Write your answers in the space provided.

1. Consider the following preference relation on the set $\{a, b, c\}$:

$$a \succsim a, b \succsim b, c \succsim c, a \succsim b, b \succsim a, a \succsim c, b \succsim c$$

(a) (5 points) Is it complete? **Yes.**

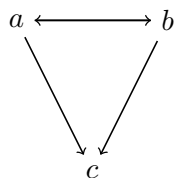(b) (5 points) Is it transitive? **Yes.**

(c) (5 points) Write the indifference relation $\sim$
$a \sim a, b \sim b, c \sim c, a \sim b$

(d) (5 points) Write the strict preference relation $\succ$
$a \succ c, b \succ c$

(e) (5 points) Write any utility function that represents these preferences.

$$U(a) = 1 \qquad U(b) = 1 \qquad U(c) = 0$$

(f) (5 points) Graph the preference relation.

2. Three people $P = \{1, 2, 3\}$ have preferences over the set of outcomes $O = \{a, b, c\}$. Their preferences are:

$$a \succ_1 c \succ_1 b$$
$$a \succ_2 c \succ_2 b$$
$$c \succ_3 a \succ_3 b$$

(a) (5 points) What outcomes strictly Pareto dominate others?
   a strictly Pareto dominates b
   c strictly Pareto dominates b

(b) (5 points) What are the Pareto efficient outcomes?
   a and c

(c) (5 points) What **social preferences** results from applying the preference aggregation rule **Borda Count** to these preferences? Use 3 points for a first-ranked outcome, 2 for a second-ranked outcome, and 1 for a third-ranked outcome.
   $a \succ^* c \succ^* b$

(d) (5 points) What **choice** results from applying the social choice function **plurality vote** to these preferences?
   a

(e) (5 points) In the example above, change the preferences in a way that demonstrates the social choice function plurality vote **does not respect IIA**. Why does your example violate IIA? *Hint: keep the relationship between a and c constant in everyone's preferences. Only change where b is ranked.*

$$a \succ_1 c \succ_1 b$$
$$b \succ_2 a \succ_2 c$$
$$c \succ_3 a \succ_3 b$$

a, b, c are all social choices. Since c is now chosen even though preferences over a, c didn't change, this violates IIA.

3. (10 points) Three people $P = \{1, 2, 3\}$ have preferences over the set of outcomes $O = \{a, b, c\}$. **Provide a social choice function** that is **nonempty**, **Pareto efficient**, and **IIA** (that is, it does not violate IIA).
   Any dictatorship social choice function. For instance "Person one chooses".

4. Three people $P = \{1, 2, 3\}$ have preferences over the set of outcomes $O = \{a, b, c\}$. Plurality vote is used to pick a social choice. If there is a tie, the outcome that is earliest in the alphabet wins. Suppose that each person's preferences are:

$$a \succ_1 c \succ_1 b$$
$$b \succ_2 c \succ_2 a$$
$$c \succ_3 a \succ_3 b$$

(a) (5 points) Plurality vote with the alphabetic tie-breaking rule described above always results in **exactly one outcome being chosen**. This property is known as:
   Decisiveness

(b) (5 points) The outcome chosen by plurality vote with the alphabetic tie-breaking rule described above is:
   a

(c) (5 points) Can anyone misstate their preferences and get a better outcome? If so, who and how?
   Person 2 could say their preferences are $c \succ_2 b \succ_2 a$ and now c is the social choice. Person 2 likes this better.

5. (10 points) What is a social choice function and what does it mean for a social choice function to be Pareto efficient? *Please answer in the space below (about two short paragraphs). Write as if you were explaining to someone who has never taken an economics course before.*

   A social choice function is a rule that considers the preferences of people in society about a set of possible outcomes. From those preferences it comes up with a *choice* for society. A Pareto efficient social choice function is one that never chooses an outcome such that there is another outcome everyone in society would strictly prefer.

6. (10 points) Circle one choice below each statement. Your answer will only be used to help me improve this course and exam-writing for the rest of this semester and future offerings of this course. **Turn this page in separately from the rest of the exam. Do not write your name on it.** Please be honest.

I felt the learning objectives were clear.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I felt the homework exercises helped me prepare well for the exam.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I felt lecture helped me prepare well for the exam.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I felt the *content* of the exam what similar to what I expected.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

Relative to my expectations, I felt the *difficulty* of the exam was:

Much Harder   Harder   As Expected   Easier   Much Easier

Additional comments that could help me improve this course?
(Feel free to use back if needed.)