

## SUPPLEMENTARY DATA

### CONBIND ALGORITHM

The pseudo code of the MSA algorithm described in the main text is shown below.

*Algorithm 1* Given a list of sequences (*sequencesList*) and a list of motifs families (*motifsList*), the following algorithm produces an aligned list of sequences using the motifs information to optimize the alignment.

```
symbolsList = emptyList()
ForEach sequence in sequencesList
    ForEach motif in motifsList
        subsequencesList = searchForMotifs(sequence, getPatterns(motif))
        ForEach subsequence in subsequencesList
            ForEach base in subsequence
                symbol = getSymbolForBase(base, getFamily(motif))
                symbolsList.add(symbol)
                replaceLetter(subsequence, base, symbol)
            EndFor
        EndFor
    EndFor
EndFor
extendedMatrix = getExtendedMatrix(symbolsList)
alignedSequences = performMSA(sequencesList, extendedMatrix)
ForEach sequence in alignedSequences
    ForEach symbol in symbolsList
        base = getBaseForSymbol(symbol)
        replaceLetter(sequence, symbol, base)
    EndFor
EndFor
Return alignedSequences
```

### WEIGHTS ESTIMATION

The performance of our motif-aware alignment method depends on two parameters; the motif match weight (MMW) and the motif mismatch weight (MSW), as described in the method section of the main text. These two parameters are responsible for the trade-off between overall alignment score and the number of aligned TFBSs. Intuitively, the heavier the MMW and the MSW, the more TFBSs will be aligned on the expense of the overall alignment score. Furthermore, in case of extremely heavy weights, TFBSs that lay far apart on their respective

regulatory regions, can be forcefully pulled together in the alignment, artificially aligning unrelated TFBSs. Contrarily, the weaker the MMW and the MSW are, the more likely it will be for the algorithm to discard the information about motifs and optimize the alignments in the traditional way (i.e. maximising the alignment score). An optimal motif-aware alignment method should produce alignments with a minimal change in alignment score and, at the same time, be able to align all (and only) functional TFBSs. These two objectives, however, are clearly discordant. We can imagine the difference in alignment score as the Cost that we need to pay for a certain gain in Effectiveness, i.e. the number of functional TFBSs correctly aligned.

In order to find the best parameter values and assessing the quality of the produced alignment compared with the efficiency in identifying conserved TFBSs we trained our method using a set of regulatory regions for which the functional TFBSs were previously experimentally validated by the Göttingen Lab in murine cell lines (personal communication). This training set includes 14 regulatory regions (Erg+75, Erg+65, Scl+40, Cx3cr1 promoter, Gfi1b+16 Meis1+48, Gfi1b+17, Pim1+10, Lmo2-70, Scl+19, Lyl1+2, Fli1-15, Gata2-3, PU.1-14) for a total of 114 experimentally validated TFBSs belonging to six motif families (i.e. ETS, GATA, EBOX, GFI1, MEIS, and RUNT). These 14 mouse regions were aligned to seven different organisms (i.e. *Homo sapiens*, *Bos taurus*, *Canis lupus familiaris*, *Loxodonta africana*, *Monodelphis domestica*, *Sarcophilus harrisii*, and *Ornithorhynchus anatinus*) using ConBind. We performed an exhaustive parameter sweep running ConBind with different MMW and MSW pairs, such that  $1 \leq MMW \leq 50$  and  $0 \leq MSW \leq MMW$  (notice that assigning a heavier weight to a mismatch would not be a sensible option), for a total of 1325 runs. The sum-of-pairs score as defined by Thompson *et al.* (1999) was used to assess the overall quality of the produced alignments. For each ConBind run (with a specific MMW and MSW pair) two values were computed for each region  $R$ . The cost

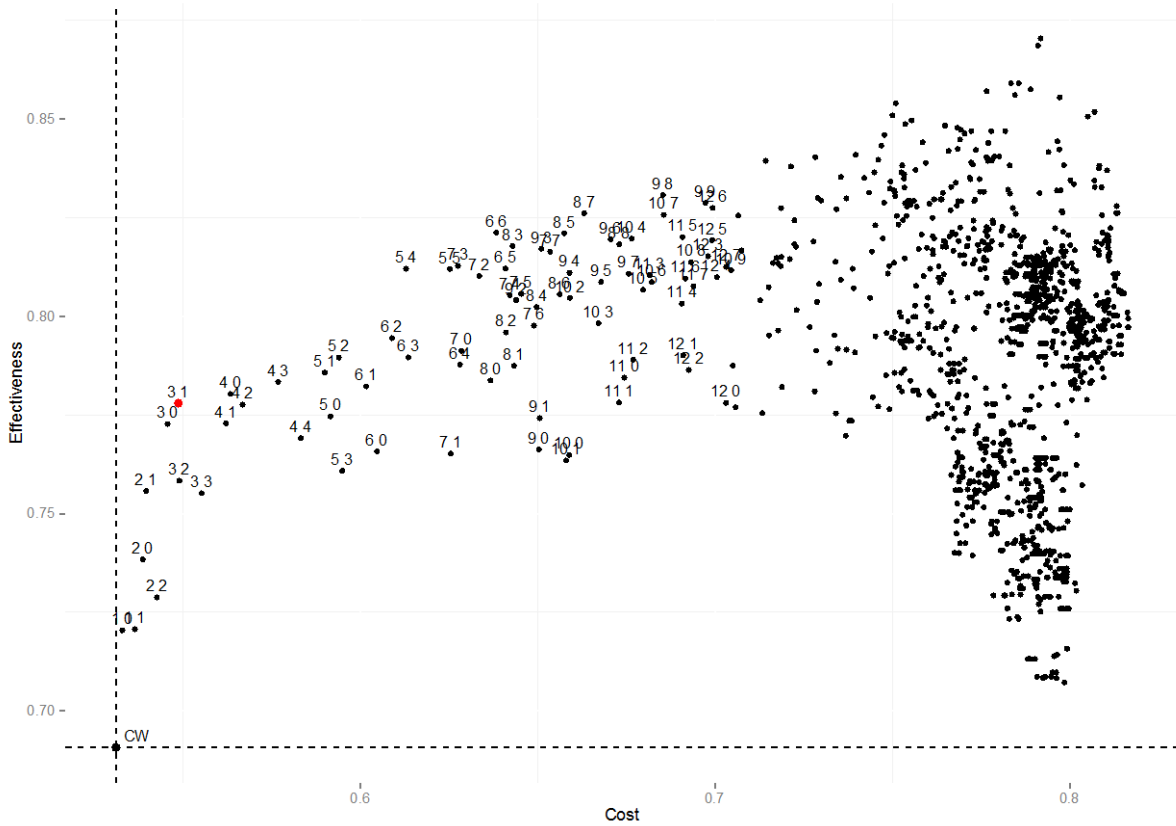
$$Cost_R(A_R^{MMW,MSW}) = 1 - \text{Sum-of-pairs Score}(A_R^{MMW,MSW}),$$

where  $A_R^{MMW,MSW}$  is the alignment of the region  $R$  produced by ConBind using the weight pair MMW,MSW. The columns corresponding to TFBSs were excluded in the Cost calculation. Notice that a perfect alignment yields a sum-of-pairs score of 1. For a perfect alignment  $A$  we expect  $Cost_R(A_R^{MMW,MSW})$  to tend to 0. The second value we computed is the effectiveness

$$\text{Effectiveness}_R(A_R^{MMW,MSW}) = \frac{\sum_{T_R^i} \frac{n(T_R^i)}{H}}{T_R}$$

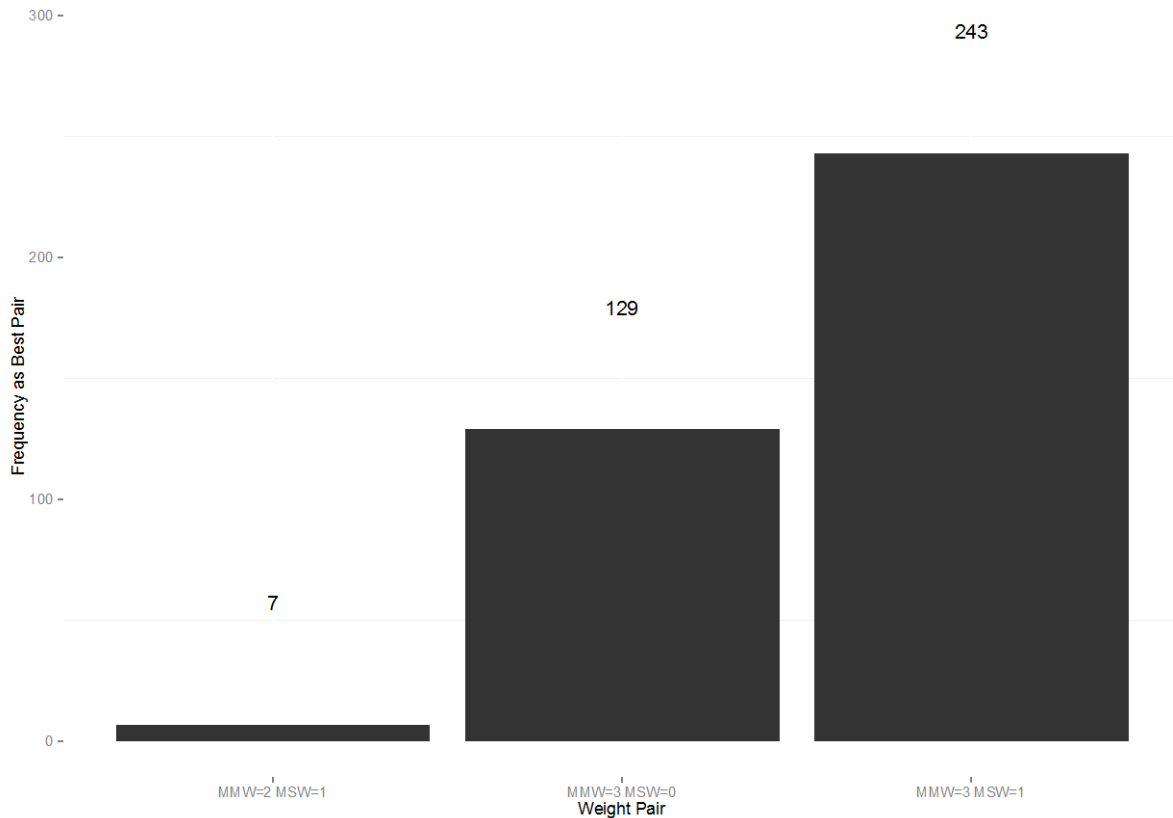
where  $T_R$  is the total number of experimentally validated TFBS on the mouse region  $R$ .  $T_R^i$  is the  $i^{\text{th}}$  experimentally validated TFBS on the mouse sequence,  $H$  the number of sequences used in the alignment and  $n(T_R^i)$  is the number of organism (including mouse) in which  $T_R^i$  is aligned in the same position. Notice that for every  $i$ ,  $n(T_R^i)/H$  should approach 1, since all  $T_R$  have been experimentally validated and should be conserved in  $H$  sequences. Therefore, we expect  $\text{Effectiveness}_R(A_R^{MMW,MSW})$  to tend to 1 for an alignment  $A$  that shows highly conserved  $T_R$ . Supplementary Figure 1 shows the mean Cost and Effectiveness (over all 14 regions) computed

for every MMW, MSW combination. Notably, every weight combination shows an improvement in terms of efficiency over ClustalW2 alignments of the same regions.



