

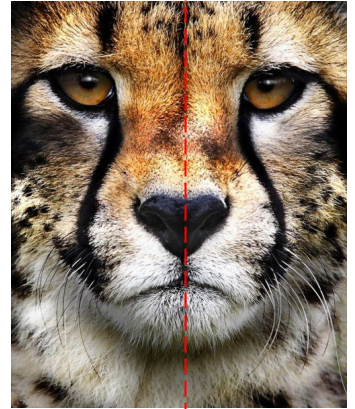
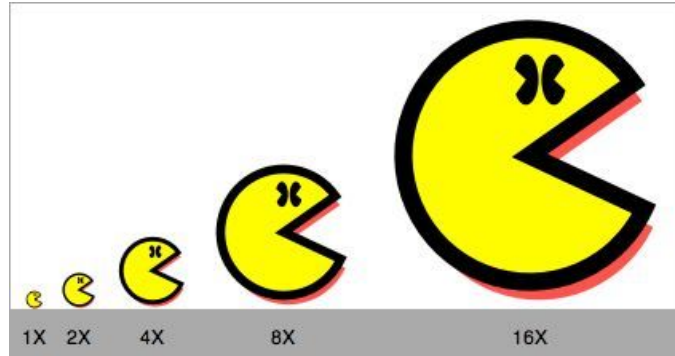
Exploiting symmetries (in images) with graph neural networks

Semester Project - Charles Gallay

Supervision - Michaël Defferrard & Nathanaël Perraudin



Symmetries everywhere



Data augmentation



Transformation
(Rotation of 90
degrees)



Equivariant network

Relation:
90 degree
rotation



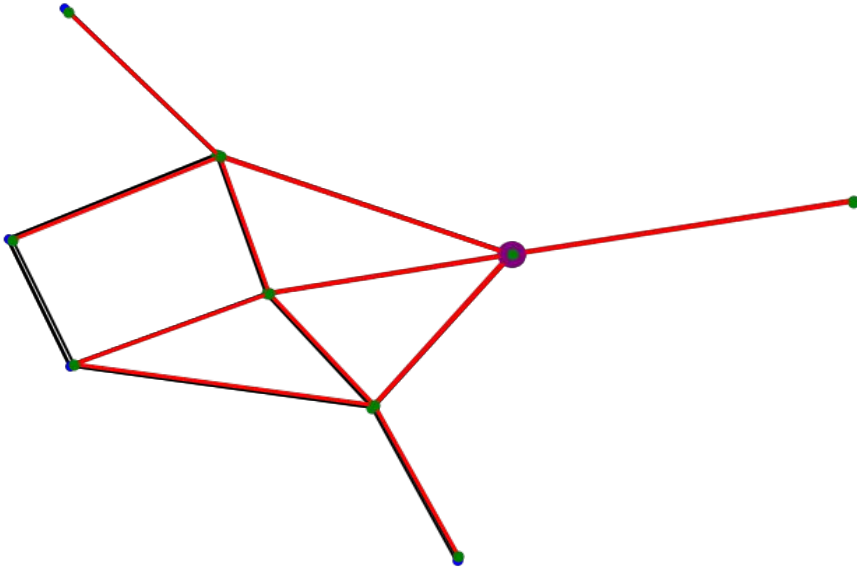
[[3,
4,
9,
6,
2,
4]]

[[3,
9,
6,
2,
8,
3]]

Shifted features



Graph Convolution

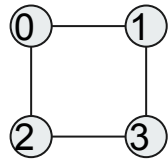
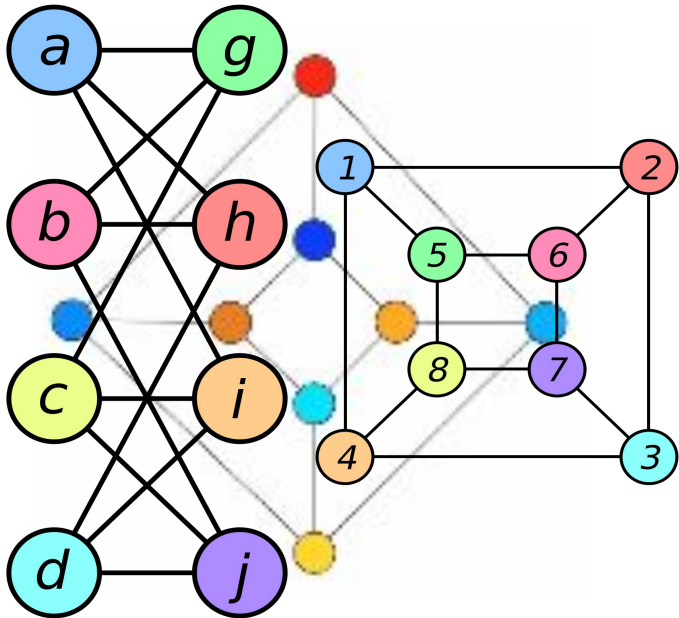


