



A Cortical-Hippocampal Neural Architecture for Episodic Memory with Information Theoretic Model Analysis

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Experimental Psychology

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Information Theory

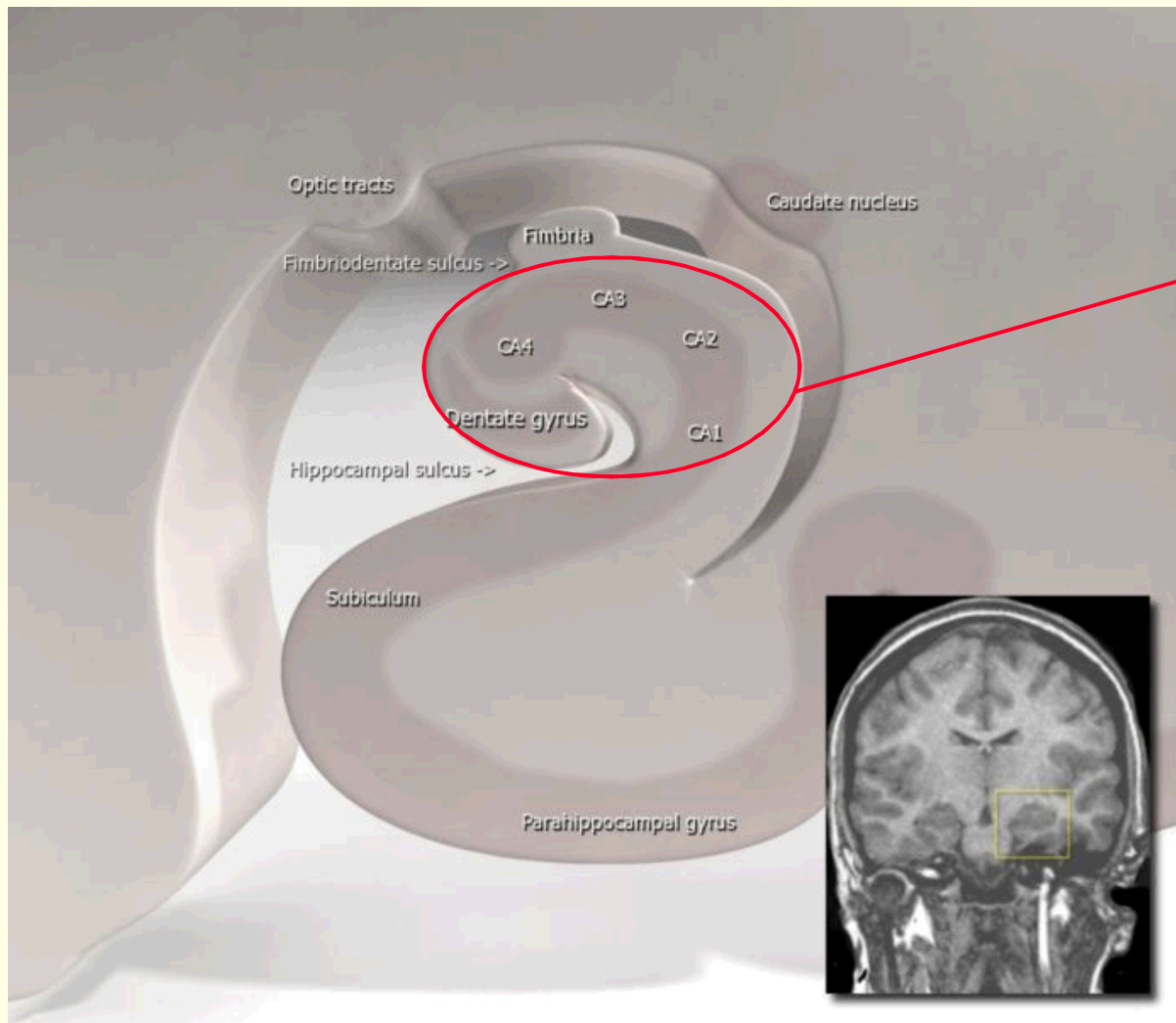
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Patrick Watson