**Supplementary Figure 1** Mean cost and effectiveness of 14 benchmark regions for every MMW, MSW combination. Each dot corresponds to a weight pair, where the number on the left is the MMW and the MSW is on the right. The point labelled CW shows the cost and effectiveness computed using ClustalW2. The dot in red shows the weight pair with the best cost-effectiveness ratio after cross-validation.

To reduce overtraining we computed cost and effectiveness using different subsets of the 14 regions. Specifically, we used every possible subset using 100%, 90% and 80% of the 14 regions, for a total of 379 subsets. For each subset we chose the MMW-MSW pair with the best cost-effectiveness ratio. For roughly 64% of the subsets the best weight pair had a MMW=3 and MSW=1. Supplementary Figure 2 shows the best weight pairs for the entire cross-validation study.

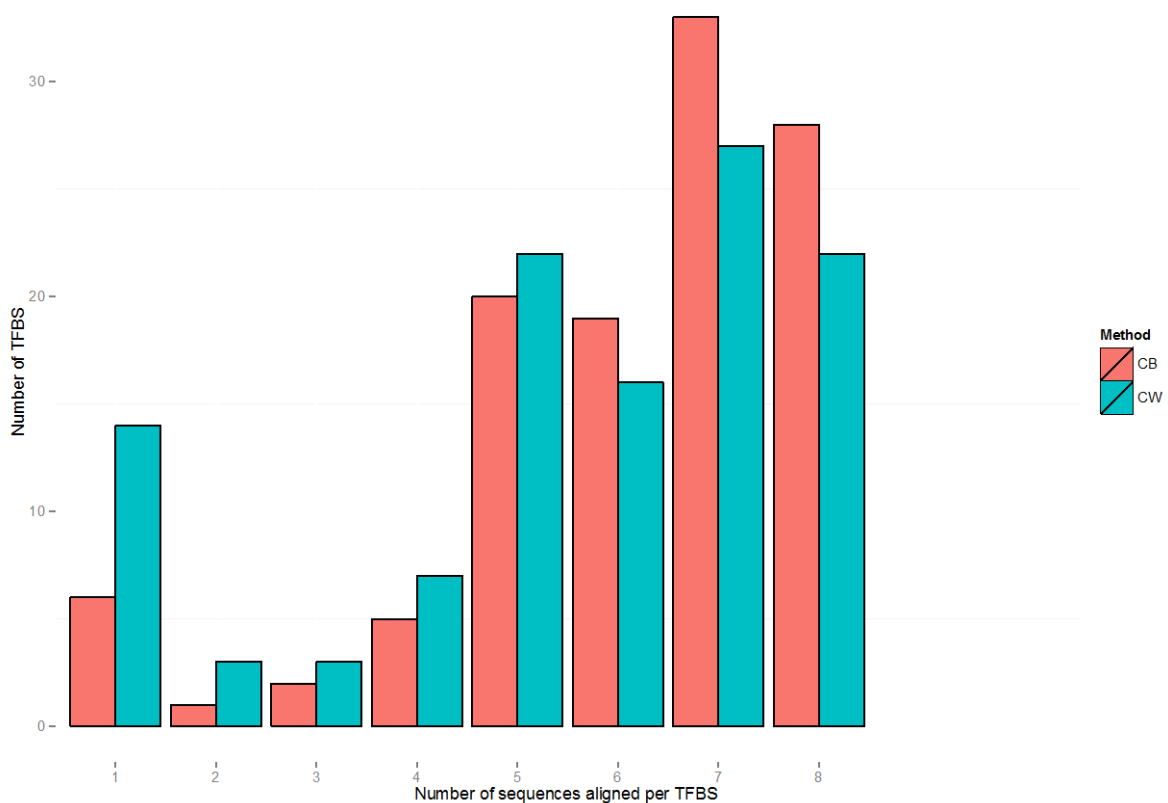


**Supplementary Figure 2** Only three weight pairs (over the total of 1325 tested) attained the best cost-efficiency ratio in at least one of the cross-validation subsets. Particularly, the pair with MMW=3 and MSW=1 is the one with the best cost-efficiency ratio for roughly 64% of the cross-validation subsets.

Using the weight pair selected by cross-validation (i.e. MMW=3 and MSW=1) we compared the alignment of experimentally validated TFBSs between ConBind and ClustalW2, as shown in Supplementary Figure 3.

## PRALINE AND PROGRESSIVE MULTIPLE SEQUENCE ALIGNMENT

The progressive multiple alignment step was performed with a flexible sequence alignment program, a reimplement of the available PRALINE MSA toolbox (Heringa, 1999). This tool was developed in-house and thus has support for required features such as the use of custom symbol alphabets and weight matrices during the alignment process. In order to reduce the number of parameters, we used default settings and implemented a minimal tree-guided progressive alignment strategy. A reasonable default was chosen for the linkage method during the hierarchical clustering (UPGMA).



**Supplementary Figure 3** For each experimentally validated TFBS we counted the number of species in which the TFBS was aligned in the same position. ConBind (CB) can detect a higher conservation signal compared to ClustalW2 (CW), indicating that ConBind aligns more TFBSs.

## GENERATING THE GFI1B+13 CONSTRUCTS

Gfi1b+13 wt (chr2:28,457,606-28,458,256; mm9)

CAGGTGCTAGATCCCGTCATTTGGGACCAATACCTAGTTGTCCCTAGTAAATTTATGTCTACAGGGACCTGGAAC  
 CTTGGCAGTTAGAACAGAATTTCTAGGTAGAGCAGGGCCCTGCCTTAGGAACTGAGATCTGGACAGTGGACACT  
 TGACTCTTCTAGGACACACAGAATTAGTTCTGGGAAGATGCCACCCAGTGGCCCCATAGATCTAGCTGGGTT  
 TGAGCCCTGCCAGGAGCCAGGCTGGCCCTGTGCTTCTCGGAACCATGAGTGCAGAAAGGCAACTGGAG**GGAAAT**  
**CT**GAGGCAGGACACGGTCAGACCTAGCCATGCTCAGGTTTGGCCT**EAT**AGTT**EAT**CAGCCTGTGCCGGCTGCCA  
 ACTGTCAGCATGGAGCCTGGCAGGGGGCTGGGTGGGAGGACACTCCTGGGTC**EAT**AGCGCC**TTC**AAGTGT**EAT**C  
 AGGGCACCGTGGCCAGAGCGCGGAAACGGGTGAAACAGGAGAGAAAGAGAC**TTC**AACCACTTTACCCAAAG  
 AAAAGCACTGGGAGG**GGAA**CCGAGGCCTCAGTG**TTC**TGGACCCTGACCTGCTGTGAAACCAGCAGTCACAGCTG  
 AGTCCCAGGGAGGCACAGGCTGAGGACCCTGCCACAGACATCCAGAGGGAA

Gfi1b+13 mutants for Gfi (yellow) and Ebox (blue) were generated using standard recombinant DNA techniques using the primers listed below.

Gfi1b13\_Gfmut\_Fw                    ggaattctgaggcaggacacggtcagacc

Gfi1b13\_Gfmut\_Rv                    agaattccctccagttgccttctgc

Gfi1b13\_Eboxmut\_Fw ttctgcagttatcaggggcaccgtggc

Gfi1b13\_Eboxmut\_Rv taactgcaggaaggcgctatcgaccagg

The Gata (green) and Ets (purple/red) mutants were generated by GeneArt® Gene Synthesis (Gata and Ets1-2) or GeneArt® Strings™ (Ets3-5) from Life Technologies. The whole Gfi1b+13 enhancer fragment with the relevant point mutations was ordered and subsequently cloned into pGL2 promoter vector from Promega.

Gfi1b+13\_Gata (generated by GeneArt® Gene Synthesis from Life Technologies):

1<sup>st</sup> GATA-GGTA, 2<sup>nd</sup> FATC-GATC, 3<sup>rd</sup> GATA-GGTA, 4<sup>th</sup> FATC-GATC

Gfi1b+13\_Ets1-2 (generated by GeneArt® Gene Synthesis from Life Technologies):

1<sup>st</sup>: GAGGGAA – AAGCTTA                      2<sup>nd</sup>: GCCTTCC – GCTAGCC

Gfi1b+13\_Ets3-5 (generated by GeneArt® Strings™ from Life Technologies):

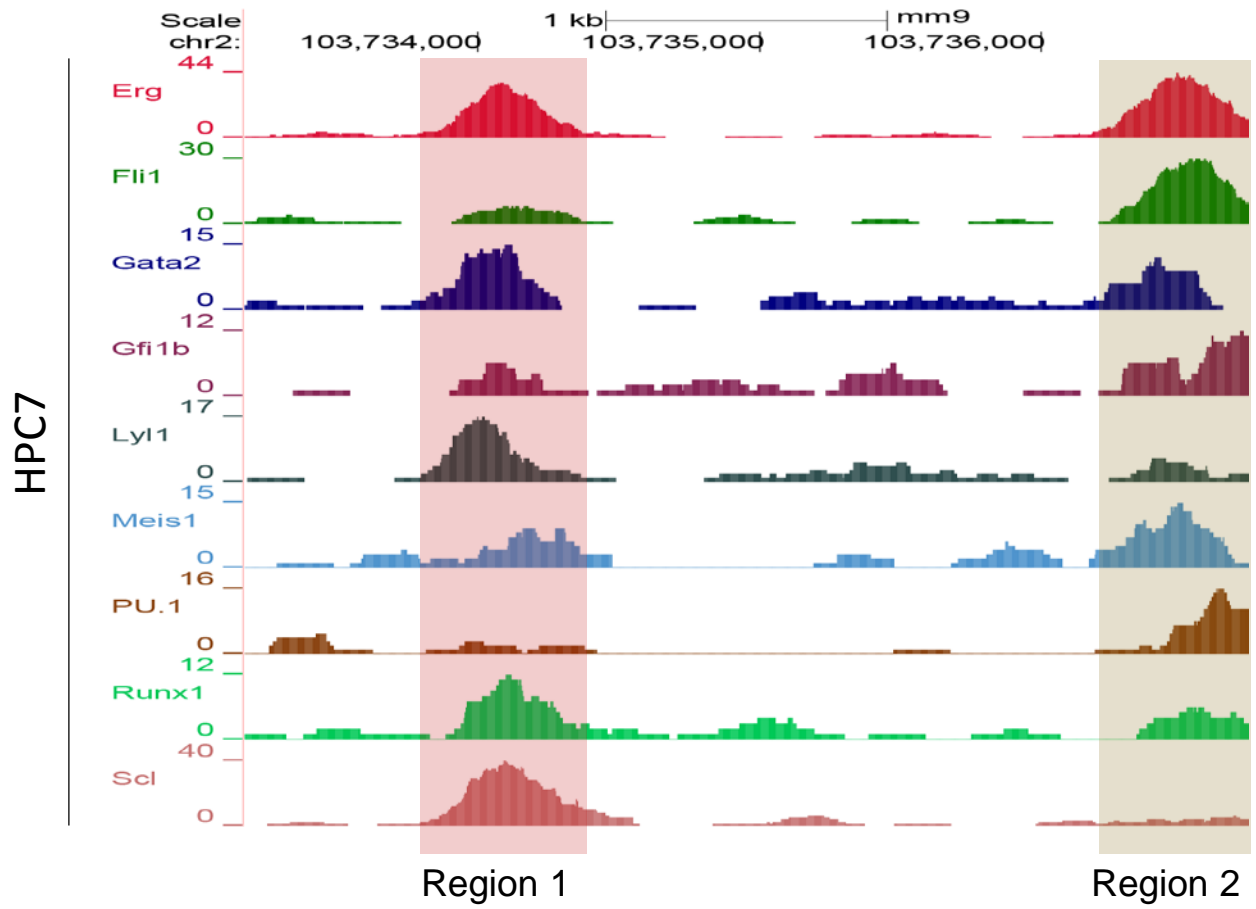
3<sup>rd</sup>: TTCC – TTCC   4<sup>th</sup>: GGGAAC – GACGTC   5<sup>th</sup>: TTCC – TACC

