

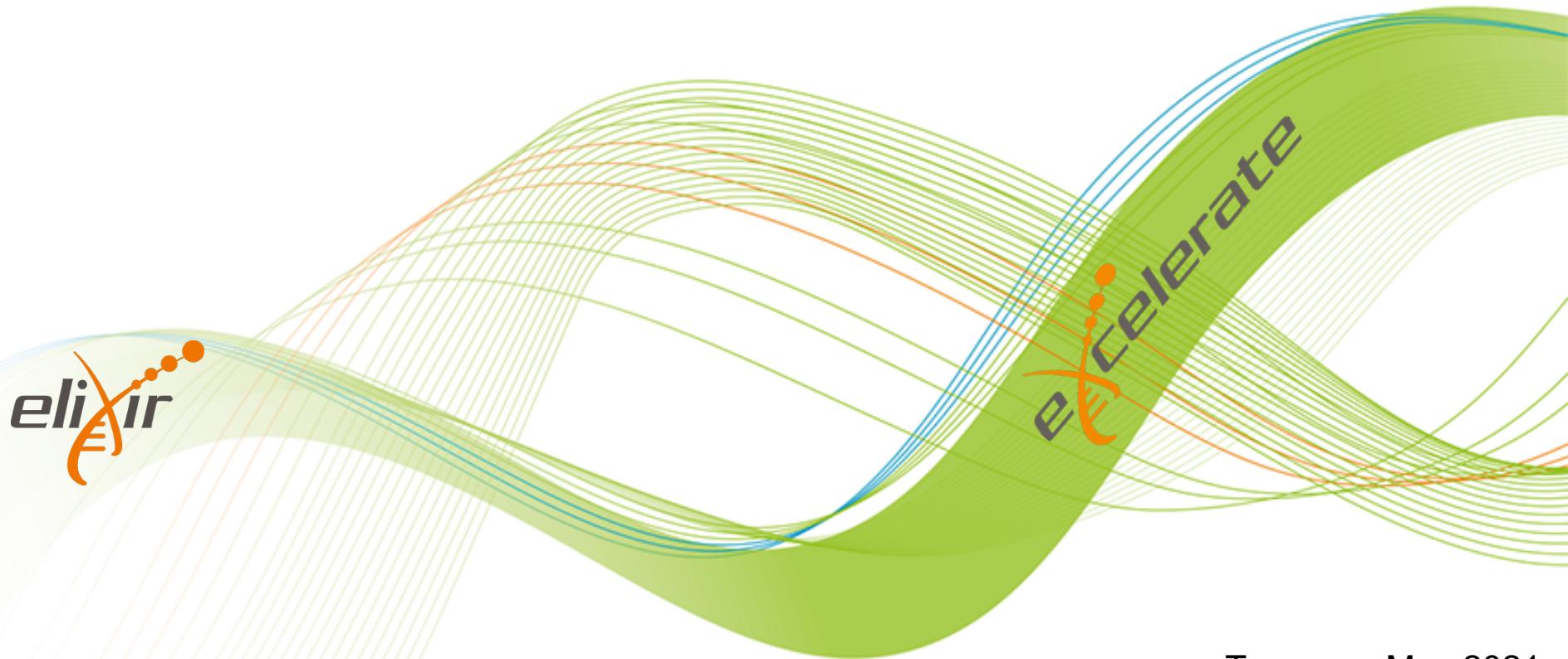


Lucile Soler, PhD  
Jacques Dainat PhD



**MAKER**  
Annotate this!

The genome annotation pipeline



MAKER



GMOD in the Cloud toolset



Galaxy: Data analysis & integration



BioMart: Data mining system



GBrowse\_syn: Synteny viewer



cMap: Comparative map viewer



Generic Model Organism Database project



GBrowse: Genome annotation viewer



Chado: Biological database schema



JBrowse: Super-fast genome annotation viewer



MAKER  
Annotate this!

MAKER: Genome annotation pipeline



Tripal: Chado web interface



Pathway Tools: Metabolic, regulatory pathways



InterMine: Data warehousing



Canto: literature annotation tool



## Eukaryotic genome annotation

[MAKER: An easy-to-use annotation pipeline designed for ... - NCBI - NIH](#)

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2134774/> ▾ Översätt den här sidan

av BL Cantarel - 2008 [Citerat av 612 - Relaterade artiklar](#)

We have developed a portable and easily configurable genome annotation pipeline called MAKER. Its purpose is to allow investigators to independently ...

[Abstract](#) · [Results](#) · [Discussion](#) · [Methods](#)

09/2018

[MAKER2: an annotation pipeline and genome ... - BMC Bioinformatics](#)

<https://bmcbioinformatics.biomedcentral.com/1471-2105-12-...> ▾ Översätt den här sidan

av C Holt - 2011 [Citerat av 514 - Relaterade artiklar](#)

22 dec. 2011 - We present MAKER2, a genome annotation and data management tool designed for second-generation genome projects. MAKER2 is a ...

