**Multiagent Systems Assignment 2**

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**Task**

Answer the following questions while providing the necessary explanation.

1. What are the means by which we can make social choices in modern society?

2. What are the differences between social choice functions and social welfare functions?

3. Give examples of aggregation procedures used in social choice theory.

4. Which criterion of social choice often fails when the voters' preferences are cyclical?

5. Why is Arrow’s impossibility theorem so important?

6. What are the key properties of voting rules?

7. What does “monotonicity” mean in the context of voting rules? Explain with an example.

8. Are there any real-world cases for the “impossibility theorem”? Give examples.

9. What are the most essential axioms for a democratic electoral system?

10.How can computational social choice theory benefit the development of online platforms?

**Explanation**

Q1

1. Voting, used to make a political decision 2. The market mechanism, used to make economic decision

Q2

A social choice function for (A, n), if, for every (A, n) -profile P, the outcome V(P) is a choice function C that picks out a non-empty subset C(v) of v, for each non-empty subset of A

A social welfare function for (A, n) if, for every (A, n) -profile P, the outcome V(P) is a weak ordering of A

Social choice functions return subsets of A (possibly singular), but social welfare functions return orderings.

Q3

Aggregation procedure can be defined as:

A resolute voting rule + A social choice function + A social choice function

The all the functions are defined as:

1. A resolute voting rule for (A, n) if, for every (A, n) -profile P, the election outcome V(P) is a single element of A

2. A non-resolute voting rule for (A, n) if, for every (A, n)-profile P, the election outcome V(P) is a non-empty set of A

3. A social choice function for (A, n) if, for every (A, n) -profile P, the election outcome V(P) is a choice function C that picks out a non-empty subset C(v) of v, for each non-empty subset of A

4. A resolute social choice function for (A, n) if, for every (A, n) -profile P, the election outcome V(P) is a choice function C that picks out a single element C(v) from v, for each non-empty subset of A

5. A social welfare function for (A, n) if, for every (A, n) -profile P, the election outcome V(P) is a weak ordering of A

6. A resolute social welfare function (A, n) if, for every (A, n) -profile P, the election outcome V(P) is a linear ordering of A

Q4

IIA criterion

Q5

Because it is the general possibility theorem that can be applied to any method of deriving social choices by aggregating individual preference.

Q6

Group 1: Unanimity & Plurality

Group 2: Oligarchies & Dictatorships

Group 3: Borda & Copeland

Q7

Monotonicity: if a winner remains a winner when a voter alters its ballot by interchanging that wining alternative with the alternative that it had ranked immediately above it

Expressed mathematically, for any P1, if we obtain P2 by only raising the position of V(P1) in one vote, then V(P1) = V(P2)

Q8

Considering the impossibility theorem, alternative methods like ranked-choice voting (voters rank candidates by preference on their ballots.), approval voting (voters can select many candidates instead of selecting only one candidate), and proportional representation (subgroups of an electorate are reflected proportionately in the elected body.) are invented in the real-world elections.

However, none of these alternative methods are perfect. For example for the ranked-choice voting sometimes still violates the rule of independence of irrelevant alternatives.

Q9

Anonymity, Neutrality, Non-dictatorship, Monotonicity, Consistency, Pareto, Unanimity, Non-imposition

Q10

By doing questionnaire-based study among users and analyzing with computational social choice theory, we can know the general choice of user group on yes-or-no questions of platforms’ development and other related questions. This process can help platform developer to deicide the direction of vital improvements.