**Supplementary Figure 4** ConBind identifies conserved TFBSs within the Lmo2-75 enhancer. **A.** The previously described, hematopoietic active regulatory region for the Lmo2 gene (called Lmo2-75, (1)) is 3.5 kb long and is comprised of two sub-regions (region 1 marked in red, region two marked in yellow) that are bound by several TFs in the hematopoietic progenitor cell line HPC7. **B.** Luciferase reporter assays in stably transfected 416b cells, a myeloid progenitor cell line, reveal that both sub-regions of this enhancer are transcriptionally active on their own. Shown is the relative luciferase activity of the wild-type (wt) enhancer compared to an empty control vector. **C.** ConBind's algorithm results in aligning two ETS motifs, one Ebox and one Gata motif within sub-region 1, matching the TFs binding to this part of the enhancer. ConBind is able to find additional ETS and GATA motifs (six and four in total, respectively) within sub-region 2 of the Lmo2-75 enhancer. **D.** Manual identification of TFBSs within the two TF-bound sub-regions of the Lmo2-75 enhancer was performed as described in Figure 4A. Despite binding of Erg, Gata2, Lyl1, Runx1 and Scl (see A), no conserved TFBS could be observed within sub-region 1. In contrast four conserved ETS motifs, two conserved GATA sites and three conserved GF11 motifs are located within sub-region 2 where binding of the ETS factors Erg, Fli1 and PU.1 as well as Gata2 can be seen (see A).

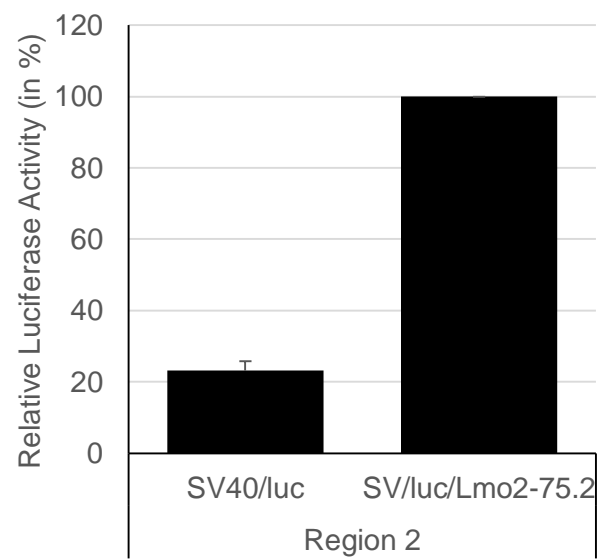
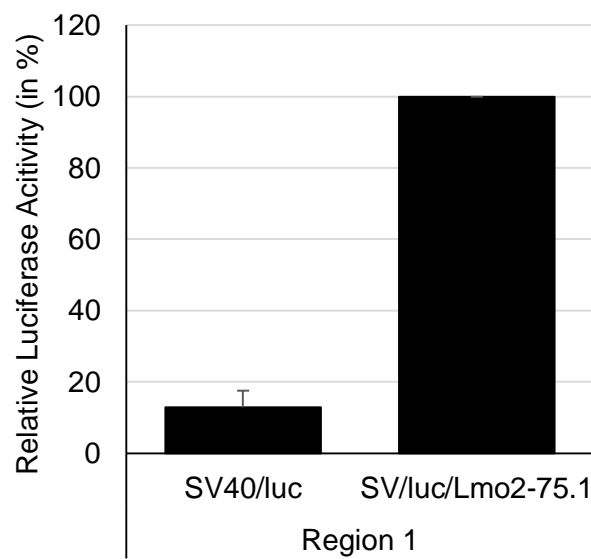
1. Landry, J.R., Bonadies, N., Kinston, S., Knezevic, K., Wilson, N.K., Oram, S.H., Janes, M., Piltz, S., Hammett, M., Carter, J. *et al.* (2009) Expression of the leukemia oncogene Lmo2 is controlled by an array of tissue-specific elements dispersed over 100 kb and bound by Tal1/Lmo2, Ets, and Gata factors. *Blood*, **113**, 5783-5792.

# A

**Lmo2-75:** chr2:103733174-103736735



# B





C

### Legend

**EBOX** **ETS** **GATA** **GFI1** **MEIS** **RUNT**

Alignment Quality: Low High

## Lmo2-75

chr2:103733174-103736735

10090 (house mouse) CTCTCTGGGGCTTTCTTGGATCCCTCCAGAACTTTCCCTCTTTTTGATTTTTTTATAA  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 -----GAGCAGAGGGA-----A-AGGGGGA-AAAGAGGGTTTAGCTCGGGAG

10090 (house mouse) AGGC AAAAATTTAATTGGGAA TAACTTA CAGATG CAATAAGCATCCATTATTATTATG  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 -----GAGATGCATGCGGTGAGGGGACAGGTTCC-----A--ATG  
 AGGTAAAGGGGGGTGGCAGAGGGAGTAGAG-GGAGAAGAGGAGCTCAGTCTGGAAAG

10090 (house mouse) GCATCATGCAGGCAGACTTGATGTTTGAAGAGCCTCCAGCCTTGATTCAAAGACAGCC  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 AGAGTAGCCAGTCTG--GTGAAGGACT-CAAGCTTT---CTGGGTGGAGACGTCTCA  
 GCCTC-TT--GGA-----G---GAGGTGAGTTTTAAG-TAGGGTTTTGAAGA---

10090 (house mouse) AAGAGGATGATATCTTCTGCATTGGGTAGAGCTTGTATAGGACCTCAAAGCCCAATT  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 GAAGGGAT-----GTGCCAGTTCTGTTCAAATATTTGAAG--CAT  
 -----GGGGAAGAGA---ATCAGTTTGGTGGAGG-----T---GAGGAGGGAGGGCGTT

10090 (house mouse) CC---CACAGTGACTCACTTCTTTCAACAG--GCCA-C-----ACC-TACTCTAAC  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 TC-----C  
 CCAGGACCGCGGGAGGACGTGTTCCAGGGGTGACGGCGGGGATAGGGAGACCGAGTG

10090 (house mouse) AAGGCC---ATATATACTCCTAATAGTGCCACTTTTCCACTTCCCTGGGCCAAGTA  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 -A--C---ATAGACCGCCACAGAG-ATCGGACTTAAATTTCC-----TACGG-  
 ACGGTGAGGAGGTGGGCGGCAGAGGAGCGGAGCGTGGGGGTGGGGGTAGAAAGAGA

10090 (house mouse) TATTCAAGCCACCATAGCACCCTCAAAGAGCTGGTTGCAGTTTGATTTTTATTAGTA  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 --TTCTGGAGAGCACAGCAAGAACCAAAA-CGATGGCTCCA-----  
 GAAGGGAGGAGAGGTAAGAAAGGGCAAGGTGATGGAGAGCCTTGAAGCCTAGAGTGAG

10090 (house mouse) CTGATTGTCCTTTTGTCTTCACTTTGA--GTACACTCTGAACCTT-ATT-----GA  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 -----G-----AGA--CACAACTTGGAC-----T-----CA  
 GAGTTTTTGTTTGGAGCGGAGGTTGATAGGCAACCCTGGAGTTGTTTAAAGAGGGGA

10090 (house mouse) GTGACACTGACCTCCAGTCTTCTAGTGATCTTAAACTTGGTCAAGGGAGAAAT-CT--  
 9615 (dog) e-value: 5e-75  
 13616 (gray short-tailed opossum) e-value: 1e-46  
 9606 (human) e-value: 3e-111  
 9258 (platypus) e-value: 8e-40  
 ATGACA-----GCAAGAAAGGTCCATCAACCAGAACTTCTGAAAAAGAAATGA-GC--  
 GTGACA-----TGCCAGATCATTCTGCAAGAAAGATGAGCCGG

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

-C-TCTGGTTTTGCTTGCTACTATAGTTCCATGCCAATACAGTGCTTAGCACACAGT  
-C-ACCTTTCTGGAA GTGTTCAAGCCTGGCCTG---GGTATGGTCGTTTATTCCATTCC  
-----  
GCAGCAGAGTGAAGAATAGACTGGAGCGGGCGAGAGAGGAAGAAAGGAGGTCAAAGA

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
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9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

AGGGACTCATAAGTAAGTTACCAATAAGATA-----AGTTTCATGGCTGGCTGGCTGA  
A--G-----ATA TGTAATGAGGGATG-----TTCCCTAGGCCTGCTGTTTGT  
-----  
GAAGGCTGACACAGTAGTCTCTCCGGATAAACGAGAGCCCGTAGCAGTAAGGTAGC

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

ATAAATGAATGAATGGATATTTTATAAGTGGTCAAAGATGCCAAAACATCAAAGTAACA  
GAGAAAG-A--GCTGGAT--GCTGGAGTAGGGGAGAGAGAAATCTAATAAGACAAA  
-----ATCTCAGACAATCTTAGCTGTGTGACCCCTGGGCAATC-----ACT  
-----  
CGTTTGGGTGGAGAAGAA-----A---GGGCAGAT-----

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

TGCTTAAAGGTACACCATAGCAAAGCTGGTCTTATAAGACAC-GACCAA-G--CGGA  
CAATTAAG---CCATTCAT-TAGTAGCTCAATAT-----G--TGGGTTCAG  
TACATTCATTGC---CTAGCCCTTACTGCTC-----TTCTGTCTTTGATTCCAA  
-----TGCGTATAGTCACTGTTCAATATGACTTCGGACCAAGGAAATTTG  
-----CTTGGCAGAT--TTGTAGAGGTGAAACTGACA-----

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

GGCTGTATTATTACATTAGGTAGAACTCAAAGCCAAAGTCAACCAATCCCTTTGAAC  
CACTTACATGC-ACC-AAGGACCGAAGTAACTACTTTGTGGGCATGACCACCTAATCC  
GACAG-AA-----GAAAGAAAAGAAAG-aaagaaagaaaaagaaaaagaaag  
GACTGAAATGCTCATTAGAGAGCAACTAAAAGCCAAAGTCAGCTAATCCCTTTGAAC  
-----GGTCTTGGTAACAGATCGGATGTGTGGGGTGAACGAGAGAGACCGAGTC

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

CAGTGTAGATA-----GAGTA--G-----AGTTGAGCCATATCTTCTGAGGCAGCTAA  
T--CATGACA-----ATCTTGGGCATTAAGTCTACAAATATC-----ACC  
---GAAAGAA-----TAAAAAGAAATAAGG-GAGGAAA-----  
AGGTAAGACA-----AAGTT--G-----GGACTGGATATATCTTCTGAAGCAGCTAA  
AAGGATGACACCGAGATTGCGGGCCTGAGAGACGGGAAGGATGGTCGTGCCATCCACG

