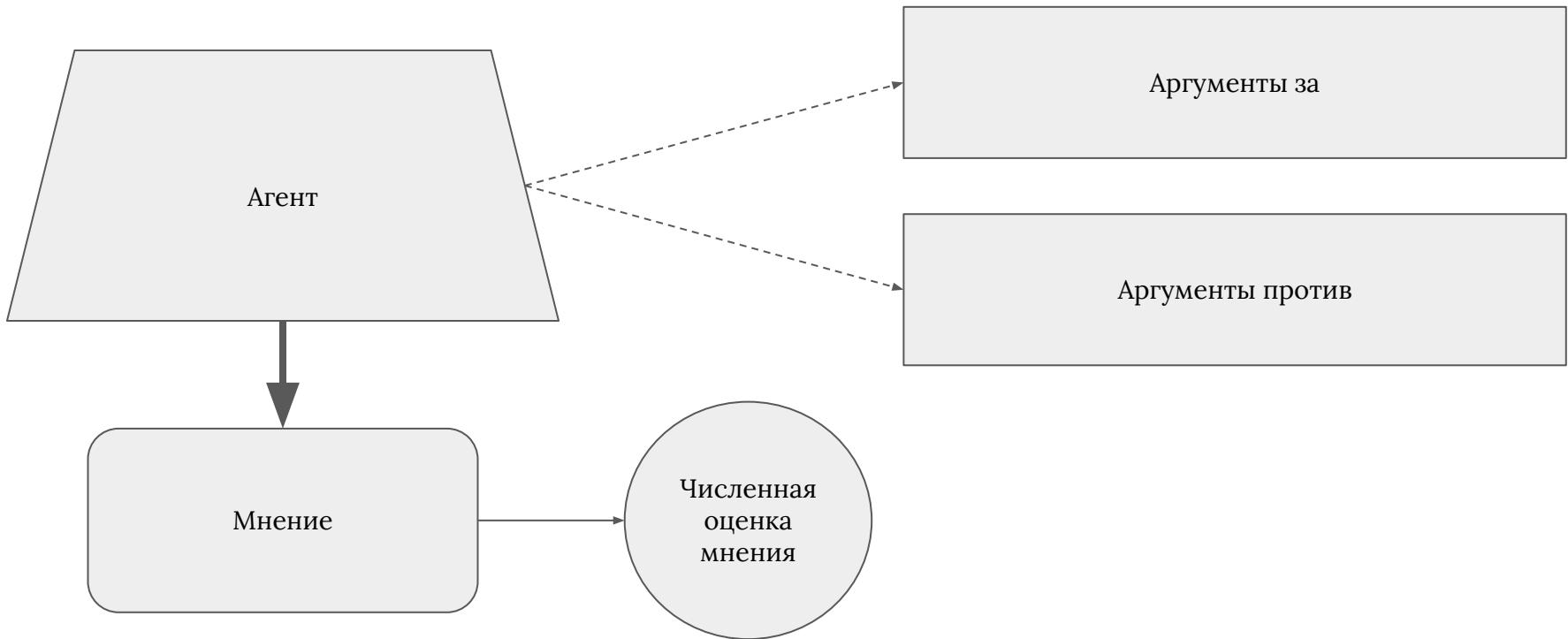


Модели социального влияния: от классических агентов до больших языковых моделей

Хлытчиев Арсений

Научный руководитель: Козицин И.В. к. ф.-м. н. ИПУ РАН

Схема модели построенная на основе формата эксперимента, представленного в статье [6] и на основе LLM модели из статьи [2]

