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Ensemble Self-Generating Neural Trees

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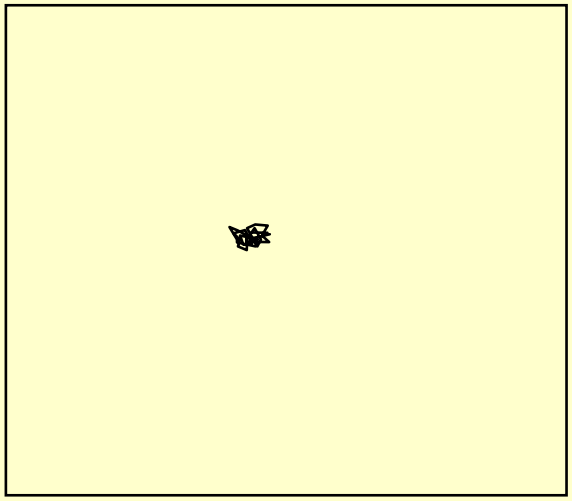
Structure

- classifiers: key issues
- attribute selection and ordering
- self-generating neural trees (Wen, Jennings, Liu 1992)
- ensemble self-generating neural trees (Inoue, Narihasi 2000)
- my variation on esgnt, rationale
- applications best suited to esgnt?

Experiment results, formation of the map ....



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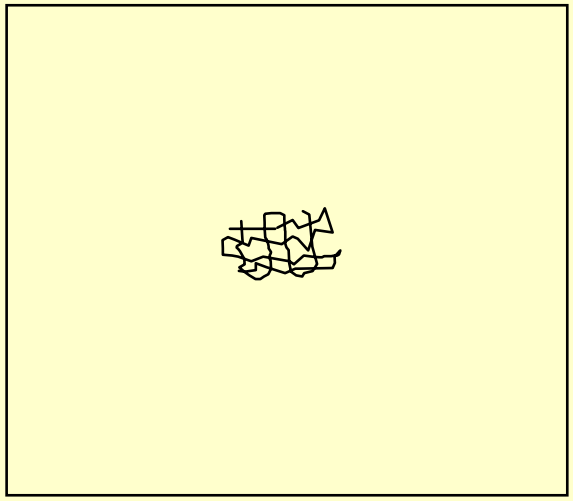

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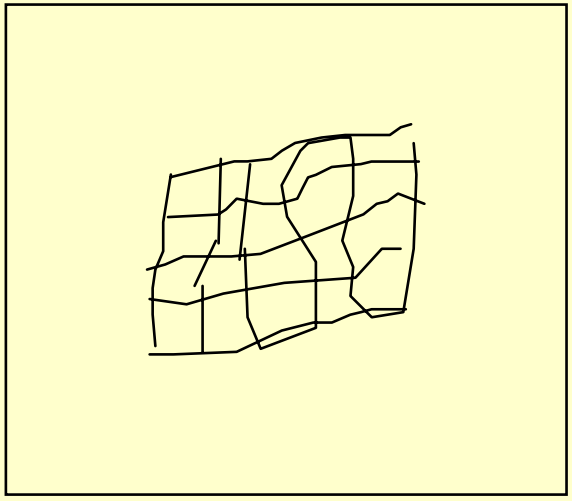

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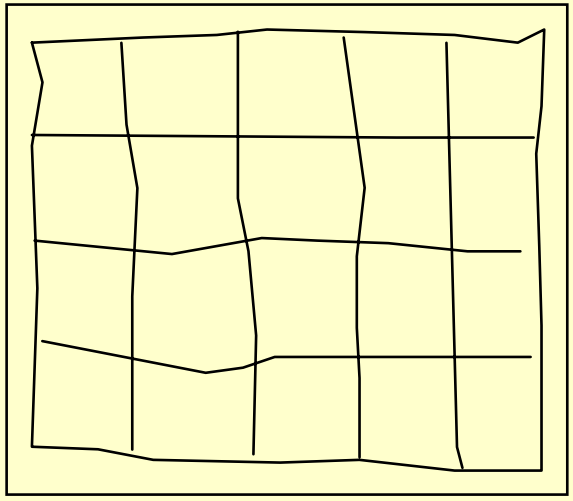

