

# **Feature extraction by activation function projection in the Reinforcement Learning Field**



# Summary

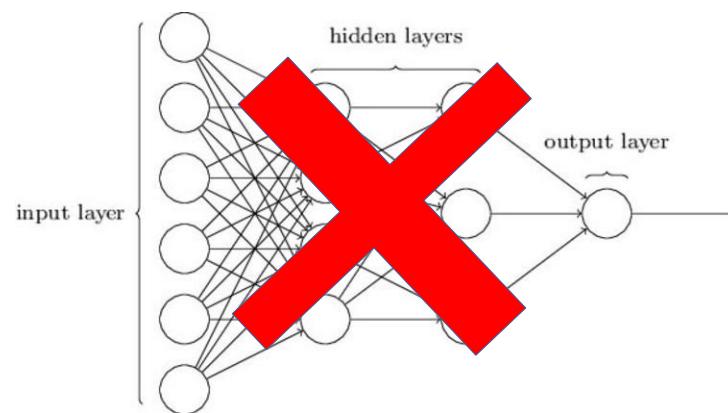
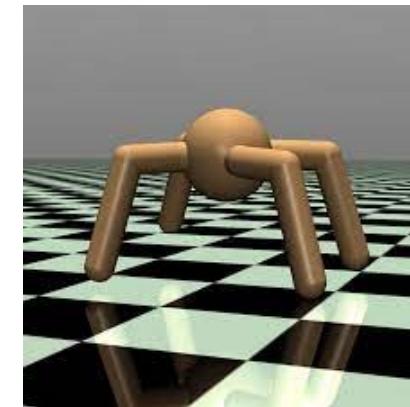
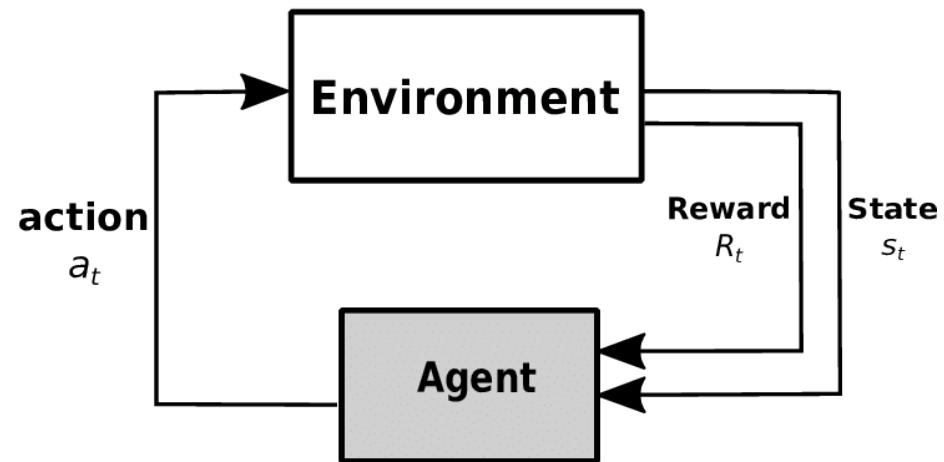
- Reinforcement Learning in robotics
- Activation function projection
- Feature extraction in RL
- Experiment and exploration
- Final result
- Conclusion

# Reinforcement Learning in robotics

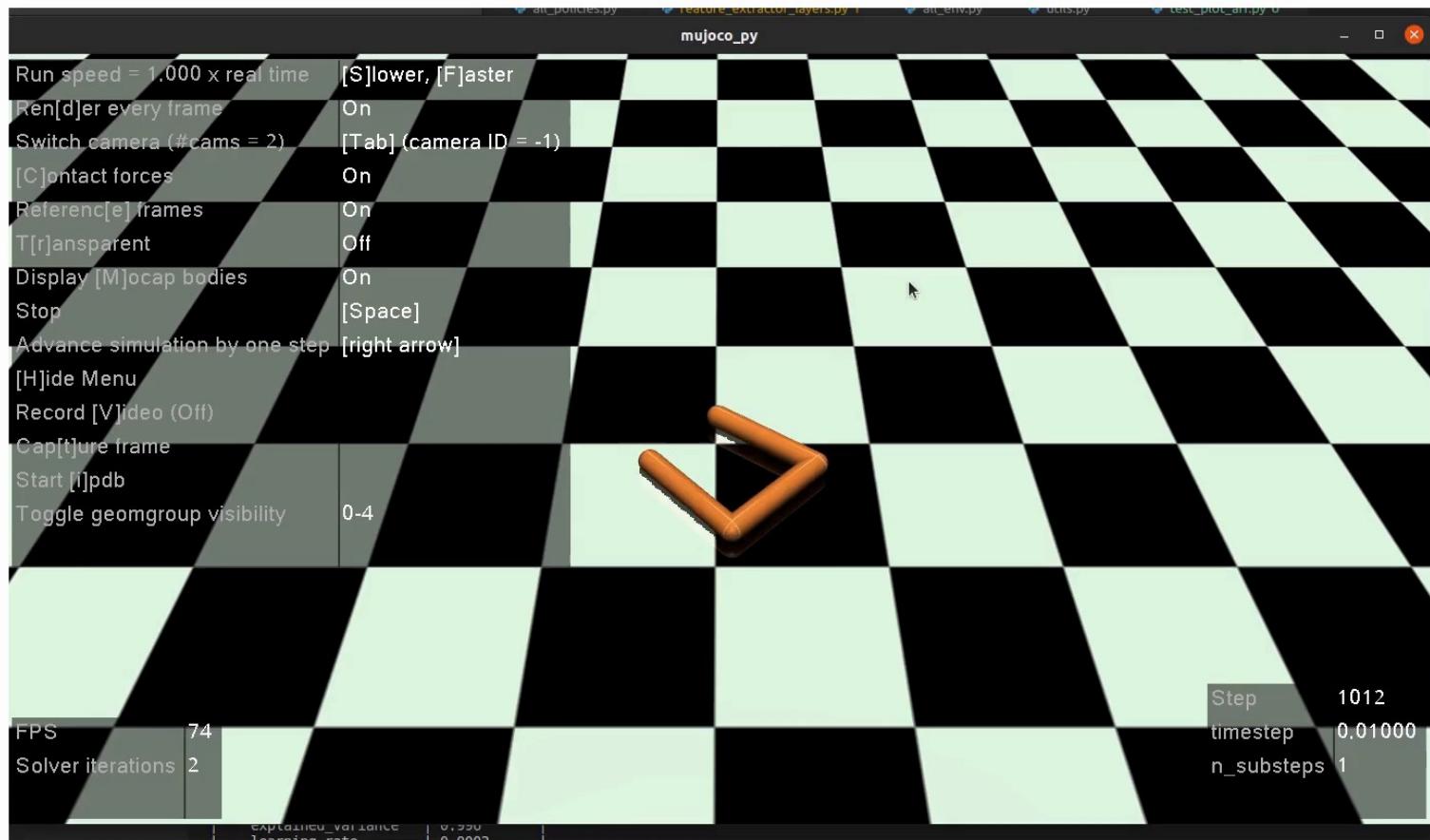
- Powerful tool
- Learn from rewards to succeed a task
- Limited to games and simulation



# Reinforcement Learning in robotics

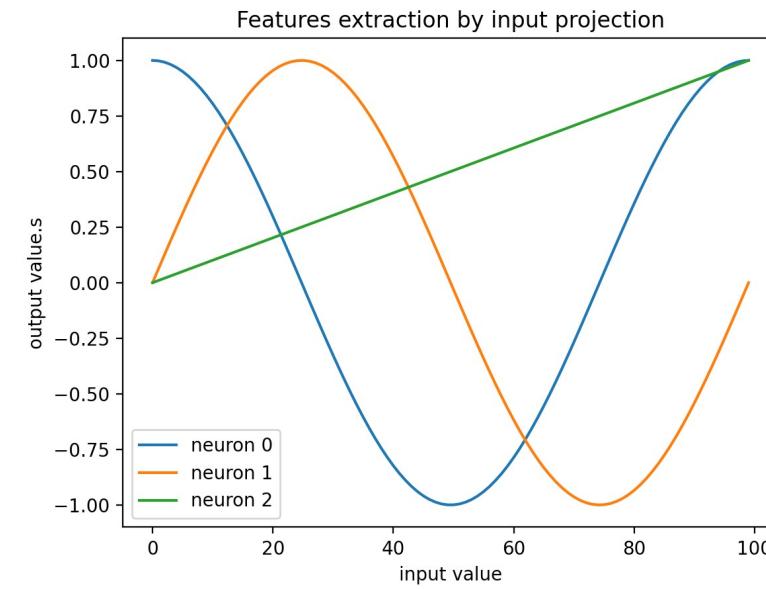
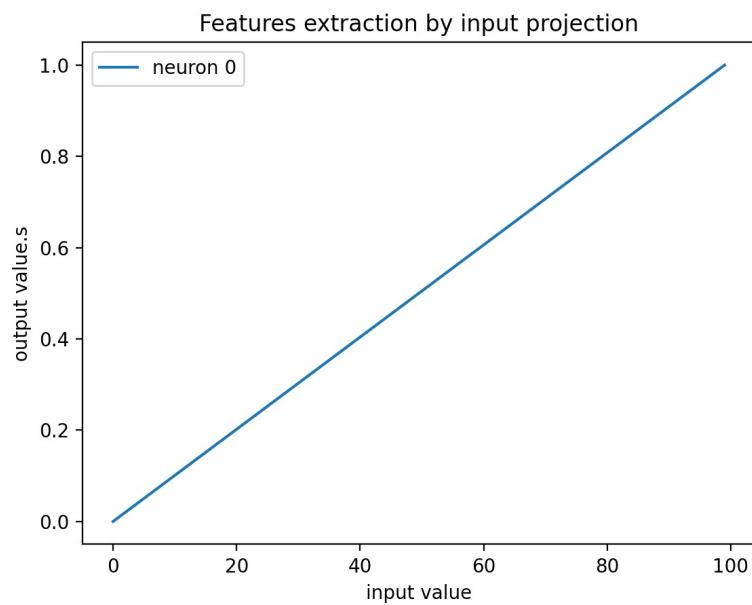


# Reinforcement Learning in robotics



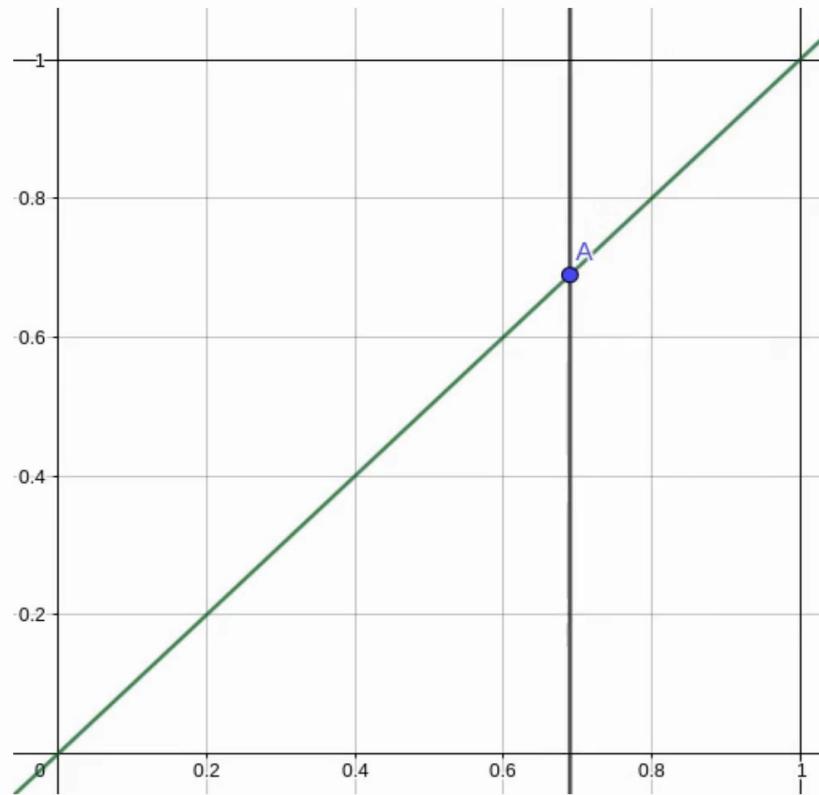
# Activation function projection

- Increase the understanding of the neural network
- Augment the dimension of expression



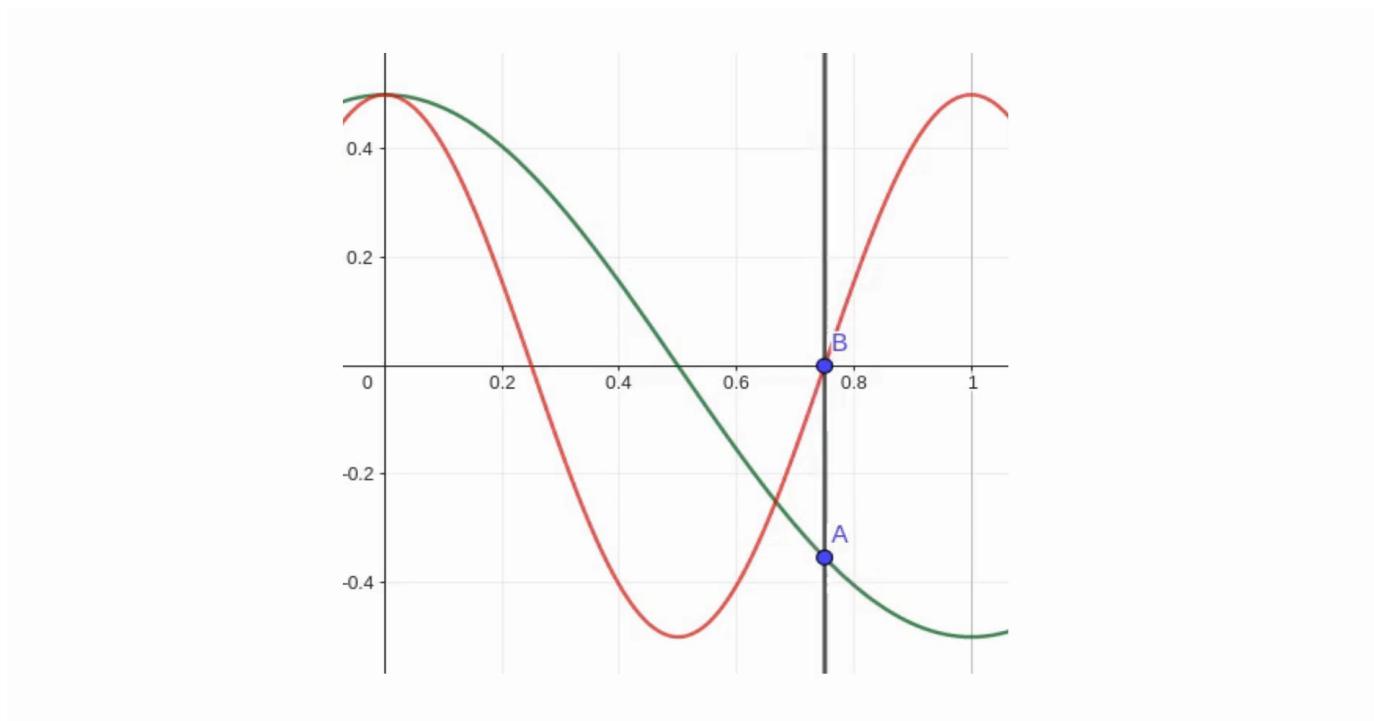
# Activation function projection

- Linear :