MAKER – developed as an easy-to-use alternative to other pipelines

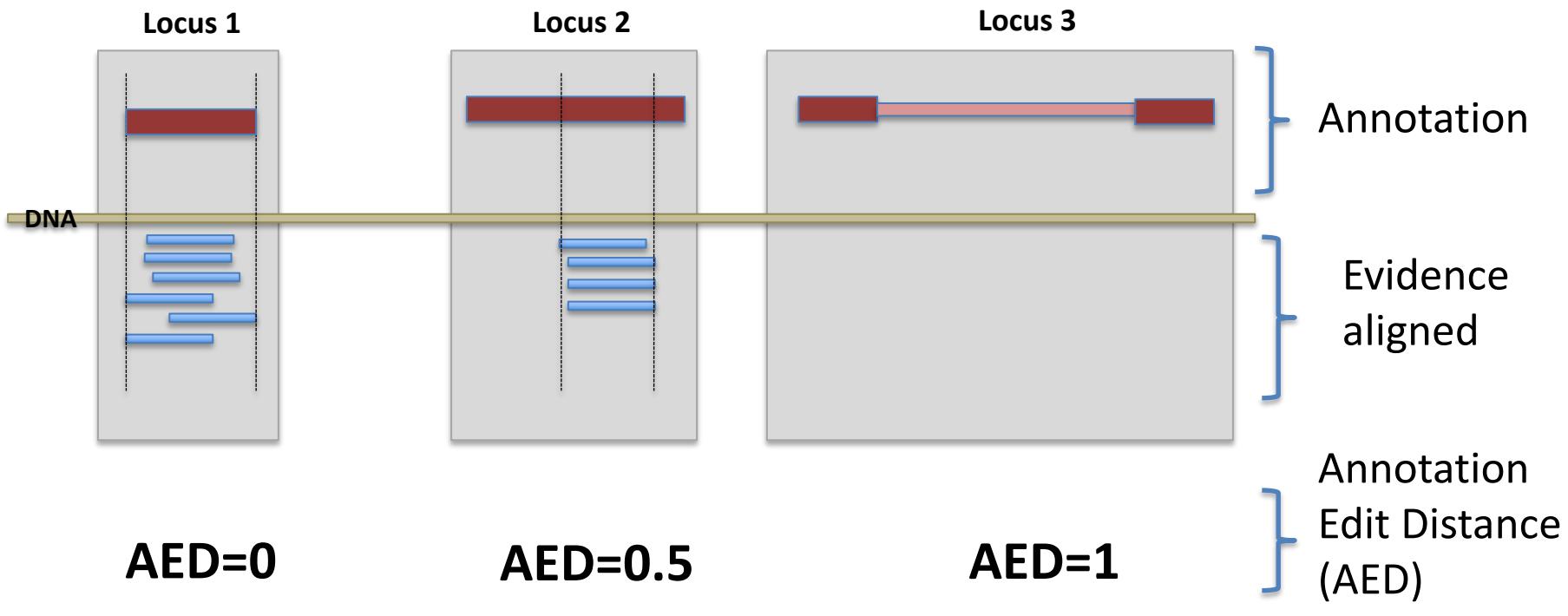
## Why choose MAKER ?

- Easy to use and to configure
- Scale to datasets of any size
- Multi-threaded and parallelized
- Everything is run through one command, no manual combining of data/outputs
- Metric for quality control (**Annotation Edit Distance** )
- Distributed with accessory scripts (>30)



## Capabilities:

- Add quality metrics to an annotation (AED)



