

# Scale Invariance/Equivariance CNN

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## Summary of this week

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We looked through four papers this week (listed below) and we found the theory behind papers is difficult to understand and still not fully figured them out.

## Paper:

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1. [Locally Scale-Invariant Convolutional Neural Network](#)

- **Method:** Firstly, they applies filters at multiple scales in each layer so a single filter can detect and learn patterns at multiple scales. Then, max-pool responses over scales to obtain representations that are locally scale invariant yet have the same dimensionality as a traditional ConvNet layer output.
- **Dataset:** MNIST-Scale

2. [Scale Steerable Filters for Locally Scale-Invariant Convolutional Neural Networks](#)

- **Method:** Using the log-radial harmonics as a complex steerable basis, we construct a locally scale invariant CNN, where the filters in each convolution layer are a linear combination of the basis filters.
- **Dataset:** MNIST-Scale and FMNIST-Scale

3. [Deep Scale-spaces: Equivariance Over Scale](#)

- **Method:** Extend convolutions to these classes of symmetry under noninvertible transformations via the theory of semigroups. Their contributions are the introduction of a semigroup equivariant correlation and a scale-equivariant CNN.
- **Dataset:** Patch Camelyon and Cityscapes

4. [POLAR TRANSFORMER NETWORKS](#)

- **Method:** Combines the ideas of STN and canonical coordinate representations to achieve equivariance to translations, rotations, and dilations.
- **Dataset:** ROTATED MNIST, SIM2MNIST(newly introduced)

## Schedule

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We decide to choose paper 1-3 to implement and generate their results. For the 3rd paper [Deep Scale-spaces: Equivariance Over Scale](#), we will use the dataset MNIST-Scale and FMNIST-Scale rather than their dataset.

### 11 Nov - 08 Dec:

- Finish the survey of relevant literatures
- Implement and repeat the results of the three papers.

### 09 Dec - 22 Dec:

- Evaluate the performance of the three papers' methods on Oral Cancer dataset (Evaluation methods haven't decided yet)
- Write the report

**07 Jan - 12 Jan:**

- Make poster
- Write the report

## Work Allocation

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Ruoqi:

- Implement the method and result of [Locally Scale-Invariant Convolutional Neural Network](#)
- Implement the method and result of [Deep Scale-spaces: Equivariance Over Scale](#)
- Evaluate the standard CNN on the downsampled Oral Cancer dataset
- Evaluate the performance of the method in [Scale Steerable Filters for Locally Scale-Invariant Convolutional Neural Networks](#) on dataset Oral Cancer (original and downsampled)
- Write the report

Wei:

- Implement the method and result of [Locally Scale-Invariant Convolutional Neural Network](#)
- Implement the method and result of [Scale Steerable Filters for Locally Scale-Invariant Convolutional Neural Networks](#)
- Evaluate the standard CNN on the original Oral Cancer dataset
- Evaluate the performance of the method in [Deep Scale-spaces: Equivariance Over Scale](#) on dataset Oral Cancer (original and downsampled)
- Write the report