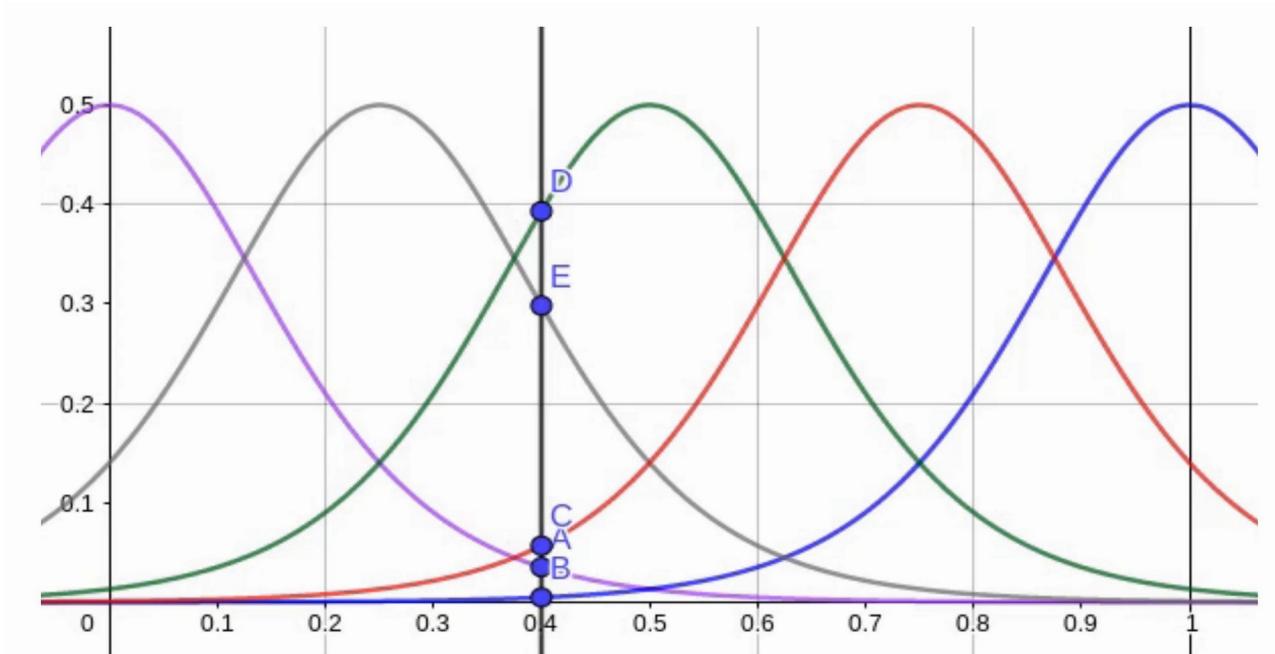
# Activation function projection

- Multi-frequencies :



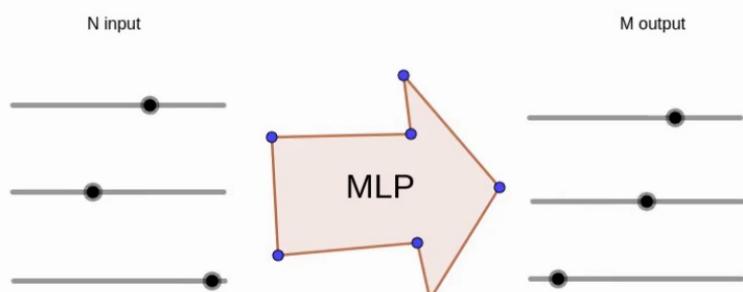
# Activation function projection

- Gaussian decomposition :

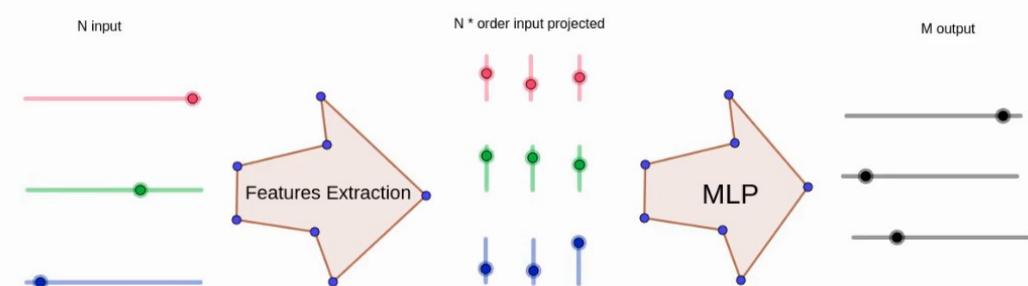


# Activation function projection

No input encoding



Input encoding



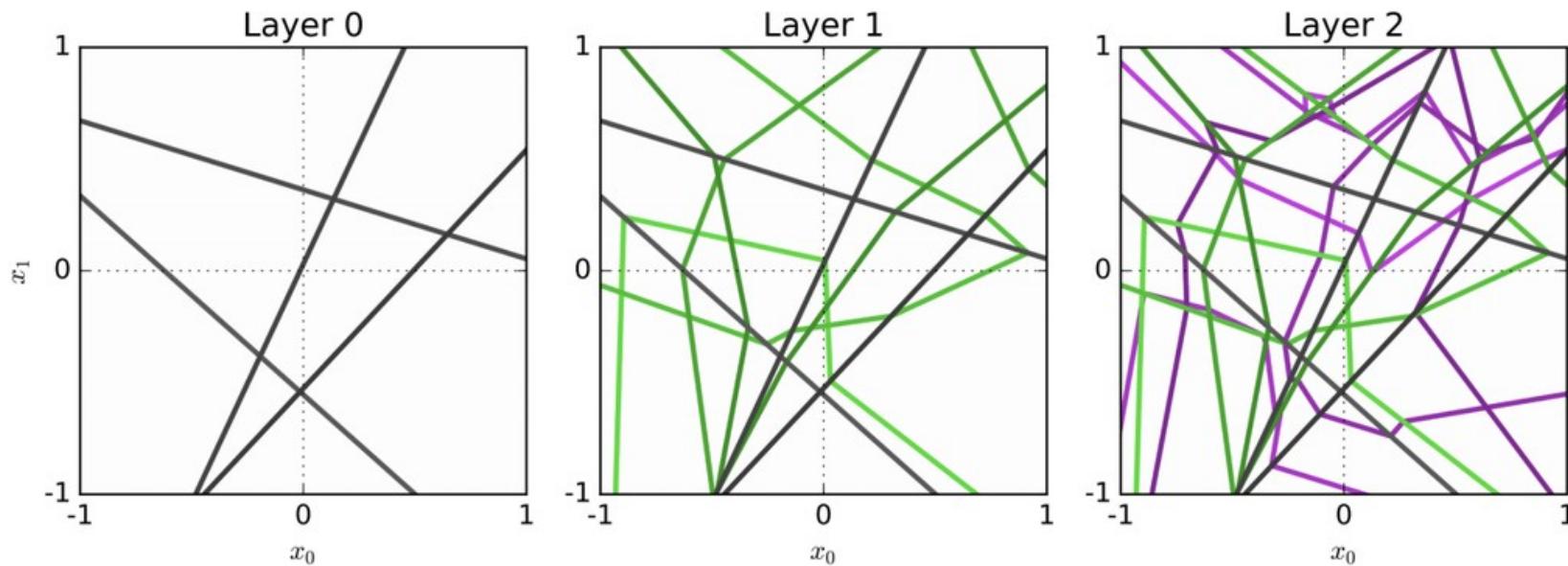
# Feature extraction in the RL field

- Activation function
- Auto-encoder / Convolution
- Fourier Features
- Radial Basis Function
- Voxelisation/Coarse encoding
- Kanerva coding
- Bspline function

# Feature extraction in the RL field

**Activation function :**

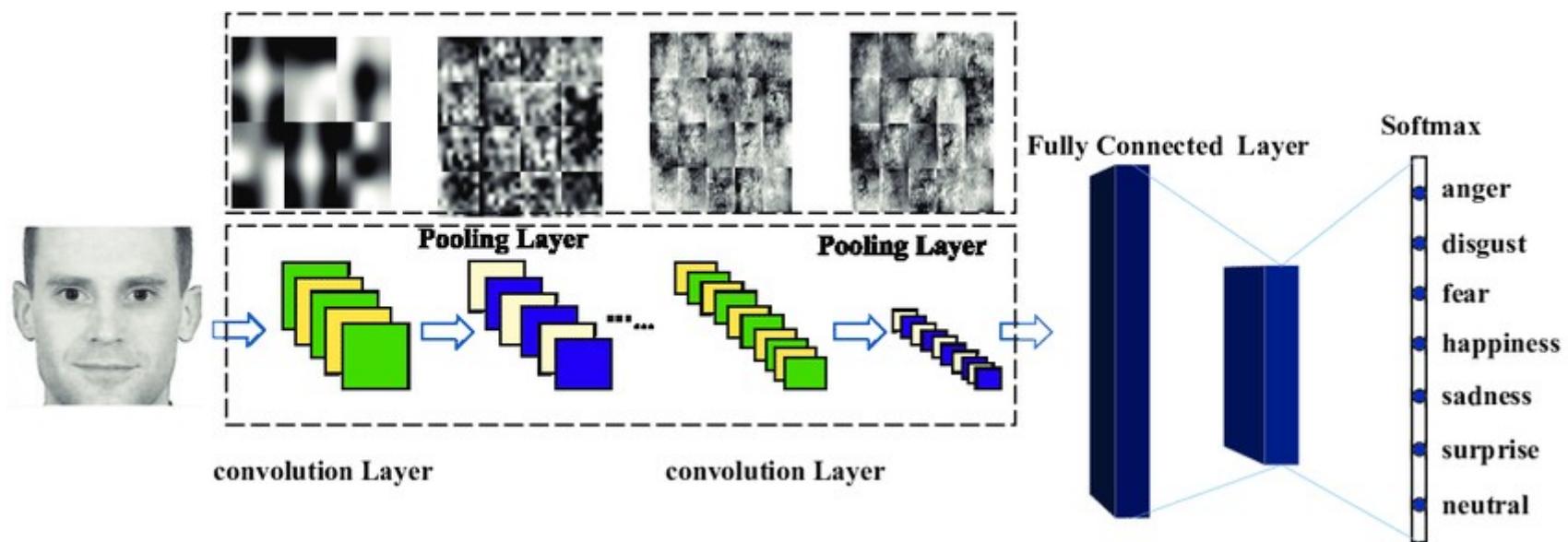
- Introduce non-linearity
- Describe an input



# Feature extraction in the RL field

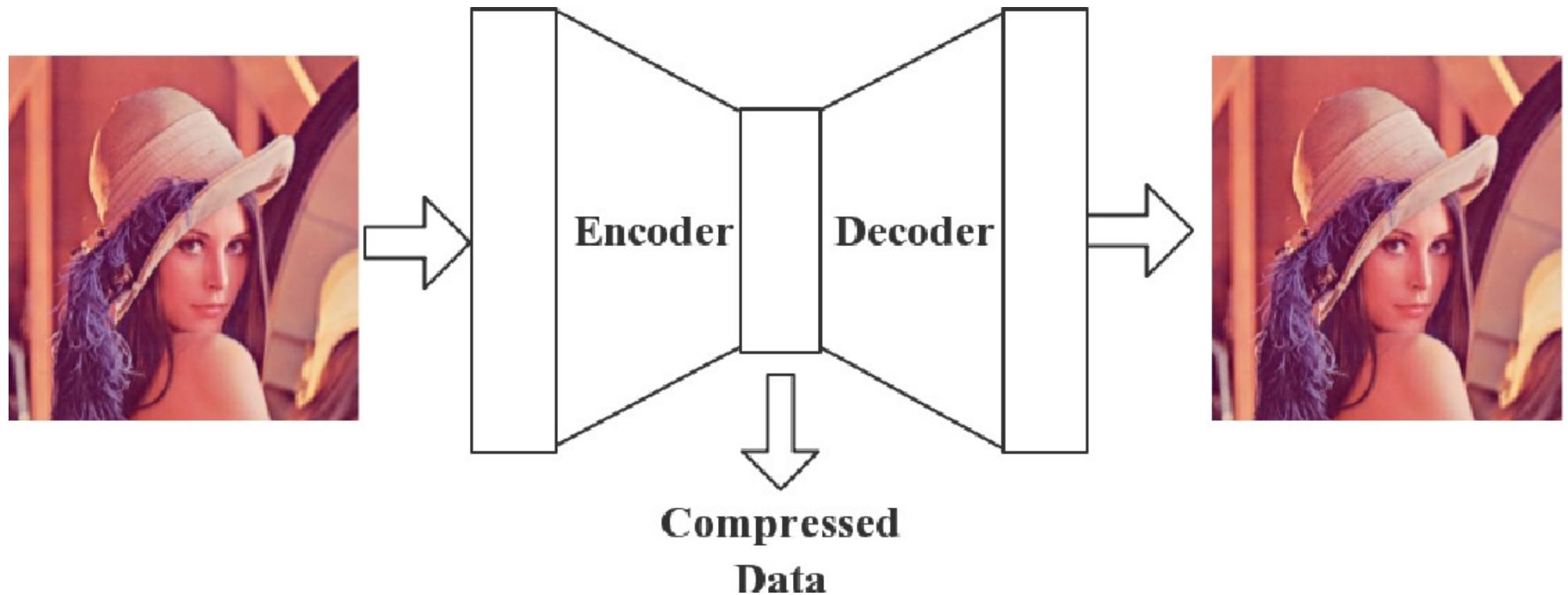
## Auto-encoder / Convolution :

- Recognize pattern and reduce data
- Feature extraction



# Feature extraction in the RL field

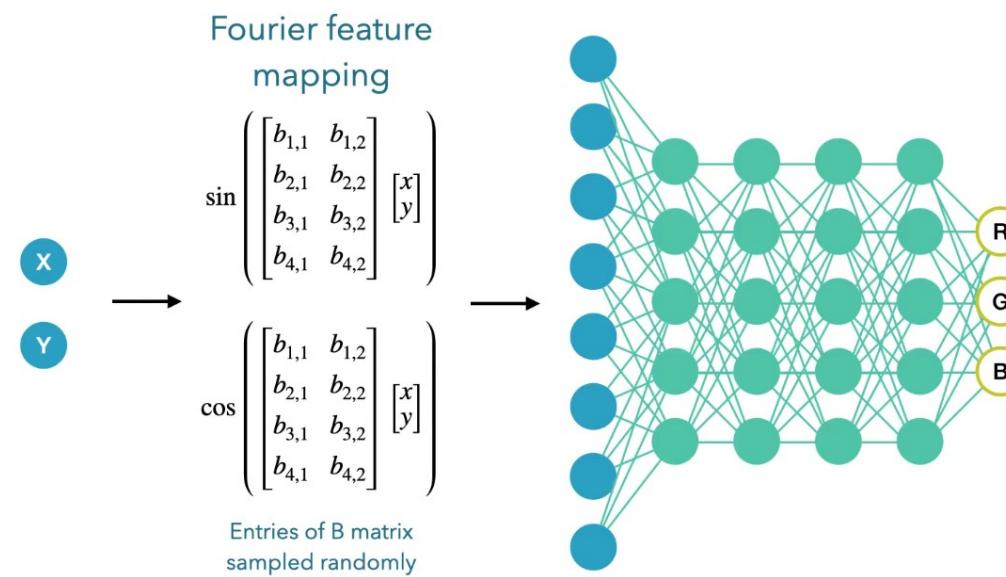
## Auto-encoder / Convolution :