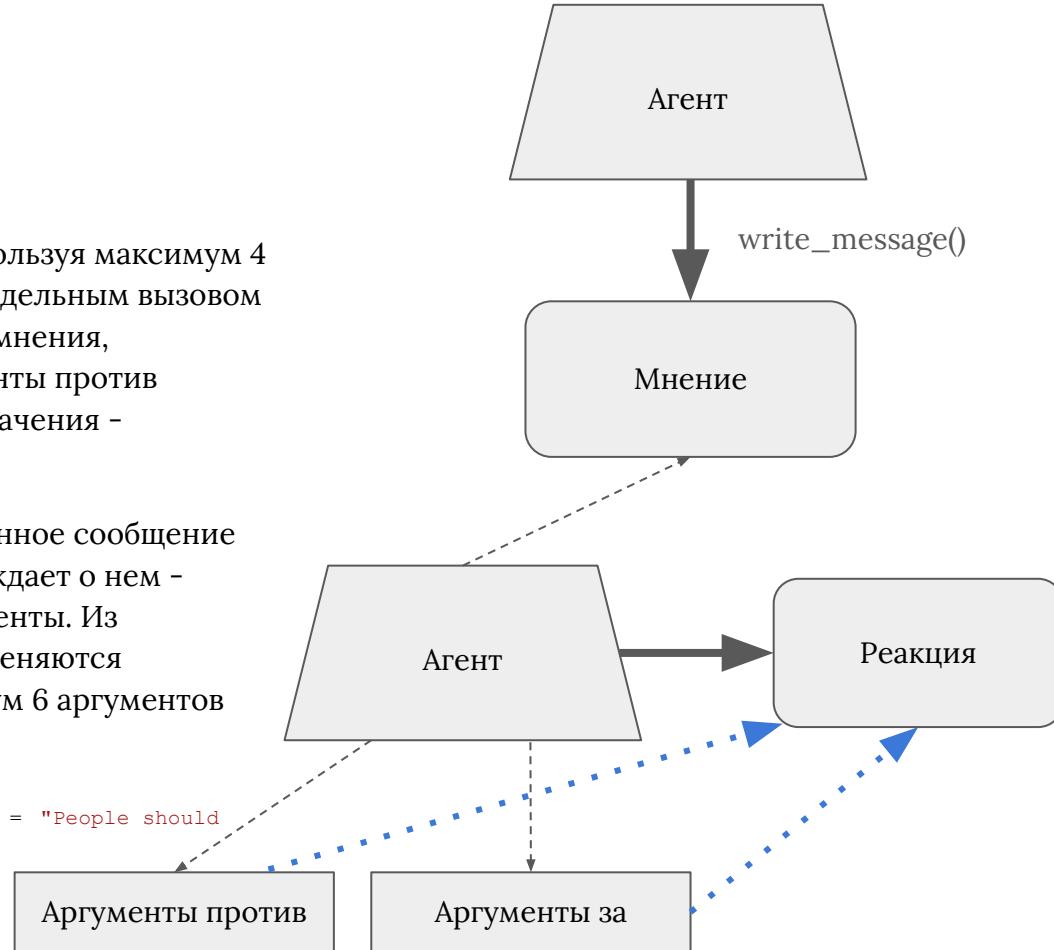


Протокол взаимодействия

`write_message()` - агент составляет сообщение, используя максимум 4 аргумента из своей аргументативной базы, далее отдельным вызовом LLM производится численная оценка полученного мнения, возвращающая результат от 0 до 4: если все аргументы против утверждения - 0, если все за - 4, промежуточные значения - количество аргументов за.

`react_to_message(msg)` - агент реагирует на полученное сообщение (в том числе от себя), на естественном языке рассуждает о нем - соглашается/не соглашается, приводит свои аргументы. Из полученной реакции отдельным вызовом LLM вычленяются аргументы за утверждение и против него - максимум 6 аргументов каждой полярности.