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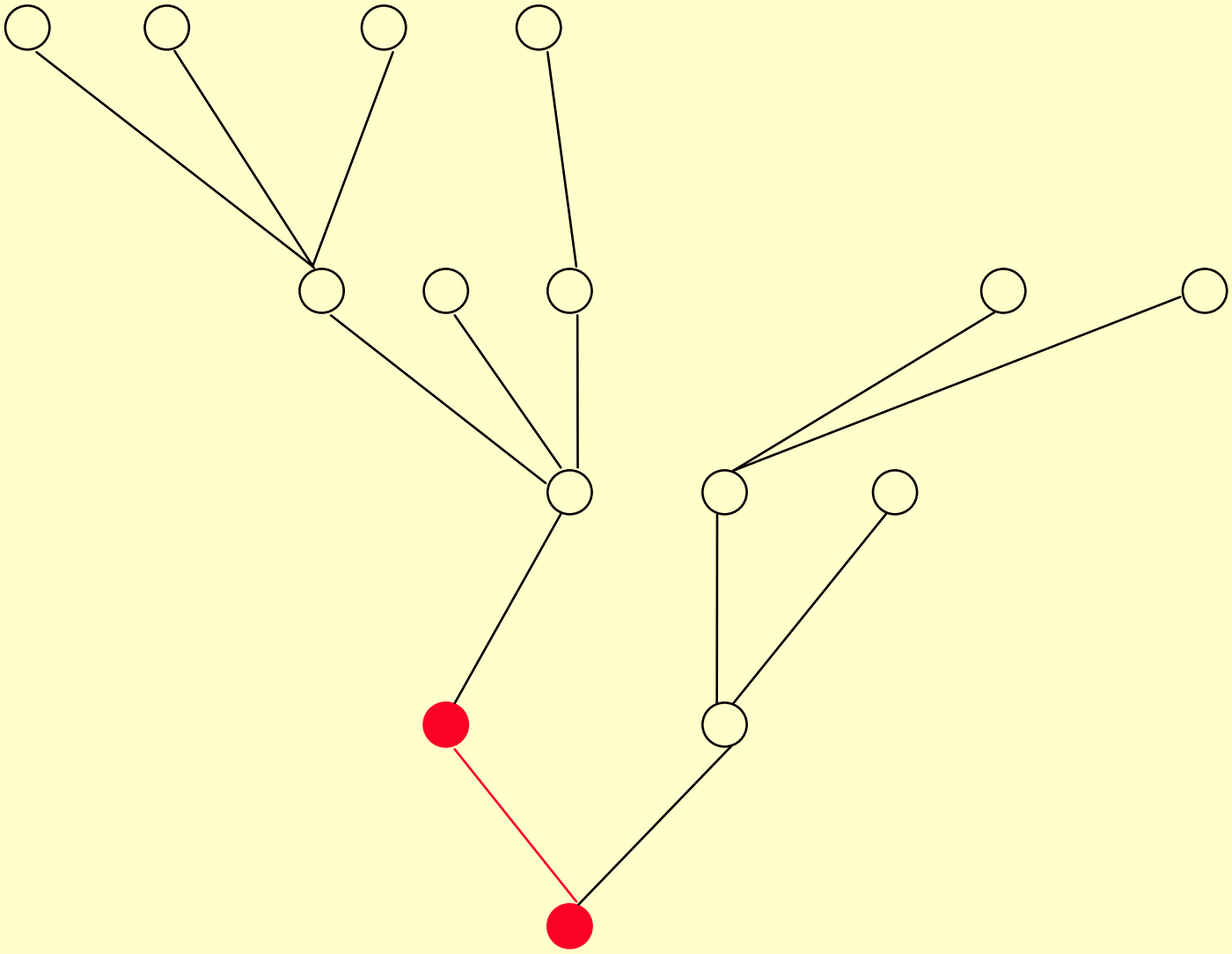
Self Generating Neural Tree