# Feature extraction in the RL field

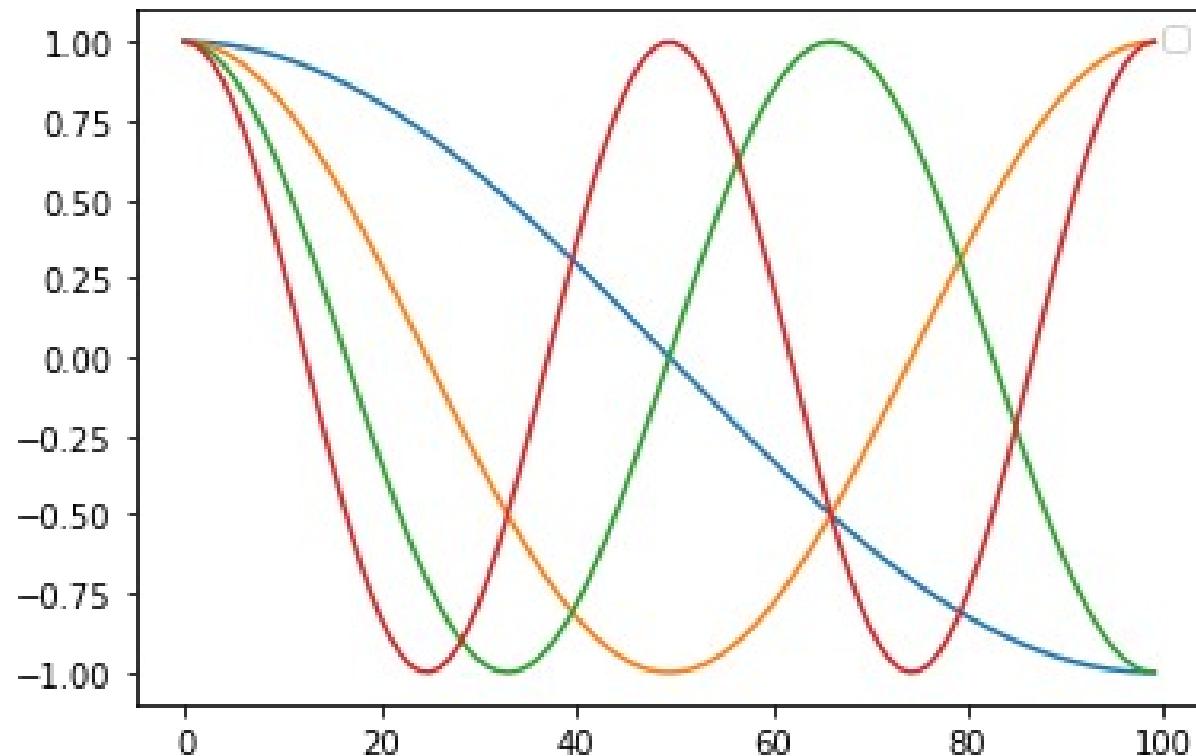
## Fourier Features :

- Multi-frequency decomposition
- Increase the dimensional understanding



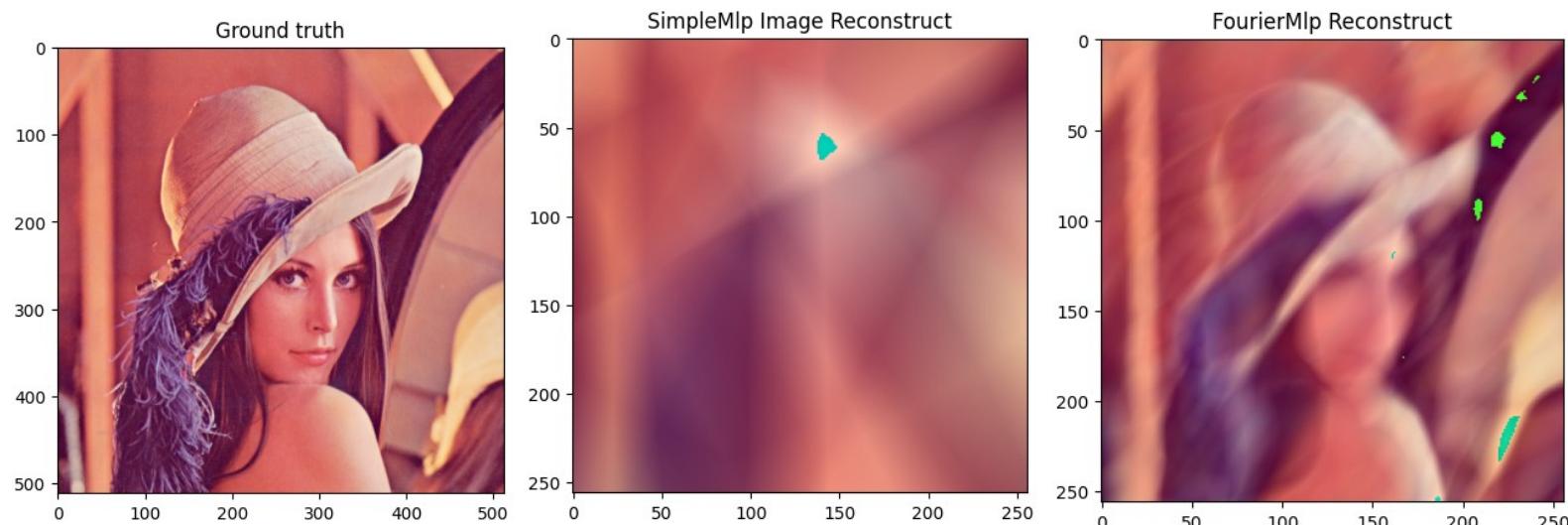
# Feature extraction in the RL field

## Fourier Features :



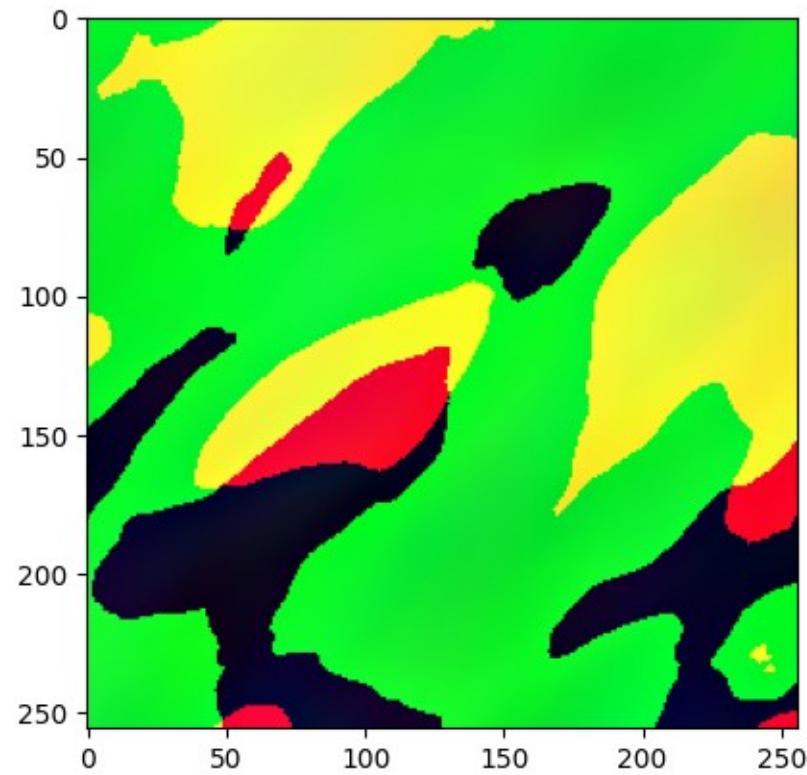
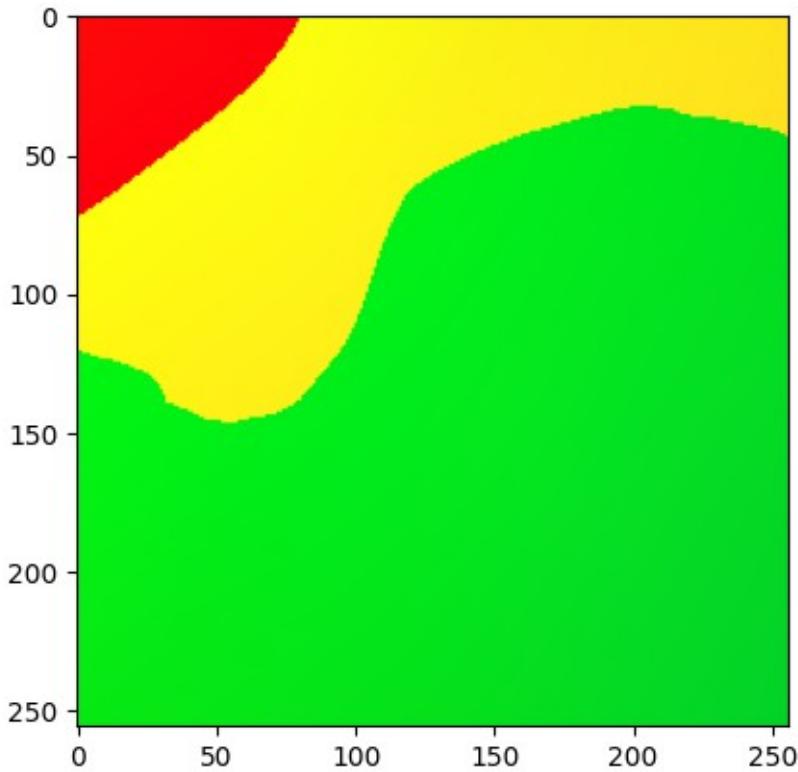
# Feature extraction in the RL field

## Fourier Features :



# Feature extraction in the RL field

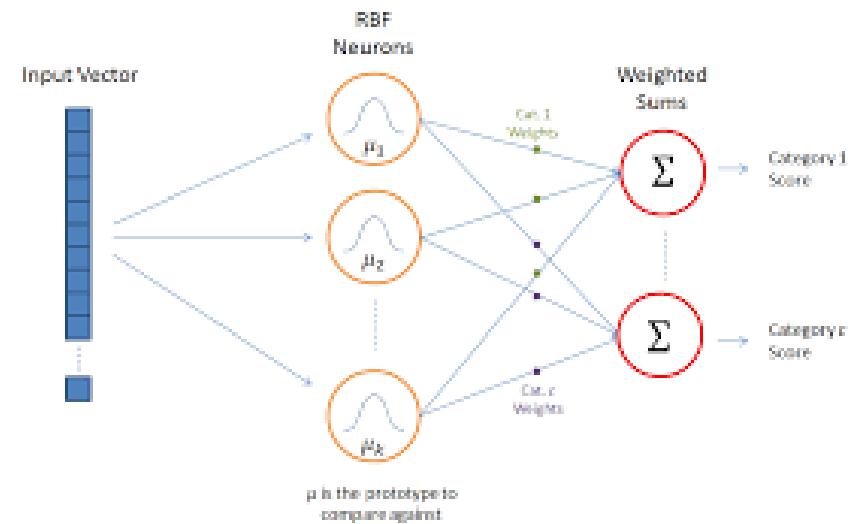
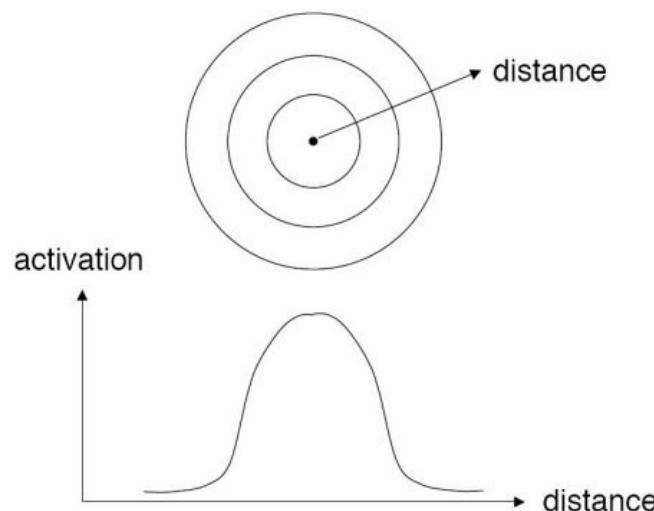
## Fourier Features :



# Feature extraction in the RL field

## Radial Basis Function :

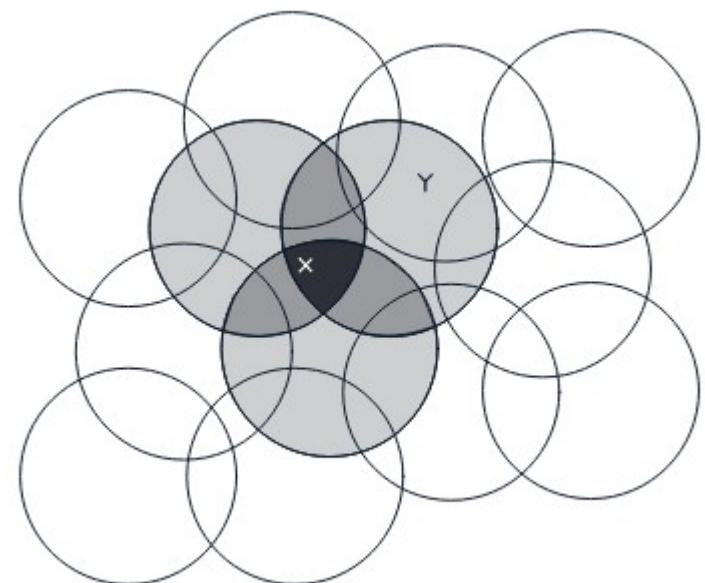
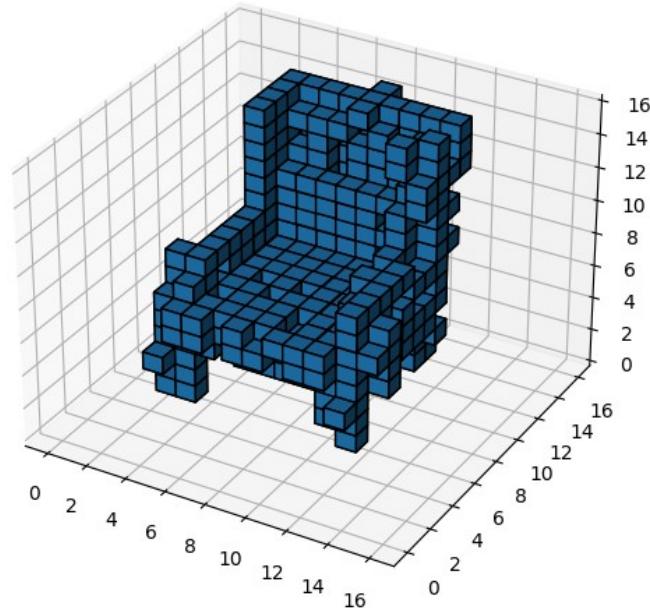
- Supervised and Unsupervised Learning
- Evaluate similarity between vectors



# Feature extraction in the RL field

## Voxelisation/Coarse encoding :

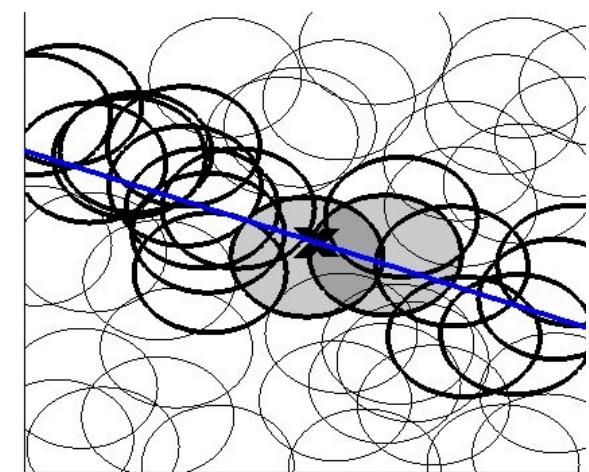
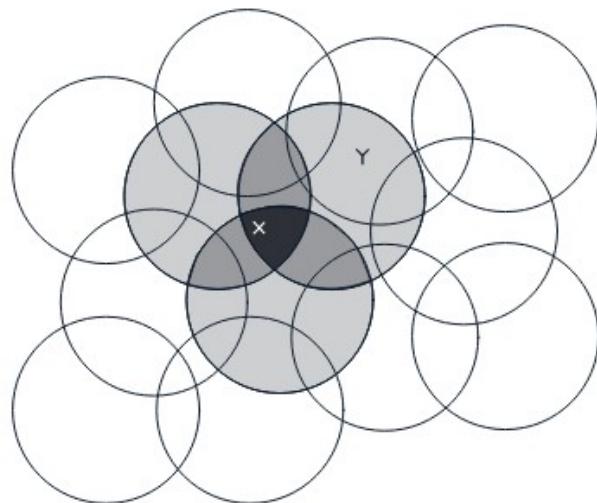
- Convert dimensions to binary array