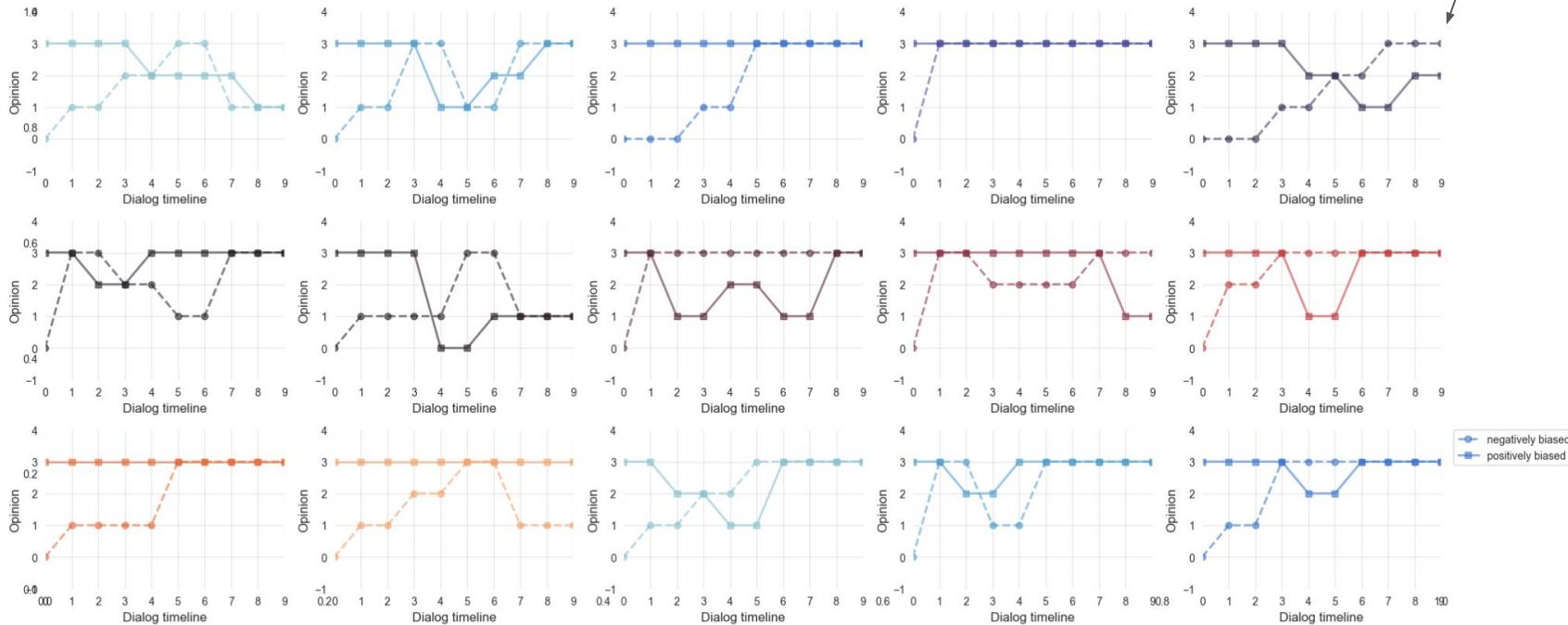
Общее утверждение - топик исследования: `statement = "People should have a right to keep and bear arms."`



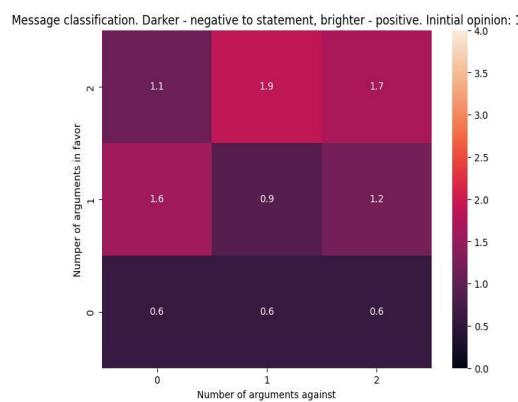
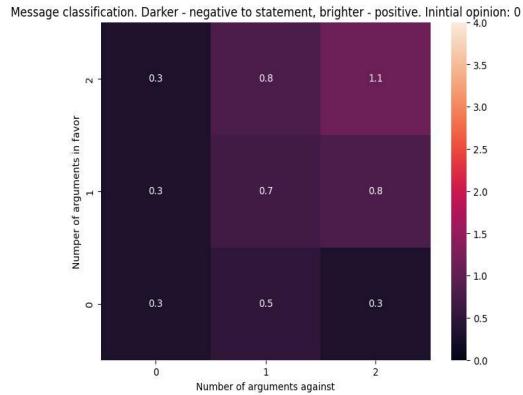
Полученные моделью результаты