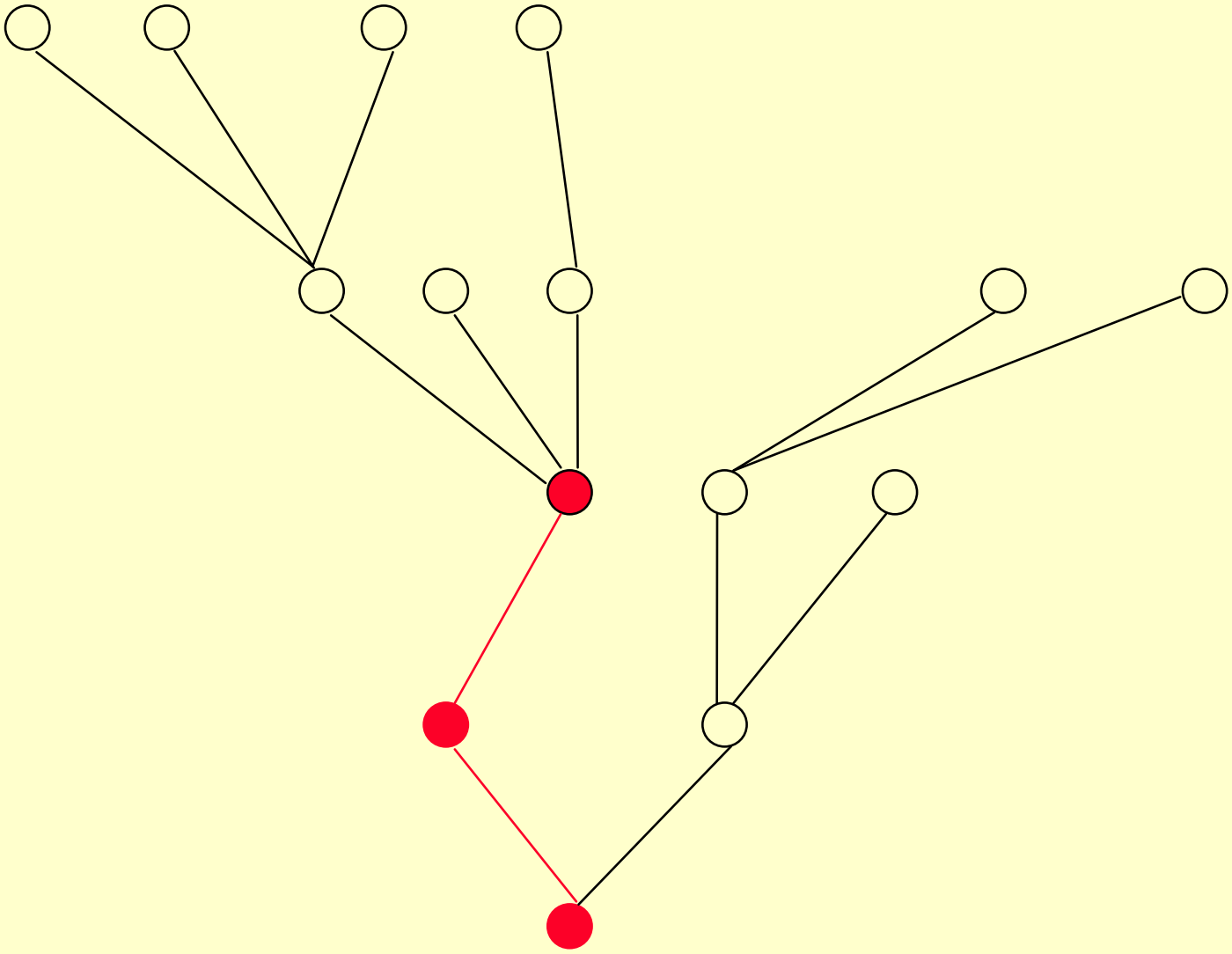
- Kohonen network lacks structure, difficult to create very large networks
- introduce a **tree** structure, with fast execution and ability to create very large networks (10,000 nodes plus)