$$K = \emptyset$$

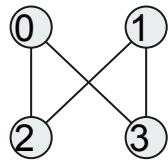
$f * g =$

$$w_0 n_0 + w_1 \sum n_i + w_2 \sum n_i$$

Invariance in Graph Convolution



[[0, 1, 1, 0],
[1, 0, 0, 1],
[1, 0, 0, 1],
[0, 1, 1, 0]]



[[0, 0, 1, 0],
[0, 0, 0, 0],
[1, 0, 0, 0],
[0, 0, 0, 0]]



Invariance on the 2d grid

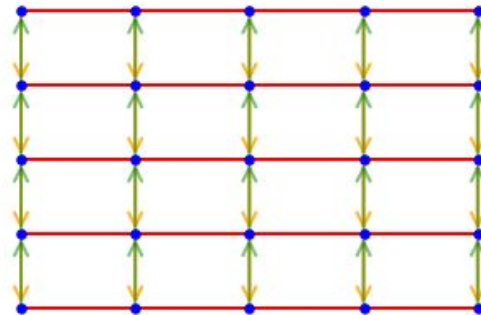
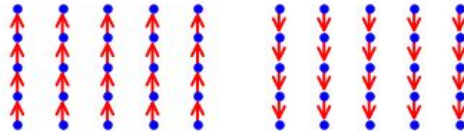
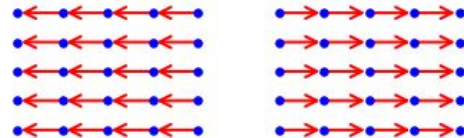
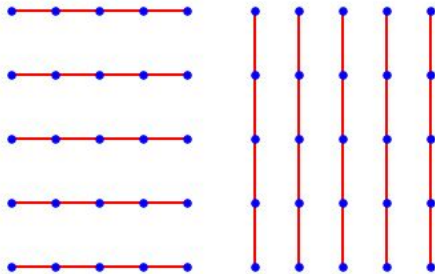
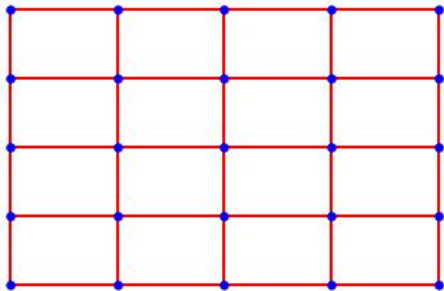


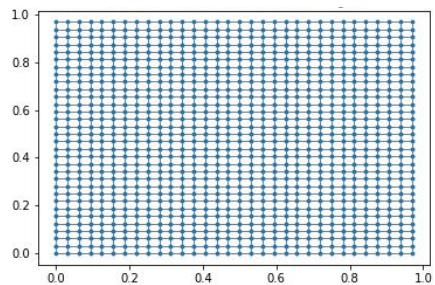


Image as signal on graph



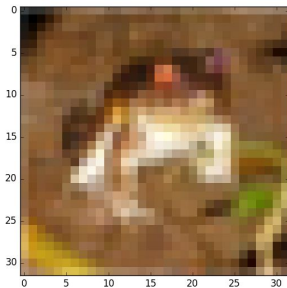
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Results

CIFAR-10:



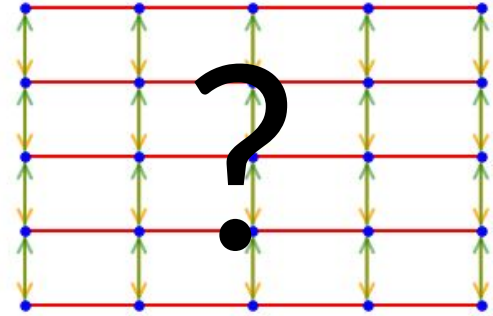
AID:



Symmetries	CIFAR-10	AID
All (2dGrid)	52.9%	70.4%
Vertical	57.8%	-
Vertical+Horizontal	60.5%	67.5%
Horizontal	64.3%	-
None (Directed)	66.6%	68.5%

Conclusion

- Test symmetries present in datasets
- Invariance not always good
- Can we learn symmetries ?





Questions

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