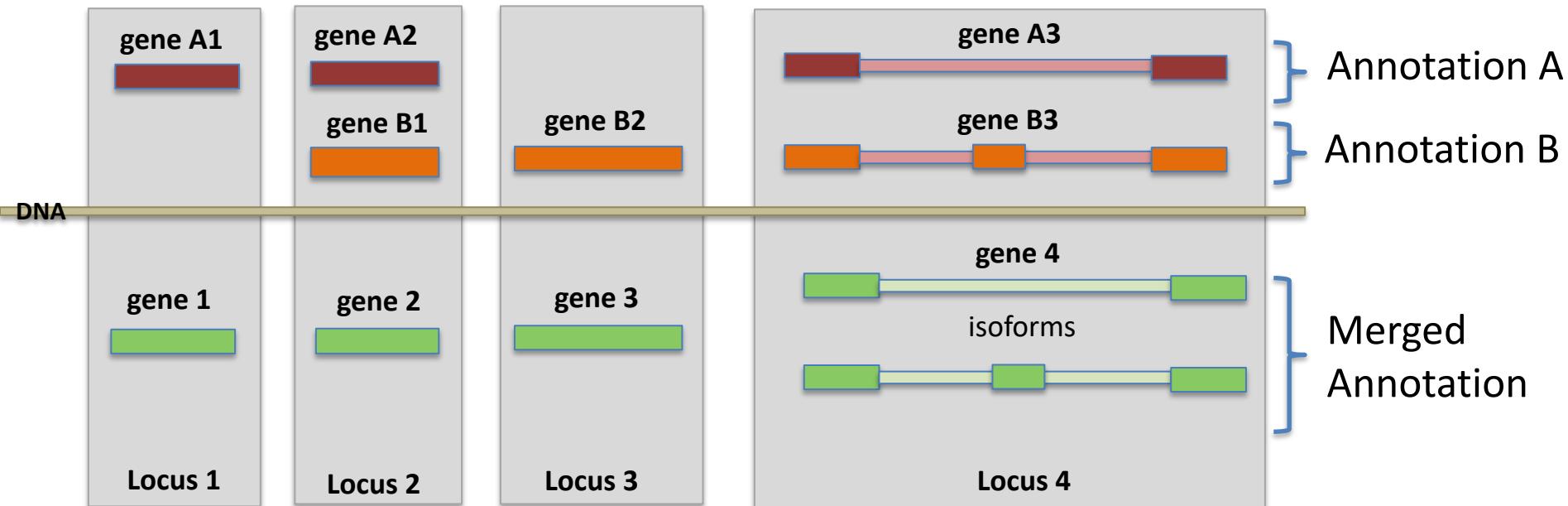
Perfect  
concordance

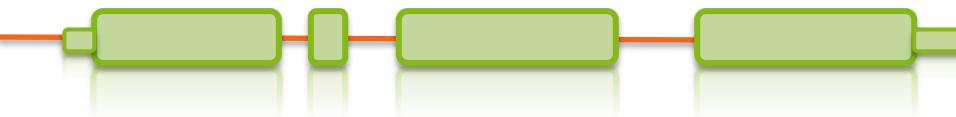
Complete  
absence of support



## Capabilities:

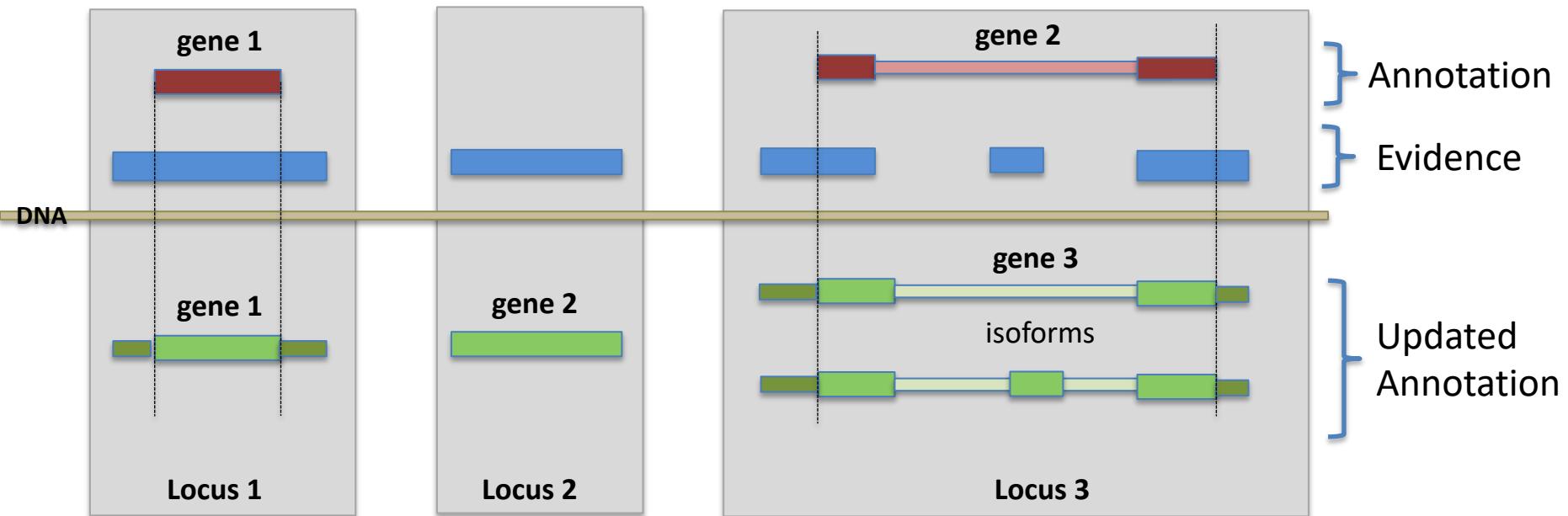
- Merge multiple annotation sets





## Capabilities:

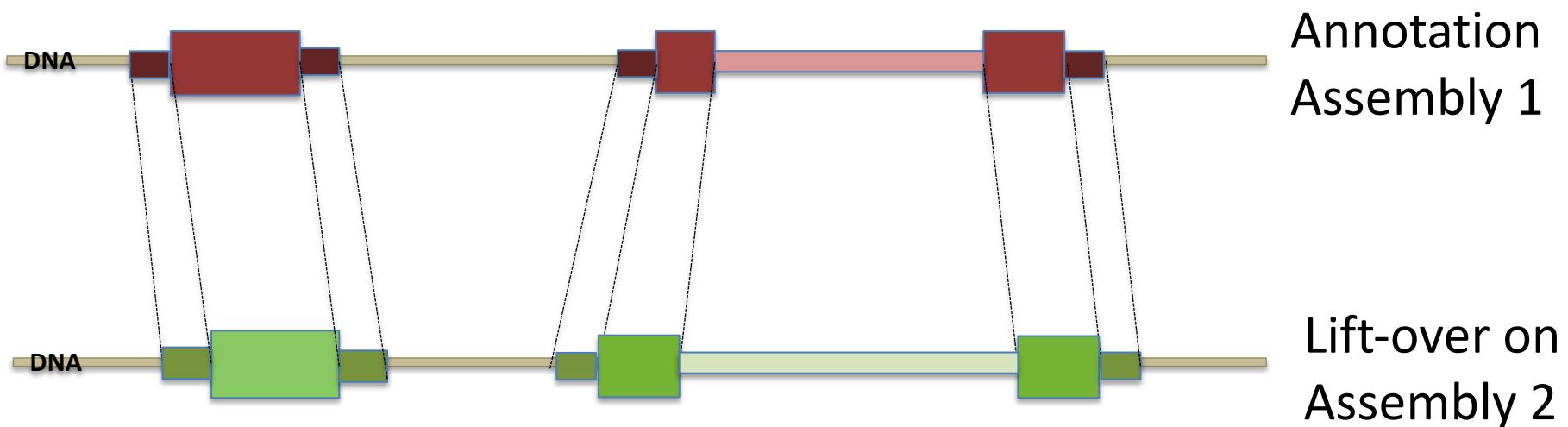
- ❑ Update an annotation in light of new evidence





## Capabilities:

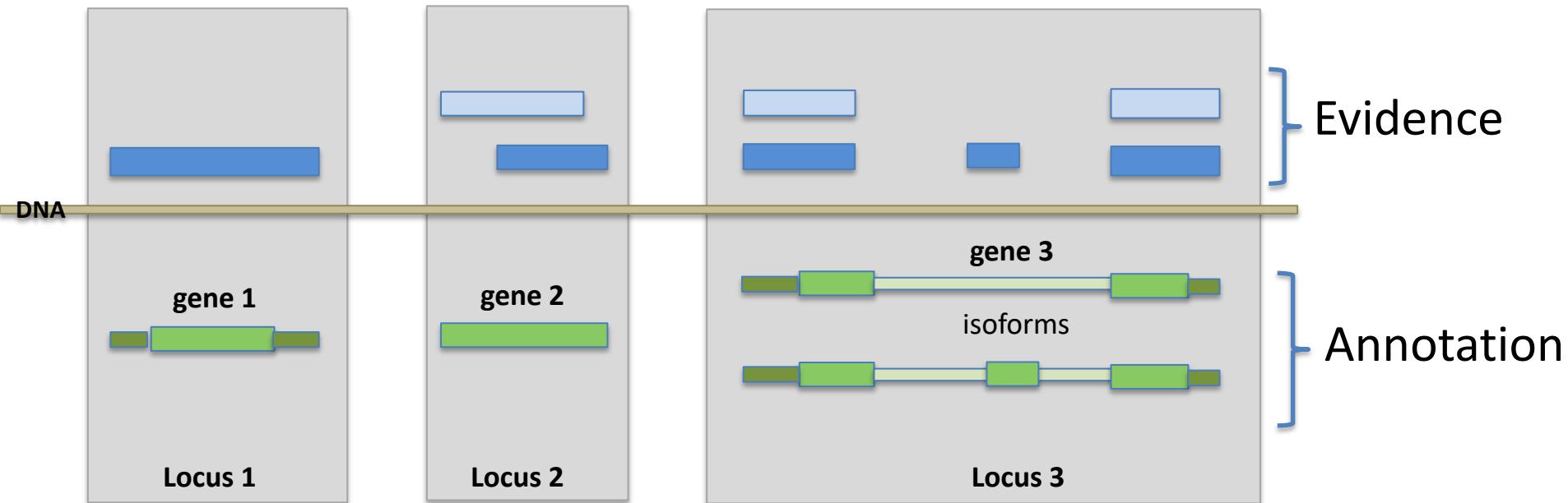
- Map annotation forwards to a new assembly