Neurocognition



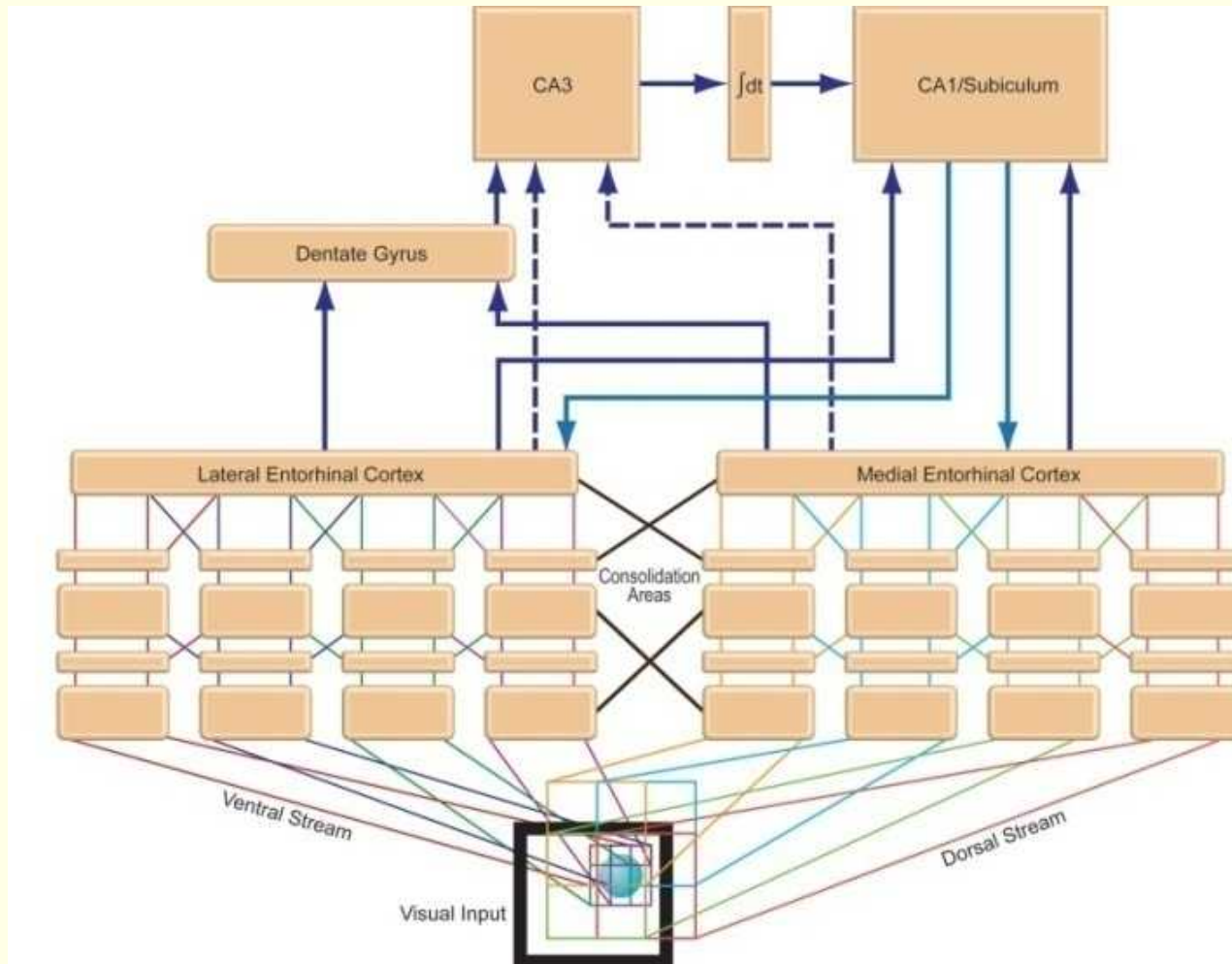
Medial Temporal Lobe



Hippocampal Region



Sandia Hippocampal Architecture





Preston et al.

Item Sequence Associations

Preston, A.R., Shrager, Y., Dudukovic, N.M., & Gabrieli, J.D.E. (2004). Hippocampal contribution to the novel use of relational information in declarative memory. *Hippocampus*, 14(2), 148-152.

