

This assignment is worth 12.5% of the final grade. Each question is worth a multiple of 5 points. If you have no idea how to answer a question, you will receive 20% of the credit for that question by saying “I do not know how to answer this question”. Leaving the question blank, you will receive 10% of the credit. If your answer makes no sense, you will not receive any credit. Any answer that shows some understanding of the question will receive more 20% credit.

1. (5 points)

Provide a ranked list of five topics you are most interested in. Explain briefly your choice.

Solution: Full credit if you make a coherent reason as to why you chose each topic. Otherwise no credit or 1/2 credit for each topic where the reason doesn't make that much sense.

2. (10 points)

Given that different individuals have different preferences, to decide what topics to present requires forming a consensus ranking. Forming consensus and making “fair” decisions are central topics in computational social choice. Briefly describe how you would form a consensus to choose a ranked list of 5 topics and then justify (in your own words) why you think your method is “fair”, whatever you think fair means.

Solution: One voting method is to use a scoring rule and give some $s(i)$ points for your i^{th} favourite candidate. For example, the Borda scoring rule is that your i^{th} favourite candidate gives that candidate $\frac{1}{i}$ points. Then you sum up (over all votes) the points for each candidate and then rank the candidates by their total score. Any reasonable voting rule is OK as long as there is a reasonable justification.

3. (10 points) Voting in our Canadian political elections (e.g. for a mayor, an MPP, an MP) is forming a consensus to choose a single winner amongst many possible candidates. We do this by plurality voting; that is, electing the person receiving the most votes. Briefly say what are the advantages and what are the disadvantages for this method.

Solution:

Advantages include :conceptual simplicity, familiarity, no reason not to vote for your favourite candidate when there are only two candidates.

Disadvantages: the winner might only be the favourite candidate of a small minority of voters, the winner might be very disliked by a large majority of voters, there is a reason for a voter to vote strategically and not vote for their favourite candidate.

4. (5 points) Give your opinion as to why von Neumann is said to have favoured a fixed point representation.

Solution: One guess would be conceptual simplicity but a better answer would be that it would make the arithmetic operations simpler to implement. I have no idea what von Neumann was thinking so anything reasonable gets full credit.

5. This exercise relates to the even more simplified floating point representation that was illustrated in slide 3 of the Lecture slides for our fourth class. Here, a floating

point number $s\#e_{k-1}\dots e_0\#b_{\ell-1}\dots b_0$ represents the decimal number $x = (-1)^s \cdot 2^{E'} \cdot \sum_{i=1}^{\ell} b_{i-1}2^{-i}$ where $E' = (-1)^{e_{k-1}} \cdot E$ and $E = \sum_{j=1}^{k-1} e_{j-1}2^{j-1}$.

- (5 points) In binary and decimal, what is the largest positive number you can represent using this simplified floating point representation?

Solution: In binary the biggest number is $1011\dots 1$; that, the sign bit $s = 1$, the exponent bit $e_{k-1} = 0$ and the remaining bits are all 1's.

In decimal that number is $2^{k-1} \cdot (\sum_{j=0}^{\ell-1} b_j 2^{-(j+1)})$.

- (5 points) What decimal number does the 8 bit floating point number 01110011 represent?

Solution: $2^{-6} \cdot \frac{3}{8} = \frac{1}{64} \frac{3}{8}$.