The following only concerns Questions 1 and 2 of this exam.

It should be pointed out that the exam mark is not the final mark for this course unit. The final mark is calculated by applying a factor of .4 to the exam mark (taken out of 100), multiplying each of the coursework marks with .3, and adding the three together. General remarks: 35 students answered questions from this part.

Overall I was disappointed by the quality of answers in this exam, in particular since I had stressed variously during the term that this is material that needs to be learned over time (best while also doing exercises from the notes) and does not lend itself well to short intense bursts of learning (such as before the exam). See below for instances where students clearly hadn’t internalized fairly basic material.

Question 1. This quality of answers for this question was generally poor. The number of students answering this question was 39, and the average mark was 9. There were 14 students below 8 (this is a failing mark), while only 6 managed a first class mark. The lowest mark was 2, the highest 17. The number of correct game trees in (a) was disappointingly small, and almost nobody could give two points of critique for (b) and illustrate them with examples. Very few students seemed to remember the content of Theorem 1.10.

a) Most mistakes seemed to result from misreading the rules of the game. There are three opening moves for Player 1, one leaving a total of one match and two leaving a total of two remaining matches. The latter two are in the same information set, but the first one isn’t since the number of remaining matches is announced. Player 2 has three choices of the three, although if only one move remains then announcing that they want to take 2 is a move leading to an immediate loss. There were a number of mistakes in calculating the pay-offs—the winning player gets 2 if the game is over after the first two moves, but only 1 thereafter. The correct number of strategies depends on to which extent symmetries have been taken into account when drawing the game tree. If one does this to the maximum then there are four strategies for Player 1 (the opening move, and in one case one further move), and nine strategies for Player 2 (threetimes three for the two information sets). Students who correctly counted strategies for an incorrect game tree received full marks as long as their tree was not significantly smaller than the correct ones. An equilibrium point is guaranteed to exist by Theorem 2.15 of the notes, but this is a mixed strategy equilibrium point in this case.

b) There is suitable criticism with examples in Example 2.4 and Exercise 15 of the notes. Some students used unjustified criticism (claiming that there need not be an equilibrium point for such games, which contradicts Theorem 2.15), or could not think of more than one problem.

c) The only procedure known which works here is described on pages 48/49 of the notes, and Exercise 19 (a) is a similar example to that given here. Typical mistakes were not using the correct procedure, or, in a few cases, drawing the wrong conclusions, or only writing down numbers without any comment on what to do with them, and why they proved the point at issue.

d) For a game as described, Theorem 1.10 applies, so it is known that a pure strategy equilibrium point exists, and it must come in the form of either a winning strategy for Player 1 or a winning strategy for Player 2. Many students did not seem to recall this fact at all. If the game is small enough then it can be given in normal form, and equilibria can be read off by looking for pairs of strategies whose corresponding pay-off is maximal in its column and minimal in its row. If the game is larger then alpha-beta pruning can be applied to the extensive form, as long as it’s possible to search the whole tree (dynamically) down to the leaves. If the game is even larger then there is no way of calculating equilibrium points.

Question 2. This question was also attempted by 39 students. The average mark was 10 out of 20. Ten students got a failing mark and seven managed a first class answer. The lowest mark was 2, the highest 15. Nobody managed full marks for part (a), but the critical evaluations asked for in (b) were only present in parts. Again, Theorem 1.10 (and its application to a game like Kalah) was much in evidence.

a) The main components are board representation and move generation, alpha-beta pruning, and an evaluation function. These are described in Chapter 4 of the notes, and a summary of how the next move is calculated appears on page 72 of the notes. Reasons for losing marks were missing components (or naming ones that do not appear on my list above), and being unable to describe correctly how they work. Quite a few answers were vague, or contained at least some factually incorrect statements.

b) Most students could write something here. I was looking for critical evaluation here (as specified in the question), and it was typical for lack of marks because they were lacking in this component. Honest answers for components/programs that didn’t work well were given full marks for critical evaluation. Sometimes the descriptions given lacked detail for me to evaluate what they were trying to say. Students who suggested ‘random moves’ as a solution to (iv) only received half a point since this is not a productive answer.

c) Kalah is a 2-person zero-sum game of complete information without chance, so Theorem 1.10 applies. We therefore know that a pure strategy equilibrium point exists, and it must be the case that Player 1 can force a win, or Player 2 can force a draw. For smaller versions of the game it is known which is the case (the game has been solved for those). Reasons marks were lost were making considerably weaker statements (such as ‘an equilibrium point must exist’—we know this for all finite games from Theorem 2.15).

General Feedback to Question 3:

• 39 students (i.e., all students except one) answered this question.

• The average mark for this question was 57% (i.e., 11.5 marks out of 20). This is in the same line as the last year, where the average mark for this question was 58%;

• 14 or 36% students received a 1st mark of 70% or better (i.e., 14 marks or more).

• 9 or 23% students received a 2nd class mark between 50%-69% (i.e., between 10 and 13 marks).

• 6 or 15% students received a 3rd class mark between 40%-49% (i.e., between 8 and 9 marks).

• 10 or 26% students received a mark of less than 40% (i.e., 7 marks or fewer)

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• General speaking, the students' performance in this question is satisfactory from the teaching outcome point of view. One reason that almost all students selected this question is that the students have done a project related to the exam question. Therefore they are familiar to the topic and better prepared for the exam.

Detailed Feedback:
• Question a). Most students have answered this question relatively well but some answers are incomplete or inaccurate. The main issues are: Some did not use the needed mathematical formulas to give the definition and so inaccurate. Further some answers only gave the rule of playing and formulations of the definition but did not give the final definition of Strategy, which is the question being asked. So incomplete.
• Question b. i). Except to a couple of students, most students know how to answer this question and many did well. The common mistake is that the boundary strategies are not checked. Some students made this mistake but much less than the last year due to the issue being highlighted in teaching. Another common mistake is the incorrect calculation but fewer students made this mistake.
• Question b.ii).
  Same as the last year, this question was designed as a more difficult question to check how good the students’ ability to extend what they learned to a case where the situation has not been occurred in those examples in the lectures and their lab exercise. That is, the best strategy is not in the middle of the strategy space but at the boundary.
  It is very glad to see more than one-third students know how to answer this question.
  There are many different mistakes for those students who failed to answer this question correctly or completely are:
  Firstly, some did the right analysis but a wrong conclusion by claiming that the best strategy is one outside the boundary; secondly, some did not recognised that the solution obtained by the function maximisation method is not within the given strategy space and used such a solution as the best strategy (so a wrong conclusion); Thirdly, some students failed to mention that the follower’s strategy is unchanged as given in question b.i) and so only needs to compare the leader’s payoff function at the two boundary points; fourthly, there are some incorrect calculation which led to the wrong conclusion.

Q4. Please see separate report from Jon Shapiro.