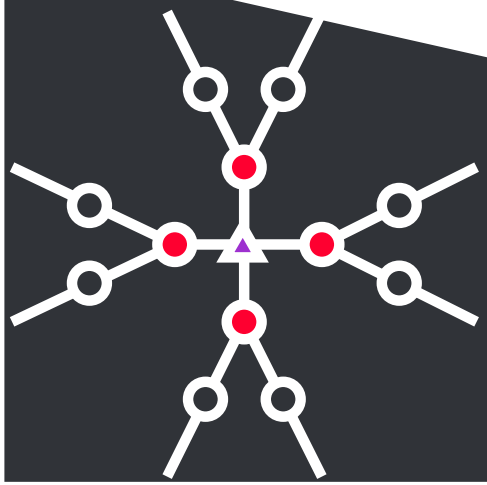
LOCAL SYMMETRIES IN NETWORKS

Petter Holme
University of New Mexico, Albuquerque, USA

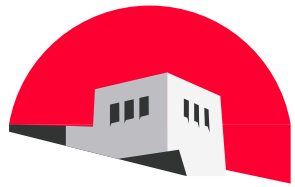


e-print physics/0605029

http://www.cs.unm.edu/~holme/

the idea

- Symmetries = invariance to certain (usually geometric) operators.



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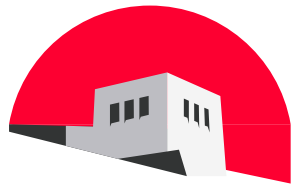
- Symmetries are useful concepts in many areas of physics.



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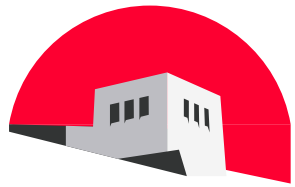

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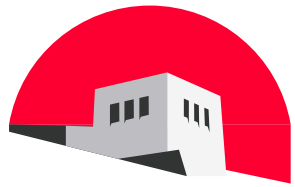

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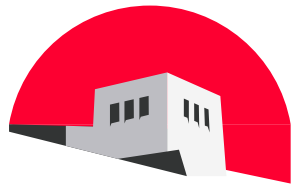
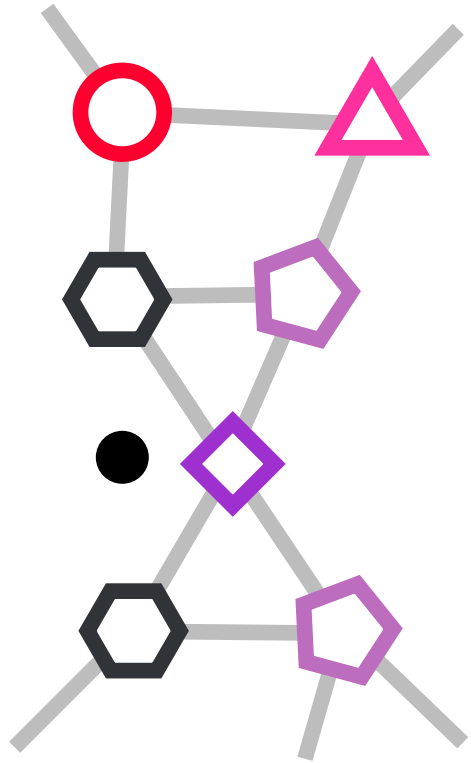
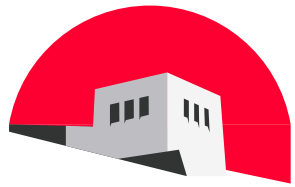
- What does a center of local symmetry mean?



what operator? role of paths



path:



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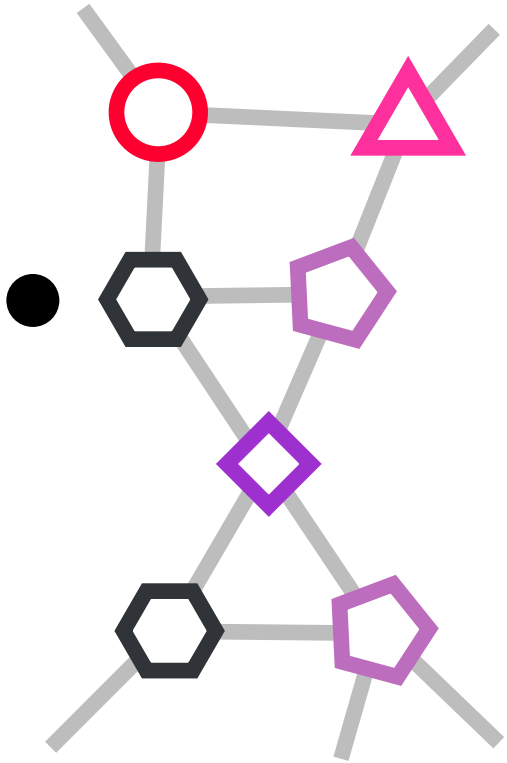

