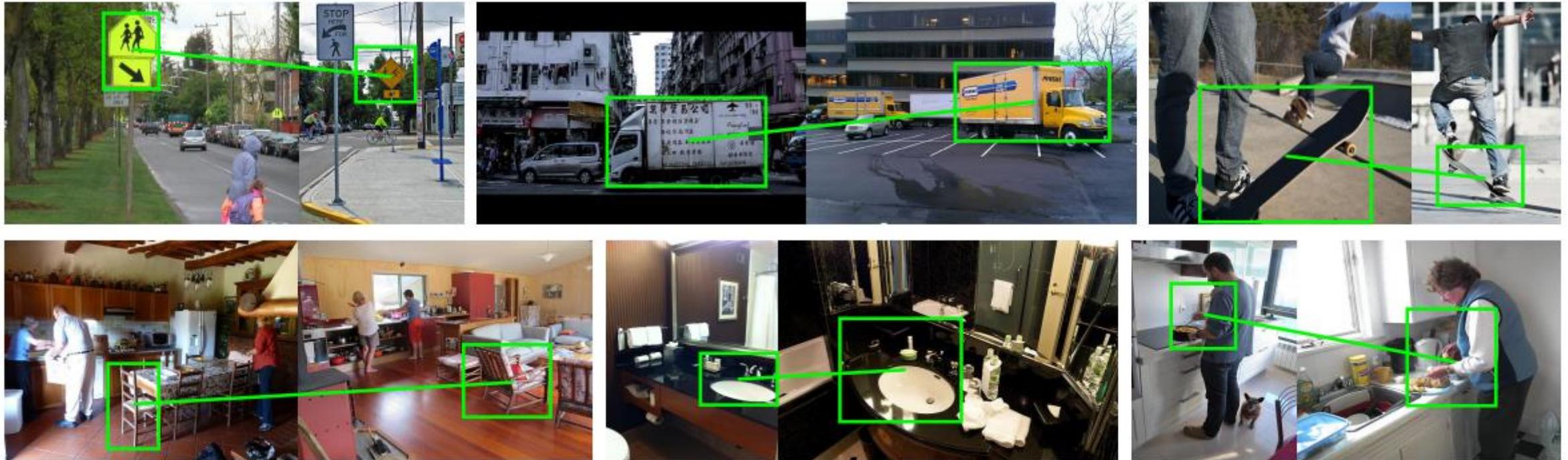
Symmetrical – VICReg



Object Level - ORL



Object Level - ORL

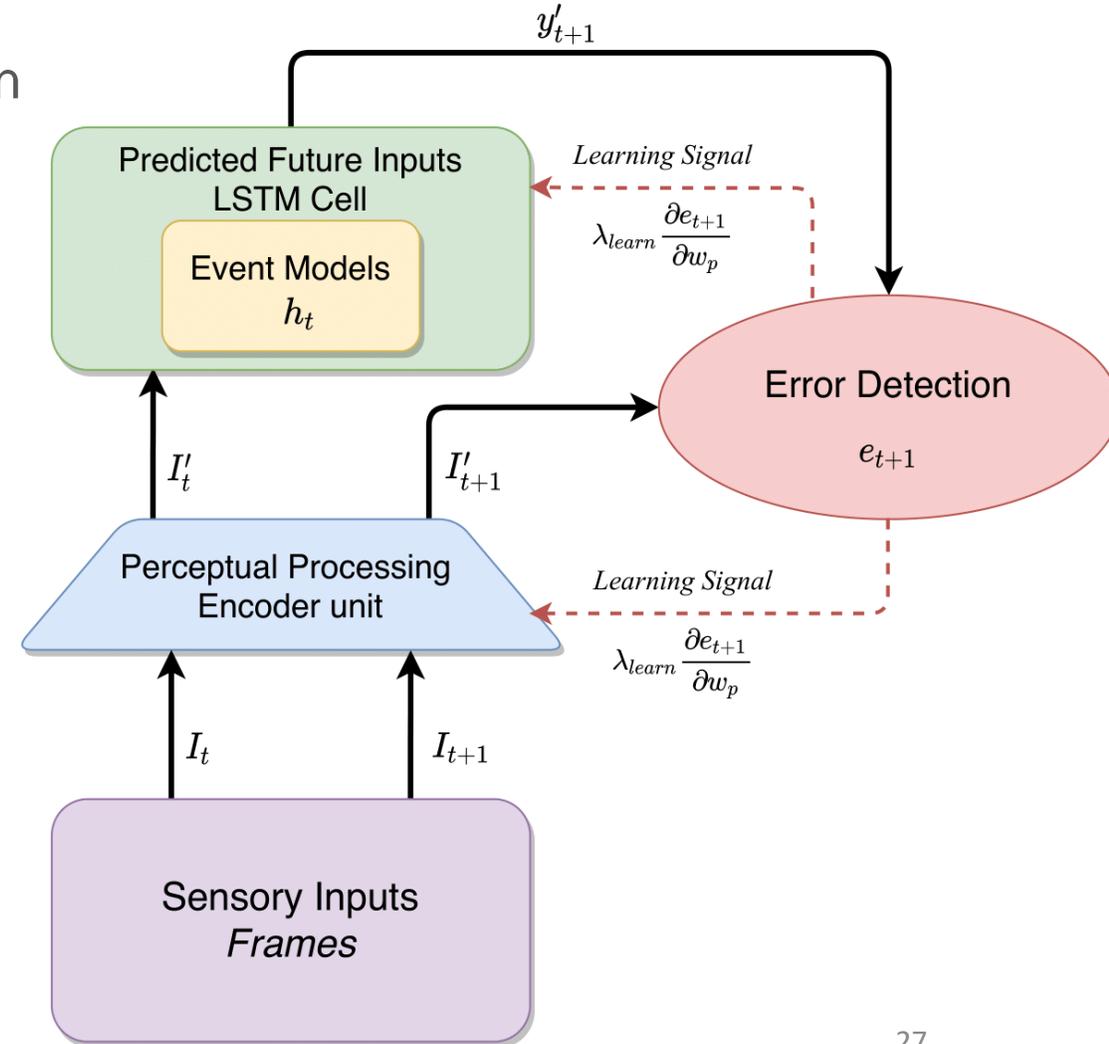


Self Supervised Event Segmentation

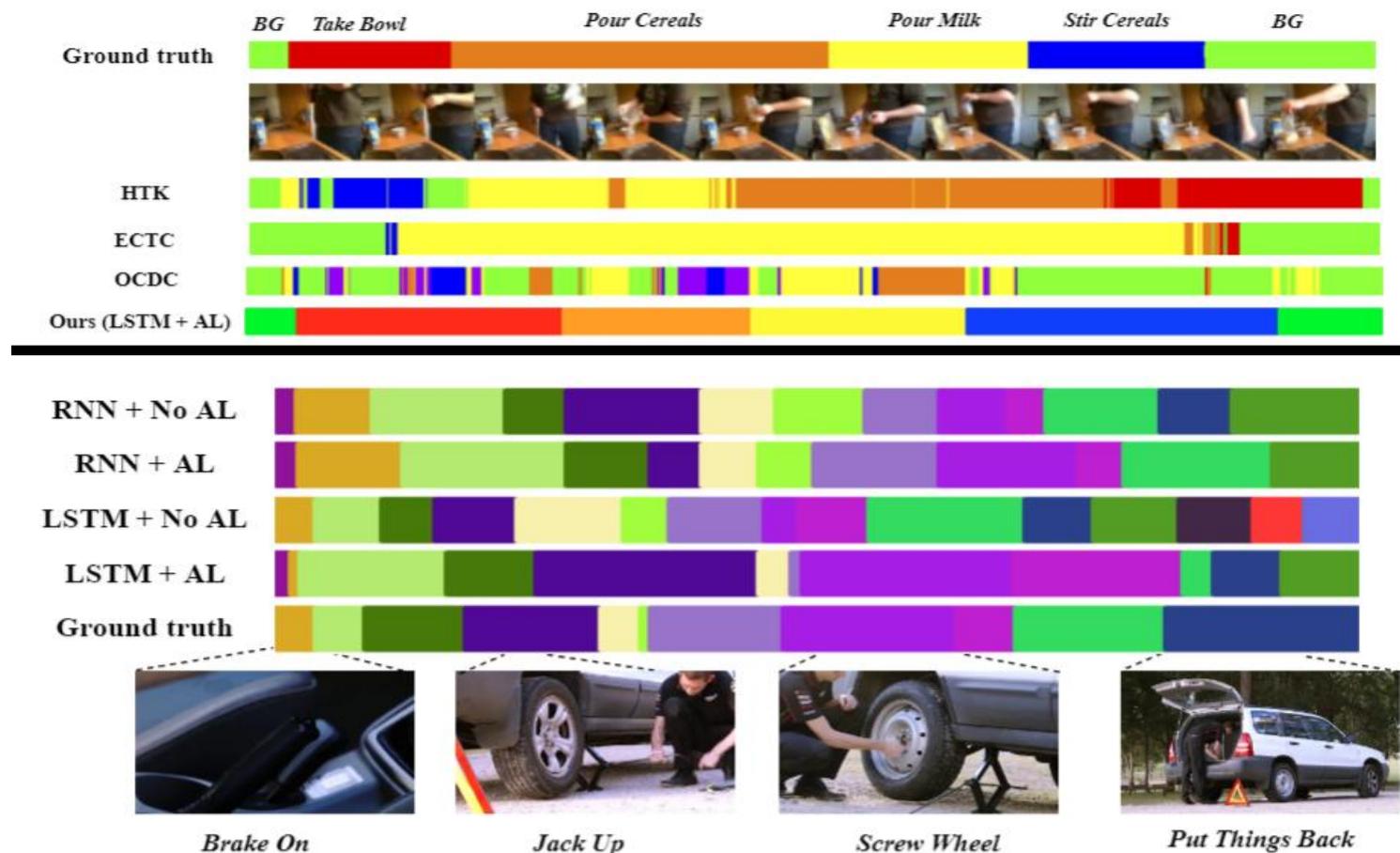
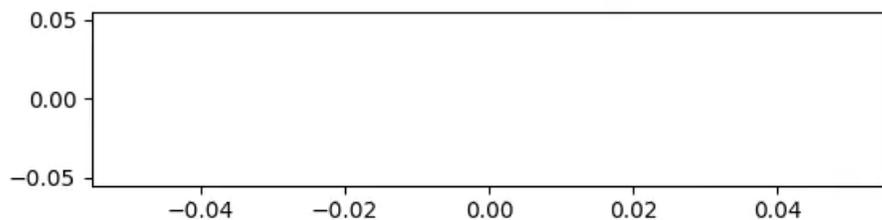
- LSTM cell for internal memory of event model.
- Error detection implemented as a low pass filter on prediction error running average.
- Gating signal triggered when error is above 1.5 times the running average.
- Adaptive learning controls learning rate

$$P_q(t) = P_q(t - 1) + \frac{1}{n}(E_P(t) - P_q(t - 1))$$

$$G(t) = \begin{cases} 1, & \frac{E_P(t)}{P_q(t-1)} > \psi_e \\ 0, & \text{otherwise} \end{cases}$$



