Total 110 points. 1-11 each 3 points: True or False, give brief explanation (one or two sentences).

1. discounted model of optimality in MDP

2. utility function

3. reward function

4. unbounded long-term reward

5. optimal strategy in Nash equilibrium

6. convergence of K-means

7. convergence of EM

8. Uninformative Feature Function

9. scale invariance

10. no free lunch theorem

11. credit assignment problems

12. (12 points) Principal components analysis & independent components analysis

PCA and ICA both seek basis vectors that the data is projected against.

In PCA, you are finding basis vectors that 'best explain' the variance of your data. The first (i.e. highest ranked) basis vector is going to be one that best fits all the variance from your data. The second one also has this criterion, but must be orthogonal to the first, and so on and so forth. (Turns out those basis vectors for PCA are nothing but the eigenvectors of your data's covariance matrix).

In ICA, you are again finding basis vectors, but this time, you want basis vectors that give a result, such that this resulting vector is one of the independent components of the original data. You can do this by maximization of the absolute value of normalized kurtosis - a 4th order statistic. That is, you project your data on some basis vector, and measure the kurtosis of the result. You change your basis vector a little, (usually through gradient ascent), and then measure the kurtosis again, etc etc. Eventually you will happen unto a basis vector that gives you a result that has the highest possible kurtosis, and this is your independent component.

Differences between ICA and PCA

PCA:

removes correlations, but not higher order dependence

some components are more important than others (recall eigenvalues)

vectors are orthogonal (recall eigenvectors of covariance matrix)

ICA:

removes correlations and higher order dependence

all components are equally important

vectors are not orthogonal

13. (15 points) Given a Deterministic Markov Decision Processes, how to find the best policy among all the policies with different values of γ.

14. (16 points) Given a Markov Decision Processes, how to calculate utilities for each state

15. (16 points) How to calculate dominated strategies, pure-strategy, and mixed-strategy in Nash equilibria

16. (18 points) How to design a reinforcement learning agent to solve real-life problems