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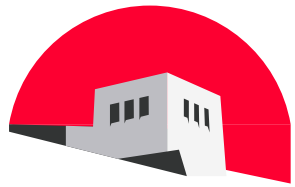

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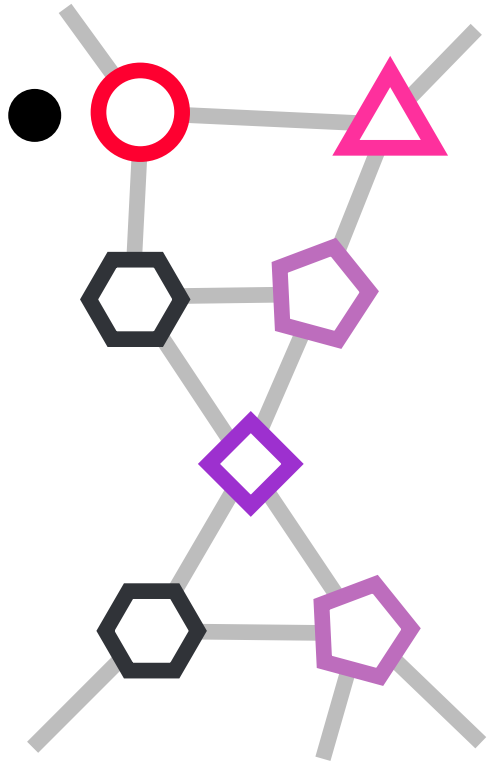

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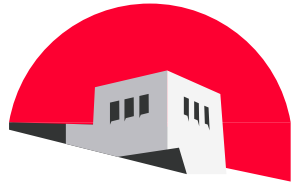

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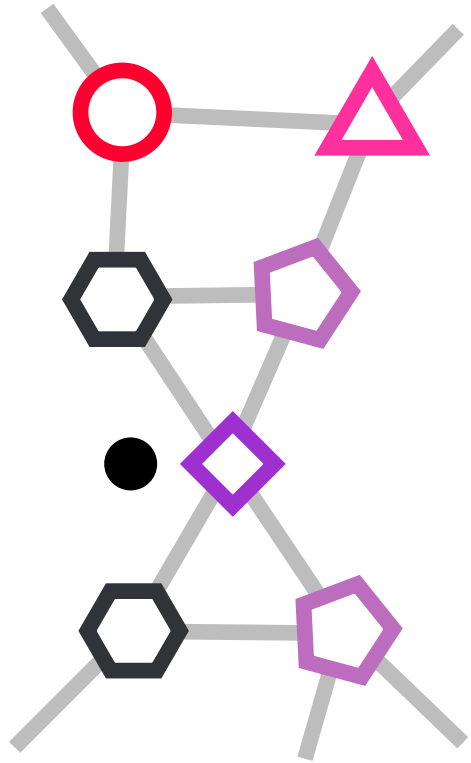

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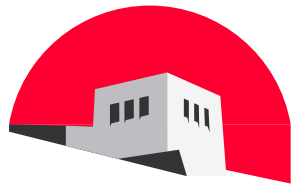

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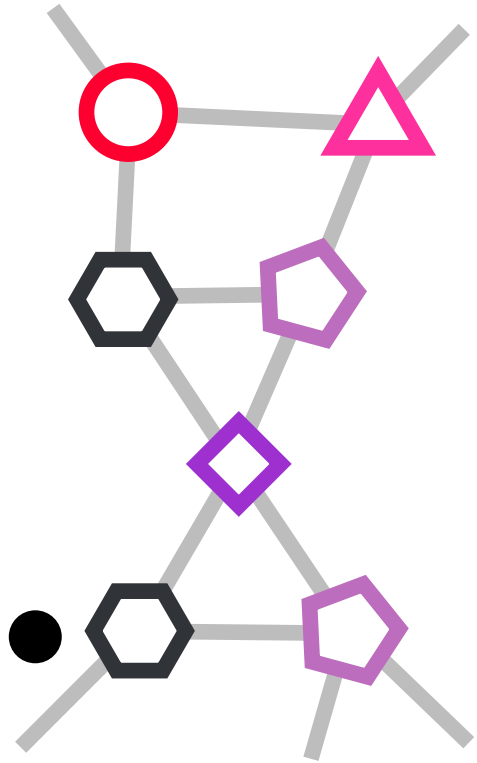

