

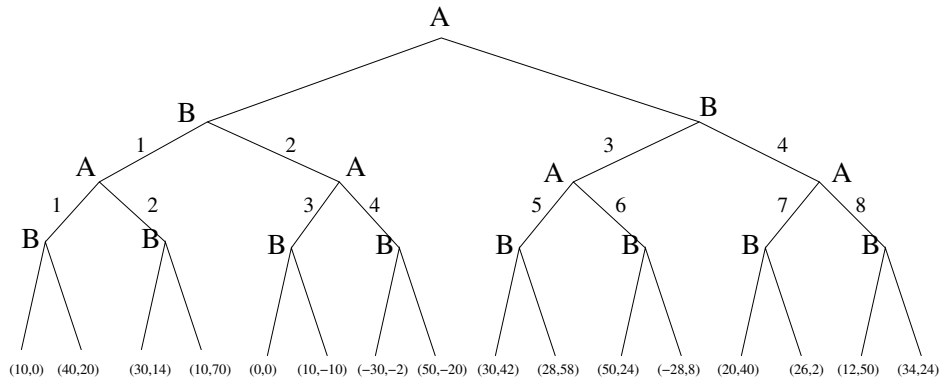
Math 10: The Art and Practice of Mathematics

Assignment 11 due Wed Apr 30

Your solutions should be written so-as to be clear to an audience of fellow math 10 students.

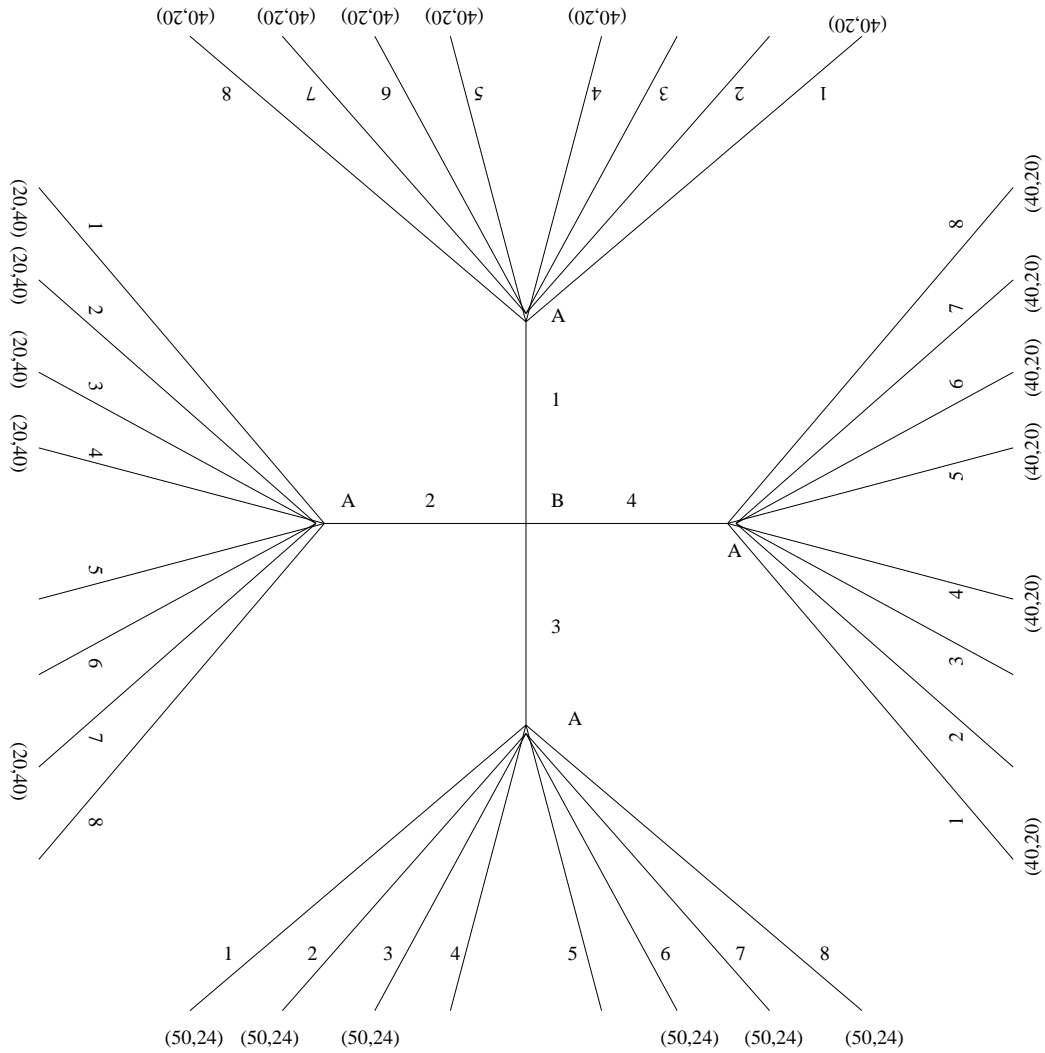
1. Suppose that PepsiCo has an distribution problem which, if solved, will increase PepsiCo's profits by \$1,800,000. PepsiCo wishes to outsource solving the distribution problem to UPS. UPS charges \$300,000 for standard shipping, for which UPS makes a profit of \$30,000. UPS charges \$450,000 for ultra shipping, for which UPS makes a profit of \$60,000. Notice that if UPS charges for ultra shipping, but provides only standard shipping, then UPS makes a profit of \$180,000. In a project proposal to PepsiCo, UPS estimates that standard shipping has a 60% chance of solving the distribution problem, and ultra shipping has an 80% chance of solving the distribution problem.
 - (a) Show that a principal-agent problem arises if PepsiCo hires UPS and pays a flat fee up-front for service.
 - (b) Consider the bonus-incentive contract wherein UPS provides up-front \$150,000 of noncompensated work to PepsiCo and earns a \$750,000 bonus if and only if the distribution problem is solved. Does this bonus-incentive contract resolve the principal-agent problem in part (a)?
2. Chapter 9 #5 *This question is about the Client-Consultant Game from class. The "negative base salary" in the statement of the problem refers to the \$50,000 of non-compensated work required of the Consultant in the Bonus-Incentive Contract.*

Recall that an *advance commitment* is an irrevocable decision by a player to make a specific move from a specific decision node. An advance commitment which improves that player's payoff is termed a *strategic commitment*. The advance commitment is termed a *threat* if it has the effect of decreasing the other player's payoff, and it is termed a *promise* if it has the effect of increasing the other player's payoff. For the game tree in the diagram below,



3. Determine the rollback strategies and payoffs.
4. Suppose player B can make a single advance commitment regarding his/her first move. Notice that there are four different advance commitments player B can make regarding his/her first move, labeled 1-4 on the game tree.
 - (a) Which of the four are strategic commitments? Why?
 - (b) Which of player B's strategic commitments regarding his/her first move are threats? Why?
 - (c) Which of player B's strategic commitments regarding his/her first move are promises? Why?
 - (d) Which is player B's best advance commitment?
5. Suppose player B can make a single advance commitment regarding his/her first move. Suppose that next player A can make a single advance commitment regarding his/her second move.

- (a) Determine the missing payoffs at the terminal nodes of the *advance commitment game tree* diagrammed below.



- (b) Rollback the advance commitment game tree to determine the rollback commitments and payoffs.
- (c) Classify the commitments you found in part 3(b) as threats or promises.