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

CTGTTACAGGAGAAGGAGGGCTGAGGAGGGGAAAGGGGGTGGCTCAGGCCCAATTA  
CTGTTAGA-G-----ATCGGGAGACTGACACTGAGAGGAGTAAAATA  
--GAGAGA-AAGAAAGAAAGAGAAATGAGAAAGAGAGAAAGAAAGAAAGAAAGAA  
CTGTTAC-----ATGA---AGACAAGGGAG-TGGGAGGTCTCCTGGGCCCAATCC  
GTGATAGAGAAGTCTGGGAGAGGAC-CGGGTTTGGGAGGAAAGATGAGGAGCTCAGTC

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

AGTGCCTCAGAGGCTGTAGTAT-ACTCTCCAGATCCAGATGCTCACACAACCTGGC  
ATTTGCCCAA-----G-----TCACACAGCGAGGAAAG--TACAGAGCTGGGA  
AGAAANNN  
AATCCATCAAAGACCATAGTGTCCCCTCCAGATCCAGATGCTCACACAACATGGC  
TTGCTCATGTTGAGTTTTAGGTGGCGGGCCAAATC-CAGGTC-----

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

CTGAGAAGATTAGAGCTGGTCTTCCCTGTGGCT--C---C--T---GCTGTATC  
CT--CA--AAT-----CC-----T---AACCACCAAGCTATTA--  
NN  
CAGAGAAGATTAGTACTGGTCTTCCCTGTGGCTCCCTGATGCTGCTATCCAGCTGTATC  
-----GAGACATCC-----T-----G-----G

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

TGACCAACCTGTGCTGCTGAC--ATTGAGGAGGCTGAGTCTGGGCCCACTCAAAG  
---CCATTCTGTGCT-AC-AGC--ACC-CT---GC-TCCCCTCTGCCTCCCCTC---  
NN  
TGGCCCAACCTGTGCTGCTGCTGCTGCTGCTGCTGCTGCTGCTGCTGCTGCTGCTGCT  
AGGCAGGAGGAGATGCGAGCCTGAAGGGAGGGGGAGAGGACAGGGACGGAGATGTAGA

10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46

GGGCCCT-ACATCTTCTCAGTAAACTACTTCCAGCTCATGCTGGGGTGGAGTGAA  
--TACCTCCAATCCCTTCTATTAGAGCATAAAGCCTATTA--GACCATTAAGAGAA  
NN

9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

GGGCCCTGTCATCTTCCATTAAAGCTACCTCCA----TTACTTCTAGTGACGGAAAT  
TCTGCGTGTCACTCTCATAGAGATGGTAGTCAAAG-----C----CATGAGAGCGAA



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

AGTGTCCCCTGACGATAGAGGAGAGGATTTGGTCTCTAGAATGACCTCCTGTCTC  
TTTCTCCCA-----AGAAAGTTCGTCAAGATGGGCCCAACAGAACAGCAACTAA  
NN  
GTTCTACCAGTACAGGGCATTTGGGTGTGCTTAGTCTCCAGAACCCCTCTCATTAA  
TGAGT-----TC-----ACCGAGGGAGTGAGTGTAAATGGAGAACAGAGAGGG



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
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9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

TCACTAACCTCATGGTTTAGGTGCCACA--GG-AGTGGA-----G-----A  
CAACAGAAAACGCCCAAAATTGGGAGAAATTACTAATTTCAGTACAATTTGCAAAATCA  
NN  
TCAGCCACCTCAACCATTTTGGTGCATAGGGGCAGAGATTACCTCCGTAACAAAA  
CCA-AGAAGTACCTTGCTCGTTGCCCGTACCCCTCTAA-TAA-TAT-T---AATA



10090 (house mouse)  
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9258 (platypus) e-value: 8e-40

-CTTAGAAATGTGCAACGTAATCCCTGCTAACTGGGTGAGCCTTCTGATGTCTTAGAT  
TCT-TGGGA----GAGAGTCTTCCC-----  
NN  
TATATGAAACTGGATGGTGTTCCTGTTAAACGAATGAGTCTTCTGATTCTTTGAT  
ATGTTGGTATTGTTAAGCATTTACTATGTGCAGAG-CACTGTTCTAAGCCCTGGGGT



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

CTCAGCGTCCCGTGAAATTGAGTGGGATA-----A-CTCCACAGTCTACGGC  
-----GCAAAGTGAGAGCCAATTTTAAACACCCCATCTC-----TG--  
NN  
CTCACCTCTACCAGACAGA-AATTGATAAATGGGACATGTTCCAAATGAGAGTGAC  
-----AGATA-----CAGGGTAATCAAGTTGTC



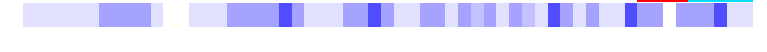
10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

ACACCTCA-GGAAAGCCTCTCAA-CTAT-TCCAAAGTGAAC-AGCT---AAAGGGTGT  
--GCCTCACTCCCTCCTC-CCCAAAG---GTTTCACTGCGCTAGCTCGGCAAAA--T  
NN  
CAGCCTCATGGACTGGACTCACAAGCATTCTGGATGGAGAC-ATCTCGGAAGGAAATAT  
CCACATGAGACTCA-CAGTTAGTCCCATTTTACAGATGAGGTAAC-----



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

GCCAATCTTTTAAAGGATTTGAAGGATTTCCATGTAGAACAAAAGCCAGA-C-GAGT  
-----CCCTTTGCCTTCAATTGCATTG-TT---CTTGGGAGGAG-GAAAG---TGAGC  
NN  
ACCAACTCTTTTGAATATTTGATGAGTTCCACACAGAAGCAGTGTAGACCTAAAT  
-----GAGGCACAGAGAAGTTGTGACTTGCCCCAGTCACACAGGTTGACA



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

TGTCTGTGATCTGGGCTCTCAGCAAGCAGTAAGTGTGATTACAGAGTGTTTGCCCT  
GAGCCCTG---CAGTCACTCCCTGAGAAGACAGTCA-GAATCAC-A-----CCT  
NN  
TTCCATATGTTTCTGGAGAGCAGCAAAAATAAATGATGGCTCCAGAGCAACAGCAT  
AGTCGCAGA-GCCGGGTTCAAACCCA--TGAC--CTCTGACTCCCAAGCCGTGC-T



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

TTGACAAGAGTAAAAGGAGAAATGTCTGCTAACCATAGTGTCTGAACACTCCCTCC  
TCAACTCAA-TG---GCCGTGACTTCTTGGGA--ATTGG--CTGAGGGTCCCAAA  
NN  
TTAATTCAAAT-AAAAGAAGAATCTCTATCAACC--A-----GAATGATCTG---  
CTT--TCAACTG-----AGCCACGCTGCTTCTCTAGGCTGTAAGC



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

CGACCCCACTCCGAACCTTCCCTCCCCCCCCCGCCCCCGCCAGCTGAATAC  
CGAGTCAAACCT---TAATTAGTCAACTTTTACCCAGAGCATGTAGACACTTGA-TGC  
NN  
-----AA-----AACGAAATGGACTAC  
TCGTTGTGGGCAAAGATGTGTCTA-TTTTT--CTATTTACTCTCCCAAGTGA----



10090 (house mouse)  
9615 (dog) e-value: 5e-75  
13616 (gray short-tailed opossum) e-value: 1e-46  
9606 (human) e-value: 3e-111  
9258 (platypus) e-value: 8e-40

CCAGCAGGAGATGAGTTGCCTACCCCATCTTTGGTGGAGTATGAGCTTGGCCTGAG  
TTTGTAAAGAAAATGAG-T---GCACCATACCGT-----TGACAAG-----AAA  
NN  
CTAGTTGAGTAGTGA--G--TCTCCT-GTCC-----AAGCCTACTGGGTATGAG  
-TT--A--GTACAGTGTCT-CTGCACACAGTAAGCTCTCAATAAATACGATTGACTGA-





10090 (house mouse) -----G---A-----AGCACGG---AGCCAGGACTCTGCTCCTCA  
9615 (dog) e-value: 5e-75 GGACCCCGAGATCAAGAGTTCGCATGGTCTGCTGACTGAACCAACCAGGCGTCT-----  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 GG-TCAGGAGTTCGAGACCAGGCTGGCCAACATGGTGAACCTTGTCTTTACTGAAAA  
9258 (platypus) e-value: 8e-40 GCACCTCAACCT-GAGACCTTCTTGAAAAACA---GAGCTAA-----AA

10090 (house mouse) T-----G-GCTAAATGCC**TTCC**-ACCCT-TCT-----  
9615 (dog) e-value: 5e-75 --CACAG**GATT**--TTTTTTG-TGTGAT**GATA**ACTTTTAAAGATCTACT**TATCA**ATTTT**CA**  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 TACAAAAATTAGCTGGGCGTAGTGGCGCA**CACCTGTCATCC**CAGCTACTCAGGAGGCA  
9258 (platypus) e-value: 8e-40 TTTTAAAAGAAGCAGTGTGGCCTAATGAATAGAGCATGAGTCT**GGAA**GTCA-G-AG**CA**

10090 (house mouse) -----C-----CCCTCAGGCTTT**CAAATC**TACCTC-CCTGC**TTCC**  
9615 (dog) e-value: 5e-75 **AATC**CACAACACAGTAGCATTAACTCT---AGTCACCATGCTGT-AC-ATTAC**ATCC**  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 GAGGCAC-A-AGA**ATC**GCTTGAACCCAGGAGGCGGAGGTTGCAGTGTAG-CCAAG**ATCC**  
9258 (platypus) e-value: 8e-40 **CCTG**--GGTTC**TAATC**---TC---AACTCCGCCACTAGTCTGTGTGACTT**GGAA**

10090 (house mouse) T-----TCTATTCAAGCGT-----AG-AAACCAG-A---G---C-TTTAAAAAGTGAC  
9615 (dog) e-value: 5e-75 -----CCAGGACTTATTTATTTTATAACAAGAG  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 TGCCACTGCA**TTCC**AGCCTGGGTAACAGAGCGAGAACTTGTCTCAAAAAAAAAAAAAA  
9258 (platypus) e-value: 8e-40 AGTCACTTAACCTCTCTAGGCCTCACT**TATC**-----T**CATCTG**TAAAAATAATTA

10090 (house mouse) TTCTACCAAGAACGTTTTCAGCAGAATGAG-CCC-AACATAGAACGACAACCTCACAGCGA  
9615 (dog) e-value: 5e-75 TTTGTGCCTTTGACCACTTTTCGCCGCTTTTGCCACCCCTC**TATCC**CTGC-CTCTGGCG  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 TTCTACCAAGAAAATTTCATCAGAATGGGCCCAAACCTCAGAATAGTAATAACA--AT  
9258 (platypus) e-value: 8e-40 TTATGGTATTTGTTACATGCTTACTAGGTGCCAGGCACCATAT---TAAGCACTGGAG

10090 (house mouse) CACAAAAGGCCCAAACAGAG**GGAA**ATTACCCTGC-----ACAATTTGCA**AAAT**-CACC  
9615 (dog) e-value: 5e-75 -ACCACCGATCTGTTCTT**TATC**TATGAACCTGGGTTTGGTTTCTTGA**TTCCACA**  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 TAAAAAAGACCTA**ATC**AGG**GGAA**ATGACCATGCTTGGAGTACAATTTGCA**AAAT**-CACC  
9258 (platypus) e-value: 8e-40 CACCA--TA--CTAAGCACT**GGA--T-A**-----G**GGAT**TAGAC

10090 (house mouse) -T-----CAAC-A-----GAGTCTTCTGGGCAAAAT-GAAGGCTAATTTT  
9615 (dog) e-value: 5e-75 **TC**TAAAGTGAATCGGACAGTATTTGTCTTTCTCTTTCTGACTTACTGTACTTGAATG  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 TTGAAA--G-----AGAG-A-----GTATGTC**TTCC**AGAAA**ATC**GAGAGCCAATTTT  
9258 (platypus) e-value: 8e-40 TATGAGTCC**CATGTGGA**-----C-ATGGACTGTGTCC**AAATC**