Preston Paradigm

Training:

Learned
Face-House
Pairs



Learned Face-
House Pairs



Testing:

Related
Face-Face
Pairs



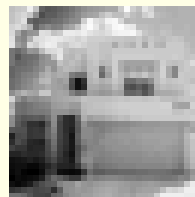
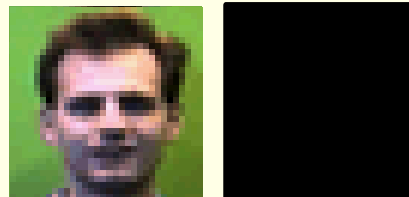
Forced choice memory task

Computational Paradigm

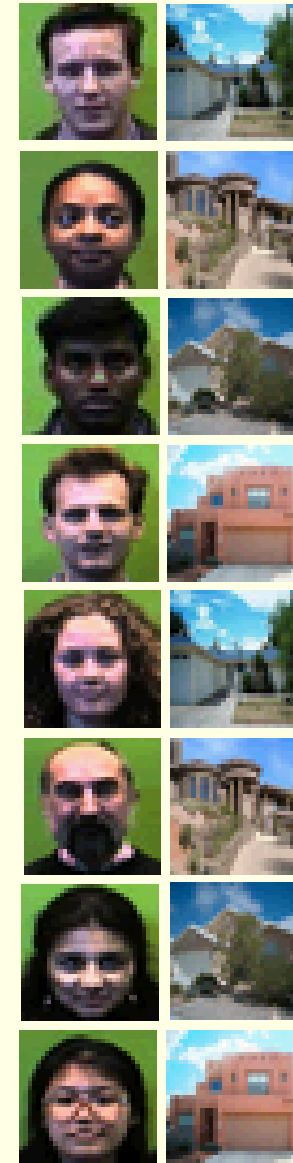
Train:

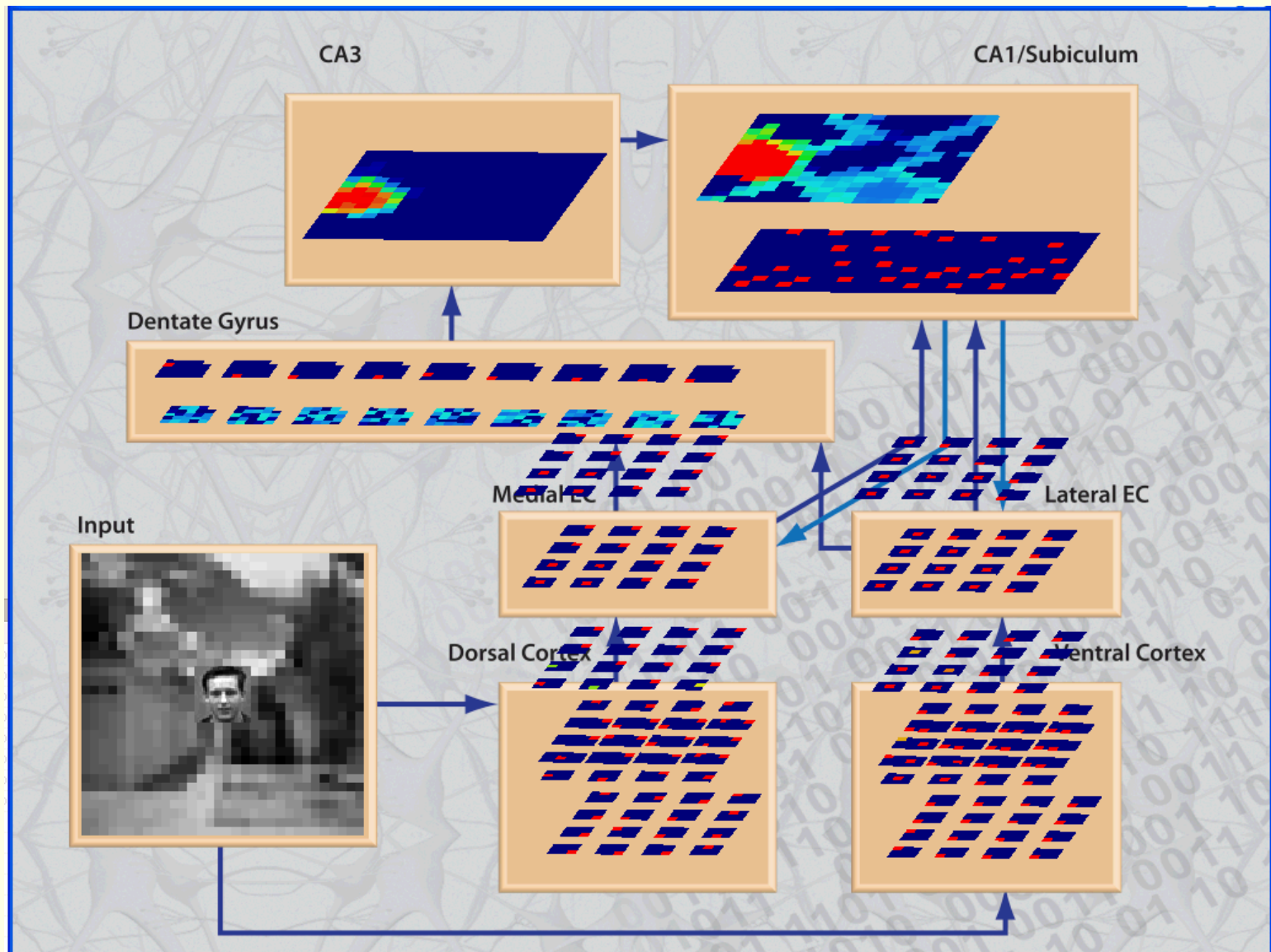