Смещение вверх для
большинства моделей

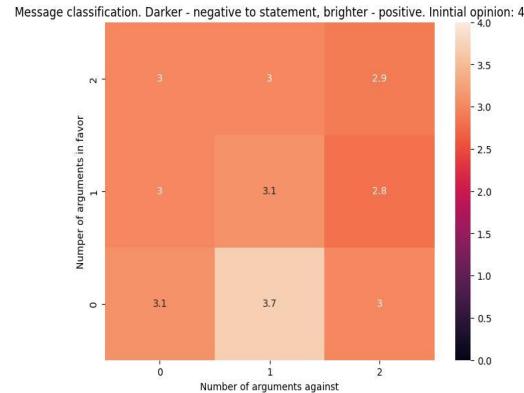
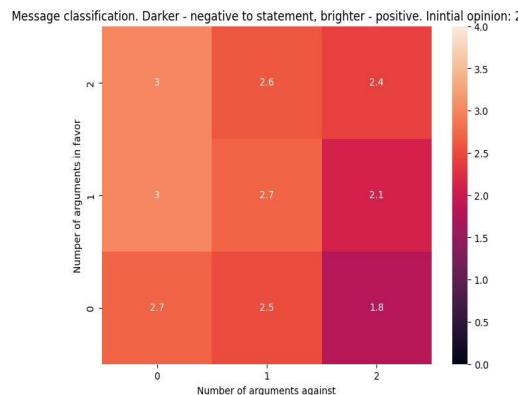
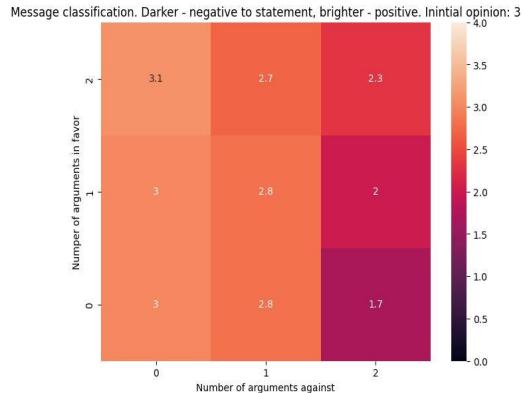
Opinion dynamics of the initially positively and initially negatively biased agents during the pairwise dialogs