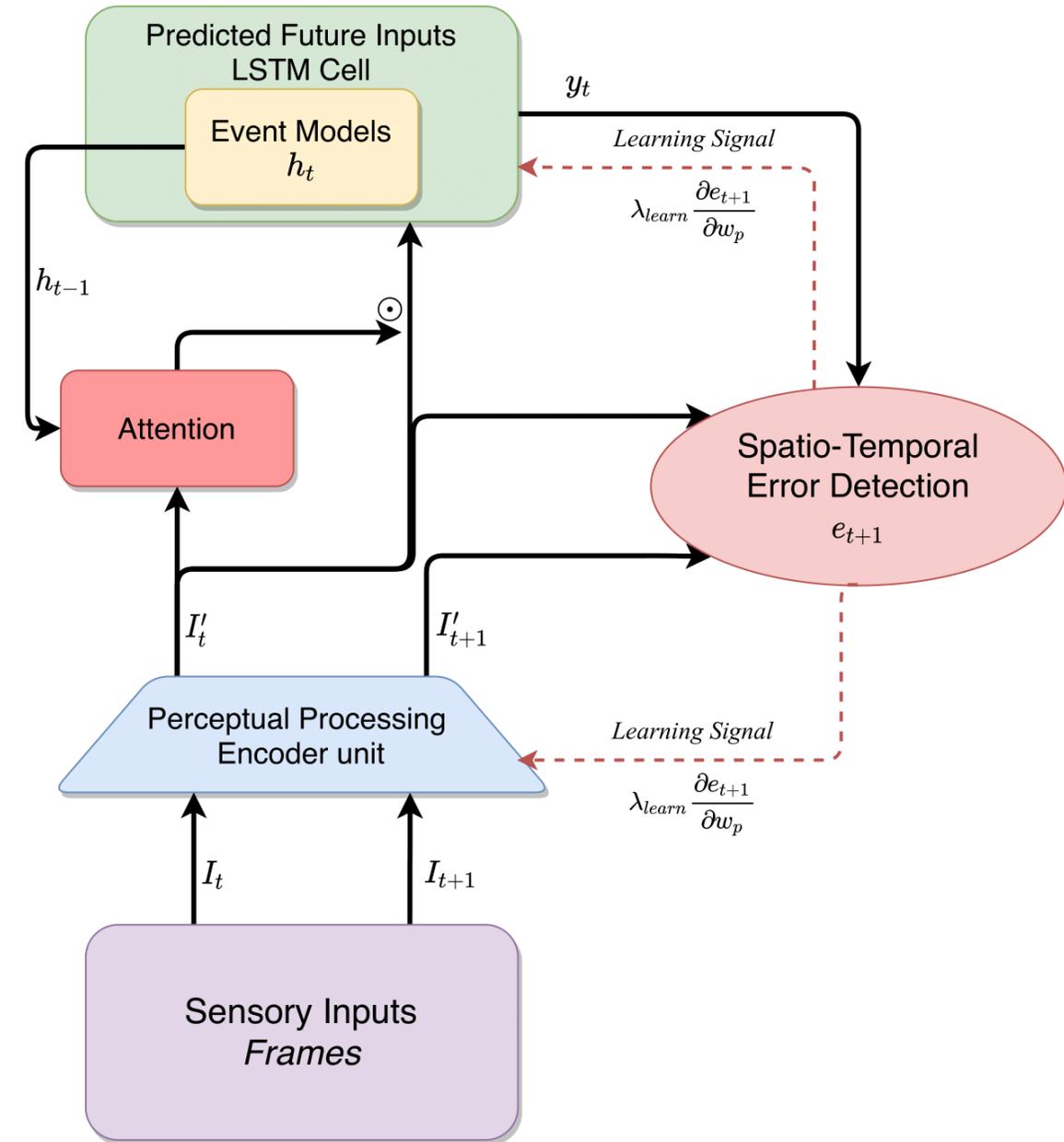
Self Supervised Event Segmentation



Wildlife Extended Videos

- Bahdanau attention is used to visualize the location of the bird.
- Motion-weighted loss is used instead of pure prediction loss.

