Possible project themes (in no particular order)

Data can come from standard archives (such as the UCI machine learning repository), be your own, or I can give you some. The critical issue is to have non-trivial data complexity (but not too large dimensions and volumes, given our time frame), and pose a good question that can be answered with three weeks’ work.

1. Investigate acceleration of BP learning using (for example)
   a. Conjugate Gradients or Simulated Annealing vs regular gradient descent

2. Other supervised learning vs BP for regression or classification
   a. Radial Basis Function (RBF) nets
   b. Cascade correlation
   c. SOM-hybrid
   d. LVQ (for classification)

3. Investigate training success (accuracy, speed, etc.) in terms of, e.g.,
   a. Generalization vs number of training samples
   b. Training with noisy samples

4. Compare the effect of different weight initialization schemes for BP

5. Study BP performance vs resources
   a. 2-layers vs more than 2 layers; vs number of training samples and/or time

6. Compare classification with neural and non-neural methods

7. Compare clustering with neural (SOM) and non-neural methods (e.g., K-means) on reasonably complex data

8. Catalog and retrieve images (e.g., face recognition, character recognition, fine art, etc.) with BAM, SOM, or ...
   a. Evaluate quality / explore limits in terms of # different categories, tile size, compression (by the NN encoding), gray-scale vs RGB representation, ...
   b. Example: create codebook for known art pieces / styles (encoding), then try to recognize the style of unseen art pieces
   c. Example: do this for noisy spectral imagery from Mars

9. Same as in 7, for audio samples (music, voice recognition)

10. Do a pruning study for structural minimization of BP network (using OBS or devise your own saliency measure).
11. Do a growing study with cascade correlation (or devise your own).

12. Track time-dependent system behavior (performance) with SOM display.

13. Create contextual map of subjects / keywords from abstracts (or other texts) with SOMs (similarly to WEBSOM)

14. Data compression with BP vs SOM vs recirculation NN.

15. Derive the relative importances of input dimensions from a converged BP by examining the weights.

16. Compare visualizations for SOMs knowledge of a manifold (or devise yours).

17. Compare objective functions
   a. do classification using BP with cross-entropy vs LSE as objective function

18. LVQ vs Bayes class boundaries

19. BP vs Bayes class boundaries

20. Find ways to improve the learning speed of an SOM. (Optimize the decrease schedule of learning rate.)