# Feature extraction in the RL field

## Kanerva coding :

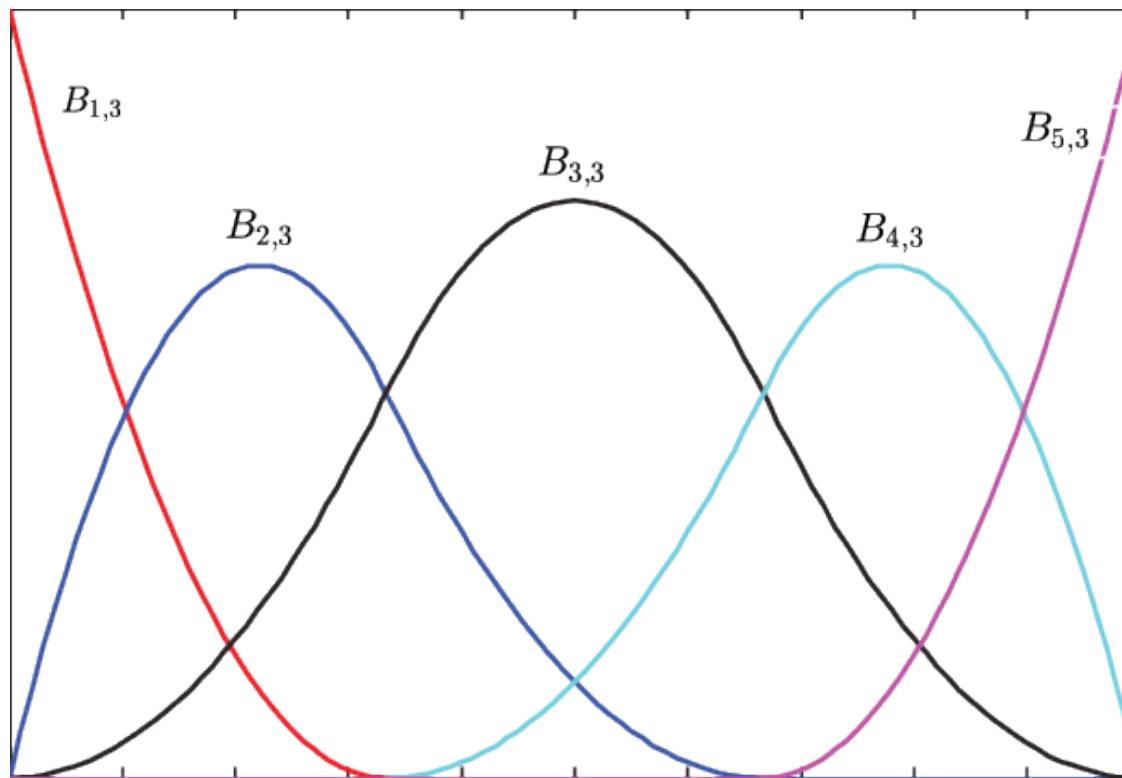
- Coarse encoding but one-dimensional focus



# Feature extraction in the RL field

**Bspline function :**

- **Focus on a specific area**



# Feature extraction in the RL field

## Conclusion :

- Dimensional exploding
- Data in-compressible
- Each dimension is important

# Experiment and exploration

**Areas input decomposition :**

- **Areas understanding**
- **Focus on the most important**

# Experiment and exploration

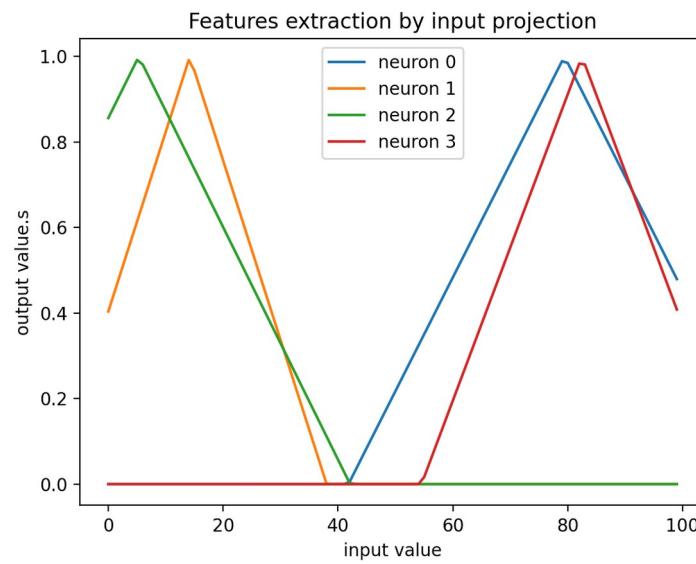
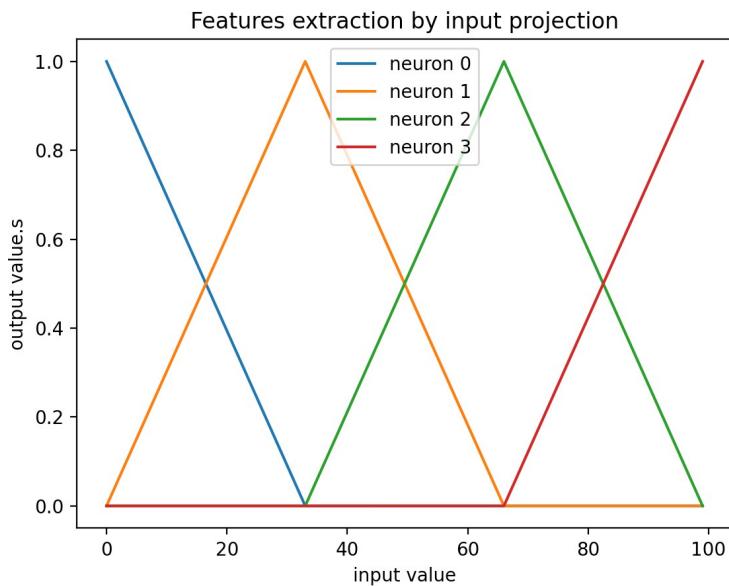
## Triangular activation function :

- Fixed and Learned
- Mix order of decomposition
- Mix variance
- Mix phase
- Gaussian ?!?

# Experiment and exploration

## Triangular activation function :

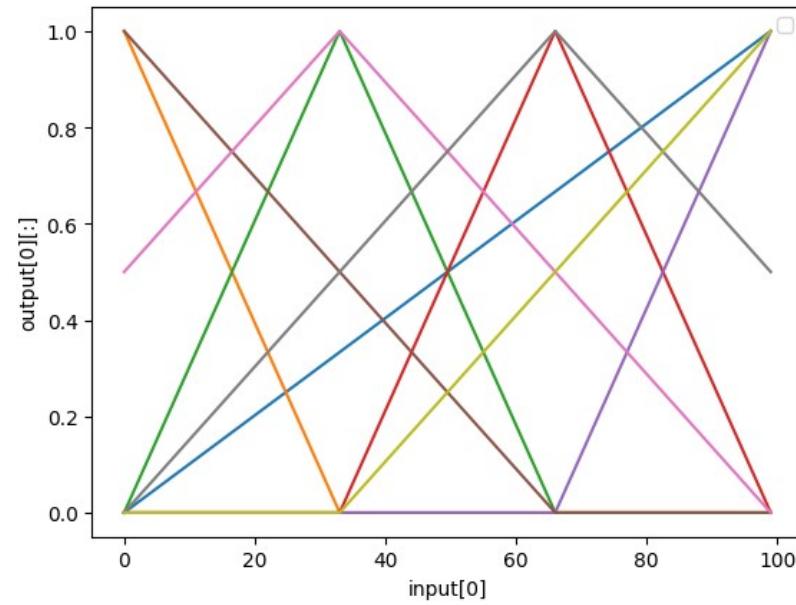
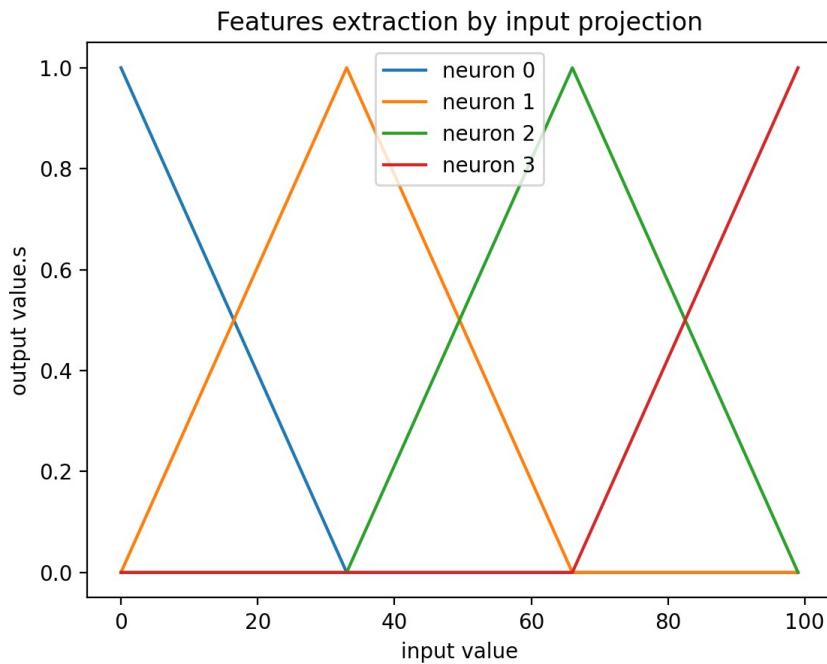
- Fixed and Learned



# Experiment and exploration

## Triangular activation function :

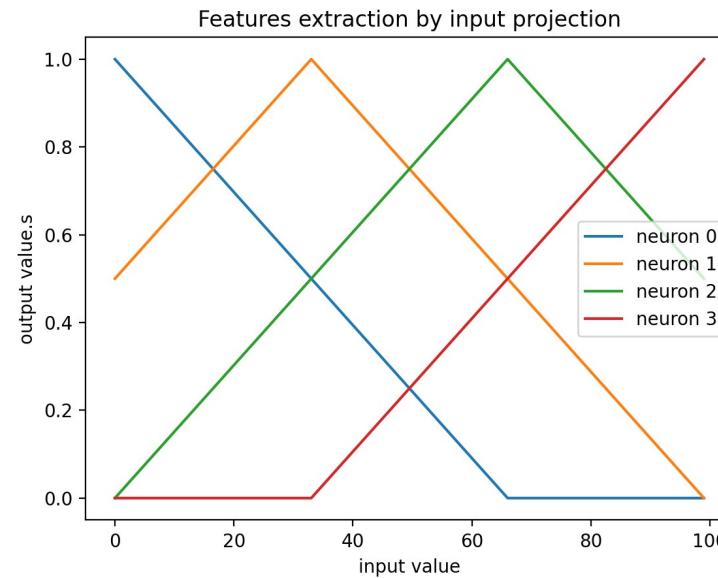
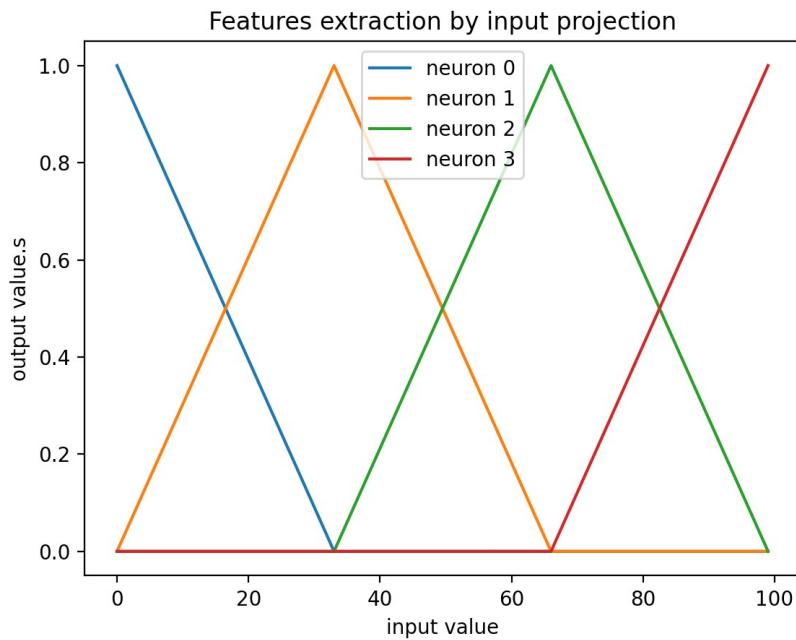
- Mix order of decomposition



# Experiment and exploration

## Triangular activation function :

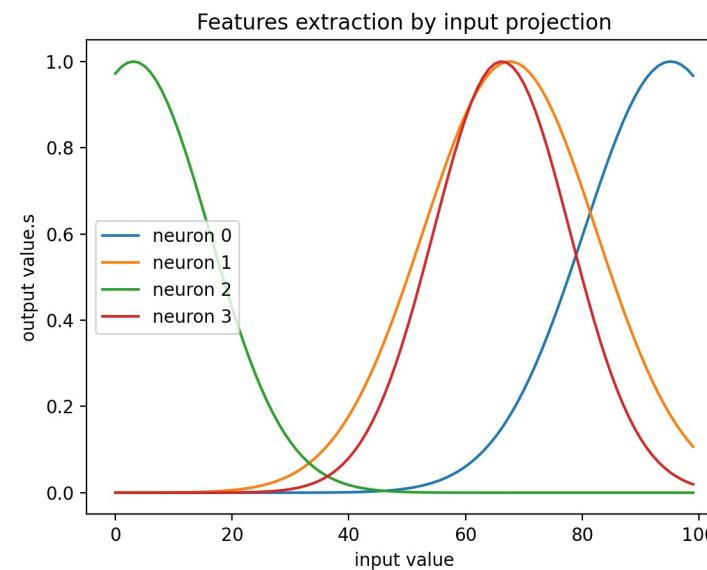
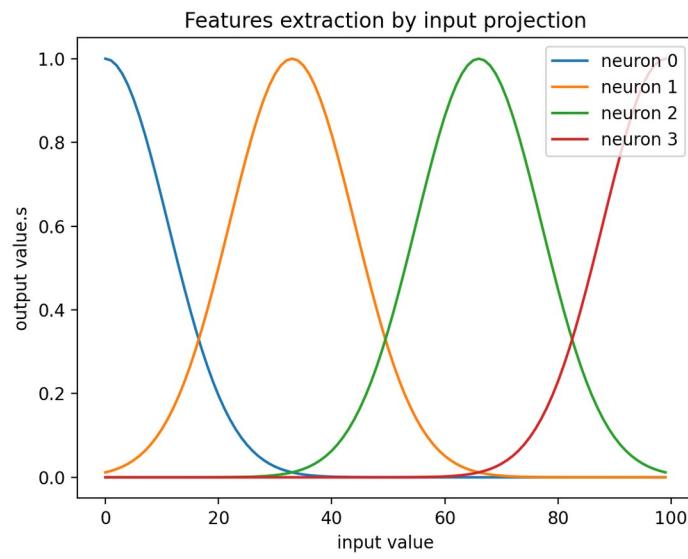
- Mix variance