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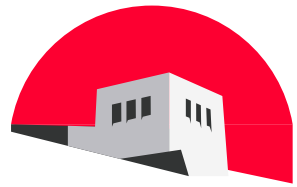

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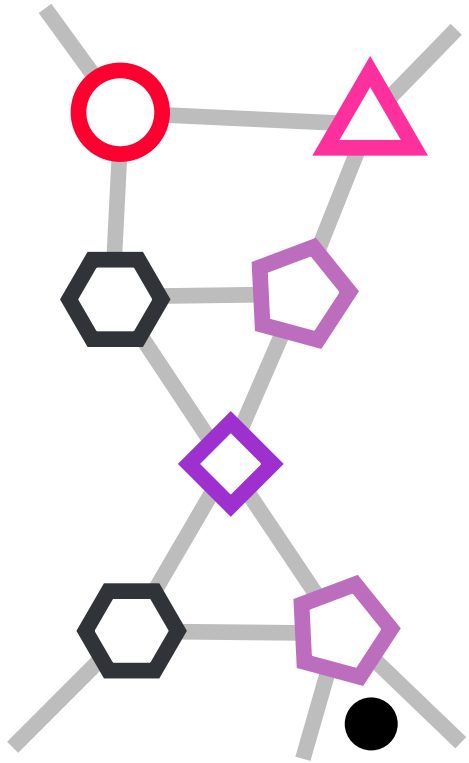

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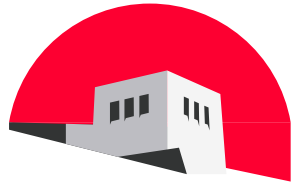
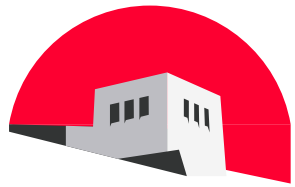


what operator? role of paths

- In many cases: the network is experienced by walking on it.



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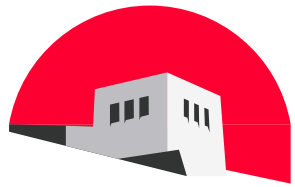
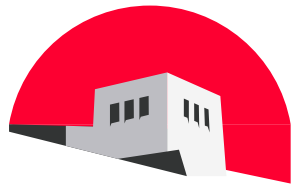
- In many cases: the network is experienced by walking on it.
- If many paths out from a vertex are similar, that vertex is a center of symmetry.

