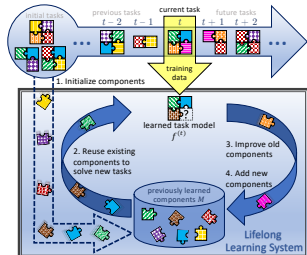


## Summary

- Developed a generalized lifelong compositional learning framework
- Based on Piagetian theory of assimilation and accommodation
- Evaluated 6 instantiations of this frameworks
  - 3 base learning algorithms
  - × 2 knowledge representations
- Results: Composition + assimilation + accommodation was best

## Compositional Continual Learner



## Four Key Steps

- Initialization**
  - Encourage reusability
  - Keep component selection fixed and train on few tasks
  - Do not assume initialization yields optimal components
- Assimilation**
  - Avoid modifying components without sufficient knowledge
  - Learn only how to combine them
- Accommodation (1)**
  - Incorporate new knowledge to make components stronger
  - Avoid catastrophic forgetting
- Accommodation (2)**
  - Add new components if current ones are insufficient
  - Use in combination with existing components

## Experimental Results

**Table 1:** Average final performance across tasks using factored linear models—accuracy for FERA and Landmine (higher is better) and RMSE for London Schools (lower is better).

Base	Algorithm	FERA	Landmine	Schools
ER	Compos.	79.0%	93.6%	10.66
	Joint	78.2%	90.5%	11.56
	No Comp.	66.4%	93.5%	10.34
EWC	Compos.	79.0%	93.7%	10.55
	Joint	68.0%	73.0%	23.32
	No Comp.	57.0%	92.7%	18.01
VAN	Compos.	79.0%	93.7%	10.87
	Joint	68.0%	72.8%	25.80
	No Comp.	57.0%	92.7%	18.00

**Table 2:** Average final accuracy across tasks using soft layer ordering.

Base	Algorithm	MNIST	Fashion	CUB	CIFAR	Omniglot
ER	Dyn+Comp	97.7%	96.3%	77.6%	75.9%	69.0%
	Compos.	96.5%	95.3%	79.2%	56.0%	67.8%
	Joint	94.2%	94.7%	76.8%	63.8%	67.9%
	No Comp.	91.2%	93.1%	43.1%	49.5%	40.0%
EWC	Dyn+Comp	97.3%	96.1%	72.7%	71.7%	67.7%
	Compos.	96.7%	95.3%	72.4%	43.4%	52.2%
	Joint	66.3%	69.1%	65.3%	41.3%	61.2%
	No Comp.	64.3%	58.5%	47.7%	34.1%	66.2%
VAN	Dyn+Comp	97.4%	96.0%	72.5%	69.6%	67.1%
	Compos.	96.4%	95.3%	73.7%	52.5%	65.3%
	Joint	67.4%	66.1%	64.4%	41.4%	60.2%
	No Comp.	64.4%	59.4%	48.3%	34.1%	64.7%
FM	Dyn+Comp	99.1%	97.0%	78.2%	74.3%	67.7%
	Compos.	84.1%	85.9%	79.2%	46.0%	58.3%