10090 (house mouse) AAAAC**ATCC**AC**ATCC**TCTGGGCTCCGCC**TTCC**CCCCCACCAGAGGTTCTTGGGGC  
9615 (dog) e-value: 5e-75 ATGCCTTCAAG**ATCC**-----**ATCC**GTGT**TGTCA****CAAATC**GCAG**GATTTCC**CCTTTT  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 AAAACACCCAC**ATCC**TCT-GG-----G-CCTCTCCCTCCTCCCAAAGTTTCTTCTGGC  
9258 (platypus) e-value: 8e-40 -----T**GATT**AGCT--T-**GI**




10090 (house mouse) CAT--TCAAGCAAAAACCCCTCTGCTC--T**CATTC**CATTGTTCTTGGGAGG**GGAA**A  
9615 (dog) e-value: 5e-75 TTATAGCCAAATA**TATCC**CATTATAT--ATATATATAATAATATT---AATA--TAT  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 CTTGCTCAGGCAAA**ATCC**CCTTGCCT--T**CATTC**CATTGTTCTTGGGAGGGGAGGA  
9258 (platypus) e-value: 8e-40 -----**ATCT**ACCCCATTGCCTAGTACAGTGTCTGGTACTTA**GGAA**GTGCTTA

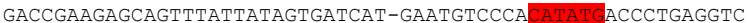




10090 (house mouse) GTGAGCAAGCTCTGAG**TGTCA**CTCCCTGAGAGGTGCAGCAGGGTCCACA-C-C--TC  
9615 (dog) e-value: 5e-75 ATAAATAACAACCTCA-G-G----CGCGCTGGGTGGCA**CAGTTG**-GTT-AAGCAC-CTT  
13616 (gray short-tailed opossum) e-value: 1e-46 NNN  
9606 (human) e-value: 3e-111 GTGAGCCAGCTCTGA--AGTCACTCCTTGAAGAGAGCCAG**AAATC**AC**ACCACA**GTCC  
9258 (platypus) e-value: 8e-40 GCAAT-ACCATTAAGAAACAAAAAAC--AAAAAAG-----**AAATC**ACA--TC---






10090 (house mouse) GTTGGCACAACC**GGAT**C-AGGCGTGAACCTGTGCAAAGTTGGCCTACAG-TC**CAAAAT**  
9615 (dog) e-value: 5e-75 ACCTT---**GATT**TTGACTCAGGTTATGATCTCAG-GGTCATGA**GATT**GAGCC**CACTT**


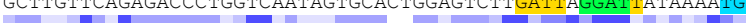
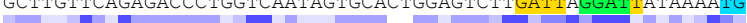
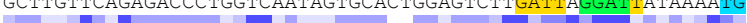
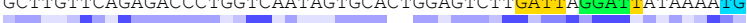







10090 (house mouse)  GAT-----  
9615 (dog) e-value: 5e-75 TTGCCT-----C---CCGACTGTAGCC-GAGAGCCACCGGGAATCC-----  
13616 (gray short-tailed opossum) e-value: 1e-46 GCCACCTTTTTCAGTGACCCACCTCCCTGAGTCTCCCACTTTCCCTGGATCC-----  
9606 (human) e-value: 3e-111 GGGTCTCACTATATTGCCAGGCTGATCTTGAACCTCCGCTTAAGGTATCCCTCCCA  
9258 (platypus) e-value: 8e-40 GTGT-TT--TCTATT-----G-----TGTTCCTCC-CCTG  
  
  
  


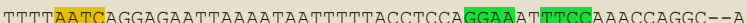



10090 (house mouse)  ---TAGACTCTTCATCAGGCTTGGCAGCAAGTGCATTTACCCACTGAGCCATCTCACT  
9615 (dog) e-value: 5e-75 -----GTGTGGGGCAGGTCATTCTCCAAAGGCCTTCTCTGTGCCCTGCAACGCGGT  
13616 (gray short-tailed opossum) e-value: 1e-46 -----CCCACAGGGCCAATGGTGTGGTGGAGGCCCGTT  
9606 (human) e-value: 3e-111 CCTCAGCCTCCCAAAATGCTCGGATTCAGGTG-----TGAGCCACGCGCT  
9258 (platypus) e-value: 8e-40 AGTCTCTCGGCAGTGAGAGTTAATTATAAGAACCT-T---GAAGGCTATAATATGTT  
  
  
  







10090 (house mouse)  GACCGAAGAGCAGTTTATTATAGTGATCAT-GAATGTCCCAATATACCCCTGAGGTC  
9615 (dog) e-value: 5e-75 TTATTATAAGGATCTGAGGTTCCCT-AAAATCCTAGCGCCCTGGATGATCTAGAGGTC  
13616 (gray short-tailed opossum) e-value: 1e-46 TGATAGGAGGAGCAGA-----  
9606 (human) e-value: 3e-111 --CTGCCAAGGATCTGAGGTTCTGTAATATCCAGAGCCCTGATACATCTAGAGGTC  
9258 (platypus) e-value: 8e-40 GGAGCCAGGAGGCT---CTAGTACTGCTGCTTTGTCCCGTTAATGTTTGTAGGCA  
  
  
  


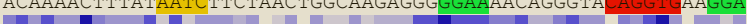
10090 (house mouse)  AC--TGTACCAGCATTTCCCAAC-GC--CTTCCCTTGAGTCA---C-TT---TGGA-  
9615 (dog) e-value: 5e-75 ACGCTGTATTAACCTTTTCTAATTTCCCTTCTTCTTCTGAGCCGCTCAGAGTGCTTT  
13616 (gray short-tailed opossum) e-value: 1e-46 ACATTGTATTAACCTTTTCTAACTCCTTCTTCCCTTTGAGCCACCTCATGAAGTGCCTA  
9606 (human) e-value: 3e-111 ACATTTTA-----GAGAGGCTTTCCCTCTGACCCTAACAGAAGGAGGCATT  
9258 (platypus) e-value: 8e-40  
  
  
  



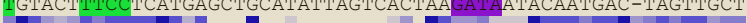
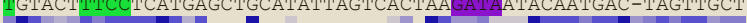
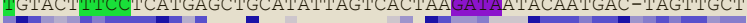
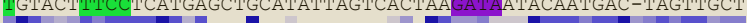
10090 (house mouse)  CTTGTCTGTGGGTCTCT-GTCT-----TAGGTC AATCC--C-CAAC  
9615 (dog) e-value: 5e-75 GTCGCTGTGGGTCTCTGTTCCAGGCTGCA-GGGGTCCTGCTCAATCCCAATCAT-  
13616 (gray short-tailed opossum) e-value: 1e-46 CTTACTTGGGGTTCCTA-TTCTAGGCTGCA--GGGGTCCATCCCATCCACATCATC  
9606 (human) e-value: 3e-111 GCTTGTTCAGAGACCTTGGTCAATAGTGCACCTGGAGTCTTGATTAGGATATATAAAATC  
9258 (platypus) e-value: 8e-40  
  
  
  



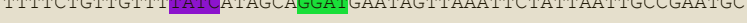
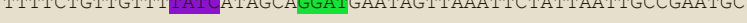
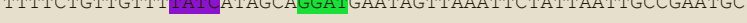
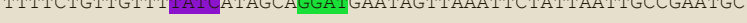
10090 (house mouse)  A---TTCTTGTCCAGAGTCTCTGGGATGGTC-A---GATAATCATGACTTTTTTTTT  
9615 (dog) e-value: 5e-75 -CCGTTCC--CCACCAGGGGCATG-GGGTGGCTG---AATAGCCATGAC---TTTTG  
13616 (gray short-tailed opossum) e-value: 1e-46 GGCTTTCC---T-GGGGATTTCTCTGTGTGATA-----AC  
9606 (human) e-value: 3e-111 ACCTTTCC---ACCAAGGAATCTGAGGGTGAAGT---GATAGTCATGA-----TTTT  
9258 (platypus) e-value: 8e-40 ACAATTTGGAGAGACTCTGTGGGAGGCTTTGTAT---GATAGCTCAGA-----  
  
  
  


10090 (house mouse)  TTTTAATCAGGAGAATTAATAATTTTACCTCCAAGAAATTTCCAAACCAGGC--A  
9615 (dog) e-value: 5e-75 T-TT-AGCAGGAGAATGAAAGTCATTTTATCTCCCGGAAAATGTCAAG-CCGGGC--A  
13616 (gray short-tailed opossum) e-value: 1e-46 CCTTAAGCAAGAAAATGAAAACAATTTTCATCTCTGTGAAATTTAGCCCAACAGAG  
9606 (human) e-value: 3e-111 TATTTAGCAAGACAGTGAATAATTTTCATCTCAATGAAATTTACAGCCCAAGC--A  
9258 (platypus) e-value: 8e-40 -----GTGGGATTAAGAAAACAATTTTACCTTCAAGAA-TTTCAAACAAGC--A  
  
  
  


10090 (house mouse)  AAA-----TGTCTTGGCTTTCCACGGCTCCTGGG-----GGC  
9615 (dog) e-value: 5e-75 GAA-----TGTGTGTGGCTCTGGCTGGCTCCTGGGCCCCCACC  
13616 (gray short-tailed opossum) e-value: 1e-46 AAATGGTGGCTCTCTTTAGGTTATTTGAGCCCTTGTGATTTGGAGCAGGCAGAGAAG  
9606 (human) e-value: 3e-111 GAT-----TGTGCATAGCCCTCTTGGCTCCGTTGG-----ACC  
9258 (platypus) e-value: 8e-40 AAA-----CAAAATGTCAGGTCAGGGGGAGAAAACA-C  
  
  
  


10090 (house mouse)  CCCGGCTCTGT-G-TCC-C-TGAGCTGTAGGGAAGATGATGCCT-GTGTGCAGTG  
9615 (dog) e-value: 5e-75 CCAGGCTCCGT-GCCCCC-----ACCCCCAGCGTGACTCTGCA-GCGT---G-A  
13616 (gray short-tailed opossum) e-value: 1e-46 AGGGCCAGGTTGGGGGAGGGGGAAGGCCAGAAGGATGG--GGGGGGTTTGGAAAT  
9606 (human) e-value: 3e-111 CCAGGCCACTGTGGCCCACTAGCAGGGAGGAGAAGATGACTTTGCA-ATGT---AA  
9258 (platypus) e-value: 8e-40 ACAAACCTTATTAATCTTACTTGGCAAGAGGGGAACACAGGTAAGGTTAAGGA  
  
  
  


10090 (house mouse)  GGGCTATTCGTCATCA---G-----AAC-A---ACAAGGCCAGCAGCAGT  
9615 (dog) e-value: 5e-75 GGGCCATCCGTCATCTG---G-----AAACAACAGGCACGAGGCCCTCGGCAGC  
13616 (gray short-tailed opossum) e-value: 1e-46 TGGGGGCGAGGATGAAGGGGTGGCTTCTCCACAATAGTAGAGTCCAGAGCCCC  
9606 (human) e-value: 3e-111 GGGCTATTCGTCATTA---G-----AAC-A---ACAAGGCCAGCAGCAGC  
9258 (platypus) e-value: 8e-40 TGTACTTCCCTCATGAGCTGCATATTAGTCACTAAGATAATACAATGCA-TAGTTGCT  
  
  
  


