a) Complete the code in `gibbsrank.m`, by adding the lines required to sample from the conditional distributions needed for Gibbs sampling for the ranking model discussed in the lectures. Run the Gibbs sampler, e.g., for 1100 iterations. Plot some of the sampled player skills as a function of the Gibbs iteration. Does it look as though the Gibbs sampler is able to move around the posterior distribution? What are the burn-in and mixing times for the Gibbs sampler? It may be helpful to look at the auto covariance coefficient, which can be calculated by the `xcov(samples, 100, 'coeff')` command.

b) Do inference in the model instead, by running message passing and EP using `eprank.m`. Explain the concept of convergence for both the Gibbs sampler and the message passing algorithms. What type of object are we converging to in the two cases, and how do you judge convergence, how many iterations are necessary? Do you reach the same answers independent of initialization and pseudo random number seeds?

c) For the message passing algorithm, compute two 4 by 4 tables of probabilities, including only the 4 top players according to the ATP ranking in the lecture notes. First table for the probabilities that the skill of one player is higher than the other, and second table for the probability of one player winning a match between the two. Explain the difference. The Φ function is implemented in matlab as `normcdf`.

d) For the Gibbs sampler, two ways of comparing skills are: 1) first compute the marginal skills for each player, then work out the probability that player one has a better skill, vs 2) use the joint samples from the Gibbs sampler to directly infer that probability. Examine these two alternatives on player 1 and 16. Which method is best? Using that method, derive a 4 by 4 table for the skills (not the game outcomes) and compare to that of the message passing algorithm (from question c)).

e) Compare the rankings based on outcomes for three different cases: 1) empirical game outcome averages, 2) predictions based on Gibbs sampling and 3) predictions based on the message passing algorithm. You may find the bar plot in `cw2.m` useful. Explain the differences.