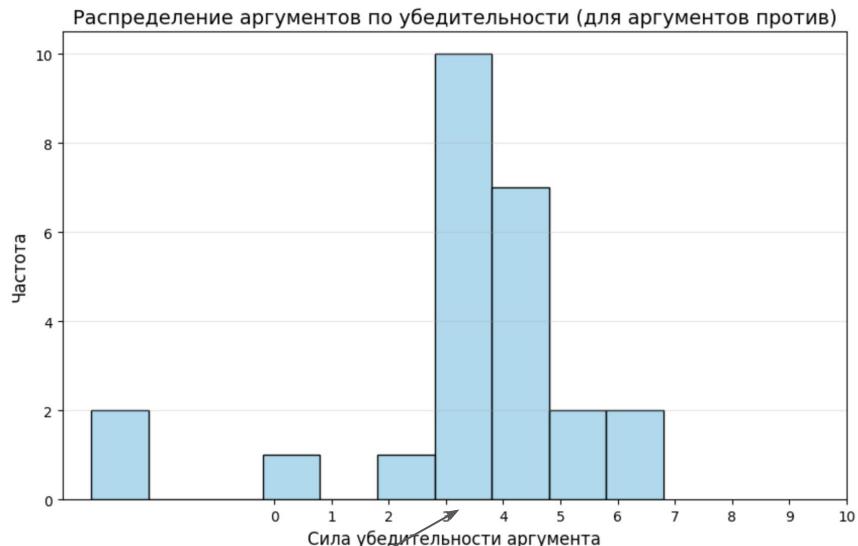
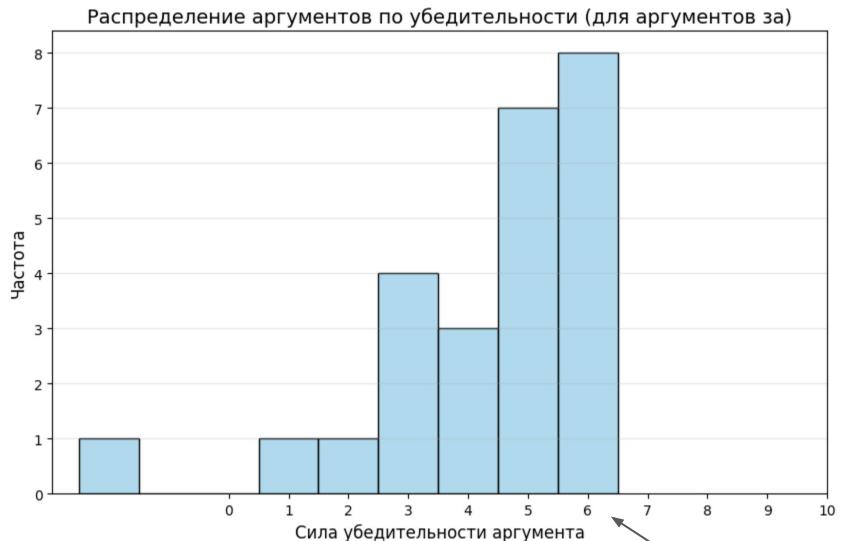
Тепловые карты связи между мнением и количеством аргументов



Тепловые карты (значения - среднее по выборке относительно заранее заданного мнения и варьирующегося числа аргументов за и против) описывают общие тенденции в изменении характера мнения относительно наличия аргументов, но довольно сильно зашумлены.



Степень убедительности аргументов по мнению модели



Повышенная средняя
убедительность аргументов за

Динамика численной оценки мнения при рассуждении агента с самим собой (без получения внешнего мнения и насыщения аргументами)

Рис 1: **0** аргументов за, **12** аргументов против, численная оценка исходного мнения - **0**

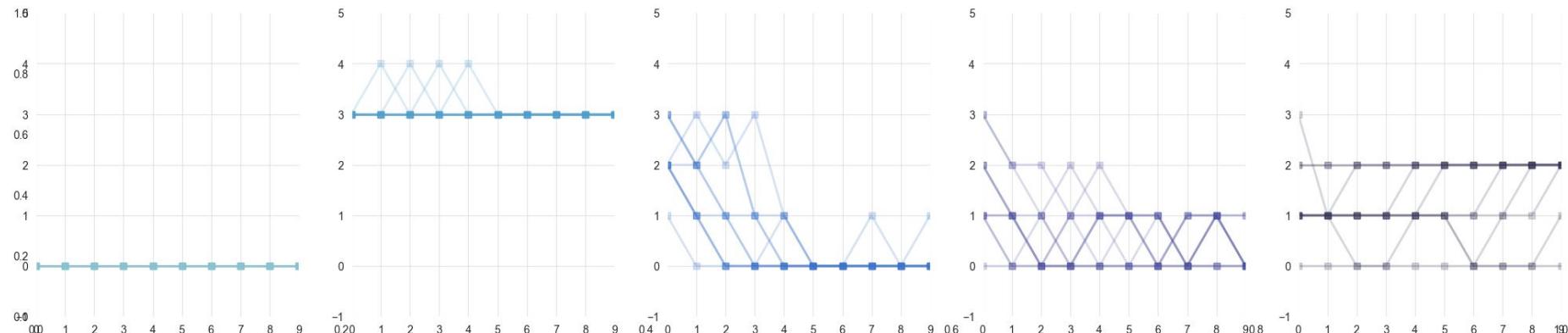
Рис 2: **12** аргументов за, **0** аргументов против, численная оценка исходного мнения - **4**