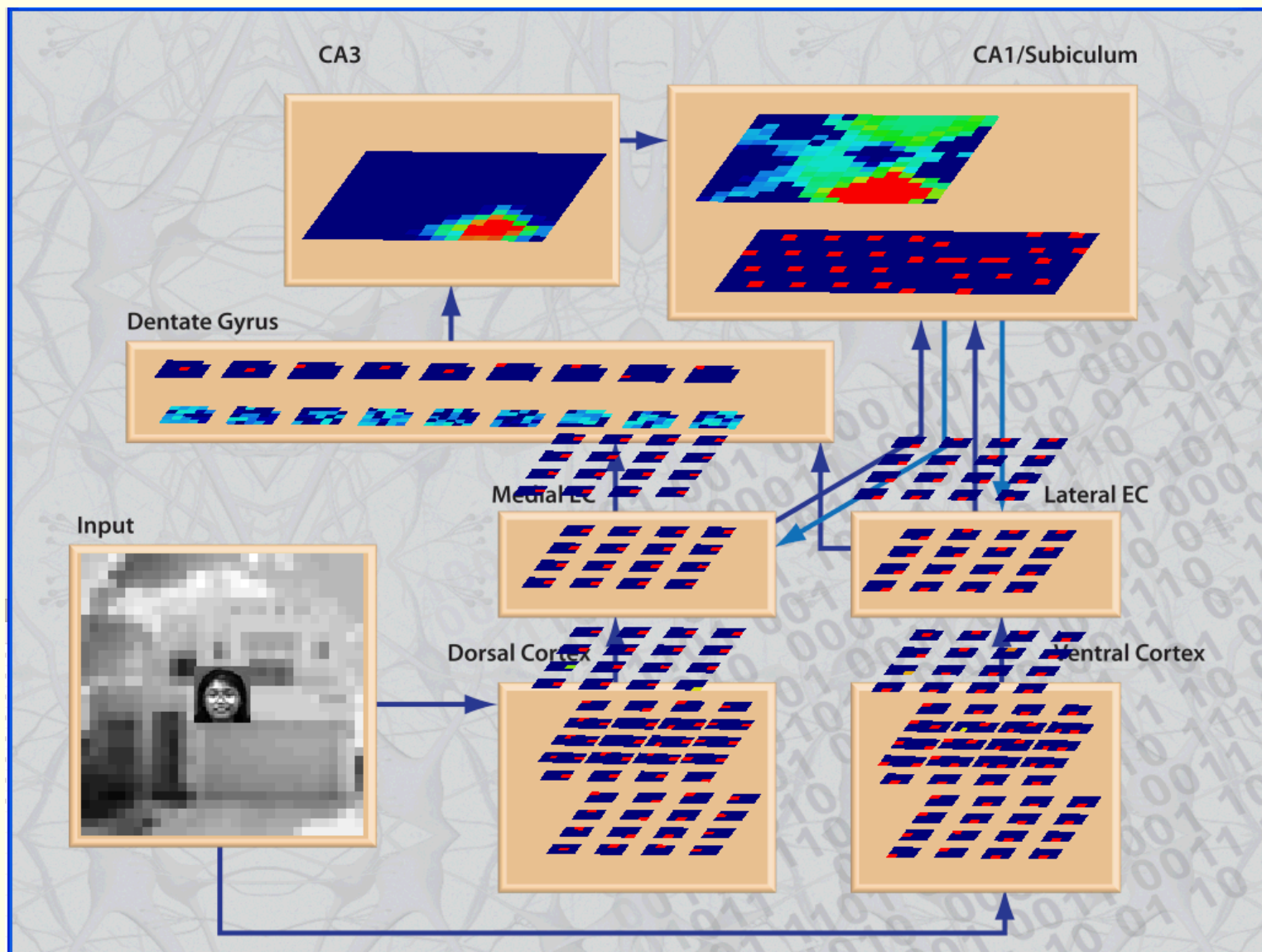
Test:

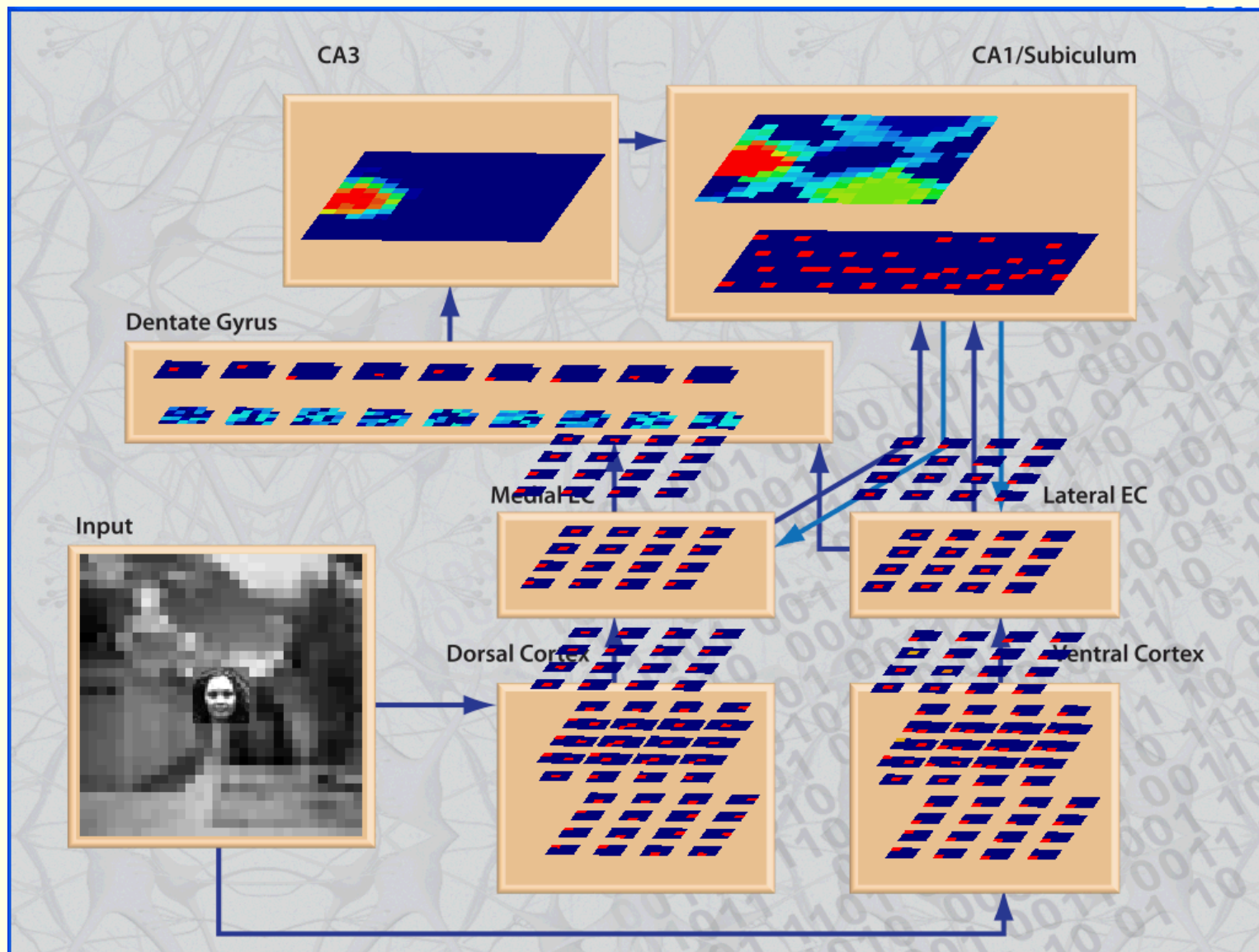


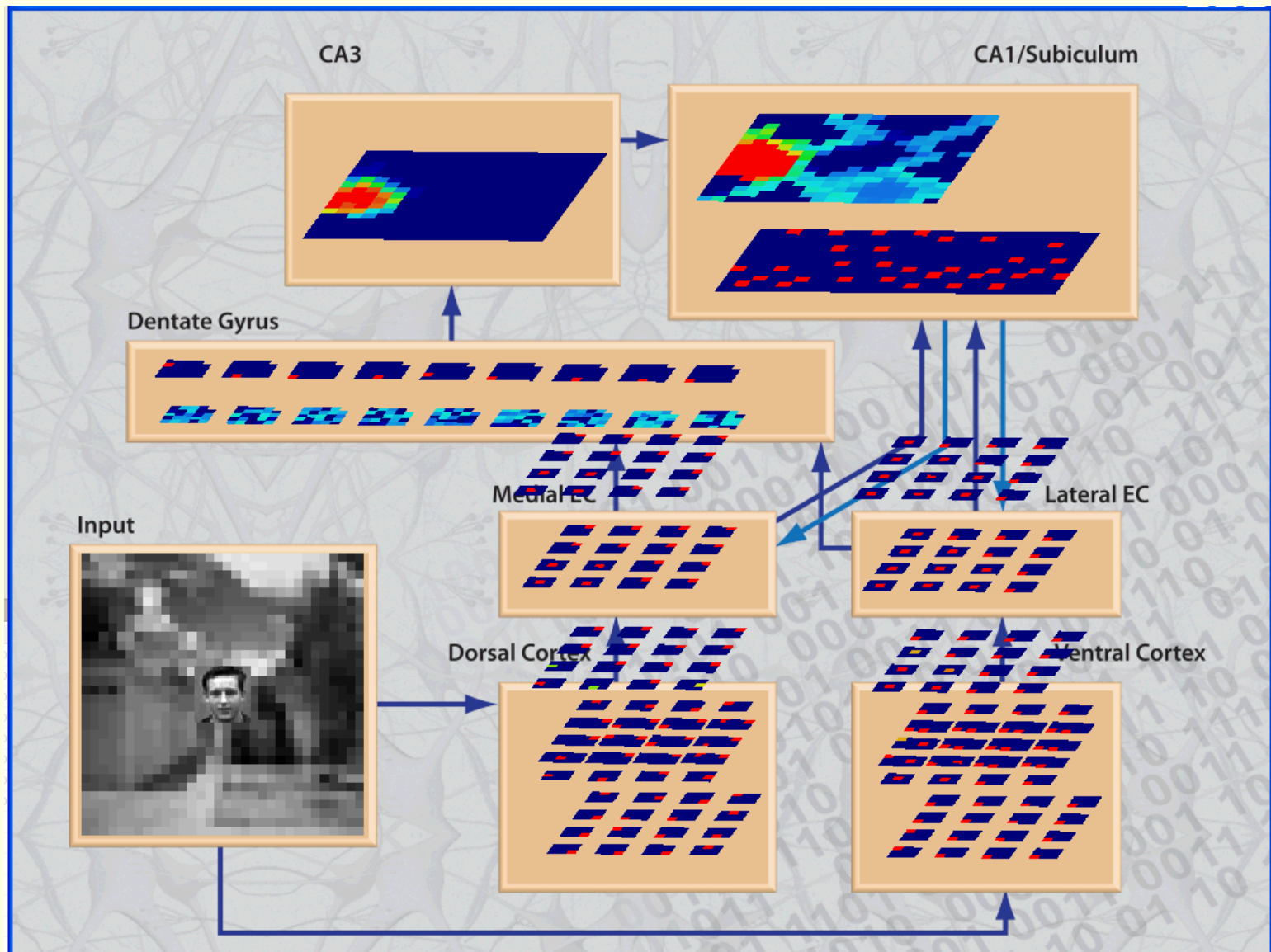
Recall











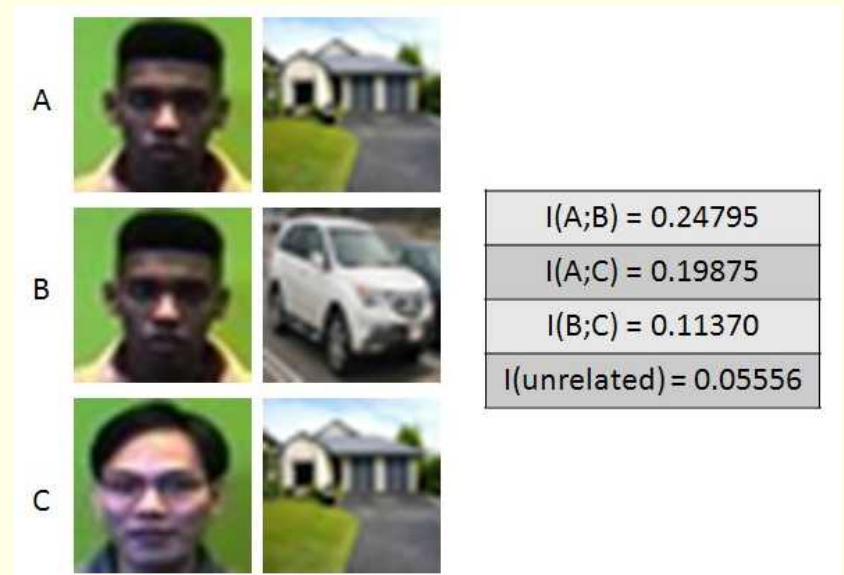


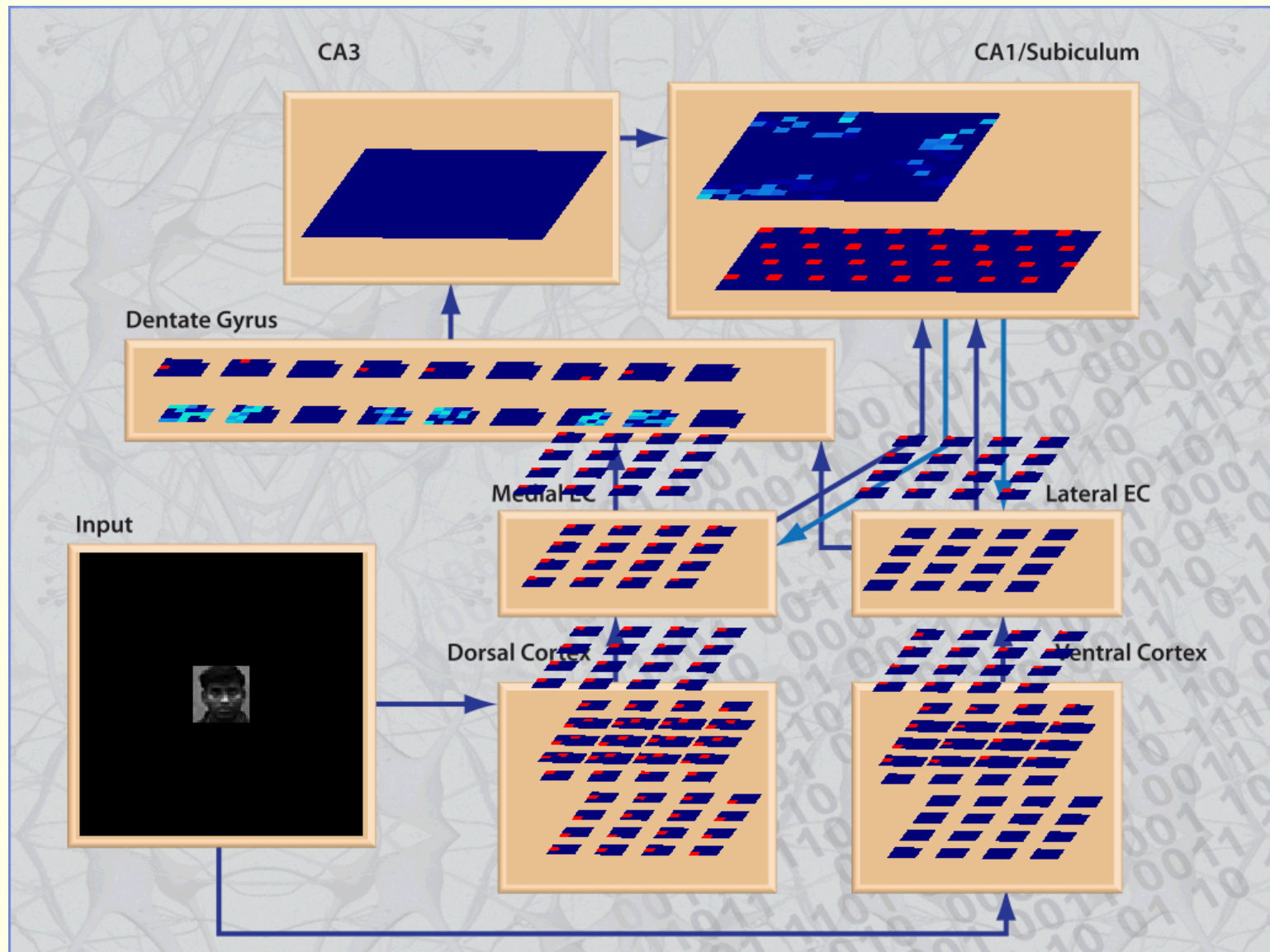
Prior Model Assessment

Quantitative Comparison

Mutual Information:

$$I(X;Y) = \sum_{x \in X} \sum_{y \in Y} p(x,y) \log\left(\frac{p(x,y)}{p(x)p(y)}\right)$$

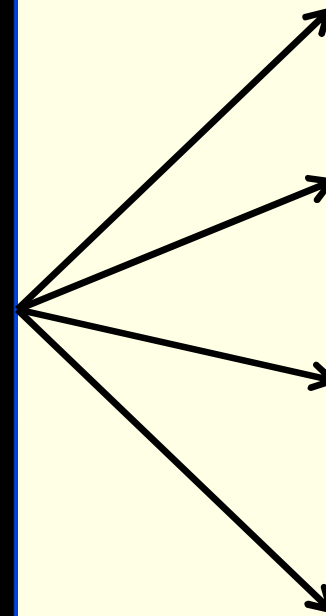




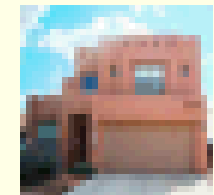
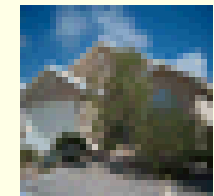
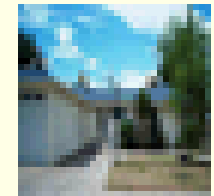


Cognitive Systems