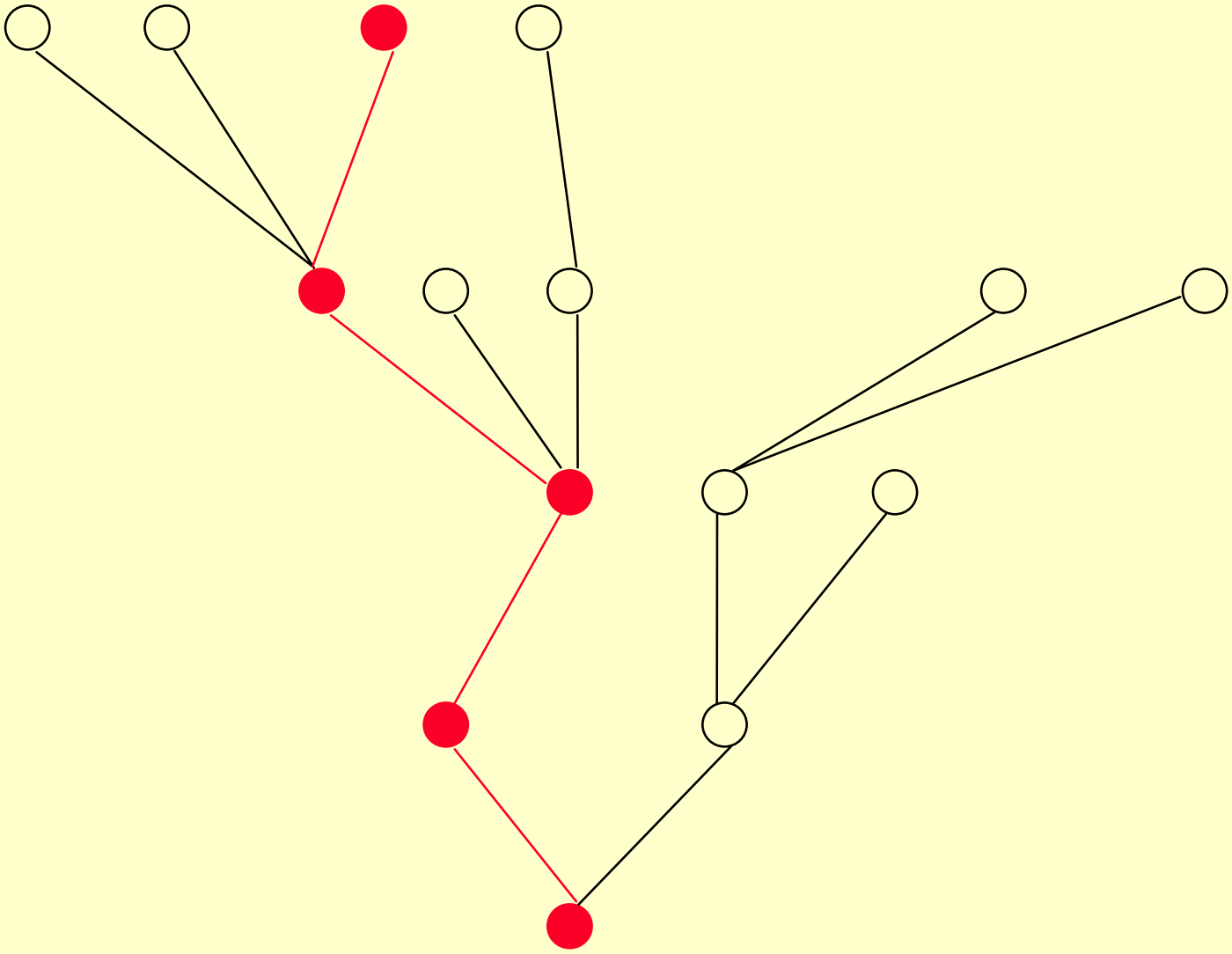
W.X.Wen, H.Liu & A.Jennings “Self-Generating Neural Networks” International Joint Conference on Neural Networks, Baltimore June 1992