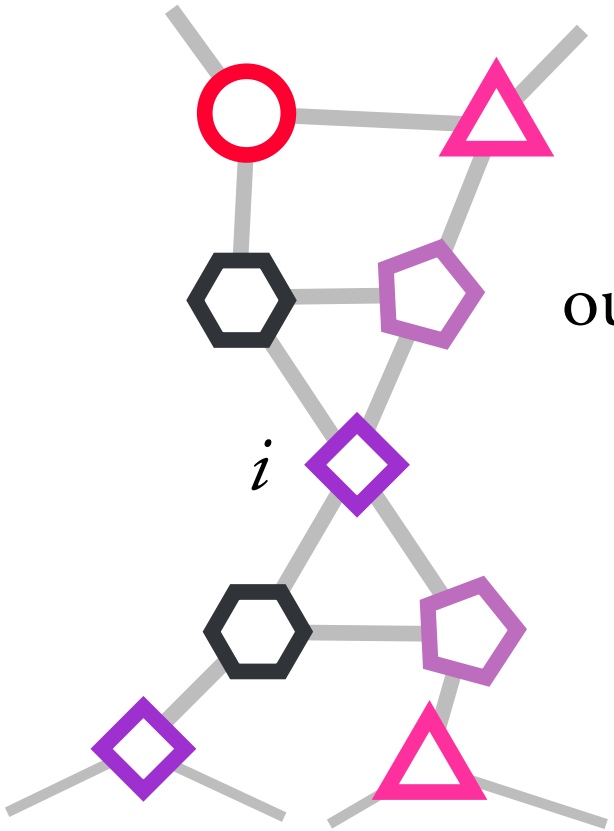


what operator? role of paths

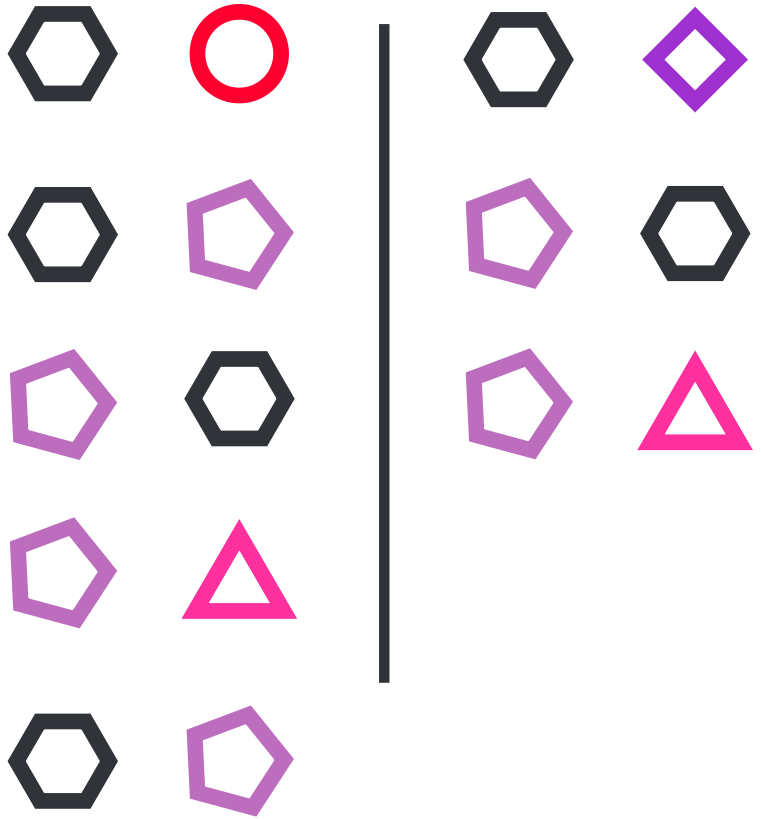
- In many cases: the network is experienced by walking on it.
- If many paths out from a vertex are similar, that vertex is a center of symmetry.
- The surrounding of the vertex is functionally invariant with respect to permutations of the paths.



definition of the coefficient



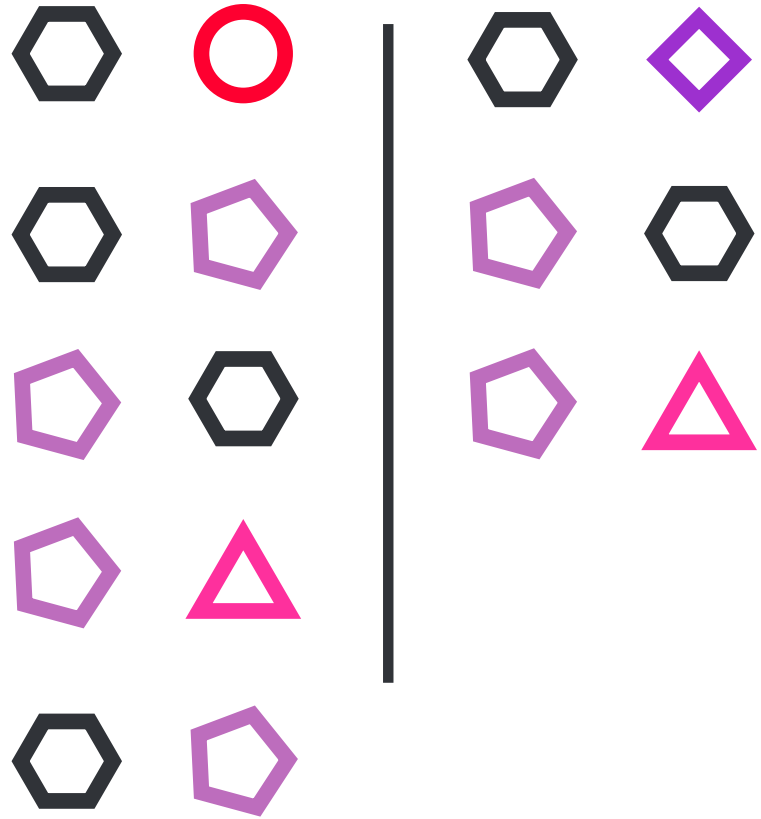
2-paths:
out from i

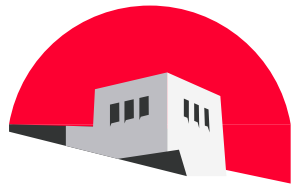


definition of the coefficient

idea:

- look at the pairs of vertices at a distance d of forked paths





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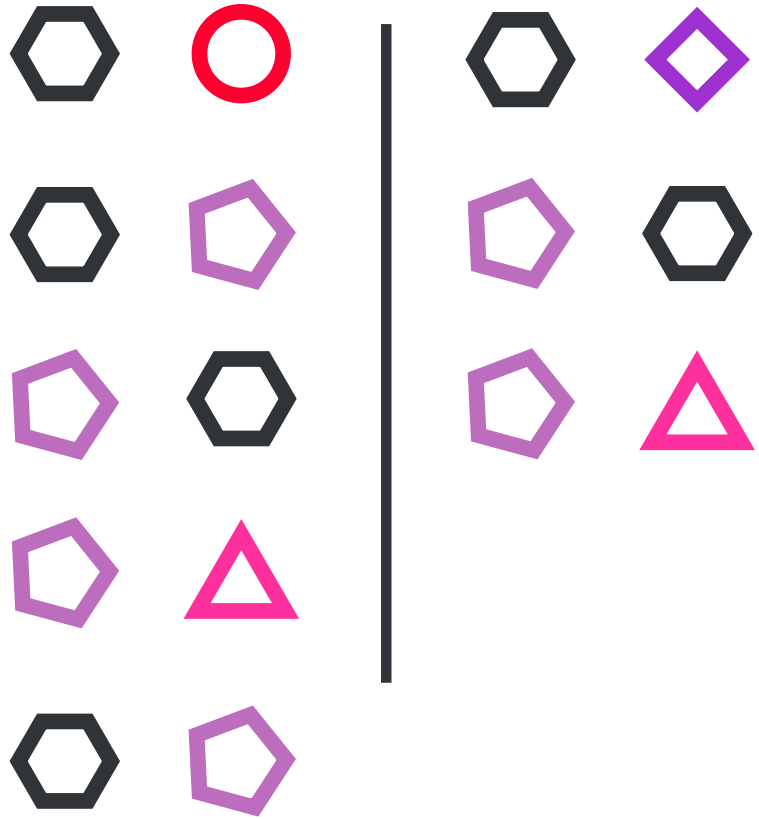
idea:

- look at the pairs of vertices at a distance d of forked paths
- count the fraction of overlapping such pairs



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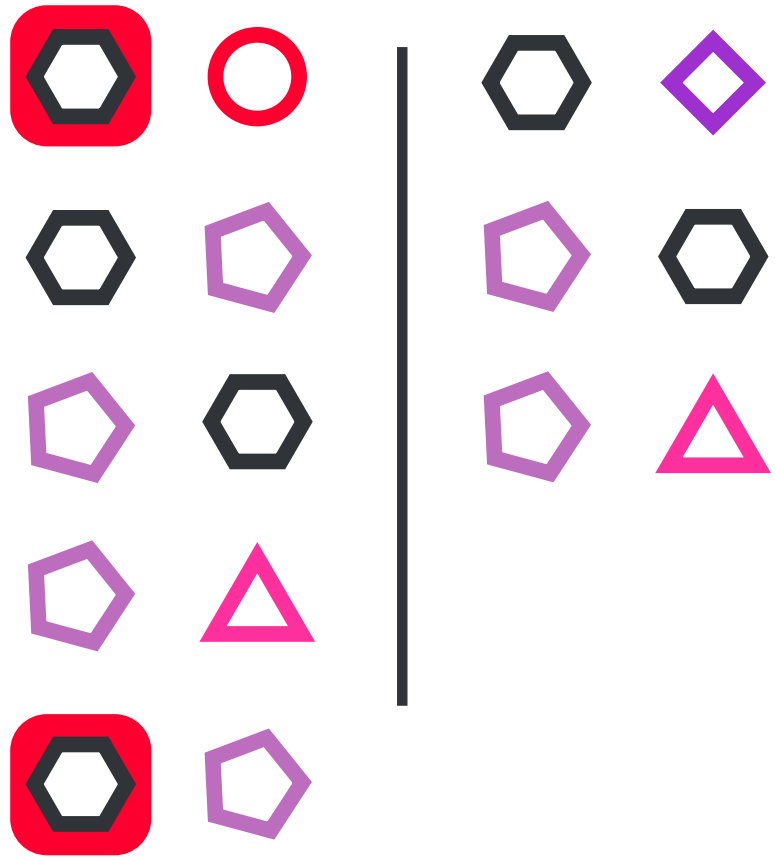

