

# AGI Exam 03.03.21

## 1 Structure:

7 tasks in total, each worth 15 points. 1 task per chapter and 1 bonus task with miscellaneous MC-questions.

## 2 Game Theory

- a) Find Nash equilibria (NEs) in example
- b) Reduction: Assume we have an Algorithm that finds NEs for 3-player NF-games. How can we use it to find NEs in 2-player NF-games? (Show why reduction is correct)
- c) Reduction: Assume we have an Algorithm that finds NEs for 3-action NF-games. How can we use it to find NEs in 2-action NF-games? (Show why reduction is correct)

## 3 Auction Theory

We want to sell A, B or C an espresso machine. B and C live together, so we can only sell espresso machine to A, {B, C} or to no one.

- a) Model scenario as Single-Parameter environment
- b) Find Social-Welfare maximizing + DSIC allocation and payment
- c) Find Revenue-maximizing allocation + payment

## 4 Matchings

- a) Demonstrate Gale Shapley on a given example: In which round is which edge rejected?
- b) Prove that a rejected edge can never be part of any stable matchings
- c) Show using b) that man-proposing Gale-Shapley is man-optimal

## 5 Information Elicitation

An example was given.

- a) Which scoring rule is strictly proper in the example?
- b) Calculate 1/Prior payment for the example
- c) Does  $s_{quad}$  incentivize truthfulness in the example? Calculate expected payments for (un)truthful reporting

## 6 ComSoc

Def: Condorcet-Loser (CL) *loses* all pairwise majority comparisons

Def: CL-consistent: If CL exists, it is never chosen by the rule

- a) construct preference profile with
  - 5 alternatives
  - odd number of voters
  - strict preferences
  - CW exists
  - CW is never ranked first
  - CL exists
- b) Is plurality CL-consistent?
- c) Is lexicographic SMC CL-consistent?
- d) Does this hold: A rule is CL-consistent iff it is CW-consistent?

## 7 Price of Anarchy/Network Formation game

An example graph was given.

- a) A path was given. Is it a Pure Nash Equilibrium (PNE) in the example?
- b) Find all PNEs in the example and explain why they are PNEs
- c) Calculate PoS and PoA

## 8 Bonus

- a) Something with Bulow-Klemperer
- b) Can a particular example be modelled as an Atomic Routing game?