Рис 3: **6** аргументов за, **6** аргументов против, численная оценка исходного мнения - **2**

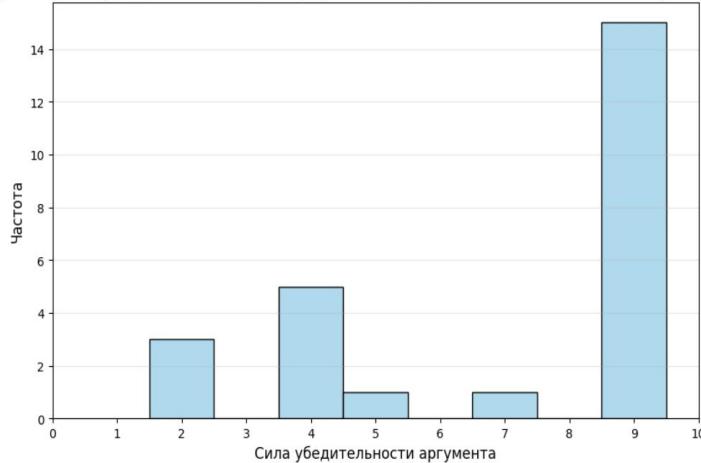
Рис 4: **6** аргументов за, **2** аргументов против, численная оценка исходного мнения - **3**

Рис 5: **2** аргументов за, **6** аргументов против, численная оценка исходного мнения - **1**

Opinion dynamics of the agents during reasonings which was conducted by them own without external influence

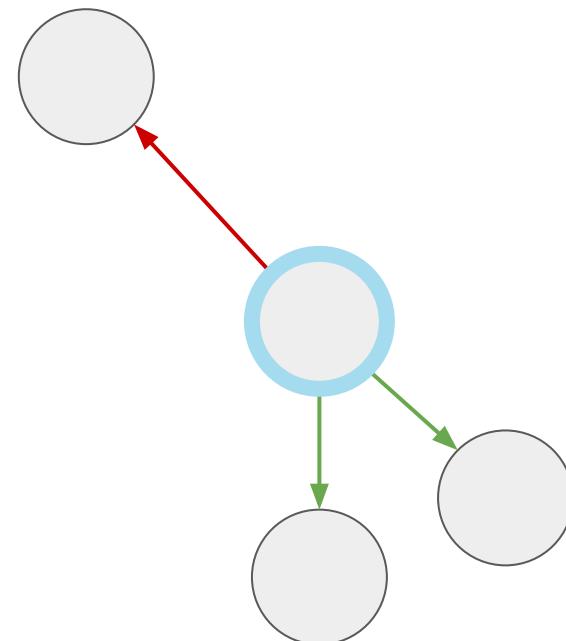
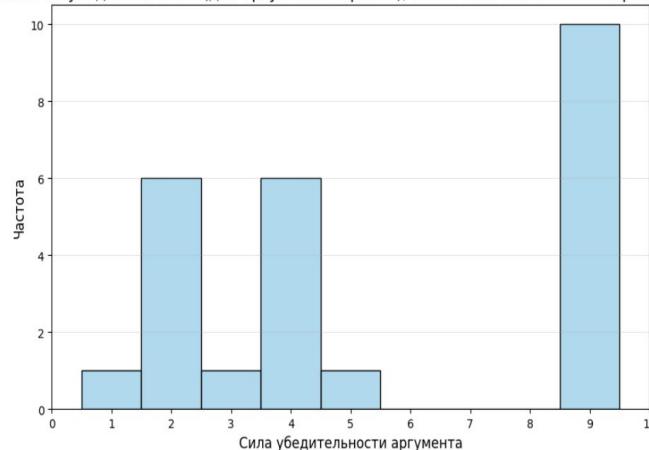


Распределение аргументов по убедительности (для аргументов за), после того как агент поверил в 1 конкретный аргумент