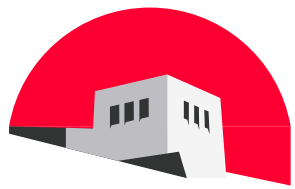

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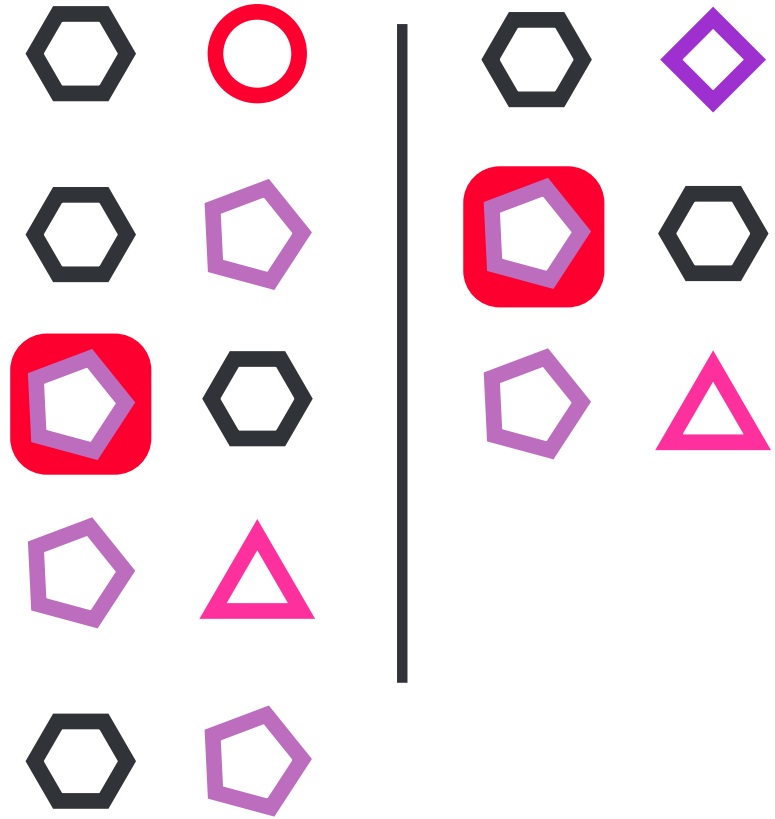

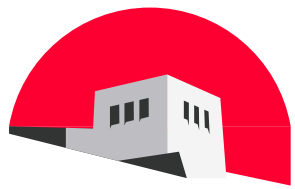

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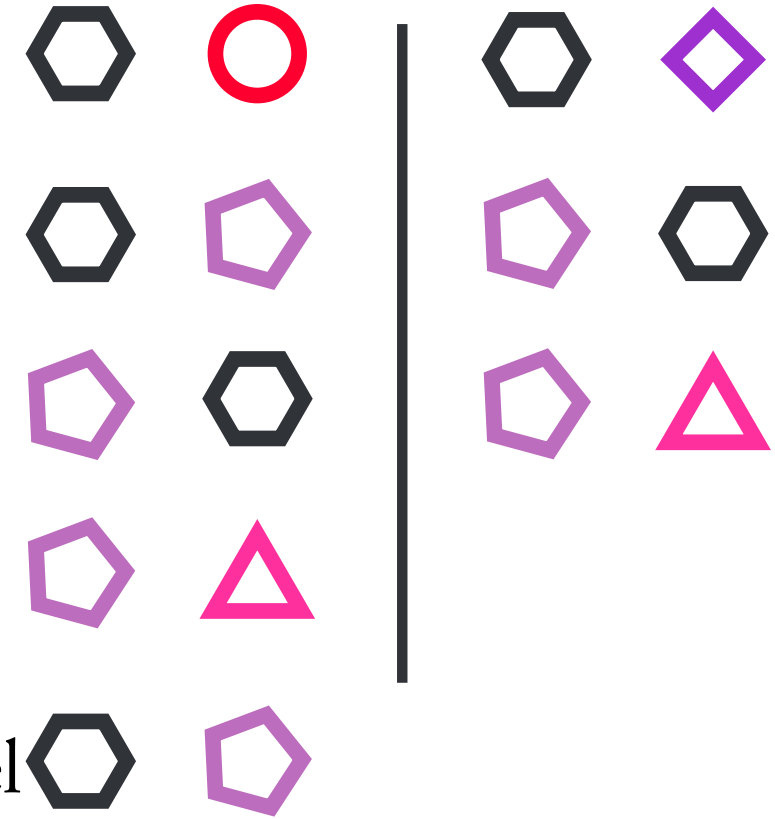
- subtract the expected value from a null-model



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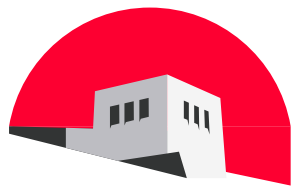
= local symmetry coefficient

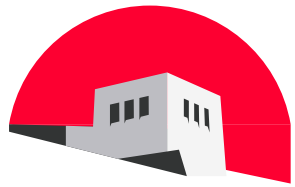


functional similarity

What determines if a vertex is  or  ?

