This is the actual Midterm Exam used in 166A last year. Answers will be posted on October 27. In the meantime, you might want to try it under realistic conditions, then compare your answers to those of your group members.

(Actual) Instructions. In class, closed book, 105 minutes. Partial credit will be granted for brief, relevant remarks and for partial results, but not for core dumps. Points as marked; total is 50.

1) Alice is hoping to buy her first house in Santa Cruz. On Sunday she attends the open house of a dilapidated “cottage” for which Catherine, the owner, has listed for the bargain price of $1 million. For some reason, the only one other interested buyer named Bob attends the open house. Alice and Bob are both aware they are the only two possible buyers. On Monday, Catherine accepts bids for the house. Alice and Bob, simultaneously must decide whether to

- Not Bid (NB), or
- Bid the Asking price of $1 million (BA), or
- Bid Over (BO) the asking price by offering $1.1 million.

If both choose Not Bid, the game ends. Otherwise, Catherine, seeing both Alice and Bob’s actions decides whether to

- Accept Alice (AA), or
- Accept Bob (AB), or
- Reject (R).

All of the above three are possible actions if both Alice and Bob have bid. If only one of them have bid, Catherine’s available actions are to accept the bid that has been made or reject it. Note that Catherine does not disclose how many bids she received, nor is she obligated to accept the highest bid. If Catherine chooses Accept Alice or Accept Bob, the corresponding bidder then gets to choose

- Close deal (C) (the house gets bought at the bid price), or
- Wiggle out (W) (The house is not sold, and there is no penalty for wiggling out).

For Alice and Bob, the payoff if they succeed in buying the house is their valuation of the house minus what they had to pay. Alice values the house at $1.2 million; Bob values it at $1.3 million. The payoff for either of them for not getting the house is 0. Catherine values her house at $1 million, so her payoff if she sells the house is the price she gets for the house minus $1 million. Otherwise her payoff is 0.

a) Draw the extensive form game tree. Pay close attention to the information sets. [5 points]
b) Specify Alice’s Strategy Space. [5 points]
2) Consider the two player game described by the following payoff matrix.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20,10</td>
<td>17,5</td>
<td>2,6</td>
</tr>
<tr>
<td>B</td>
<td>15,60</td>
<td>8,32</td>
<td>1,65</td>
</tr>
<tr>
<td>C</td>
<td>6,12</td>
<td>40,10</td>
<td>10,20</td>
</tr>
</tbody>
</table>

a. Does either player have a dominant strategy? (1 point)
b. Does either player have a dominated strategy? (1 point)
c. Which strategy profiles survive iterated deletion of strictly dominated strategies? (3 points)
d. Find all pure Nash equilibria (NE) of the game. (3 points)
e. Find all mixed NE. If none, explain why. (3 points)

4) Sherlock Holmes (player #1) is pursued by his archenemy Professor Moriarty (player #2) in a classic story. It comes down to whether Holmes will exit the train at Canterbury (C) or Dover (D), and which choice (c or d) Moriarty makes simultaneously. The payoff matrix is

<table>
<thead>
<tr>
<th></th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>10,90</td>
<td>70,30</td>
</tr>
<tr>
<td>D</td>
<td>90,10</td>
<td>20,80</td>
</tr>
</tbody>
</table>

a. Write down each player’s best response to each choice of the other player. (2 points)
b. What are the pure strategy NE? If none, explain why. (3 points)
c. Find all mixed NE. If none, explain why. (3 points)
d. Which outcome do your answers above suggest is the most likely? (1 point)

3) You are employed by a government agency to study the widget industry. Widgets are made by only three companies: (A)llen Industries, (B)ush Co, and (C)henney International. Widgets are commodities and thus widgets produced by the three companies are identical. The price per widget is determined by the total quantity Q produced according to the demand function

\[ p = (100 - Q) \]

where Q is in millions of widgets, and p is in dollars.

Suppose that it costs each company $25 for each widget they produce. Thus the profit of each company i = A, B or C is

\[ V_i = (100 - Q - 25)q_i \]

where Q=q_A + q_B + q_C, and the units are millions of dollars.

a) What is the best response function of company \( i \)? Express your answer in terms of \( Q_i \), the sum of the quantities the companies other than \( i \) produce. [8pts]
b) Find a symmetric NE. [4pts]
c) What is the profit of each company in the equilibrium you find in part b? (Leave your answer in millions of dollars because that should be easiest.) [4pts]
d) The CEOs of the three companies propose to merge into 1 mega-company because they claim it will be “good for America.” By how much will the total number of widgets produced by the industry change (up or down) after such a merger? What profit would the merged company make? \[4\text{pts}\]