## Capabilities:

- ☐ Annotation pure evidence-based



- ⇒ Suitable for ab-initio training purpose (filtering needed)
- ⇒ Prediction not always complete ! (always\_complete option)



## Capabilities:

- Annotation pure *ab-initio*



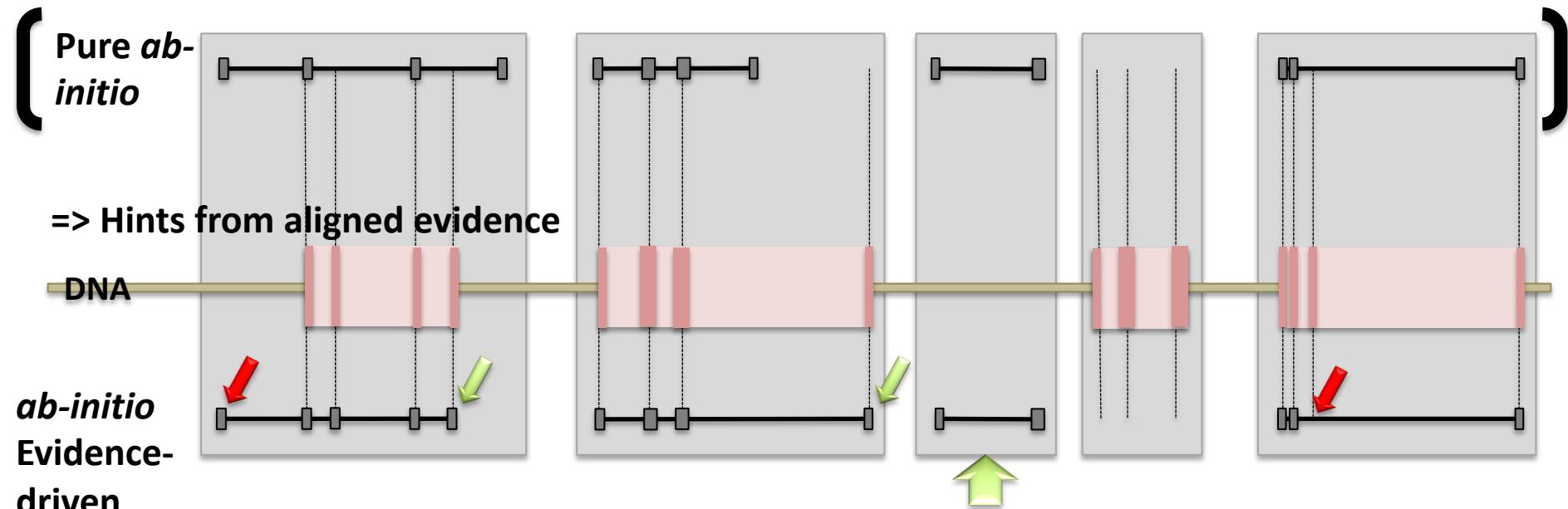
The same as standalone *ab-initio* ! So why MAKER ?

- ⇒ To take advantage of parallelization !
- ⇒ Can use several *ab-initio* tools (they can complement each other)