10090 (house mouse)  GTGGCTCTCACTTATCAGGGTGGTTGGCCTAGCTGGATTTCTATTAATGCTGAAGGC  
9615 (dog) e-value: 5e-75 GCTGCTCCGGCTTATCGGAGCGGGAGGCCTAGCTGGATTTCTATTAATGCCCCAATGC  
13616 (gray short-tailed opossum) e-value: 1e-46 GTGGCT-----TATCAGAGTGGGAAGATAGCTGAATCTATTAATGCTGGGTCC  
9606 (human) e-value: 3e-111 ATGGCTCTGGCTTATCGGAGCAGGAGGCCTCGCTGGATTTCTATTAATGCCCCAATGC  
9258 (platypus) e-value: 8e-40 TTTTCTGTTGTTTATCATAGCAAGGATGAATAGTTAAATCTATTAATGCCCCAATGC  
  
  
  






# D

## Lmo2 -75kb: Manual alignment

```
mouse : CTTCTTGGGGCTTTCTTGGATCCCTCCAGAACTTCTCTTTTTGATTTTTTTT--TATAAAGGCAAAAATTTAATTGGAATAACTTACA
human : -----
dog : -----GATATTAGTGTGGAGAGTGAAGGACAG--CACAAAACACCGAAGTAACCCAGGCTCAAGTTT-
opossum : -----GTGTGTCTAGTGAAGCTCTA
platypus : -----TTGAACTCTCTCTGGAGGACTCTATGGCTACAAAAGGTGTGTCTCTGTGAGAGAGCTC

mouse : GAAGCAATAAGCATCCATTATTATTATGCGCATCATGAGGAGACTTGTATGTTTGAAGAGCTCCAGCTTTGATTCGAAGCAGCCAAGA
human : -----
dog : -GTTGTGATAGTCACTATTGTTTCACTATGTCGCTGGGCTTGGGATTTGATTT---AAAATTTTCATCCGGTAGCAAGGGAAAGTTGAGA
opossum : TCTGCCCTGAAGTAGAACAGAGAAAGCAAGTGTGAGTCAAGGATCAAAAGGCTTTCCTTCTCAGGGAACGTGCCCTATCACTATTATCC
platypus : TAATTATTGAAGTAGAGCACAGAAAGCAATGACTAAATCATCAAAAGGCTGTCTTCTCAGGGAACGTGCCCTATCACTATTATCC

mouse : GGA-TGATATCTTCTCATTGGGTAGAGCTTGTAGTATAGGACCTCAAAGCCATTCCCACTGACTCACTTCTTTCACAGGCACACCC
human : -----
dog : TTAGCCATGGCCTTTCAACTACATGTGACAAAGTTGAGACTGAAGATTATCTGCAGAAGCACTAACTGTTGTGTGTAGAGGAGCGAGGG
opossum : CCTTACAATAATACAGTTTCAAGAGACTGGGAGCCAGAGCCCTGTAGCCATGTAACTCTTCTGTATTGCGCAAG---TCAAACA
platypus : CGTTACAATAATACTGTTTCAAGAGACTGTGAACCAGAGCACTGCGTAGTCAATGTAACCTCTTCTGTATTGTCAAAA---CAAAAT

mouse : TACTCTAACAAAGCCATATATACCTCTAATAGTGCACCTTTCCACTTCCCTGGCCAAGTA-TATTCAAGCCAC----ATAGCACC
human : -----CTCCTTGGGTGCTTCT--CAGCAAGCCTTCCCTGCTTCCACACTCCTGGA-TGGGATTCCTAG----CAATCACC
dog : GAAGGTTCAAAGACTGGAGCATTCCCTGCCCAGTTCAGATGCTCACAACAGGCCCCCGGA-GATTAGTCTGTTCTTCTGTGGCT
opossum : TGGACCCAGAAATTAAGAACTTCACTATTTCTGATCTGATGATCAACAGGGCTCTGTGGGAGCTACTATTGTGGGAAAGCCAC
platypus : AGCATTCCGCAATTAATAGAAATTTAACTATTCATCTCTGATGATAAAAACAAGAAAAGCACTAGTCACTGTATTAT--TTAGTGAC

mouse : CCTCAAAGAGCTGGTT--GAGTTTG--ATTTT-TATTAATA-CTGATTTGCTTTTGTTTTCA---CTTTGAGTACA---CTCTCAACT
human : CCTTCAGAAGTTGCT--CCTTTCT--TTTAACTTTTAT-TGGTTTGTGTCTGTACTCT---ATTTTAGTA-A---TCTTTAAT
dog : CCTCAAGGCCATTATCTAGGGTTAT--CTGTCCACCTE---CTGCCCTGGGAGGCTGAGCCACAGCTCCA---CTTCGGAGA
opossum : CCCTTTCATCCCTGCCCCCAACTTCAAAGCCCTCCCATCTCTGCTTCCCTCCCTCCACCTGGGCCCTTT-CTCTGCCTG
platypus : TAATATGCAGCTCATGAGGAAAGTAC--ATCCTTCACTTACCCTGTTTCCCTCTTGGCAGTTAGAAGATTATAAAGTTTGTGTG

mouse : TATTGAGTGACACTG-----ACCTCCAGT-----CTTCTAGTG---ATCTTAAGTGG-TCAAAGG-GA--GAAATCTCTCT
human : TAATGTATGTCTCTA-----CCACTTAGA-----TCTTAAGC-----TCAGCCAGG-GCAGGA-ATCTGCAATCTGCT
dog : GGCCAGTCACTCTT-----CCATTCAGG-----CTACTCCA-----G---TACTTCTGG-TGAAGG-AG--ATGTTCCAGCA
opossum : CTCCAAAATCAAAGGGCTCAAATAACCTAAGAGAGCCACCATTTCTGTTTGGGGCTGAATTTACAGAGATGAAAATGTTTTCAT
platypus : TTTTCTCCCTTGG-----ACCTGACA-----TTTGTTTGCTTTGTTTGAATTC-TGAAGGTGAAAATTTGTTTCTT

mouse : GGTTTTGCTTG-CTACTATAGTTCATGCCAACTACAGTGCTTAGACACAGTAGGGACTCATAAG-TAAGTACCAA-----
human : GGTTTTGCTCA-CCGTGATAGCCCATGCCATCAACAGTGCCTGGACACAGTAGGAATCAGACA-CAAGTGTGTATGAATATATGG
dog : GTCACACGACA-TTGGGGTGGCT-TGATATCTGGGCGACTCCATGAGTAGGCAAGCCACTTCCAGC-TGTTTGGTGC-----CATTGAC
opossum : TTTCTTGCTTAAGGTTTATCACACAGAGAAATCCCAGGAAAGCCCTGGATCAGTCAAGTCTGCTTCTCTCTATCAAACGGGCTCTCA
platypus : TATCCCACTCT-GAAGCTATCATAAAAGCCCTCCAAGGAGTCTCTCAAATTTGTCAATTTATAAT-C--CAATCAAAGACTCCAGTCA

mouse : -----TAGATAAGTTCATGCTGGCTGCTGAATAAATGAATGAATGGATATTTATAAGTGGTCAAGG-ATGCAAAA
human : ATGGATGGATGGATGGATGGATGGATGGATGGATGAATGAATGAACGAACCAATGCTTTCTAAGTGCCAGGATATAAAAAG
dog : GTGGAAATTCACCTCAGTAACAAAAGACCTCAA-ACTTACCAATGAATGAGTCTTCCAGTTTCTTGAACTCACCTTCCACTAGAGA
opossum : CCAC--ACCATTGGCCCTGGTGGGGATCCAGGAAAGTGGGAGACTCAGGGAGGTGGTCACTGAAAGAGGTGGCT-TTAATCTCCAC
platypus : CTATTGACCAGGGTCTCTGAACAAGCA-ATGCTCCTCTCTGTTAGGCTCAAGGAAAAGCCCTCTCAAAGTGTGACATCAACATTA

mouse : C--ATCAAAGTAACT--GCTTAAGGTAACCATAGCAAAG-CTGGT--TCTATATGACAACG-AC-CAAGCGG---AGGCTGTATTA
human : CTAGACAAAGTAACTTAAGGCTCAATATAGCTGATAGTCACT-ACTGT--TCAAATGACTTCCGAC-CAAGGAATTTGGACTGAATG
dog : ---GAAAGCATGCT--CGGTGAGGGGACAGCTTCCAATG-AGATAGCCAGTCTGGTGAAGGACTCAAGCTTCTGGTGGAGACG
opossum : CAAAGCTGAGATTAAT--CAATGGCTCCAGGCCNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
platypus : CGGGACAAAGCAGCAGTGC-ACTAGAGCTCCATGGCTCCAAATATATAGCTTCAAGGTTCTTATATTAATCTCTACTGCCAGGAGGA

mouse : TTACATTAGGTAG-ACCTCAAAGC----CAAGTCAACCAATCCCTTTGAAGTCA-CTGTGATAGAGTAGAGTTGAACCATATATCTTCTG
human : CT-CATTAGAGAGCAAATAAAGC----CAAGTCAAGCTATTCCTTTGAAGTCA-CTGTGATAGAGTAGAGTTGAACCATATATCTTCTG
dog : TC---TCAGAGGAGTGTGCCAGT----TCTGTTCAATATTTGAAGCATTTCACATAGACCGCCACAGAGTCCGACTTAAATTTCT
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
platypus : CTCAGGGGAAACACAAATAGAAAACACCTTCACTCAATAATCCATTTGTGATTTCTTCAAGTCCAGTCAAGACAGAGGGTTAGAATATG

mouse : AGGCAGCTAACTGTACAGAGAAAGGAGGCTGAGGAGGGGAAAGGGGGTGGCTCAGGCCAAATTAAGTGCCTCAGAGGTGT--AGT
human : AAGCAGCTAACTGTACATGAGACAAGG-----AGTGGAGGTTCTCTGGGCCAAATCAAATGCATCAAACAAT--AGT
dog : ACGTTCAGGAGAGCAGCAGAACCAAAAC--GATGGCTCCAACACACAACACCTTGGACTCAATGACAGCAAGAAAGGTCCATCAACC
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
platypus : GGGTGA--GAGAGTCAAGACTCTTTGGCACT-ATTGGGATACAAATATGAAATAGCTCACAATA-ATAGTCAATCCATTAT--ACA

mouse : ATACTCTCC-AGATCCCAGATGCTCACACAACCTGCTCAGAGATTAGAGCTGGTCTTCTGTGGCTCCCTG-----CT
human : GTCCTCTCCAGATCCCAGATGTTACACAACATGCCAAGAGATTAGTACTGGTCTTCTGTGGCTCCCTGATGCTGCTATCCAGCT
dog : AGAATTTCTGAAA---AGGAAATGAGCCACTTCTGGAGTGTTCAGAGCTGGCTGGCTATGCTGTTTATCCATTAG--ATAT
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
platypus : AAACATTTGTTTGGTGTATACATGGGGCA--TCAGAGTAAACCTGTGCCAATGTTGTCTTAACTCAATGTCAGAGT-----ATGT

mouse : GTTATCTGACCCAAAGTGTGCTGACATTCGAGGAGCTGAGTCTGGCCACCTCAAAGGGGCCCTA-CATCTTCTCAGTAAACTA
human : GTTATCTGACCCAAAGTGTGCTGACAGGCTGTG-GGAGGCTGAGGCTCACAGCTGCTGCTCAGAAGGGCCCTGATCTTCTCATTAAGCTA
dog : GTAAAGAGGAGTGTTCCTAGGCTGCTGTGTGAGAAAAGCTGATGCTGGGAGTAGGAGAGAGAGAACTAATATGACAAAACA
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