SGNT Execution

- at each level of the tree, determine the node *closest* to $\underline{x}$
- when we finally reach a leaf of the tree, then we output the value z_j
- with this structured approach, rapid execution is possible and large networks are straightforward







SGNT learning

For set of training instances $\underline{x}_1$, $\underline{x}_2$, ...

- find node of minimum distance n_j
- if (minimum distance > threshold)

  {create new leaf, with n_j as parent}
- update winner:

$$w_{ij}' = w_{ij} + (1/(t+1)) (x_i - w_{ij})$$

Example 1. Suppose we have 4 one-dimensional training instances $e_1 = 1$, $e_2 = 2$, $e_3 = 3$, and $e_4 = 4$, and $\xi = 0$. The SGNT generation is as follows:

1. e_1 is just copied to a neuron n_0 as the root, $w_{00} = 1$.
2. w_{00} is updated by e_2 to $1 + \frac{1}{2}(2-1) = 1.5$, n_1 and n_2 are generated as the children of n_0 (Fig. 1 a)[1], and $w_{10} = 1$, $w_{20} = 2$.
3. w_{00} is updated by e_3 to $1.5 + \frac{1}{3}(3-1.5) = 2$. The winner in $\{n_0, n_1, n_2\}$ is n_2 since $d(e_3, n_0) = 1.5$ (before w_{00} is updated), $d(e_3, n_1) = 2$, and $d(e_3, n_2) = 1$; and thus, w_{20} is updated to $2 + \frac{1}{2}(3-2) = 2.5$. n_3 and n_4 are generated as the children of n_2 and $w_{30} = 2$, $w_{40} = 3$ (Fig. 1 b).
4. e_4 updates w_{00} to $2 + \frac{1}{4}(4-2) = 2.5$, w_{20} to $2.5 + \frac{1}{3}(4-2.5) = 3$, w_{40} to $3 + \frac{1}{2}(4-3) = 3.5$, and n_5 and n_6 are generated as the children of n_4 with $w_{50} = 3$ and $w_{60} = 4$ (Fig. 1 c).