Поиск взаимосвязей между аргументами, построение графа зависимостей

Распределение аргументов по убедительности (для аргументов против), после того как агент поверил в 1 конкретный аргумент за



Планы

1. Изучение характера манипуляции мнением агента
2. Кластеризация аргументов и генерация аргументов определенной степени влияния
3. Выделение графа активации аргументов
4. Уточнение модели относительно статьи [6]
5. Получение математической детерминированной модели взаимосвязи относительно определенной статистики аргументов и численной характеристики мнения
6. Уточнение аргументативной LLM модели

Color map: strictly against agent1 but not agent2 in blue but not strictly against agent2 in green

Agent 1: 1. Public Safety: By removing or restricting access to firearms, governments can reduce the risk of harm to individuals and communities. 2. Gun Violence Epidemic: The United States experiences a high rate of gun-related deaths and injuries compared to other developed countries. Limiting access to firearms could help mitigate this epidemic and reduce the number of lives lost. 3. Easy Access to Firearms by Children and Mentally Unstable Individuals: With insufficient background checks and regulations, children and mentally unstable individuals can easily acquire firearms, posing a significant risk to themselves and others. 4. Culture and Societal Norms: The normalization of gun ownership in American culture has led to a culture of violence and a lack of respect for human life.

Agent 2: 1. Self Defense: The primary purpose of the right to bear arms is for self-defense, allowing individuals to protect themselves and their families from harm. 2. Second Amendment Protection: The Second Amendment to the US Constitution guarantees the right to keep and bear arms, which has been interpreted by courts as essential to individual liberty and freedom. 3. Deterrence to Crime: The presence of firearms can deter potential criminals from committing crimes, as they know that the homeowner or individual may be able to defend themselves.

4. Protection of Personal Property: Firearms can provide a sense of security for personal property, allowing individuals to protect their homes, businesses, and valuables from theft or vandalism.

Arguments of agent1 after listening to agent2: 1. Public Safety: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that the ban on assault weapons and high-capacity magazines is not effective in preventing mass shootings. 2. Gun Violence Epidemic: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that gun control measures have not been effective in reducing gun violence. 3. Easy Access to Firearms by Children and Mentally Unstable Individuals: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that background checks and regulations are not sufficient to prevent children and mentally unstable individuals from accessing firearms.

Agent 1: 1. The presence of firearms in society does not guarantee public safety, as other factors such as mental health support, education, and community programs play a significant role in preventing violence. Instead of relying on firearms for self-defense, it's crucial to focus on addressing root causes of violence and providing peaceful conflict resolution. 2. The right to bear arms is not necessarily an effective deterrent to crime. By focusing on socioeconomic conditions, access to education, and mental health support, we can create a safer environment that does not rely solely on gun ownership for protection. These holistic approaches are more likely to reduce crime rates than simply increasing the number of firearms in circulation. 3. Unrestricted access to firearms may not always be the best solution for preventing mass shootings. While firearms can be used for self-defense, they can also be used for harm. It's important to strike a balance between gun rights and gun control measures to ensure public safety.

4. Protection of Personal Property: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that firearms are not the sole solution for protecting personal property. Other measures like security systems, alarms, and community watch programs can also be effective in preventing theft and vandalism.

Arguments of agent2 after listening to agent1: 1. Self Defense: The argument against agent2 is that it is not strictly against agent1 but is strictly against agent2. This argument suggests that the right to bear arms is essential for self-defense. 2. Second Amendment Protection: The argument against agent2 is that it is not strictly against agent1 but is strictly against agent2. This argument suggests that the Second Amendment to the US Constitution guarantees the right to keep and bear arms, which has been interpreted by courts as essential to individual liberty and freedom. 3. Deterrence to Crime: The argument against agent2 is that it is not strictly against agent1 but is strictly against agent2. This argument suggests that the presence of firearms can deter potential criminals from committing crimes, as they know that the homeowner or individual may be able to defend themselves.