## Capabilities:

- Annotation *ab initio* evidence-driven



*Ab-initio* tools are better when hints are provided

*Ab-initio* predictions can fill gaps with no evidence

⇒ But may still be incomplete / partially wrong



# But how does Maker work exactly?

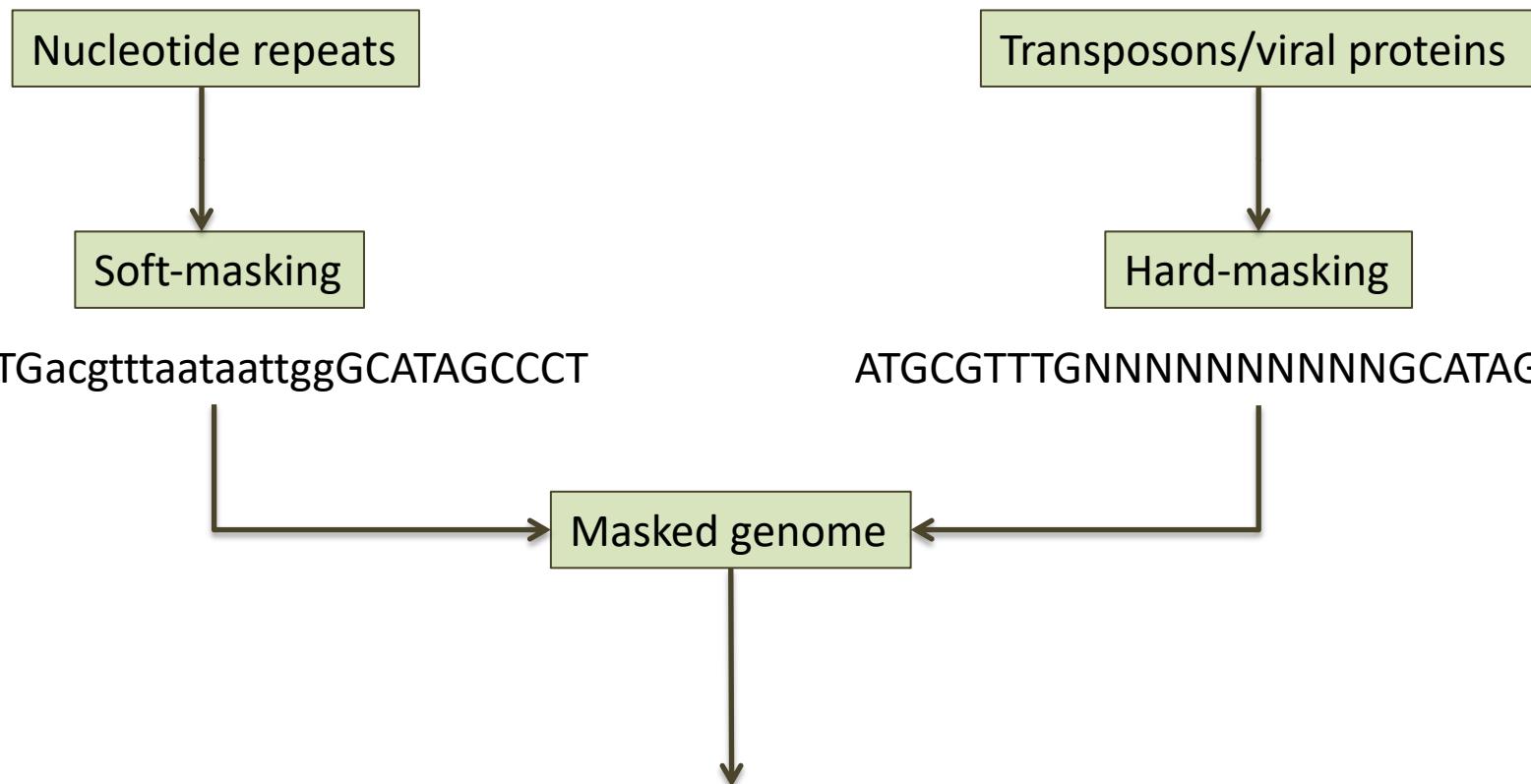
## Use case

⇒ *Ab-initio* evidence-driven

Prerequisite:

- Evidence (proteins and/or transcripts)
- Hmm profile for *ab-initio* tool(s)  
(Augustus comes with some pre-calculated profiles)

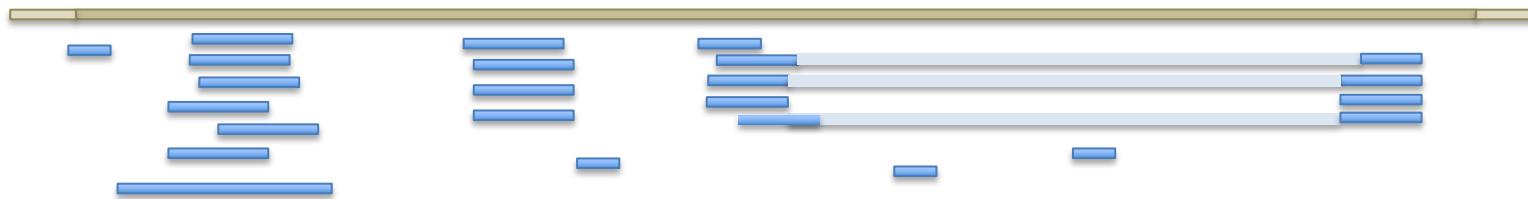
## Step 1 - Repeat masking with repeatmasker



## Step 2 - Transcript and protein evidence alignment



## Step 3 - Filtering and clustering alignments



Filtering is based on rules defined in the Maker configuration for a given project

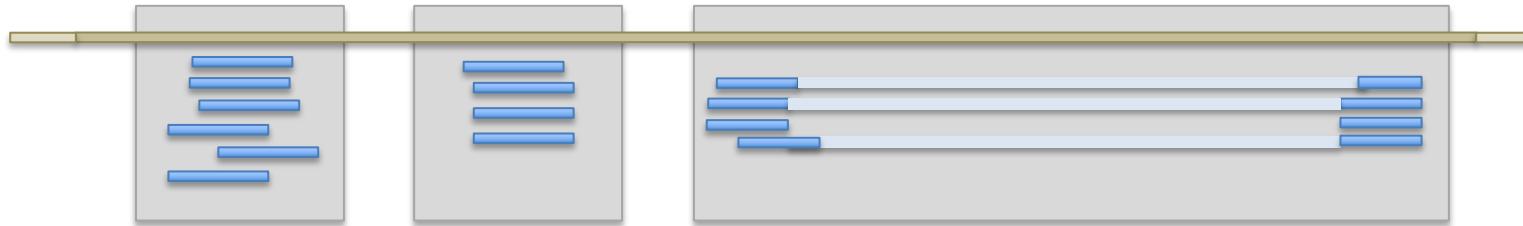
Example: EST alignment – 80% coverage and 85% identity

Default settings sensible for most projects, but can be changed!