How define equivalence classes?

- Degree.



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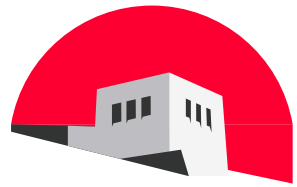

functional similarity

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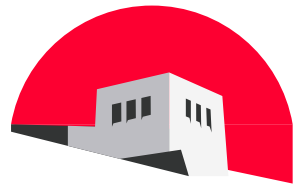
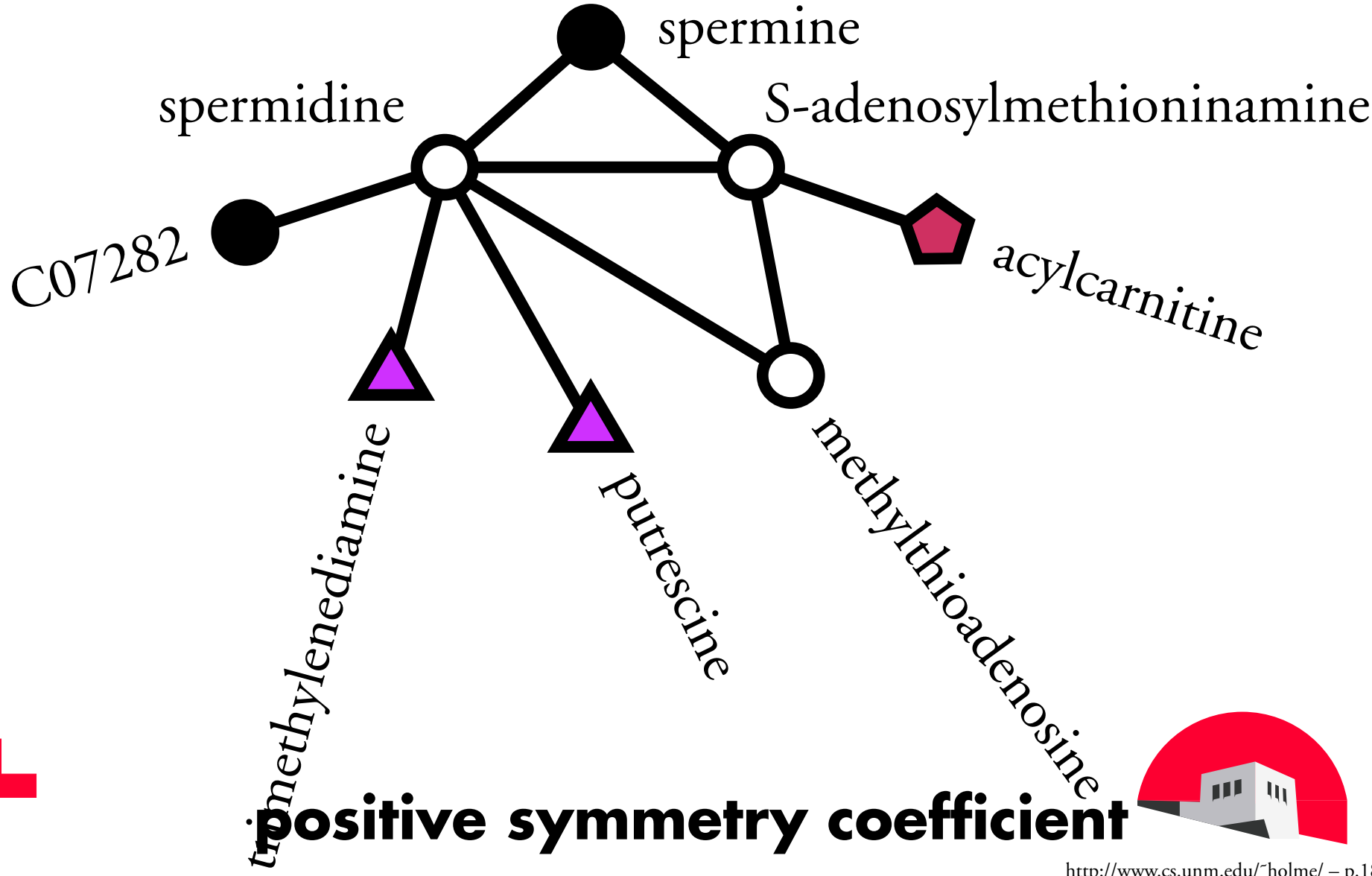
- Clustering coefficient (or any other vertex specific network measure).
- External functionallity. E.g. protein function.