# Experiment and exploration

## Triangular activation function :

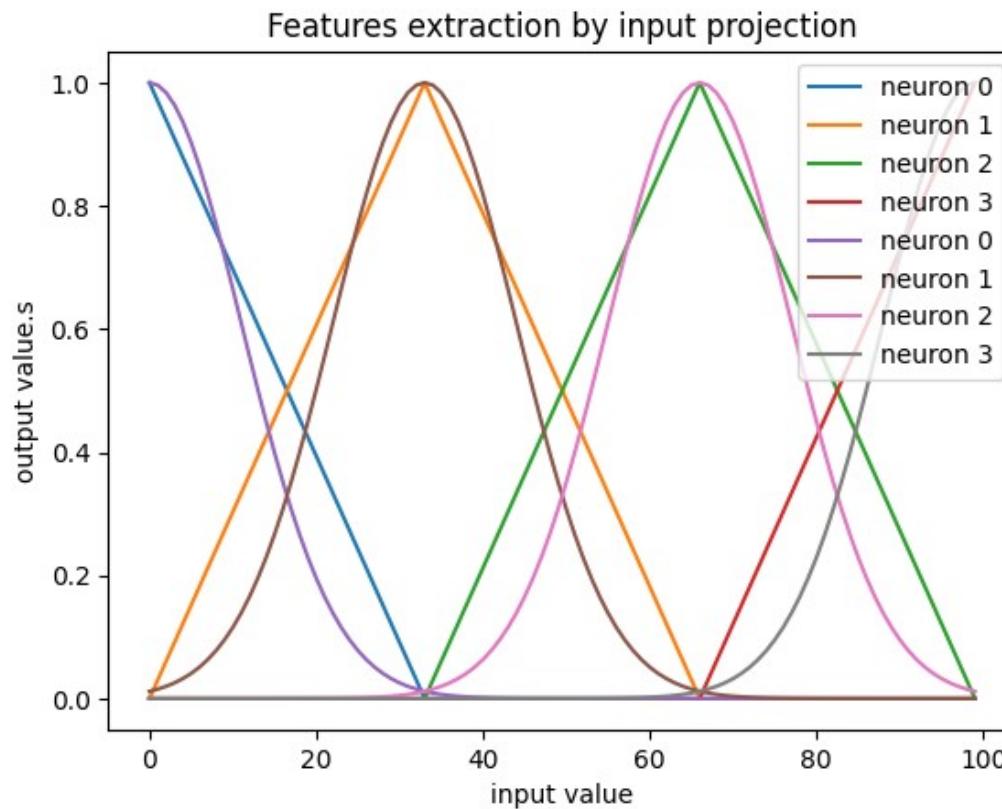
- Gaussian ?!?



# Experiment and exploration

## Triangular activation function :

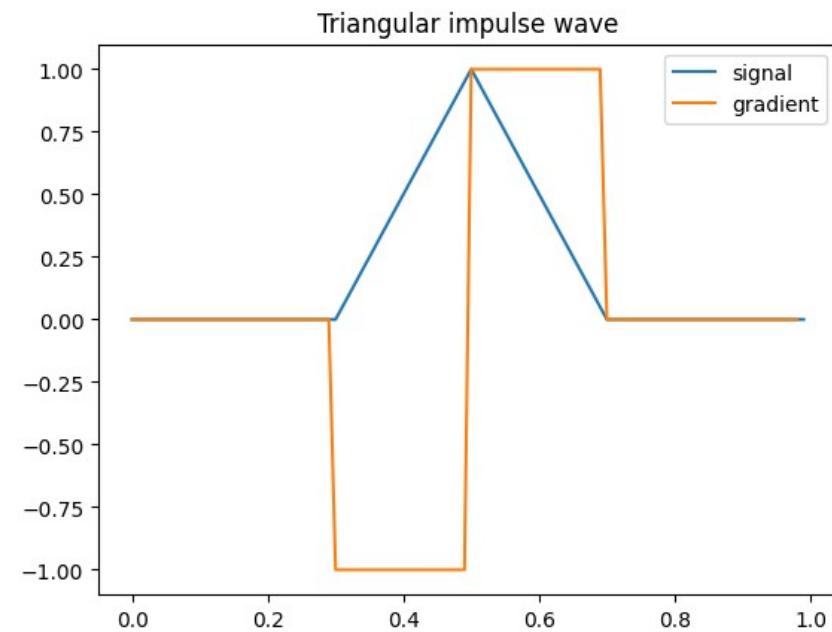
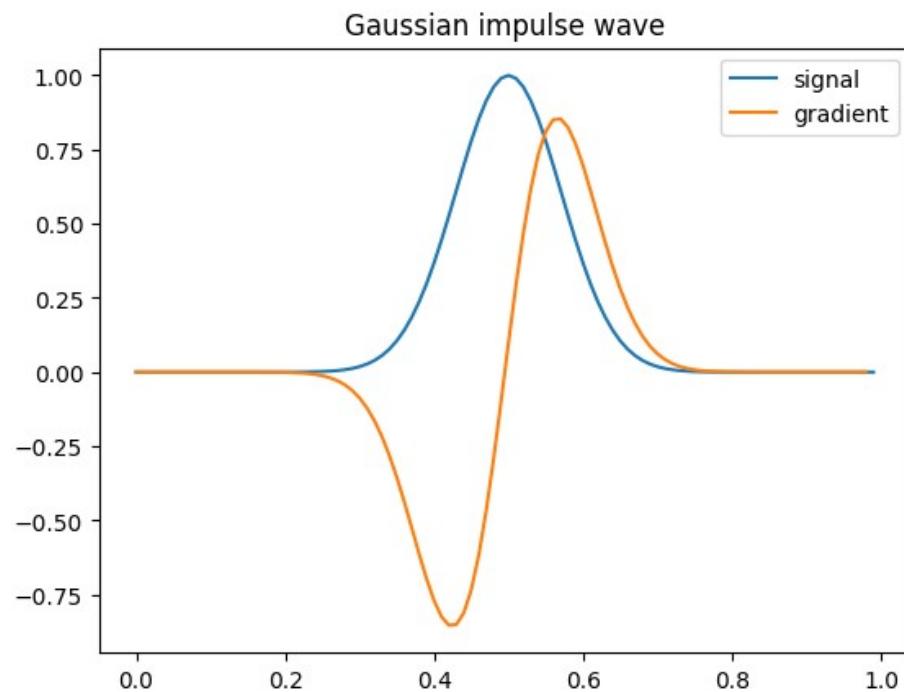
- Gaussian ?!?



# Experiment and exploration

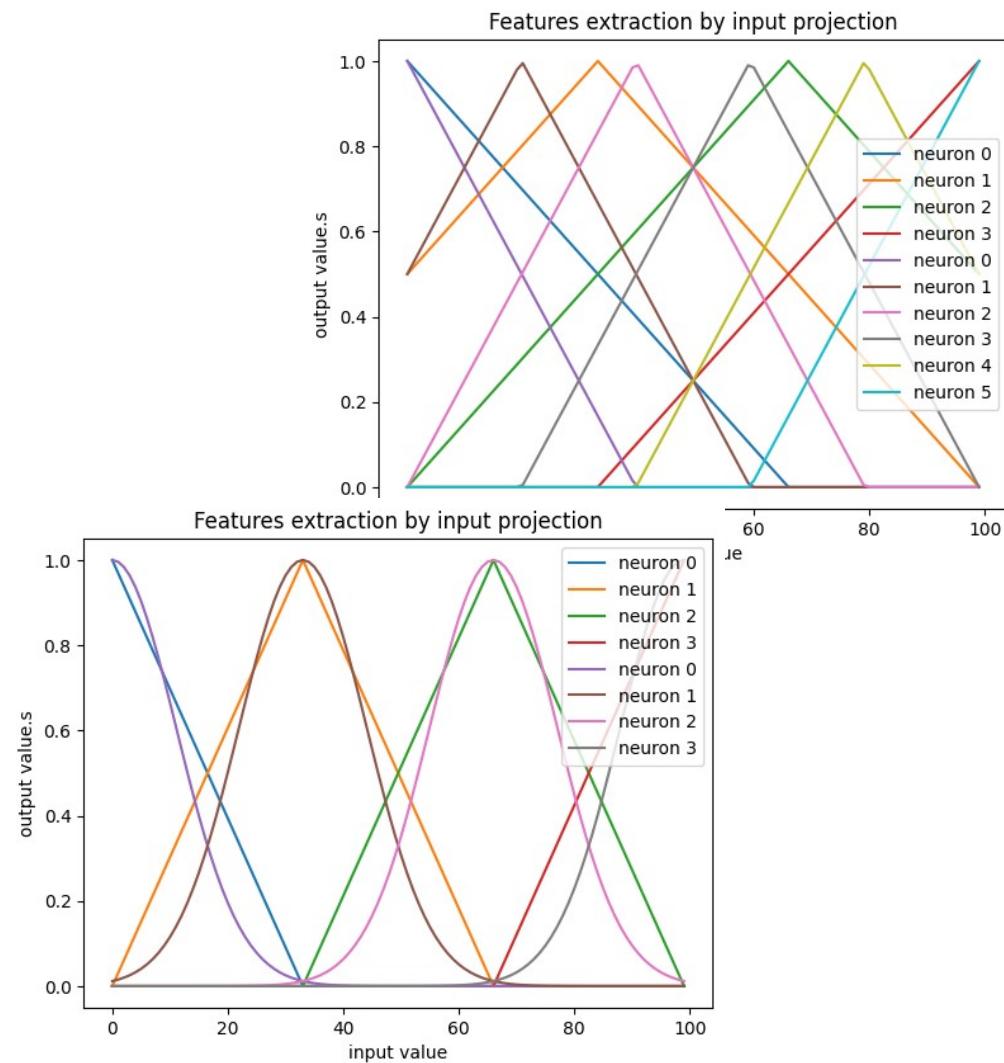
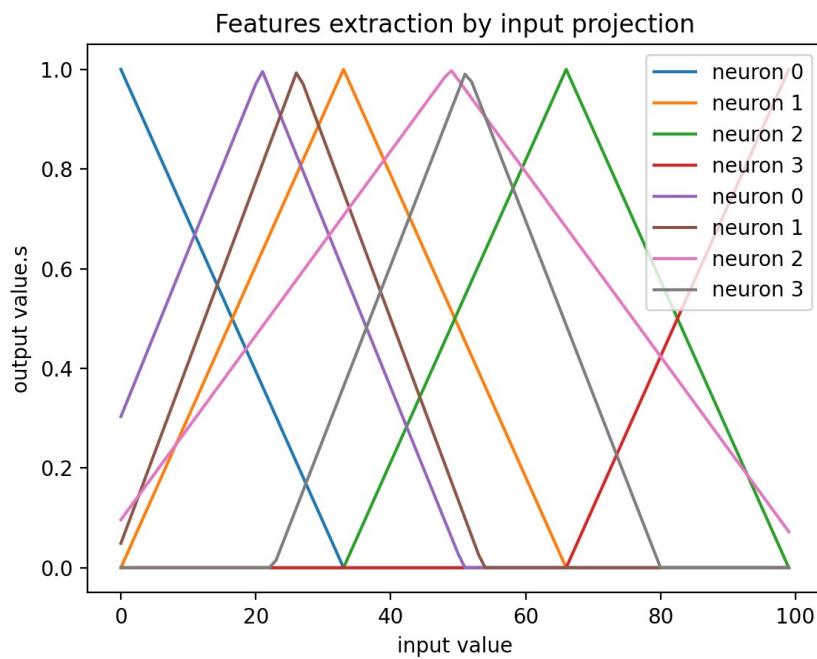
## Triangular activation function :

- Gaussian ?!?



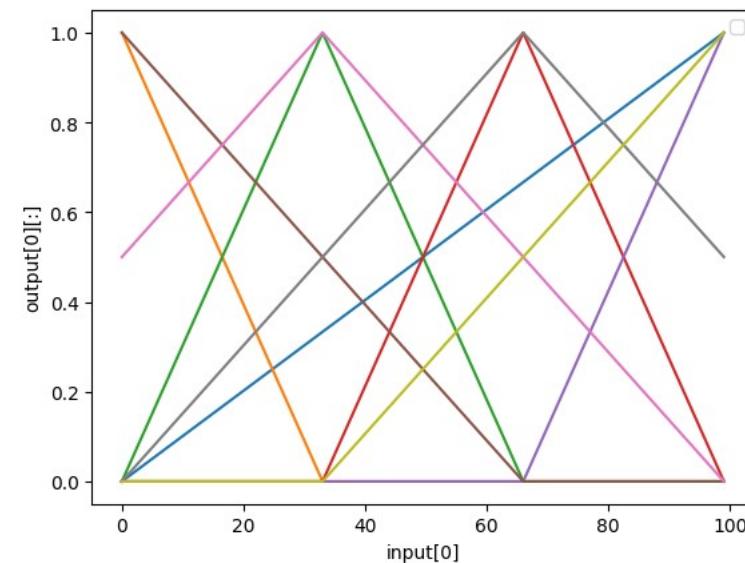
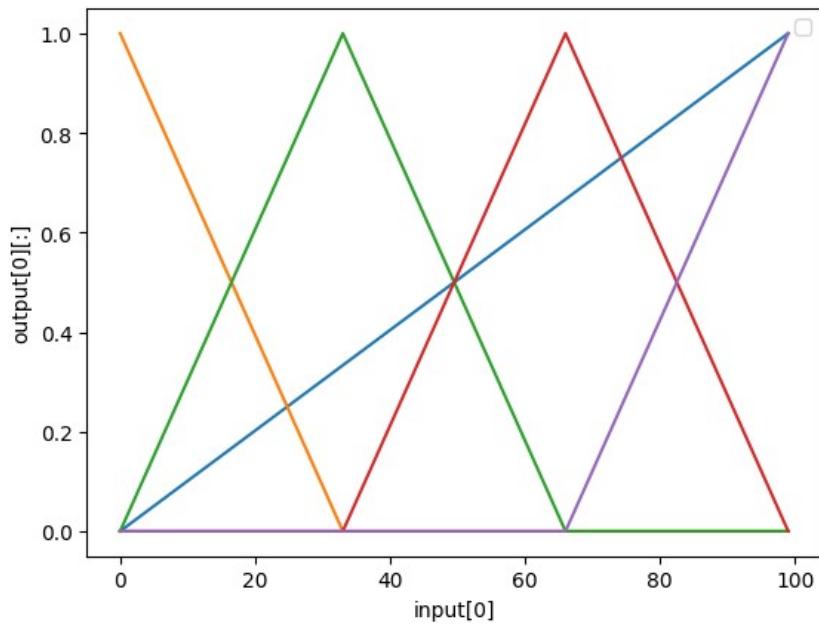
# Experiment and exploration