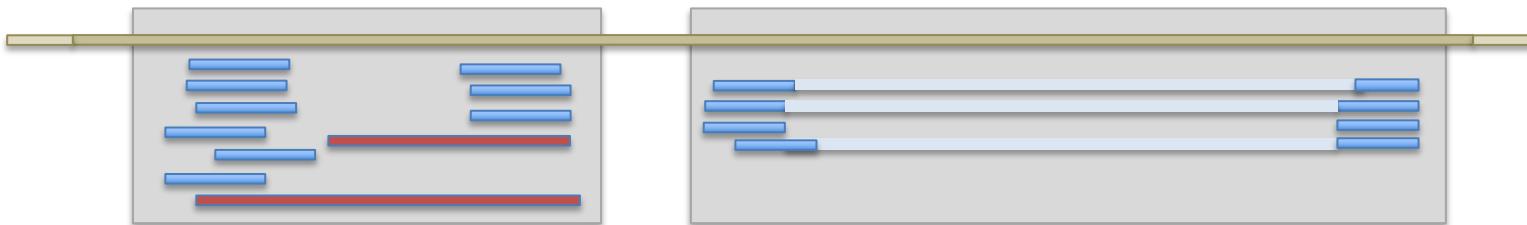


## Step 3 - Filtering and clustering alignments

Clustering into 'loci'

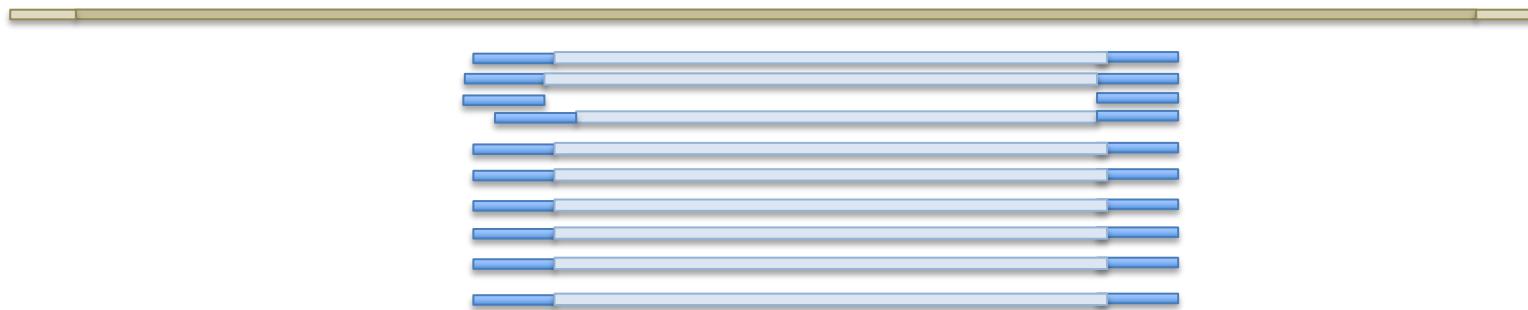


Importance of the quality of the data used:



=> Bad data can complicate clustering

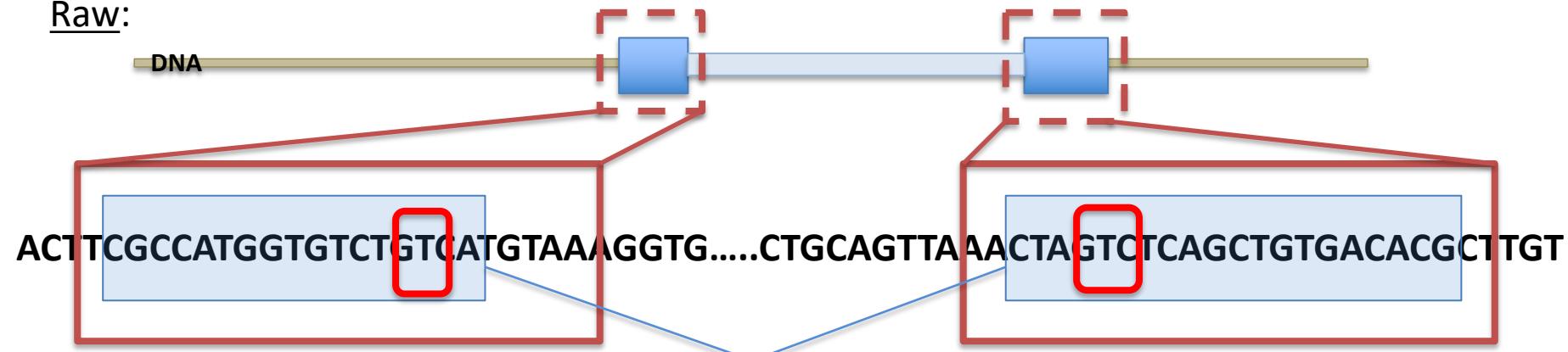
## Step 3 - Filtering and clustering alignments



Amount of data in any given cluster is then collapsed to remove redundancy

Threshold for the collapsing is also user-definable

## Step 4 - Polishing evidence alignments

Raw:

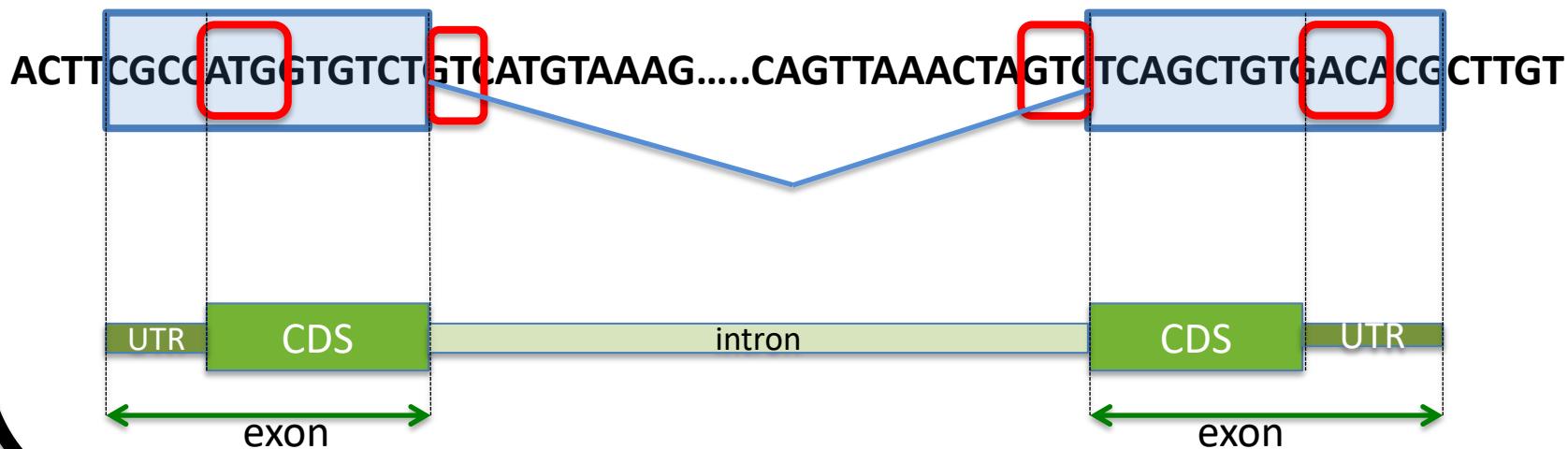
Blast-based alignments are only approximations, need to be refined