Applying computer models of human cognition to create unique technology solutions



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Normalized Information Distance:

$$NID(x, y) = \frac{\max\{K(x|y), K(y|x)\}}{\max\{K(x), K(y)\}}$$

$K()$ – Kolmogorov complexity

Normalized Compression Distance:

$$NCD(x, y) = \frac{c(x, y) - \min\{c(x), c(y)\}}{\max\{c(x), c(y)\}}$$

$c()$ – compressor



Preliminary Experimental Results

	House1	House2	House3	House4
Face1	0.849	0.8571	0.8601	0.2308
Face2	0.85	0.4104	0.8599	0.8268
Face3	0.8432	0.861	0.5191	0.8484
Face4	0.849	0.8571	0.8601	0.2308
Face5	0.8432	0.861	0.5191	0.8484
Face6	0.85	0.4104	0.8599	0.8268
Face7	0.8432	0.861	0.5191	0.8484
Face8	0.849	0.8571	0.8601	0.2308

Correct Answer

Incorrect Answer



Increased Vigilance Parameter Quantitative Results

	House1	House2	House3	House4
Face1	0.0087	0.8523	0.8538	0.8432
Face2	0.8471	0.094	0.8596	0.8442
Face3	0.8519	0.861	0.2701	0.8464
Face4	0.0087	0.8523	0.8538	0.8432
Face5	0.0087	0.8523	0.8538	0.8432
Face6	0.8471	0.094	0.8596	0.8442
Face7	0.8519	0.861	0.2701	0.8464
Face8	0.849	0.8571	0.8594	0.1054
Correct Answer			Incorrect Answer	

Questions?

Backup Slides

Memory Systems