## Empiric mix :



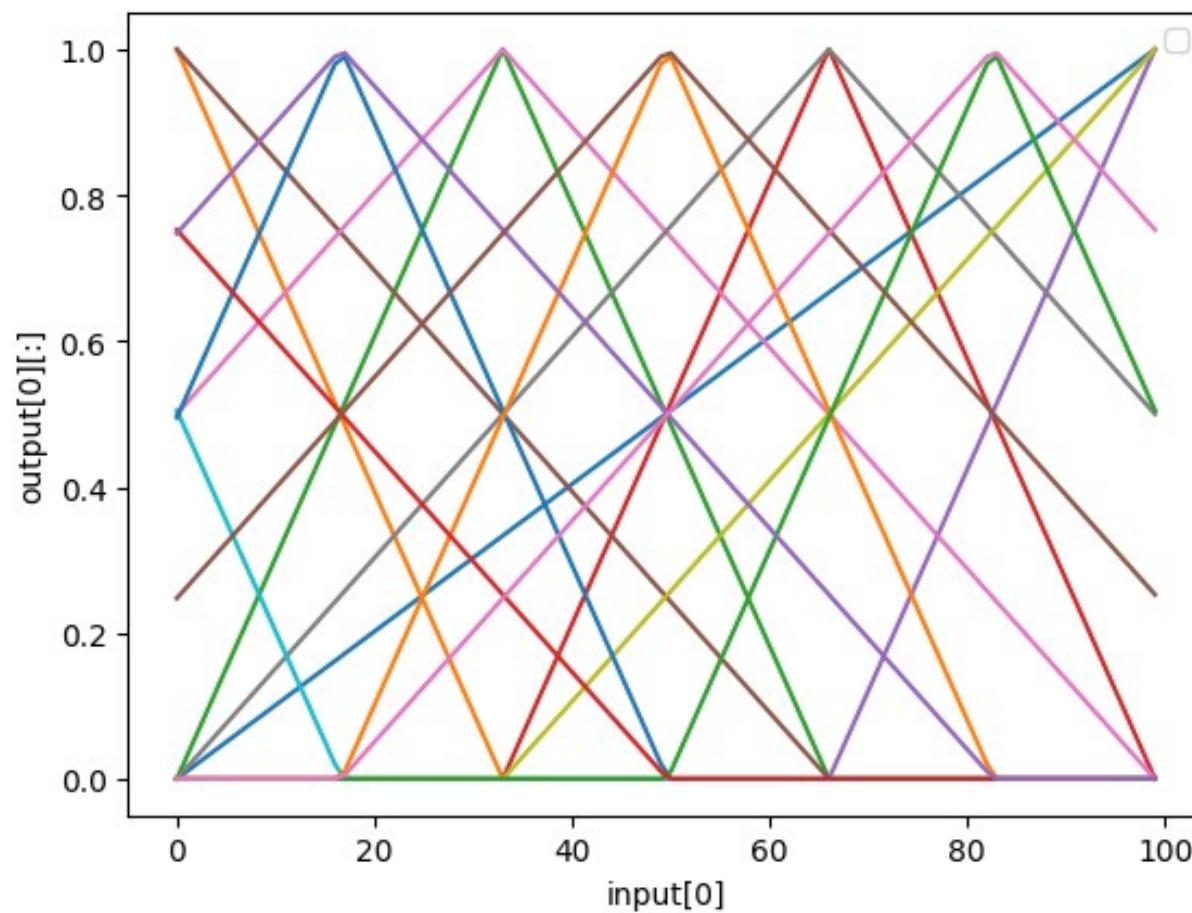
# Final result

## Triangular activation function :



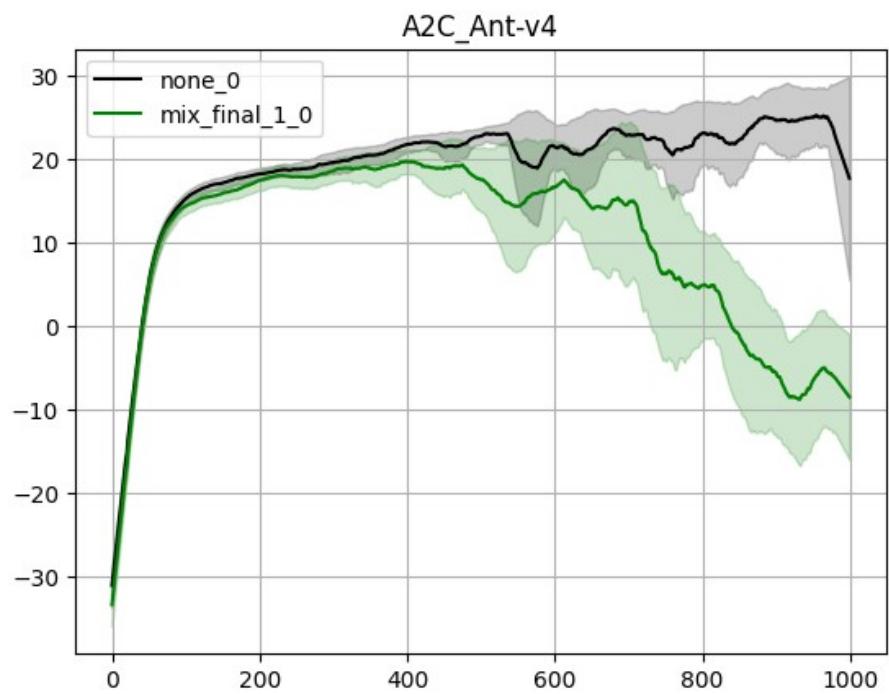
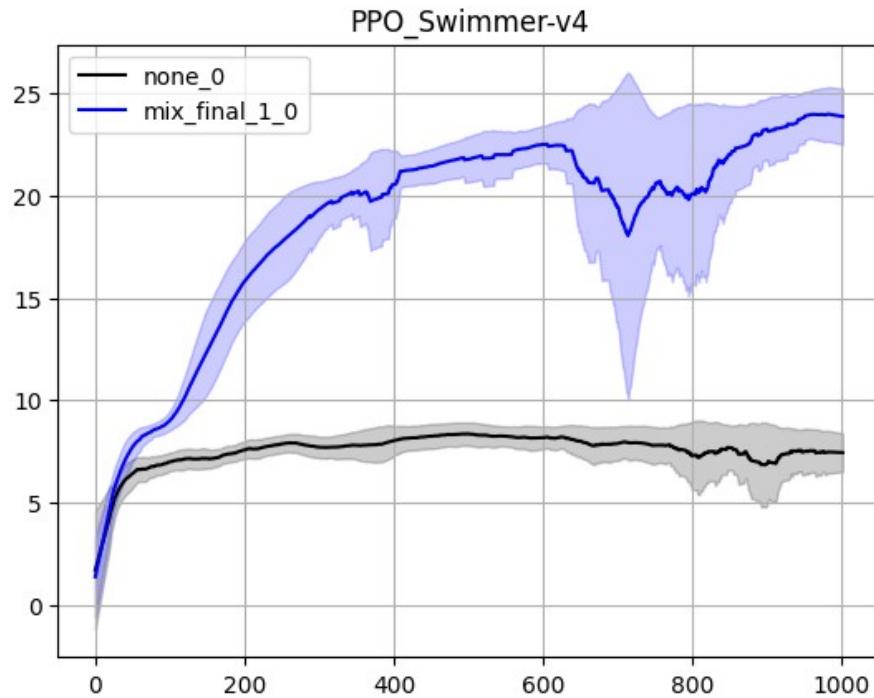
# Final result

Triangular activation function :



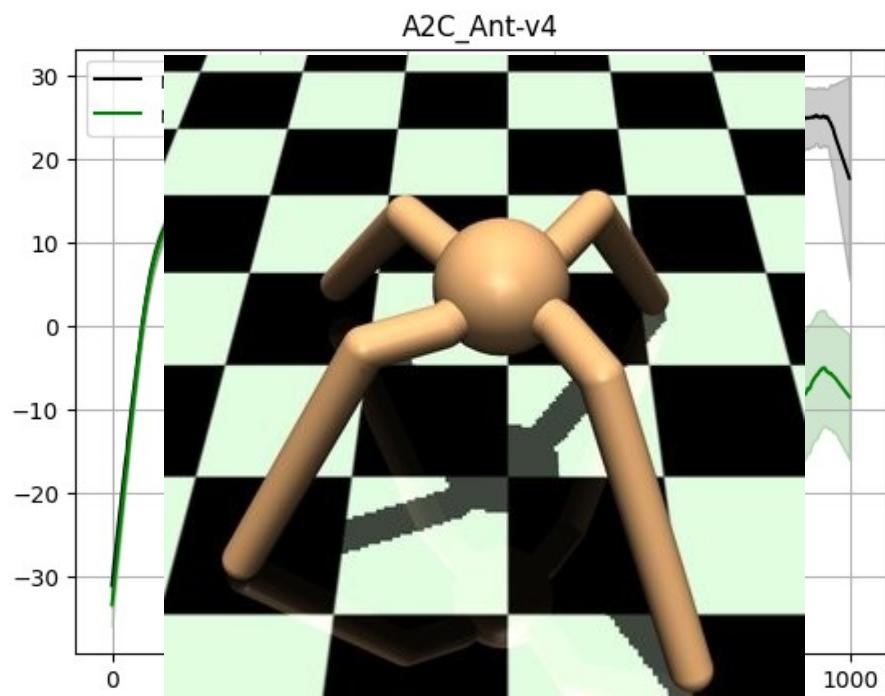
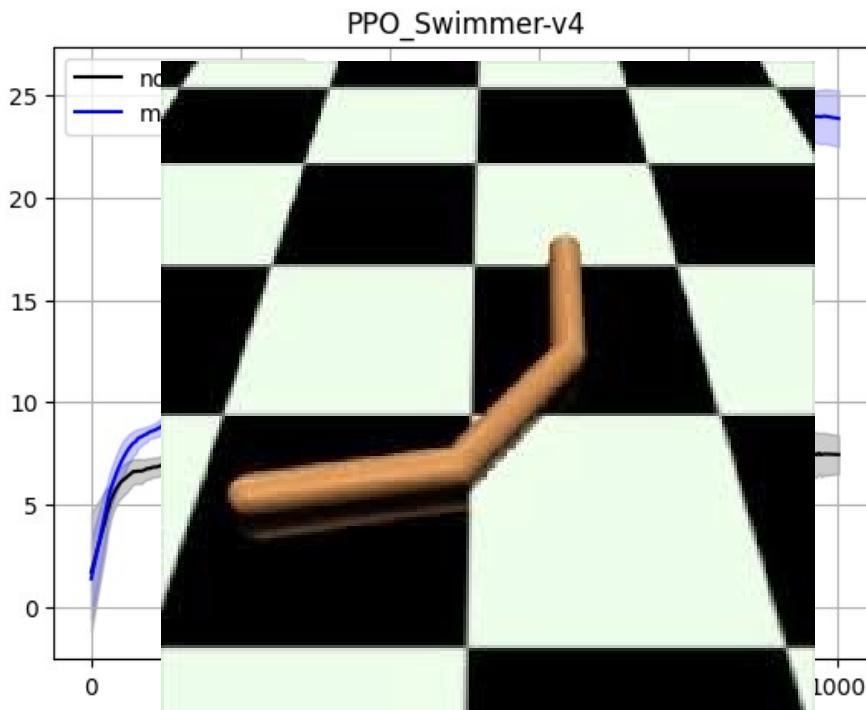
# Final result

Triangular activation function result :



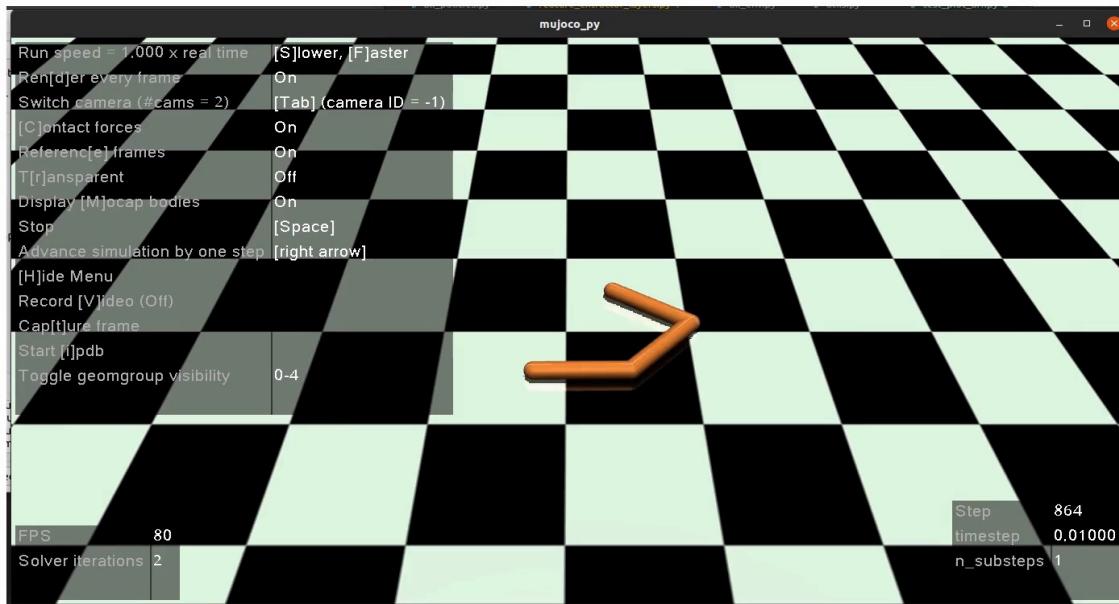
# Final result

Triangular activation function result :



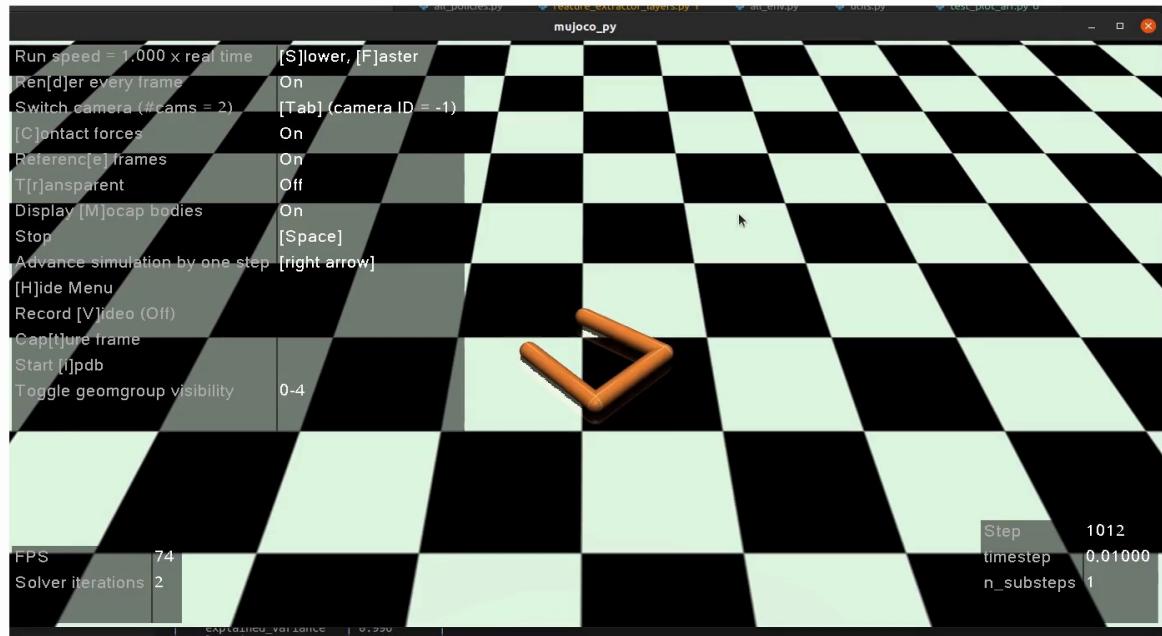
# Final result

Triangular activation good result :



# Final result

## Triangular activation bad result :



# Final result

Triangular activation bad result :