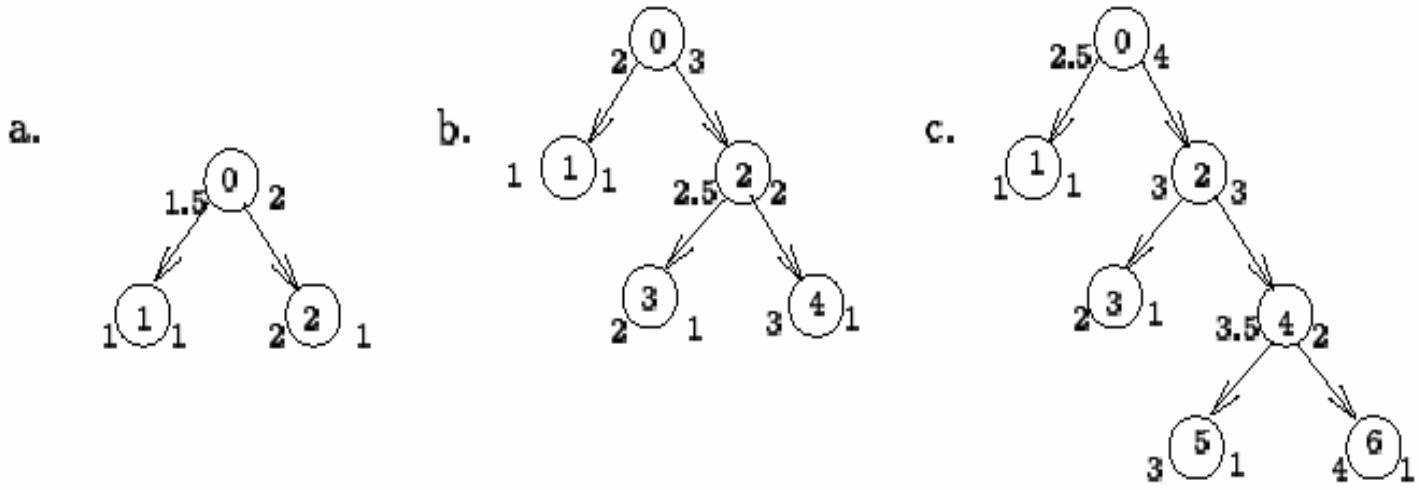


Figure 1: Network generation in Example 1.

Inoue et al, ensemble SGNT

- extends the idea of the isolated network, using bagging for improved prediction
- a set of ensembles are used for training of a number of networks
- the network signals are then assembled for an improved predictor.

Hirotaka Inoue, Hiroyuki Narihisa, "Predicting Chaotic Time Series by Ensemble Self-Generating Neural Networks," IJCNN , p. 2231, 2000.

Inoue: ensemble SGNT

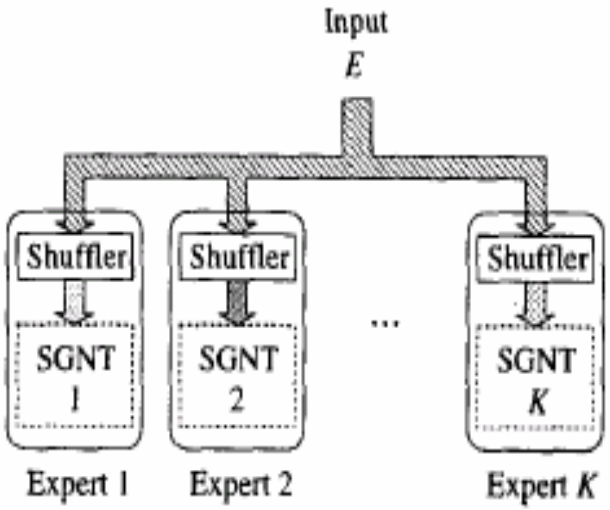


Figure1 ESGNNs which constructed from K SGNTs (training process). One expert corresponds to one SGNT, the shuffler makes shuffle elements of input data.

