CS 176: Algorithms for Computational Biology
Discussion Section 1: September 4, 2013

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1. **Open problems in computational biology**

   (a) When did humans and chimpanzees last share a common ancestor?
   (b) What genes impact the risk of diabetes?
   (c) How does malaria become resistant to antibiotics?

   [discuss in groups what data/models/etc you would need to start answering these questions]

2. **Z-scores**

		G	G	A	A	G	G	A	A	G	A	G	G	G	A	A	G	G	A	A	G
Z_k	-	1	0	0	5	1	0	0	1	0	2	9	1	0	0	5	1	0	0	1

[runtime for naive algorithm: $O(|S|^2)$]

3. **Z-algorithm**

		G	G	A	A	G	G	A	A	G	A	G	G	G	A	A	G	G	A	A	G
k	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
case	-	1	2a	2a	2a	2b (i) $Z_j < \|\beta\|$	2b (i)	2b (i)	2b (ii) $Z_j > \|\beta\|$	2a	2a	2b (iii) $Z_j = \|\beta\|$	2b (i)	2b (i)	2b (i)	2b (iii)	2b (i)	2b (i)	2b (i)	2b (iii)	
j						2	3	4	5			2	2	3	4	5	6	7	8	9	
Z_j						1	0	0	5			1	1	0	0	5	1	0	0	1	
$\|\beta\|$						4	3	2	1			1	8	7	6	5	4	3	2	1	
Z_k	-	1	0	0	5	1	0	0	1	0	2	9	1	0	0	5	1	0	0	1	
ℓ	-	2	2	2	5	5	5	5	5	5	11	12	12	12	12	12	12	12	12	-	
r	-	2	2	2	9	9	9	9	9	9	12	20	20	20	20	20	20	20	20	-	

[runtime: $O(|S|)$]