

# Exercise sheet 6: BLAST

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## Exercise 1

You are given accession number **NM\_000667.3**. Use the BLAST web server to find out about the gene that belongs to this accession number (choose nucleotide blast, and the database RefSeq RNA).

**Question 1A** Which gene is it, and in which organism?

**Solution** Gene: Alcohol Dehydrogenase 1A

Organism: *Homo sapiens* (human)

**Question 1B** Which other organisms does it seem to be highly conserved in?

**Solution**

- *Gorilla gorilla*: gorilla
- *Pan troglodytes*: common chimpanzee
- *Pan paniscus*: bonobo
- *Nomascus leucogenys*: northern white-cheeked gibbon
- *Cebus capucinus*: white-headed capuchin

Many more...

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## Exercise 2

You are given the sequences  $A = \text{TAKTQHTSLPL}$  and  $B = \text{TGTCTTCTGGGTCAGCAAA}$  which stem from the same patient and are supposedly from the same gene.

**Question 2A** What kind of sequences are these (DNA, RNA, Protein)?

**Solution** A is a protein, B is a DNA sequence.

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**Question 2B** If you BLAST these sequences, for which sequence do you expect a lower *E-value*?

**Solution** Even though sequence A is shorter, as a sequence of amino acids it holds more information and should be more unique than sequence B. Hence the E-value for A should be smaller.

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**Question 2C** BLAST both these sequences. Which gene do the sequences come from? Which BLAST result gave you a lower *E-value* and why? (use db: nucleotide collection and non-redundant protein sequences)

**Solution** For sequence A one needs to use blastp for sequence B one needs to use blastn. Result is Forkhead box protein FBXW10. Sequence A gives an E-value of 0.27. B gives  $E = 0.76$  (these numbers can change due to changes in the database, the important message is that  $A < B$  in this case). The reason for this is stated in the answer to the last question.

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### Exercise 3

You are given a nucleotide query sequence  $q = \text{ATAC}$ , and a nucleotide database sequence  $s = \text{ATAAAACGGGGGGG}$ . The word-size  $k = 2$ . Use a simple scoring scheme that assigns a score of 2 for a match and a score of  $-1$  for a mismatch.

**Question 3A** Generate all  $k$ -length words of the query sequence.

**Solution**

- $w_1 = AT$
  - $w_2 = TA$
  - $w_3 = AC$
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**Question 3B** List all possible words for the first  $k$ -length word (AT) that have a score of at least  $T_1 = 1$ .

### Solution

- $s(AA) = 1$
  - $s(AC) = 1$
  - $s(AG) = 1$
  - $s(AT) = 4$
  - $s(CT) = 1$
  - $s(GT) = 1$
  - $s(TT) = 1$
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**Question 3C** Scan the database for exact matches for the words from the question 3B.

**Solution**  $AA$  at position 2,3,4.  $AC$  at position 5,  $AT$  at position 0.

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**Question 3D** Extend the exact matches that you found in the question 3C to the left/right and report all MSPs with a score greater than 4.

**Solution**  $AA$ :

Pos: 2           ATA  
                  |||  
                  AAA       with score 3

Pos: 3           ATAC  
                  ||||  
                  AAAC       with score 5

Pos: 4           AT  
                  ||  
                  AA       with score 1

$AT$ :

Pos: 0           ATA  
                  |||  
                  AAA       with score 6

$AC$ :

Pos: 5           A  
                  |||  
                  AAA       with score 6

MSPs start in the template at index 0 and 3.

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**Question 3E** What happens if we vary the parameters  $k$  and  $T_1$ ?

**Solution**

- Higher  $T_1$ ,  $k$ : - faster (less seeds), - less sensitive (some hits will be missed)
  - Lower  $T_1$ ,  $k$ : - slower (more seeds), - more sensitive (less hits will be missed)
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