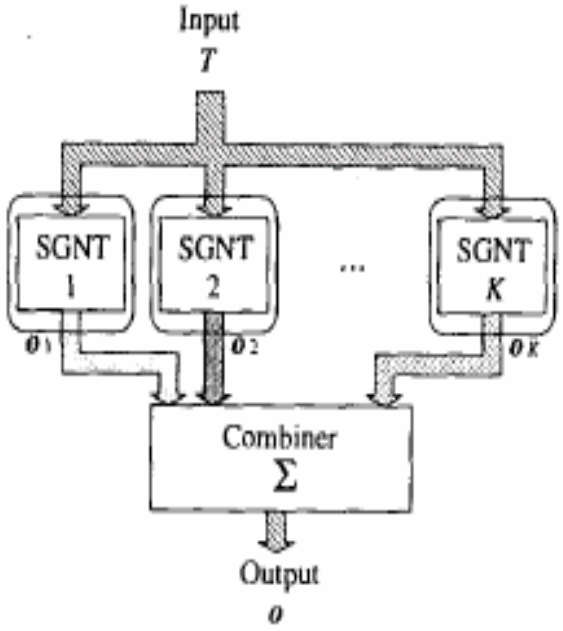
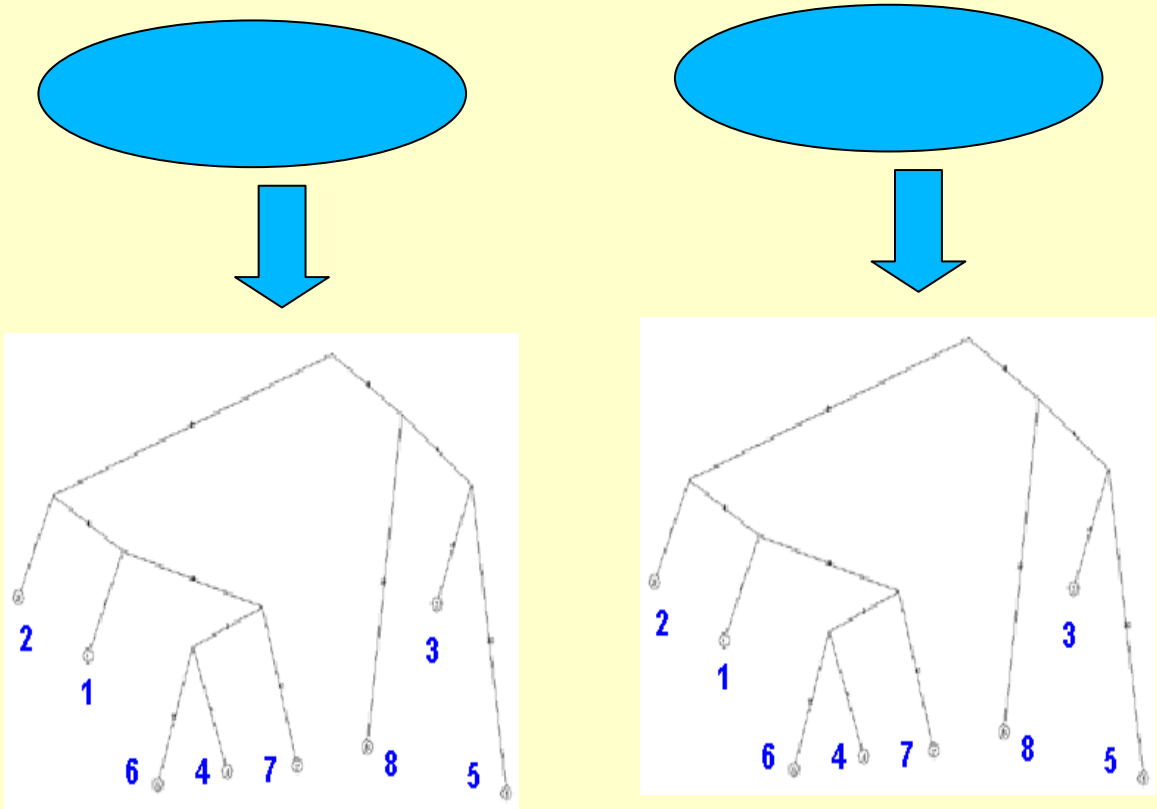


Figure2 The structure of ESGNNs (testing process).

AJ2004 : ensemble SGNT

- instead of a bagged sample, precede the SGNT with a clustering stage
- each cluster feeds to a distinct tree: creates a forest of trees
- two-stage process: find closest ensemble, then closest node within its tree

ESGNT



What sort of problems are suitable to ESGNT?

- requiring fast classifier execution
- tolerant of large storage for the trees
- large training data set available
- suitable for unsupervised approach: although supervision is possible with sgnt.

Some thoughts on classifiers

- data representation is *much more important than the choice of classifier (eg. see Ferra, Jennings, Kowalczyk on attribute selection)*
- *why worry about the size of networks? we have plenty of storage*
- *why worry about the training time? we have plenty of computation power*
- *why worry about biological fidelity? aren't we just using a tool here?*

What's available?

- raw java code at my web page
- possible development of gui based tools, if there is demand to use it

References

- search on Google scholar for SGNT with the two generations:

1992--- Wen, Jennings, Liu

2000---- Inoue, Narihisa