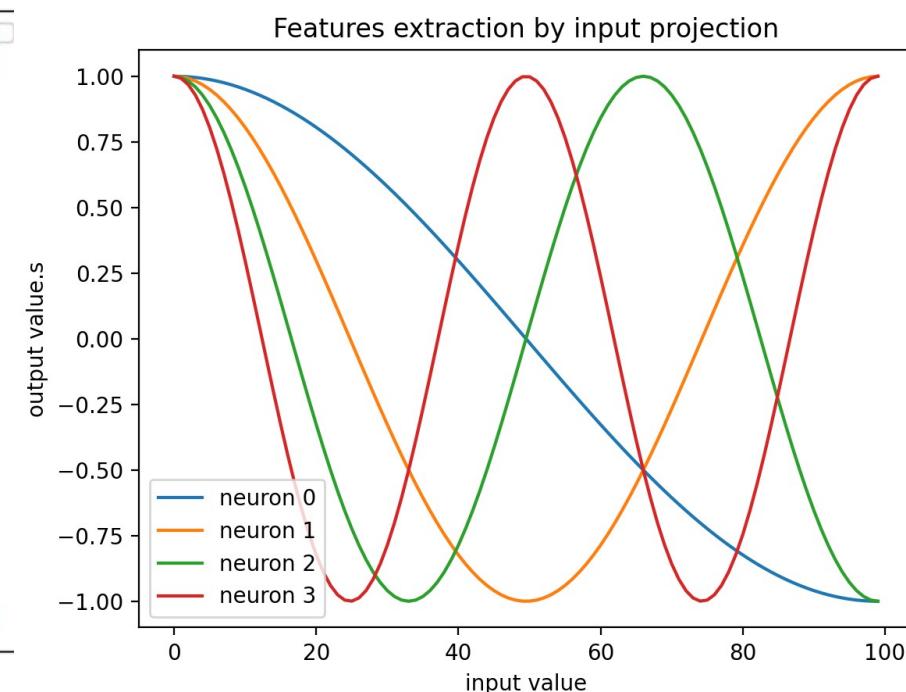
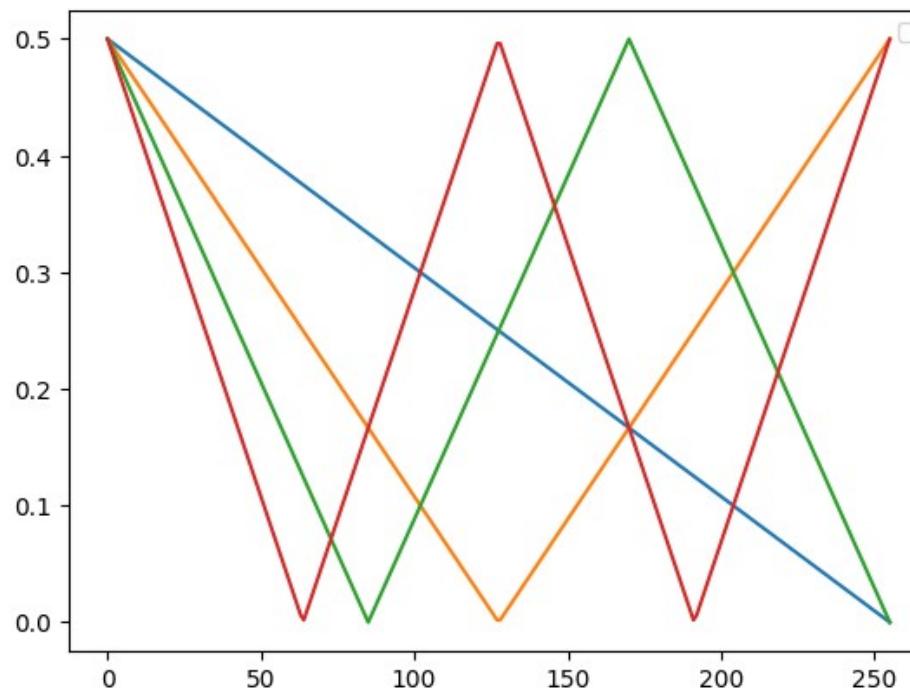
# Final result

Triangular activation good result :



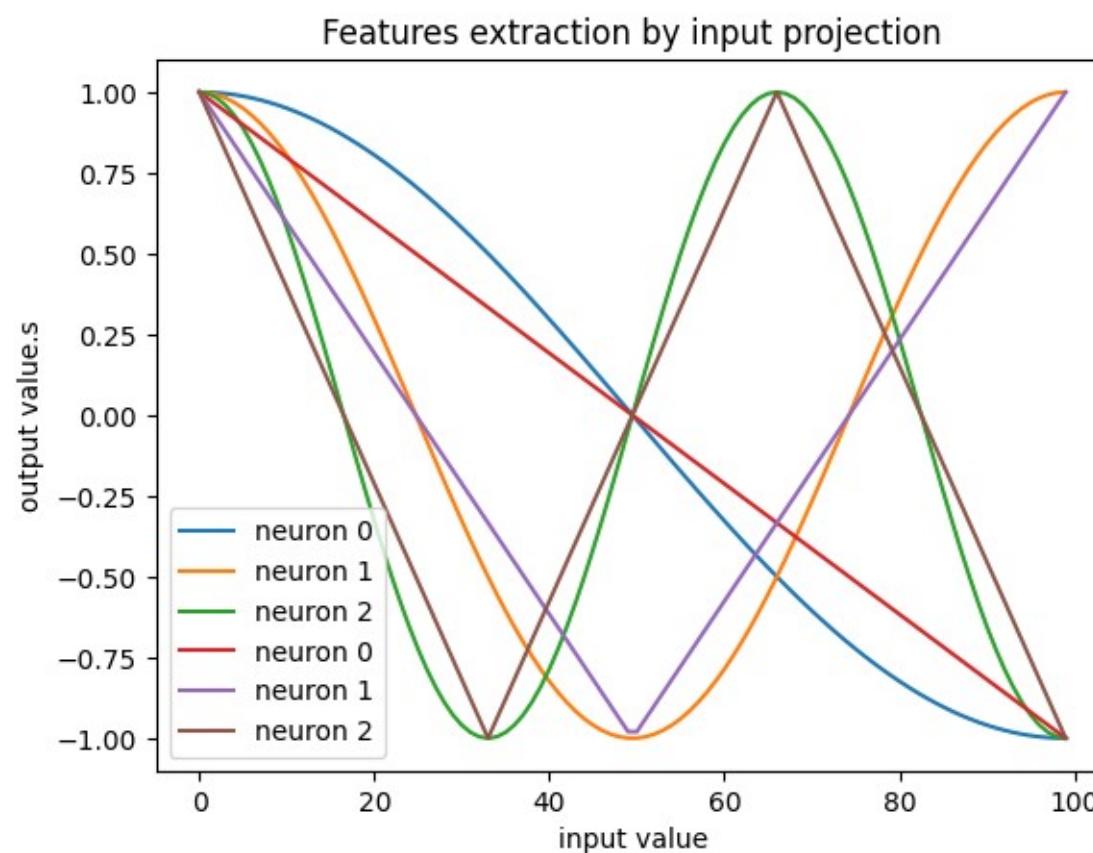
# Final result

## Triangular Light Feature :



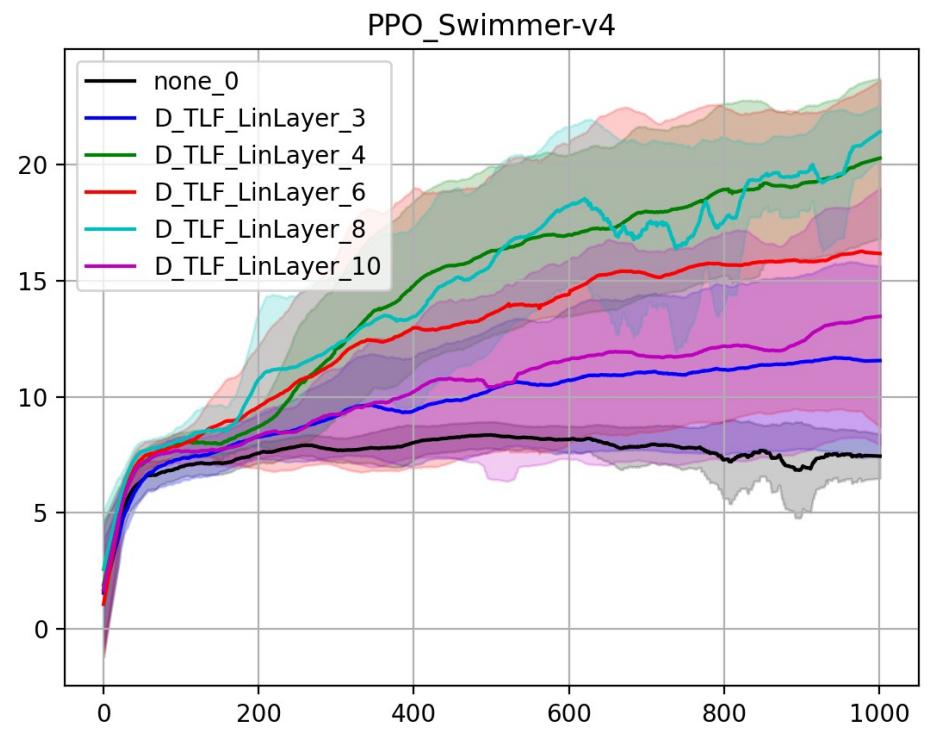
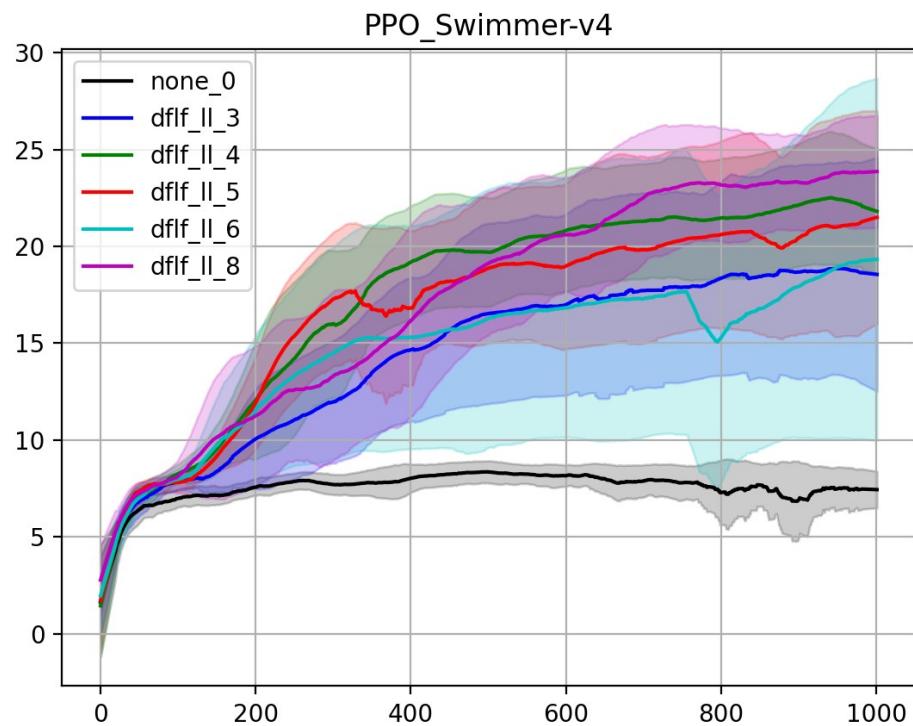
# Final result

## Triangular Light Feature :



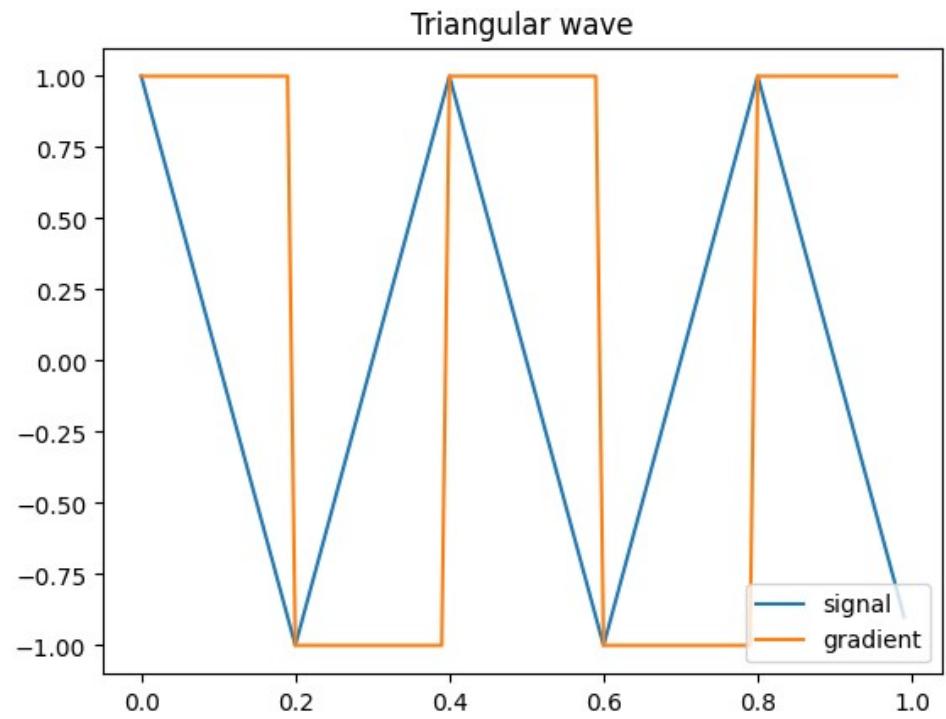
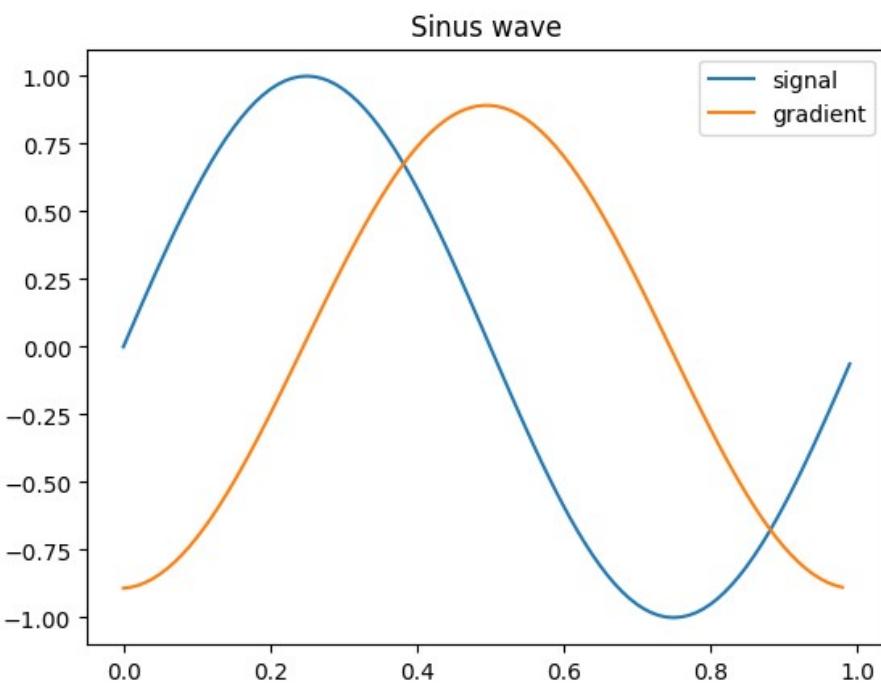
# Final result