**Exonrate** is used to create splice-aware alignments

Polished:

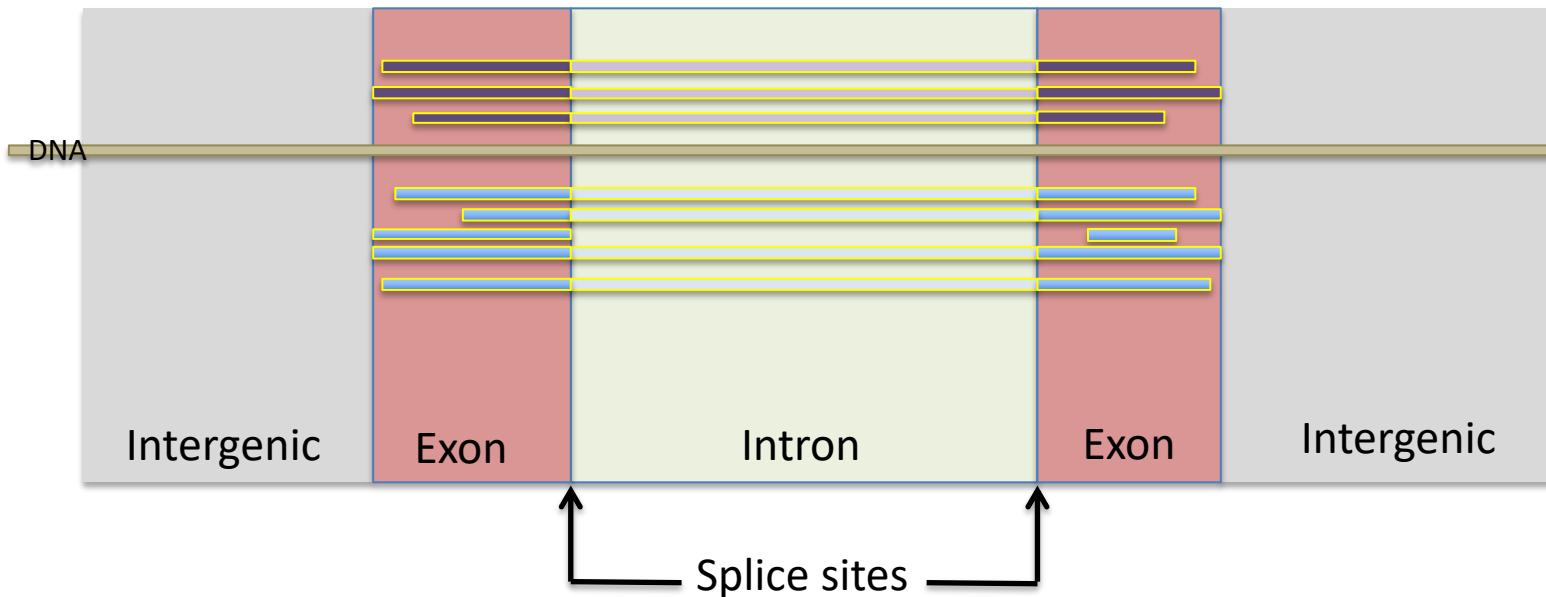
# Parenthesis !

⇒ In a pure evidence based case, the last step will be the creation of gene model from polished alignments.

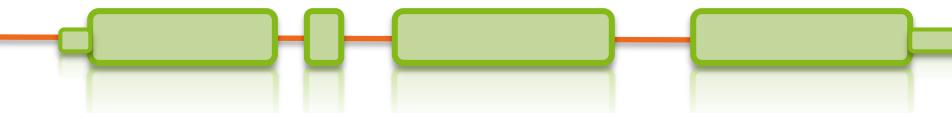


Let's get back on track !

