

Technical Challenges in Genome Privacy

Dear participant,

You have been invited to fill out this survey because you are an expert in genome privacy.

In the following survey, we highlight 10 issues in the context of genome privacy research, and ask you to weigh on their importance and difficulty to address.

The survey is anonymous and should take no longer than 10-15 minutes. No personal information will be collected.

Thank you for your time!

* Required

Privacy Overhead

Some technical genome privacy solutions rely on cryptographic tools (e.g., homomorphic encryption, garbled circuits, or ORAM). These might come with non-negligible computation and communication overheads.

1. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

2. How difficult is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not difficult at all / Acceptable solutions exist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely difficult

3. What can be done to address this problem?

4. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert

Utility (Functionality)

Some genome privacy solutions may result in a loss of utility for clinicians and researchers. For instance, privacy tools might limit flexibility, portability, and/or access to data.

5. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

6. How difficult is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not difficult at all / Acceptable solutions exist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely difficult

7. What can be done to address this problem?

8. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert

Utility (Statistical Research)

Some genome privacy solutions rely on differential privacy, which introduces noise to the data. This yields a potential loss in utility.

9. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

15. What can be done to address this problem?

16. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert

Long-Term Security

An individual's genomic sequence does not change much over time. As a result, the sensitivity of the information it conveys may not diminish. However, modern cryptographic schemes typically guarantee security only for 20-30 years.

17. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

18. How difficult is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not difficult at all / Acceptable solutions exist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely difficult

19. What can be done to address this problem?

20. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert

Malicious Security

Some genome privacy solutions are designed for settings where the adversaries are considered to be honest-but-curious as opposed to malicious.

21. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

22. How difficult is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not difficult at all / Acceptable solutions already exist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely difficult

23. What can be done to address this problem?

24. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert

Non-Collusion Assumptions

Some genome privacy solutions involve a collection of entities. These solutions further assume that the entities do not collude with each other, which may be hard difficult to enforce or verify.

25. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

31. What can be done to address this problem?

32. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert

Relevance to Genomics Initiatives

Current genomics initiatives -- such as All of Us in the United States, Genomics England, and the Global Alliance for Genomics and Health -- primarily address privacy by relying on access control mechanisms and informed consent. In the meantime, we lack technical genome privacy solutions that can be applied to such initiatives.

33. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

34. How difficult is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not difficult at all / Acceptable solutions exist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely difficult

35. What can be done to address this problem?

36. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert

Relevance to the Private Market

Direct-to-consumer genetic testing companies, such as AncestryDNA and 23andMe, provide cheap services for personal genome tests. They strive for pleasant user experience and can do better at finding relatives as their customer base grows. In return, they can monetize customers' data, and/or use it for research studies. As such, genome privacy solutions for personal genome tests may lack a viable business model.

37. How important is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely important

38. How difficult is it to solve this problem? *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not difficult at all / Acceptable solutions exist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely difficult

39. What can be done to address this problem?

40. How knowledgeable are you in this area? *

Mark only one oval.

	1	2	3	
Unfamiliar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expert