$$e_t = \|(I'_{t+1} - y'_t)^{\odot 2} \odot (I'_{t+1} - I'_t)^{\odot 2}\|^2$$

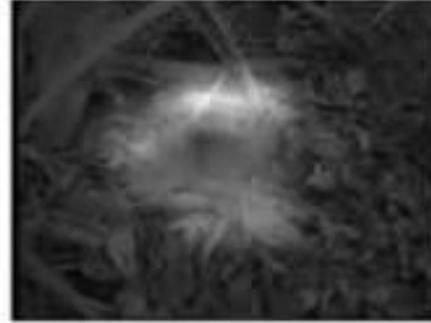


Wildlife Extended Videos

Raw Video Frames



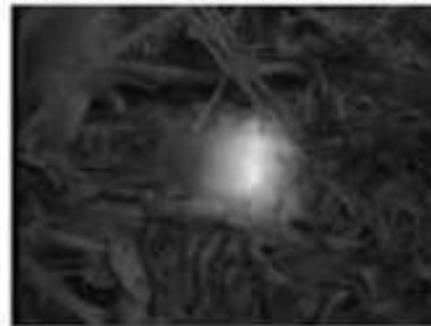
Bahdanau Attention



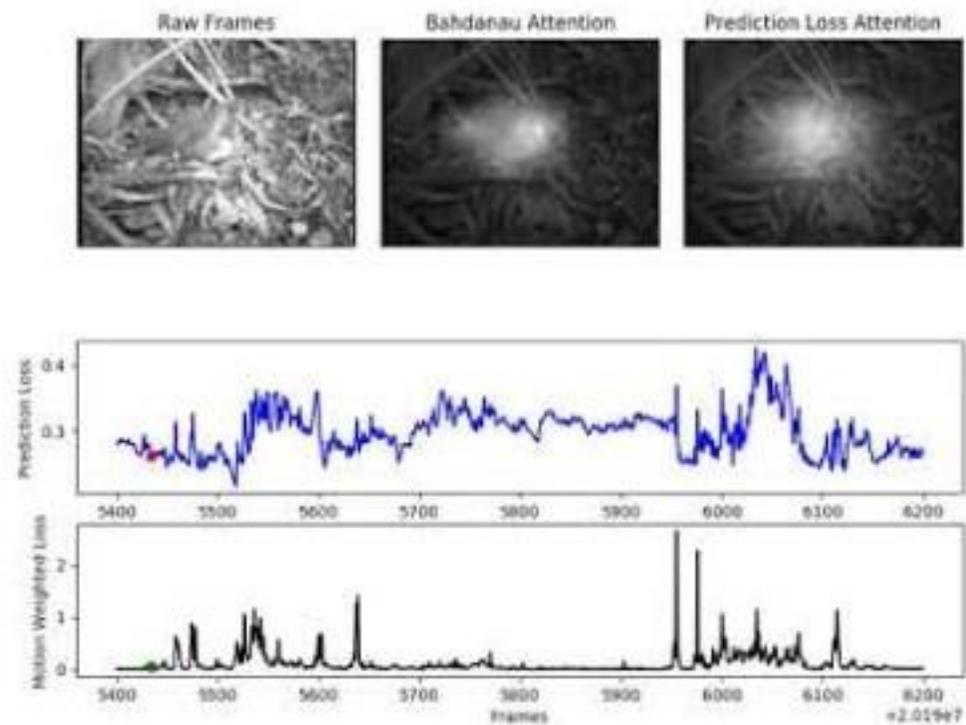
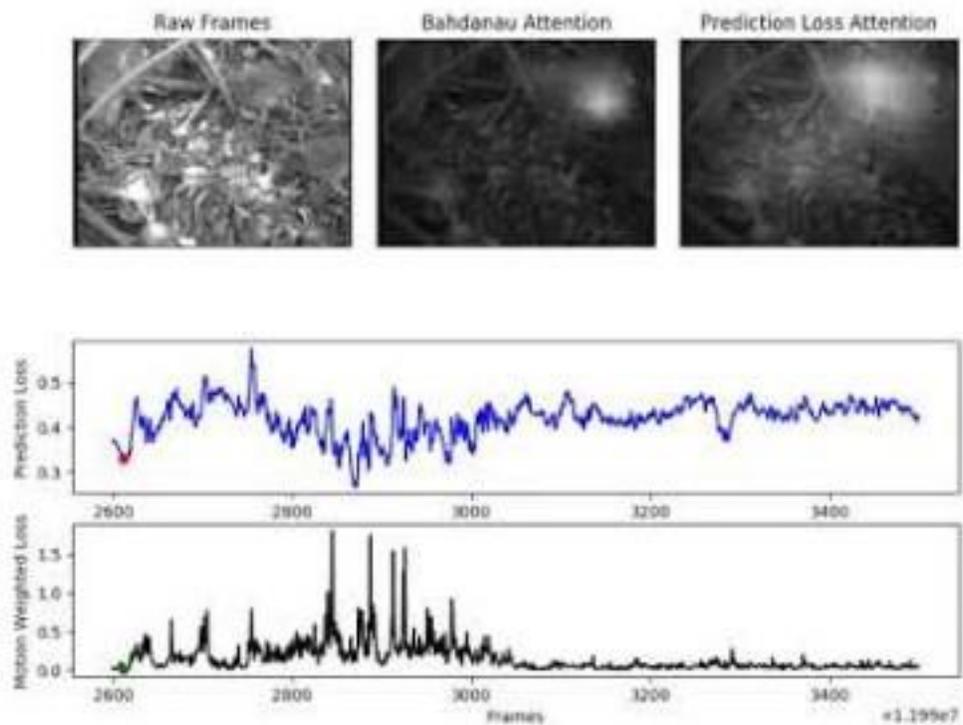
Raw Video Frames