platypus : GGGAGATATATTTTATGATTTCTTTCTCTCTCTTATTTTTTGGACTCAGAACTGTCAGTAAAGAAATTTGTTTCTCCCTGAAATTA

mouse : CTTCCAGCTCATGCGTGGGTTGGAGTGAAGTGTCC-CAACTGAGGATAGAGGAGGAGAG--GATGGTCTCT-----AGAATGACCT
human : CCTCCA--TACTTCTAGTG-----ACGGAATGTT--CTACCAGCTACAGGGCATTGGGGTGTGCTTAGTCTCC-----AGAACCCT
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dog : TTAAAAGCCATTTCATAGTAGCTCAATATGTGGGTTC--CCAGCACTTACATGCACCAAGGACCGAACAACACTACTTTGTGGCATGACCA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : TCTGAAGTAAAGAGACTTCTTAACCTCTGTATTTTATCCAAGAAAATACAGAGGAATAGTT-----CTTCTTCCCTAGAACCAACAATTTT  
  
mouse : CCTGTCTGTACCTAACCTCATGGTTAGGTGCCACAGGACTGGAG-----ACTTA-----GAAATGTCACACTA  
human : CTCATTAATGACGCCCTCCACCATTGTTGGTCCATAGGGCAGAG-----ATTCACCTCCGTACAAAATATATGAACTTCGATGCTG  
dog : CTTAATCCCTATGACATCTTGGGCATTAGTCTTACAATTATCACCCCT--GTAGAGATCGGGAGACTGACACTGAGAGGAATGAAATA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : TCTGCAGTAAATGCATCAGACCAAT--ACGAGCTGGAGAAAGCAATTCAAAGATGTGATTCTTTTTTGTTTTTTGTTTCTTAAATGTA  
  
mouse : TTCCCTGCTAAGCTGGTGAACCTTCTGATGTCTTAGTCTCAGCGTCCCGT-----GAAATGGA--GTGGGGATACTTCCAAGTCT  
human : TTTCCTGTTAAACGAATGAGTCTTCTGATTTCTTTGATCTCACCTCCTACCAGACAGAAATGATAAATGGGGACATGTTCCAATGAGA  
dog : ATTTGCCCAAGTACACACAGGAGGAAGTAC--AGAGCTGGGACTCAAAATC-----CTAACCCACCAAGCTATTACCCATTCTGTA--CA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : TTTGCTAAGCACTTCCCTAACT--ACAGACAC--TGTACTAGGCAATGGGGTAGATACAAAGCTAATCAGATTGGACACAGTCCCATGTGCC  
  
mouse : ACGGACACCTCA--GGAAAGCGCTCTCAACTATTCAAGTGA--GAGCT--AAAGGGTGTGCCAACTCTTTAAGGGATTGAAAGGA--  
human : GTGACACAGCTCATGACTGGACTCAACAAGCATTTGGATGGAGACATCTCGGAAGSAATAATCCAACTCTTTGTAAATTTGATGAG--  
dog : GCACCTGCTCCCT---CTCTGCCTCCCTCTACCTCCCATCCTTCTAT---TAGAGCATA---AACGCTATTAGACCATTAAGAAGAA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : ACATGGGACTCATACTCTAAATCCCTATCAGTGTTAGTATGGTGTCTC-----ACTGCTAATAAGGTGCCCTGGACCTTAGTAAGCAT  
  
mouse : TTTCCATGTAGAACAAGCCAGAC--GAGTTGTCTGTGATCTTGGGGCTCTCAGCAAGCACTAAGTGTATGATTACAGAGTGTGTGCCCT  
human : TTTCCACACAGAAGCAGTGTAGACCTAAATTTCTCATGTTCTGACAGCACAGCAAAAATAAATGATGGCTCAAGAGCAACAGCATT  
dog : TTTCTCCCAAGAAAGTTTCTCAGAAATGGGCCCAACAAGCAACACTAACAAAGAAAACGCCCAAATTTGGGGAAATTAATACACT  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : GTAAACAATAACCAATAAATATTAT---TTTACAGATCAGATAAAGTGGGCTAGAGAAATTAAGTCACTTTCCCAAAGTCAAC--ACAGC  
  
mouse : TGACAAAAGTGAAGACGAGAAATGCTGCTAACCATAGCTCTTGAACAC-----TCCCTCCGA  
human : TAAATCAAAT--AAAGCAAGAAATCTCTATCAACCAAGATGATCTGAAAACGAAATGGACTACCTAGTTGAGTAGTGTCTGTGCAA  
dog : TGAGTCAAT---TTGCAAATCATCTCTGGGAGAGAGTCTCCCGCAAGGTGAGAGCCAAATTTTAAACACCCACACTCTCTGCCTCA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : AGACTAGTGG--CGAGTGTGAGATTAGAACCAGGTCTCTGACTTCCAGACTCATGCTCTATTCATTAGGCCACACTGCTCTTTTAAAA  
  
mouse : CCCCACTCCGA-----ACCTTCTCTCCCCCCCCCCT-----CGCCCCCGCCAG-----CTGA  
human : GCCTTACTGCGTATGAGTTGTATATTTCACTCTATTACAATATAAATAGGGACGTTTCGTAGGTAGGCTATCTCTGAGGAAAGTCTGG  
dog : CTCCCTCCTCCCA-----AAGTTCTACTGGCCTAGCTC--GGCAAAATCCCTTTCCTTCAATTGATGTTCTTGGGAGGAGG  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : TTTTAGCTCTCTTTTCAAG--AAAGGCTCAGGTTGAGGTGC-----AACTTCCACATTCACTTTTCTTTCAGACTCAAGCAGGCGC  
  
mouse : ATACCAG--CAGGGAA--TTGAGTTCCTCACCCCA-----TCTTGGTGAGTATGAGCTT--  
human : ACACGTGAGAGTACGGAA--AAGGATACTTAATACAAATAAAATTAACATCA--TTAGTAGCTCCTATGTGGGTAATGAGCACTT  
dog : AAAGTGA--CGACCC--TGCACTCACTCCCTGAGAAGACATCAGAAATCAC--ACCTT--CAACTCGCCGCTGACTCTCT  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : ATACTGGGCTGAGTGAACCTAGAGGGCCCAATTTCTTAAATACTCCCTCCCTGATTTTATATGTCTATGTTTAGAGTGTGTTG  
  
mouse : -----GGCTGAGCTGTCTGTTCTATT-----CTAGGATATACATAATG--GGT-----GCTGTG  
human : CCATGTACCACACAACAATCCTGTGCACTGACTCTATAATTACCACCATGATACAGGCAAG--AGACTGAGATGGAGACAGGTGTG  
dog : GGGAAAT-TTGCTGAAGGCTCCAAAC--GAGTCAAACCTAATTAGTCACTTTTACCCAGA--GCATGTAGACACTGTATGCTTTG  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : GGGTGGGAGAGATTGATGCTTTCGCTGCCCATTTGCAATTA-----TTTATTTGTACATAATGCCAGATTTTTTAAAAAAGAGCACTA  
  
mouse : TGAGT-----CTGCTATTCCAAAGGA  
human : TAACTTGTCAG--TTGCACAGCGAGGAGGTGCAGT--GGGACTCAAATCCTAGCAGCCAAACTACCACCATTATGCCAGACTCCC  
dog : TAACAAAATGAGTGCACCATACCCGTTGACAAGAAATG--TGGGTGCTGGTCACCAAAA-----GAAAAATAGAAAGGGGAA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : GCACACATGAGTGTGATTTTCTATATACTATGAGTATGCTTAGCTAGCATAGCCCAATTCTGGGGTCTATTTTGCCTGCAGAAATG  
  
mouse : -----AGTCTTGCACAG-----GAGCAGGA  
human : GCTCCATTCCTACTCCTCTACCTCCCAGTCCCTTCTATTAAGTATAAAACGACTAGCTTGAAGAGAGATTTCTGACAGACA  
dog : GAGTGGTGGTTATTTATTTATAAGACTTTATTTATTTATTTATTCATGAGAGATACGGCAGGCAAGACAGACAGGCCGAAGGAGAGACA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : AGGGAAATGAAGTCAGAGAGGAAAGGTAAGTGGAAATAGAGGTCTAGGAGAGCTGGAACCTTCACTGTTTATTAGGTGTGAGAAATAA  
  
mouse : AGGATGCTTA-----GCACAACCTAAAA--ACCATTAAATAGCTCAATATG-----TTGGCT-CTGACATCTAT  
human : CCGTGGCTCAGCC-----TGTAATCCAGCACTTTGGCATTTTGGGAGGCCAAGACAGAGGATGCTTGAAGC--CCAAGAGTTCGA  
dog : GCTCCTCTGGGGAACTGATGTGGACTCGATCCAGGATCAGCCTGAGCCAAAGACAAA-----CACTCAACCACTGACCCACCA  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : ACTAAGGTCTTAATA--TTTAGGGAACTTAATAATAGACTCCACGCTGGTGCATTTAAGAGGAGAGTGTGAATGATATTACAGTCA  
  
mouse : GTTCA-CTGAACGCATAGC-----CTGT-----ACAGA--AGCCTGATAGTTATCAACATGCTCTAGA-----TGAGAAACAGAT-TCTA  
human : GACCAGCTGGGCGAATAGTGAAACTGTGTCTCAAA--ATAATAATAAATAAATAAAATCCGGGA-----CGGTGCTCAACCTGTA  
dog : GGTGTCATGTTTCTTCTTTTAAATGATGTAATGATATTATACTAGTTAACAATCATATTGGTTAACAGTATACTAGTCCACATATT  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : CTCAGTCAATCGTATTTATGAGAGCTTACTGT-GTGCAGCACTGTACTAATCACTTGGAGAGTAA--AATAGAAAATAGACACATT  
  
mouse : C-----AGGTAACACTCATCAAGGT--CA-----CACAGCTCGAAGCAGG-----AGC  
human : ATCCAGCTCTCTGG---GAGGCCGAGGCAAGTGGATCACTTGAAGT---CAGGAGTTCAGACCAGGCTCGCCAACATGG---TGAAC  
dog : CTATAATAATAACAAG---ATACTAACGACATTATAGTGTGAGGTATACAACAGCATCTTTGATATTCTACGTAATG---TGAAC  
opossum : NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
platypus : CTTGCCCAACAGAGCTTACACCTAAGCAGAGCAGCGTGGCTCAGTTGAAAGAGCAGCGCTTGGGACTCAAGGTCATGGGTTTCAAC
