

Mutual Information: RNA sequences

The purpose of this interactive is to teach the principles of the RNA structure prediction method called “Mutual Information”.

Step 1. Create a sequence alignment the same RNA sequence from different species.

Here is a sequence alignment made of RNA sequences from 10 species. The length of each sequence is 15 nucleotides, so there are 15 alignment positions.

RNA sequence 1:

RNA sequence 10:

Length:

Number of Sequences:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	A	U	C	A	A	C	C	U	U	U	G	G	U	U	G
2	C	A	C	A	A	G	C	C	G	G	G	C	U	U	G
3	A	U	C	A	U	G	G	C	G	U	C	C	A	U	G
4	A	G	C	A	A	C	G	U	U	U	C	G	U	U	G
5	C	G	C	A	A	C	G	G	G	G	C	G	U	U	G
6	A	A	C	U	U	C	G	C	G	G	C	G	A	A	G
7	C	C	C	A	A	G	G	A	G	A	C	C	U	U	G
8	A	G	G	A	U	G	C	C	G	G	G	C	A	U	C
9	A	G	C	A	U	G	C	C	G	G	G	C	A	U	G
10	C	G	G	U	A	G	C	U	G	A	G	C	U	A	C

Alignment Position 1 to 15

Mutual Information: Sequence variation

In order for Mutual Information to be able to determine RNA structure, the sequences need to be different from one another – in other words, they need to have variation.

Step 2. Look for alignment positions with variation.

Position 1 sometime is "A" and sometimes is "C".

Length:

Number of Sequences:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	U	C	A	A	C	C	U	U	U	G	G	U	U	G
C	A	C	A	A	G	C	C	G	G	C	U	U	G	
A	U	C							U	C	C	A	U	G
A	G	C							U	C	G	U	U	G
C	G	C	A	A	C	G	G	G	G	C	G	U	U	G
A	A	C	U	U	C	G	C	G	G	C	G	A	A	G
C	C	C	A	A	G	G	A	G	A	C	C	U	U	G
A	G	G	A	U	G	C	C	G	G	G	C	A	U	C
A	G	C	A	U	G	C	C	G	G	G	C	A	U	G
C	G	G	U	A	G	C	U	G	A	G	C	U	A	C

Position 3 is either a "C" or "G" depending on the sequence.

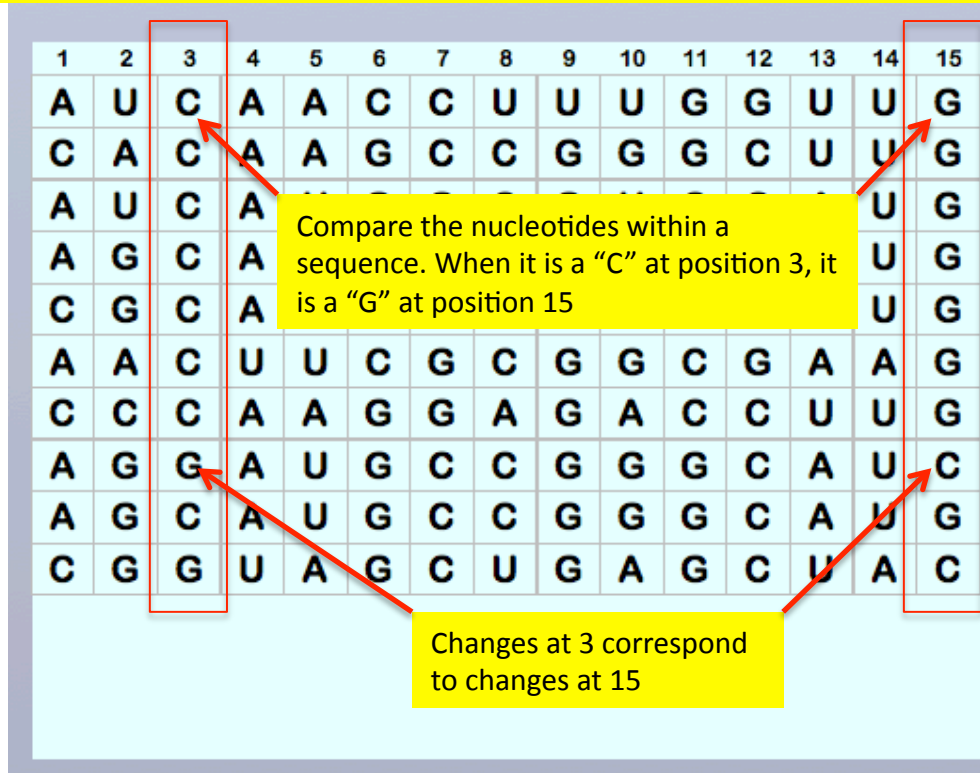
Mutual Information: Co-variation

If you see a pattern where two positions of the alignment co-vary then this is evidence that the two are interacting.

Step 3. Find PAIRS of positions in the alignment that Co-vary (change at the same time).

This is a highly variable alignment. All the positions have at least some variation between sequences. In other words, not all the nucleotides are the same at each position.

The next step is to look for positions that co-vary. I look at the ends and work to the middle. Here I've found co-variation between positions 3 and 15.

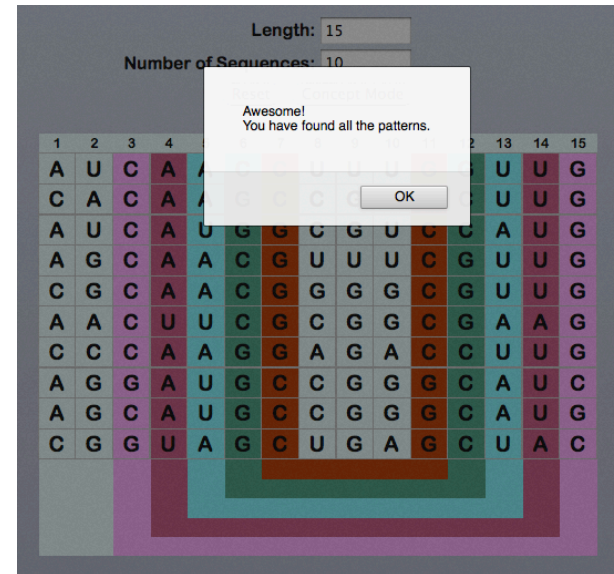


Mutual Information: QUIZ MODE

Click on the columns of the pairs of position that are covarying. For example, select 3 then 15:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	U	C	A	A	C	C	U	U	U	G	G	U	U	G
C	A	C	A	A	G	C	C	G	G	G	C	U	U	G
A	U	C	A	U	G	G	C	G	U	C	C	A	U	G
A	G	C	A	A	C	G	U	U	U	C	G	U	U	G
C	G	C	A	A	C	G	G	G	G	C	G	U	U	G
A	A	C	U	U	C	G	C	G	G	C	G	A	A	G
C	C	C	A	A	G	G	A	G	A	C	C	U	U	G
A	G	G	A	U	G	C	C	G	G	G	C	A	U	C
A	G	C	A	U	G	C	C	G	G	G	C	A	U	G
C	G	G	U	A	G	C	U	G	A	G	C	U	A	C

When you have selected all the pairs correctly, the interactive will tell you that you have found all the patterns:



Here is the first sequence of the alignment:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	U	C	A	A	C	C	U	U	U	G	G	U	U	G