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Agent 2: 1. The right to bear arms can serve as a deterrent in certain situations, potentially reducing crime rates, but it does not guarantee public safety. 2. In areas with high crime rates or gang activity, firearms may provide an essential layer of protection for individuals and communities. 3. The availability of firearms can increase the likelihood of self-defense, potentially reducing the risk of violent crime, although this has been linked with public safety concerns. 4. Education and training on safety, responsible gun ownership, education, and mental health support are crucial for addressing gun violence and promoting a culture of safety rather than using it. Instead, focus on addressing root causes through education and training.

Arguments of agent1 after listening to agent2: 1. Public Safety: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that the ban on assault weapons and high-capacity magazines is not effective in preventing mass shootings. 2. Gun Violence Epidemic: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that gun control measures have not been effective in reducing gun violence. 3. Easy Access to Firearms by Children and Mentally Unstable Individuals: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that background checks and regulations are not sufficient to prevent children and mentally unstable individuals from accessing firearms.

Agent 2: 1. A balanced approach is crucial in addressing the complex issue of gun violence, considering both individual rights and public safety concerns. This includes prioritizing education and training on firearm safety and responsible gun ownership. 2. Effectively combat gun violence, a comprehensive mental health support system must be established to prevent violence caused by mental illness. 3. Addressing socioeconomic conditions and access to education can help reduce violent behavior, creating a culture of safety and nonviolence. 4. Increasing access to mental health services, gun safety training, and community programs can help reduce gun violence. 5. Addressing gun violence through education and training, mental health support, and community programs.

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Agent 1: 1. Community-led initiatives focusing on education, job training, and socioeconomic mobility have proven effective in reducing violent behavior and creating a culture of safety, making them more beneficial than increasing firearm availability for addressing gun violence. 2. Comprehensive mental health support systems, including access to mental health services, gun safety training, and community programs, are an essential component for addressing gun violence.

Arguments of agent1 after listening to agent2: 1. Public Safety: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that the ban on assault weapons and high-capacity magazines is not effective in preventing mass shootings. 2. Gun Violence Epidemic: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that gun control measures have not been effective in reducing gun violence. 3. Easy Access to Firearms by Children and Mentally Unstable Individuals: The argument against agent1 is that it is not strictly against agent2 but is strictly against agent1. This argument suggests that background checks and regulations are not sufficient to prevent children and mentally unstable individuals from accessing firearms.

Agent 2: 1. By focusing on the right to bear arms, agents could limit the types of gun violence, such as community and individual violence, that are available to individuals in their communities. 2. The argument for community-led initiatives, such as gun safety training and community programs, is an effective approach to addressing this complex issue. 3. Collaboration between government agencies, private organizations, and community groups is necessary in addressing the complex issue of gun violence.

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Список литературы

- [1] Chuang Y. S. et al. Simulating opinion dynamics with networks of llm-based agents // arXiv preprint arXiv:2311.09618. – 2023.
- [2] Betz G. Natural-language multi-agent simulations of argumentative opinion dynamics // arXiv preprint arXiv:2104.06737. – 2021.
- [3] Bail C. A. Can Generative AI improve social science? // Proceedings of the National Academy of Sciences. – 2024. – T. 121. – No. 21. – C. e2314021121.
- [4] Carpentras D. et al. Deriving an opinion dynamics model from experimental data // Journal of Artificial Societies and Social Simulation. – 2022. – Vol. 25. – No. 4.
- [5] Flache A. et al. Models of social influence: Towards the next frontiers //Jasss-The journal of artificial societies and social simulation. – 2017. – T. 20. – No. 4. – C. 2.
- [6] Mäs M., Flache A. Differentiation without distancing. Explaining bi-polarization of opinions without negative influence //PloS one. – 2013. – T. 8. – №. 11. – C. E74516.
- [7] Banisch S., Shamon H. Biased processing and opinion polarization: experimental refinement of argument communication theory in the context of the energy debate //Sociological Methods & Research. – 2025. – T. 54. – №. 1. – C. 187-236.