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platypus : CCCACTTAGataAAACEtsCACCTCCTCC-----AAMeisGAGGCCEtsTTCCAGACTGEts-ACEtsTCCTCTTCTCCCTCTACTC-----CCTCTG
mouse    : TCEtsACTGACCEtsGAAGA-----GCAG-----TTEtsATTA-----TAGTEtsCATCAEtsGAATCTCCEtsAC-A-----TAT
human    : TCAGCCTCCEtsCAAAATGCTGGGATTEtsGCAGGTGTGAGCCACCGCCCTEtsCGCCEtsAGGATCTGAGEtsTTEtsCGEtsGAATATEtsCCAG-AGCCTGATEtsAC
dog      : TCATTCTCCEtsAAAGGCTTCTCTGTCCEtsCCTGCAACGC----GGTTEtsTAEtsTATEtsAGGATCTGAGEtsTTEtsCCEtsAAA-ATCCTEtsAG-CGCCTGGGAT
opossum  : AGACAGAAGAGCATAAGGGCTAGCAEtsATGGGAAGTAAG-TGATEtsTTGCCEtsGGGTACACACEtsCTAAGAATTCTEtsGTGEtsGATTAGGACEtsCT
platypus : CCACCCCEtsCTTTTACCT---CTCCEtsGACGTAEtsAACCT---CTTTEtsCCCCCTTTCCCTCTEtsCTEtsCCEtsCCEtsCTCTCCEts-T-----TCC

mouse    : GACCCTGAGGTEtsCAC--TGTEts-ACCAGCATTEtsCCCAACGCEtsCTC---CCTEtsTGAGTCAEtsTTTGGGACTEtsTG-TCTEtsGT-----GGEtsCTCTEtsGT
human    : AAICTAGAGGTEtsCACATEtsTGT-ATTAEtsACTTTEtsTTCTAEtsACTCCTEtsTCTTCTTTEtsGAGCCACEtsTCATGAAGTEtsG-CCTEtsACTTACTEtsGGGEtsTTTCCAT
dog      : GATCTAGAGGTEtsCACEtsGCTGT-ATTAEtsACTTTEtsTTCTAEtsATTCCTEtsTCTTCTTTEtsGAGCCGEtsCTCACAGAGEtsCTTTEtsGTEtsCGTCTGTGGEtsCTCCTEtsGT
opossum  : CAICTCCACACEtsCTAGTTCTEtsCAATEtsCATCCATEtsTGAGTEtsCATEtsCTAGTT-GTCCCCCTEtsCTAGTTTCTEtsTTAAATGAEtsTGAGT-GTTTATEtsTCTEtsGT
platypus : CATCCCCEtsACAGEtsCAC--TGTEts-ACTCGTCEtsTGCEtsCAEtsCTGTATEtsTAT---ATEtsTTCCATTAEtsCCT---ATTTEtsATTTEtsGTEtsTAATGGATTEtsGTACAEtsTG

mouse    : CTEtsTAGGT-----CAATCEtsCCAAAEtsCATTCCTEtsTGTEtsCC---AGAGTCCEtsTGGEtsGATGTCEts-AGATAEtsATCATEtsGACTTTTEtsTT
human    : TCEtsTAGGCTGC-AGGGG-TCCTACCCATEtsCCACATEtsCATCACCTTTEtsCCACCAAGGAATEtsCTGAEtsGGTGACEtsCTGGATAGEtsTCATGATTTTEtsTAT
dog      : TCCAGGCTGC-AGGGGTCTCTGCTCAATCEtsCAAATEtsCATCCGTEtsTCCEtsCCACC-AGGGGCAEtsTGGEtsGG-TGGEtsCTGAATAGEtsCCATGACEtsTTTGT
opossum  : CATEtsGGTEtsCCCATEtsGTEtsCAGAGAGAGEtsTTTTEtsCTTGAEtsCTGGGCCAAATEtsCTC---ACTTAATEtsCAGAGEtsGAAAAGAAEtsTTAGTEtsTGATEtsCAAT
platypus : CCTEtsTGATEtsTCT-ATTTAGTTGCCATTGTTTEtsTACGAGEtsATGTTEtsCTCCCT---GACTCEtsTATTATEtsTCC---ATEtsTGCTEtsTGTCEtsTGTCEtsGT

mouse    : TTTTAAATEtsAGGAGAATEtsAAAATAEtsTTTTEtsTAEtsCCTCEtsCAGGAATEtsTTCCAAACEtsGAGG---CAAATEtsGTEtsTCTEtsTG-----GCTTTCCACGEtsCC-
human    : T----AGEtsCAAGACAGTGAEtsAAATAEtsTTTTEtsCACTEtsCAEtsTGAATEtsTTAAGACEtsCAAG---CAGATEtsTGEtsGCATA-----GCCCTCCTEtsTGC-
dog      : T----AGEtsAGGAEtsGAATGAEtsAGTCAEtsTTTTEtsTCTEtsCCGCAATEtsTGTC-AAGCEtsGGG---CAEtsGAATEtsGTGEtsTG-----GCTCTGGCTGEtsCC-
opossum  : C----TGTTTTEtsAGTCAEtsAAATEtsTTACCEtsCTGTEtsGCAAAEtsTTCTEtsGTEtsTAAGGCACAGTEtsTGAGTEtsCTTTCTT----TCTTAGGATCATA
platypus : CTCC--CCEtsGATTAGACTGTAEtsAGCCCGEtsTCAEtsACAGEtsCAGGEtsACTGTEtsCTCTATEtsTGTTGCAEtsACTEtsTGEtsTCAEtsTTCCAAGCACEtsTTAGTACAEtsCT-

mouse    : CTCEtsTGGGGCCCCGGGCTEtsCTGTGEtsTCCCTG---AGCTGTAGGGAGGATAGEtsATGCEtsCTEtsGTEtsTGCAGTC-GGGEtsCTATTEtsCTEtsCATCAGAAEtsCAA
human    : CTCEtsTGGGACCCCGGCAEtsCTGTGGCCCC---ACTAGCAGGGAGGAGEtsAGATGACTEtsTTGCEtsATEtsGTEtsAAGGEtsCTATTEtsCTEtsCATTAGAAEtsCAA
dog      : CTCEtsTGGGGCCCCCACCEtsCCCAGGEtsCTCGTEtsGCCCCCACCEtsCCCCAGEtsGTGACTEtsCTGCEtsAGCEtsGTEtsAGGEtsCCATEtsCCEtsCTEtsCCTGGAEtsCAA
opossum  : GATTEtsAAAGCTGGAAGGAAEtsCTTGGAGTCA-----TCTA-GTCTGAGEtsCTCCTEtsTTTTEtsTAEtsGACEts-GASAAEtsATEtsTAGGCCACEtsAAA
platypus : GCTEtsTGCACATAGTAAGEtsCGCTCAATAAATACTATTGAATGAATGAATGAEtsTCAAEtsATTTEtsCAEtsTATEtsTCGGAAGGAAATEtsTTTTCTAAEtsATAG

mouse    : -----CEtsAGGCCAGC--AGCAGEtsTGTGGEtsCTCEtsCACTEtsAT---CAGGGTGGTTGEtsCCEtsTAGCTEtsGGATTEtsCAEtsATT---AATTEtsCTGAAGEts
human    : -----CEtsAGGCCAGC--AGCAGEtsCATGGEtsCTEtsCGGCTEtsAT---CGGAGCAGGAGEtsCCEtsCTCGCTEtsGGATTEtsCAEtsATT---AATTEtsCCGAATEtsG
dog      : ACAAGGCAGGAGCCCTC--GGCAGEtsCCEtsCTGEtsCTCCGEtsCCEtsAT---CGGAGCAGGAGEtsCCEtsCTAGCTEtsGGATTEtsCAEtsATT---AATTEtsCCCAATEtsG
opossum  : C---TGAGGEtsAGACTEtsTGCCTAAGTAEtsAGEtsCCEtsTCTEtsCACATTAGAG--TEtsACTATTCTTTEtsCTCCTTATEtsGAAEtsCEtsGACTC-TCTTEtsCTTAGGGG
platypus : CATGTACATEtsGCATTAEtsACTTAEtsATGEtsTGTATEtsCAAAAAATAEtsTAACATAEtsGTATGAGTTEtsGATAATTEtsTCAGGACEtsCCEtsCTCAGEtsGTEtsTTGGCCG

mouse    : CTGTTGG----AGTT--GCAGATAEts-CAGCAEts-AAGCAGTTTACATG--GTACACAGGGCCEtsCAGCTEtsCGCAGCCTEtsCTCAG---AAACTG
human    : CTGTTGG----GTTT--GCAGATAEts-CAGCAEts-AGCAGTTTACATG--GTACACAGTGCCTGGCTEtsCACAGTGTCTCTG---AAATGG
dog      : CTGTTGG----GTTT--GCAGATAEts-CAGCAEts-AAGCAGTTTACATG--GTACACAGTGCCTGGCTEtsCACAGTGTCTCTG---AAATGG
opossum  : ATTTTACCTAGGGGEtsCTCCTCATTEtsTCCCEtsCAGAGTAAATAEtsAAATTAEtsA--ATTATTTCAAATEtsTCTGCTEtsGATEtsTAAGGCTEtsAGGATGGCCTG
platypus : GTCTTAC----AGCTGTEtsATAGATAEtsCAAAACAEtsATAGCCAGCATAAAGEtsCAGCACAGEtsGAAACTEtsCAGGAGTEtsATCTEtsCTTTGEtsGTCAAAEtsATG

mouse    : TATTATTGTAGTGGGATA---ATTCTEtsGATTAGGGA---CAG--TTCCCTGAGGAEtsAGCAGACEtsCTTTGATEtsGATTEtsGAGTCACTEtsTTCCCTC-TG
human    : TATTATTGTAGTGGGATA---ATTCTEtsGATTAGGGA---CAG--TTCCCCGAGGAEtsAGCCAGEtsCCEtsCTTTGATEtsGATTEtsGAGTCACTEtsTTCCCTC-TC
dog      : TATTATTGTAGCGGATA---ATTCTEtsGATTAGGGA---CAG--TTCCCCGAGGAEtsAGCCAGEtsCCEtsCTTTGATEtsGATTEtsGAGTCACTEtsTTCCCTC-CC
opossum  : TGA-AGCAAGCCAAAGAGGA-TGEtsTGEtsGCTEtsTTTTAAEtsAATEtsTGEtsCTCTEtsCACTTTATGG--AAAGEtsCTCCCTCTEtsGTEtsGGEtsGTEtsGATTEtsTGCAACG
platypus : TGGTAGCAATCTGGGEtsAAAGAAEtsGCATEtsGGCTTTTGA---TGEtsACTEtsTGATCTGEtsGGAGCEtsAAAGATTCCCAC-ATTAAEtsACCATTEtsTGCTT-TT

mouse    : CACTCCACTEtsTCAG-TGTGATAEtsGTGTGGCC-----CACGGACCEtsCTT--GCTGGC--CAGAG-ACEtsTTAGACTEtsCCACAGGAAA
human    : TACTCTACTEtsTCAG-TGTGATAEtsGCGTGGCTCGCCCCACAGACACACACCEtsCTT--TCTGGC--CAGAG-AGCCTGATEtsCCACAGCAGG
dog      : CACTCGGCTEtsTCAG-TGTGATAEtsGCGCAGCTGGCCCCAGAG--CACACACCEtsCTT--TCTGGC--CAGGCGGTCCCCGGTCCGGGGCCAG
opossum  : CCTTTACATEtsTAGGTAATEtsTCCCCEtsTAAGATEtsTGGGCTTTTGTGTGTGTTAGGGTEtsTGACACACACEtsAGGTCCTGGAGEtsCTCEtsCAGEtsGAGA
platypus : CCAEtsTATGTEtsTCA--CAAGATAEtsATAEtsCCATEtsTCCCATCTTTCATTEtsTGCATEtsACA--TGCACC--CATAG--GATATAAATEtsCTAATTTTTA

mouse    : GCTCTCEtsCAACAGGGGCAGTCCAACCTC-----
human    : GTTCCCAACCAAG--AGCCAAGACT-----
dog      : GCTCCCCGGGTGG--CAGGAGGGCCTGGGAGCC
opossum  : CCCTTTCTTAACTCCT-----
platypus : TTTTTCCTCACTEtsATGATTGGACT-----

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Gata  
Ets  
Meis  
Gfi1  
Ebox  
Run