## Triangular Light Feature result :



# Final result

## Triangular Light Feature :



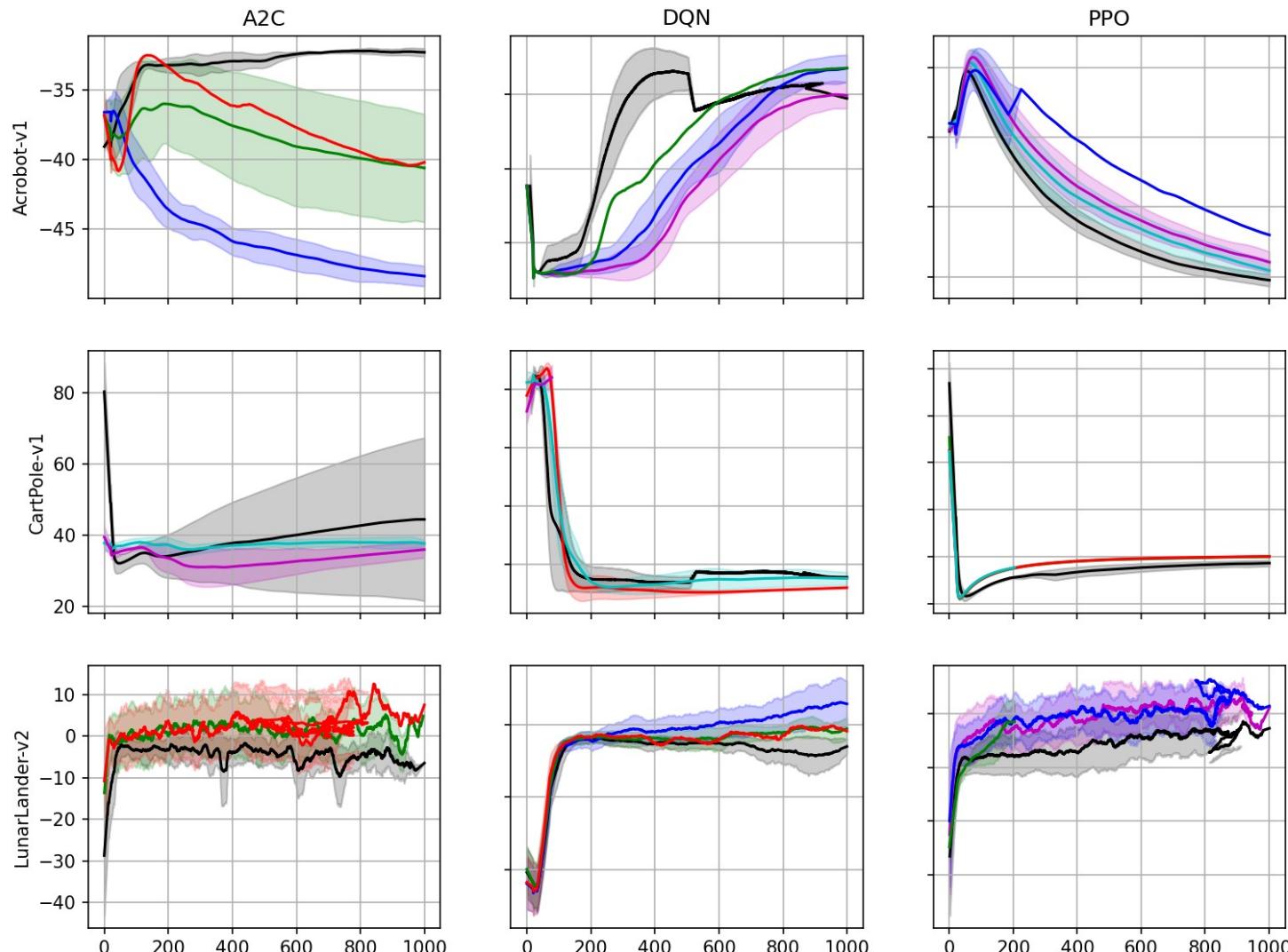
# Conclusion

- **Useful but for specific task/policies**
- **Need more work in this field**

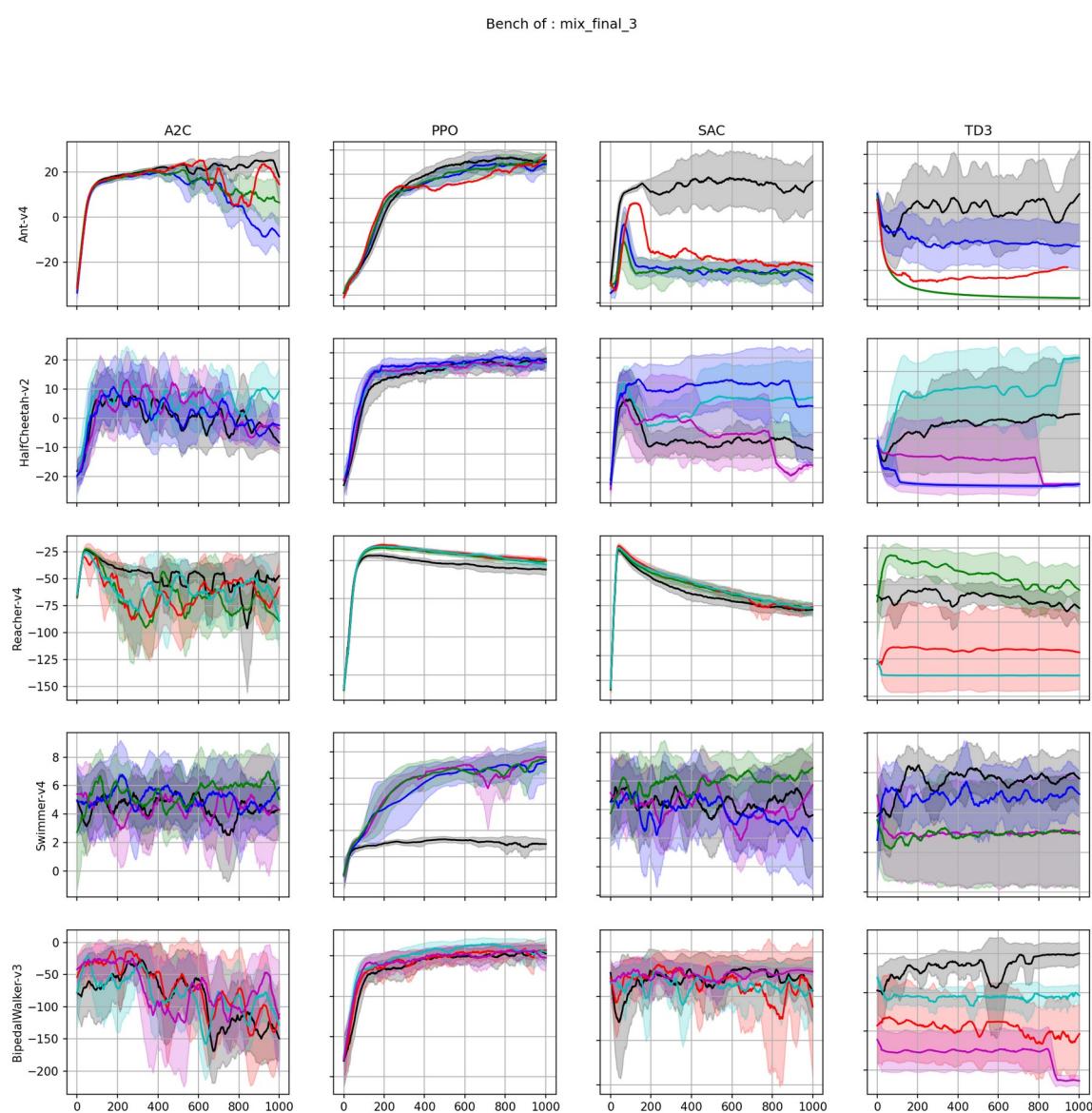
# Questions ?

# Triangular activation projection

Bench of : mix\_final\_3

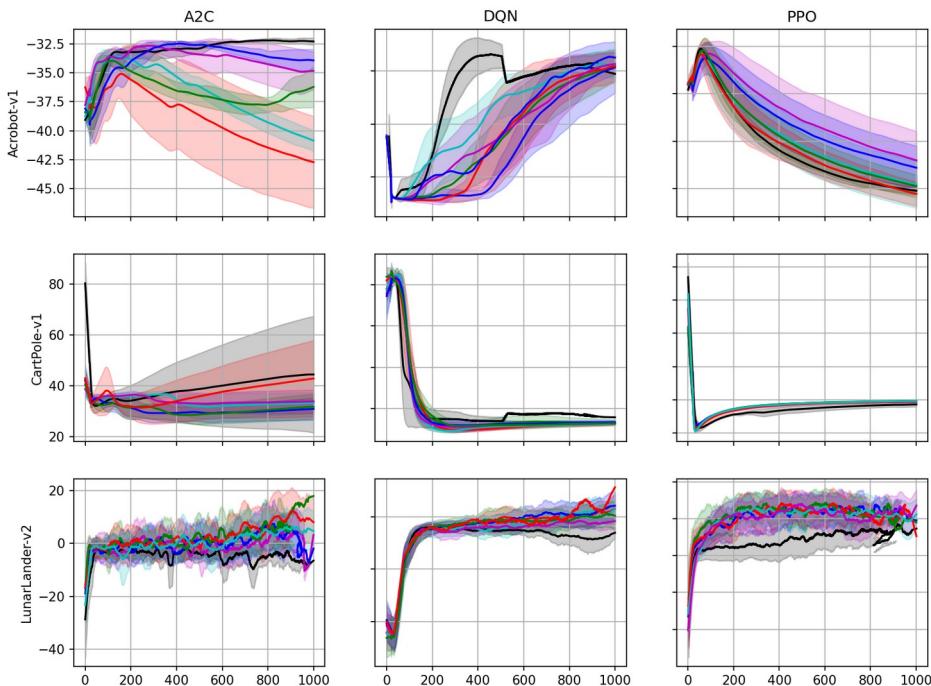


# Triangular activation projection

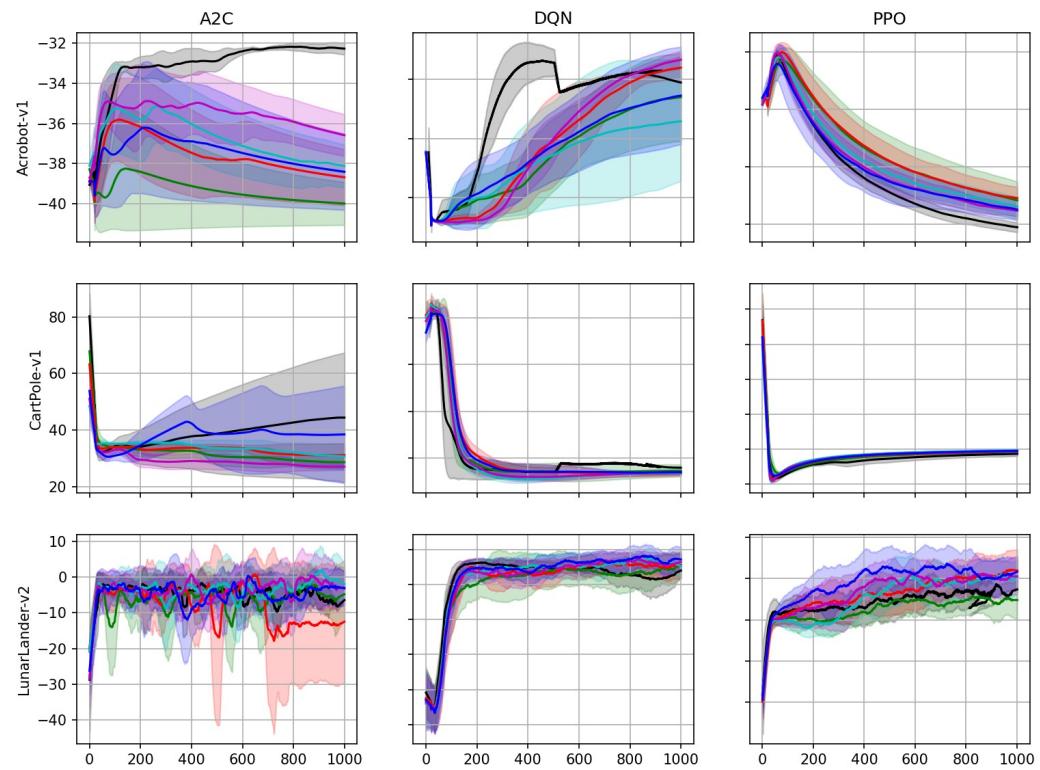


# Triangular Light Features

Bench of : dfif\_ll

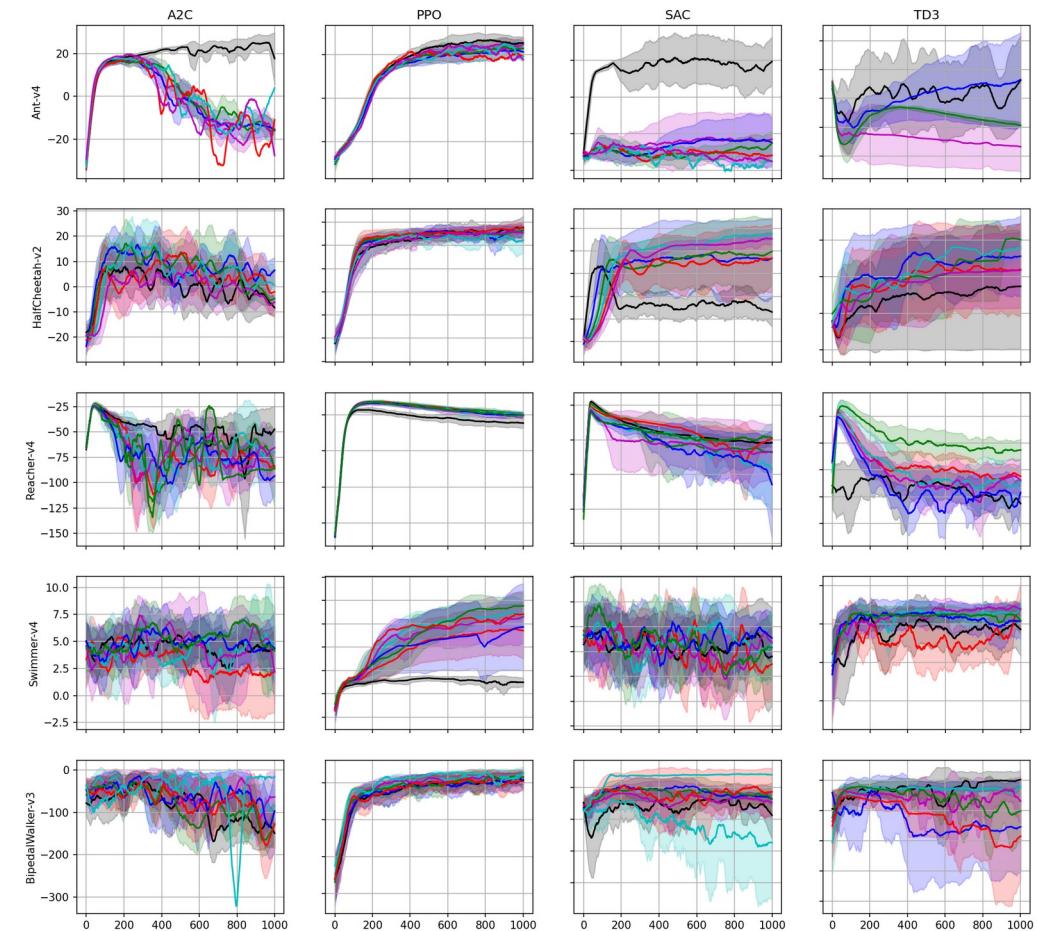


Bench of : D\_TLF\_LinLayer



# Triangular Light Features

Bench of : dflf\_ll



Bench of : D\_TLF\_LinLayer