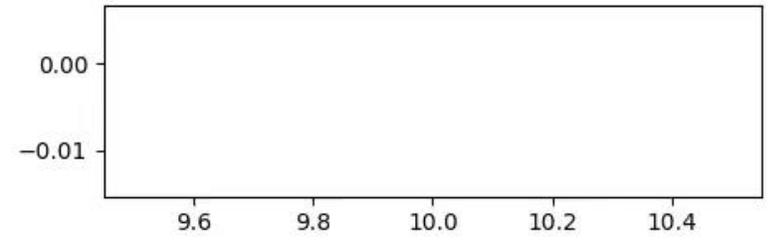
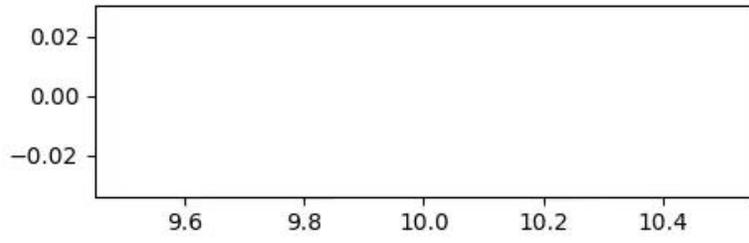
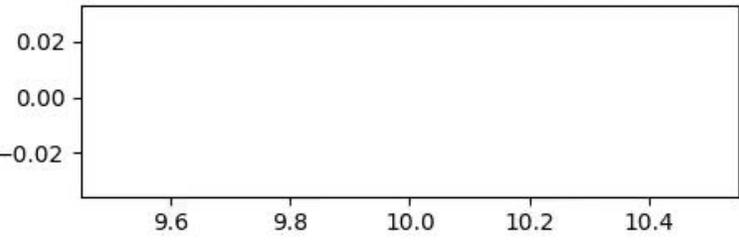
Bahdanau Attention



Wildlife Extended Videos



Other Domains



**Thank you
Questions?**



**UNIVERSITY OF
SOUTH FLORIDA**