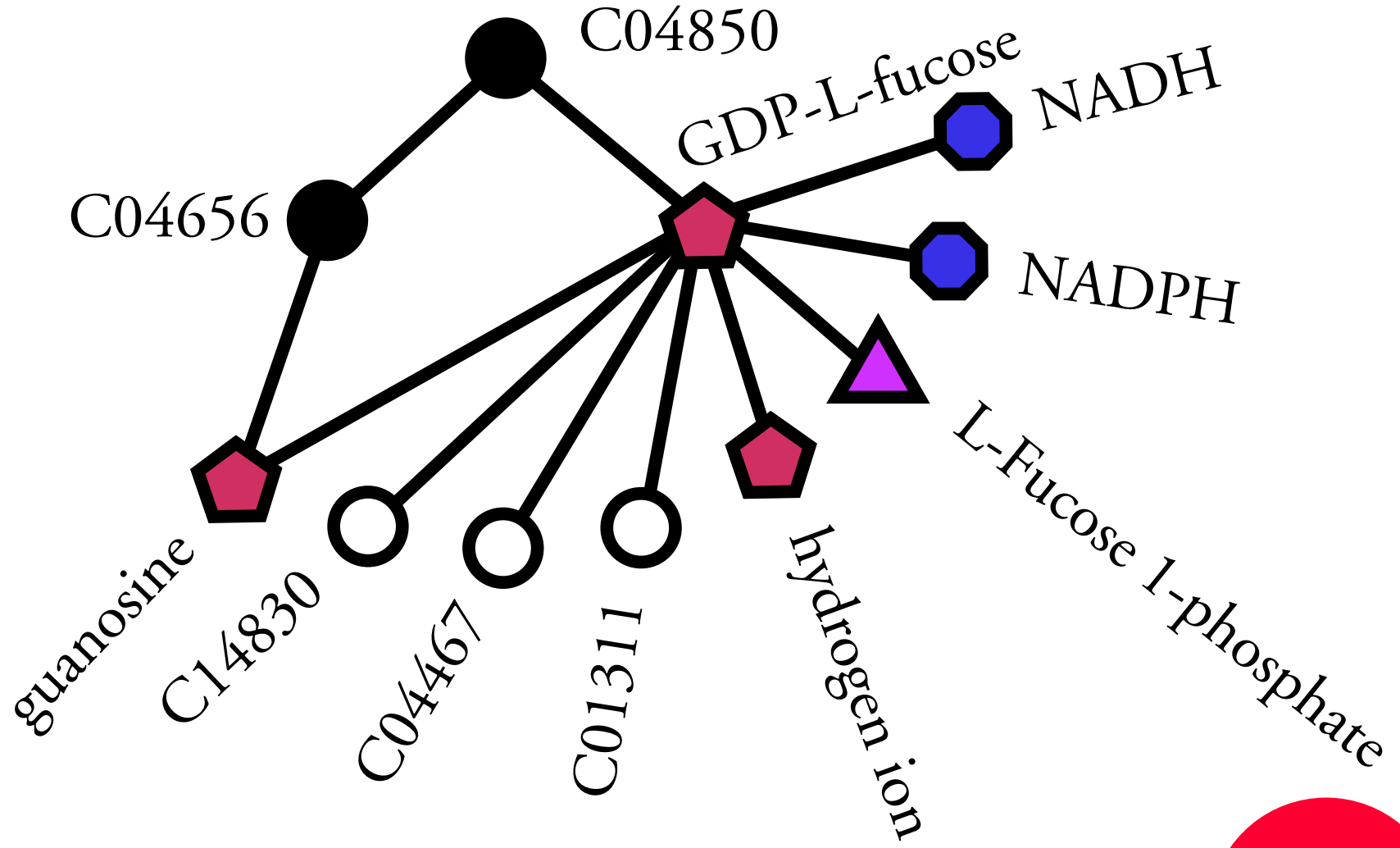


degree sym.: human metabolism



positive symmetry coefficient

degree sym.: human metabolism



negative symmetry coefficient