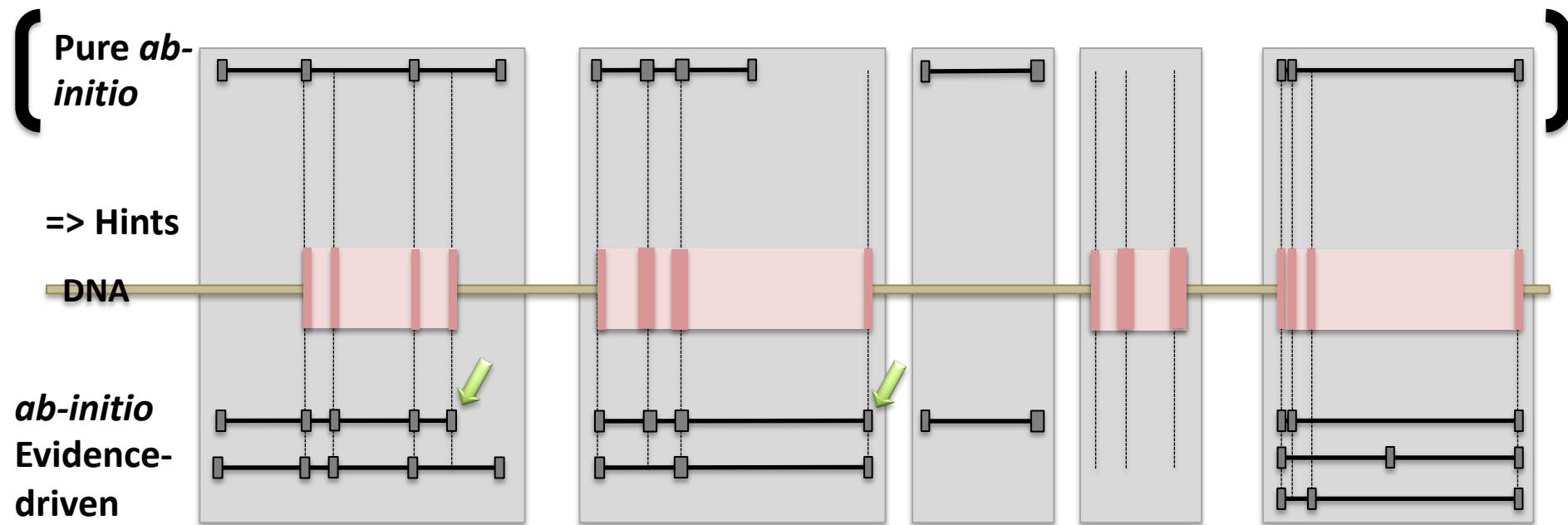
## Step 5 – Generating hints



Hints are passed to *ab-initio* tools that accept them



## Step 6 - *Ab-initio* gene prediction (evidence-driven)

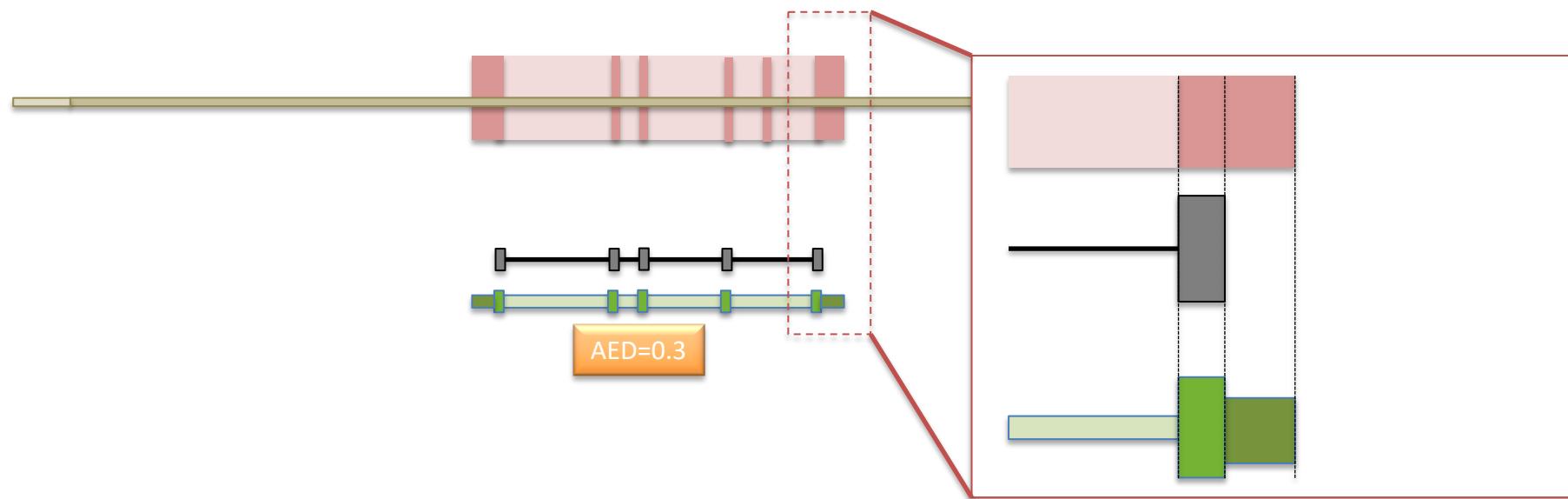


*Ab-initio* predictions are refined when hints are provided

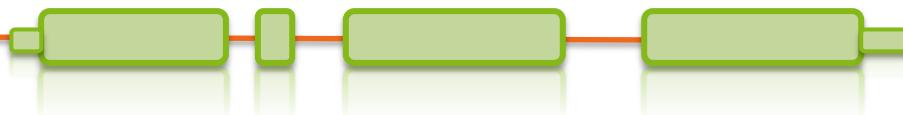
Isoforms accepted if parameter activated



## Step 7 - Annotation

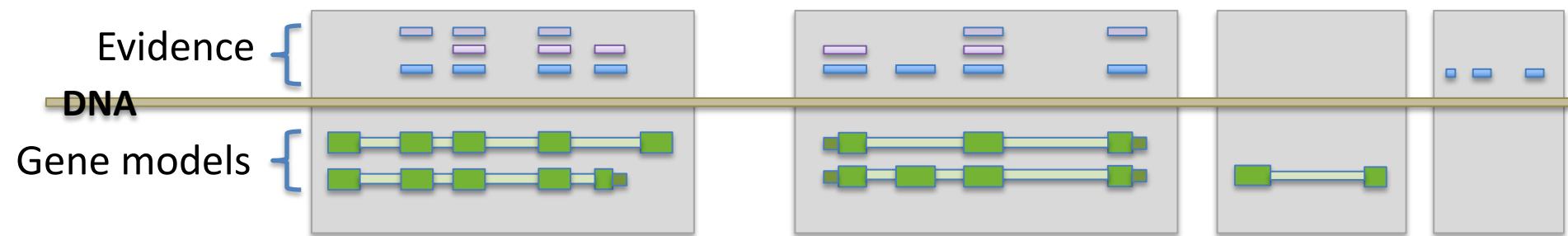


- Add UTRs
- Add quality control metrics



## Step 8 – Selecting gene models

- ⇒ selected in agreement with the available evidence
- ⇒ The minimum agreement threshold can be chosen



### Final MAKER Annotation:

keep\_preds=0

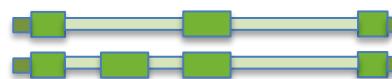
Maximum sensitivity



alt\_splice=1

keep\_preds=1

specificity ↑ sensitivity ↓

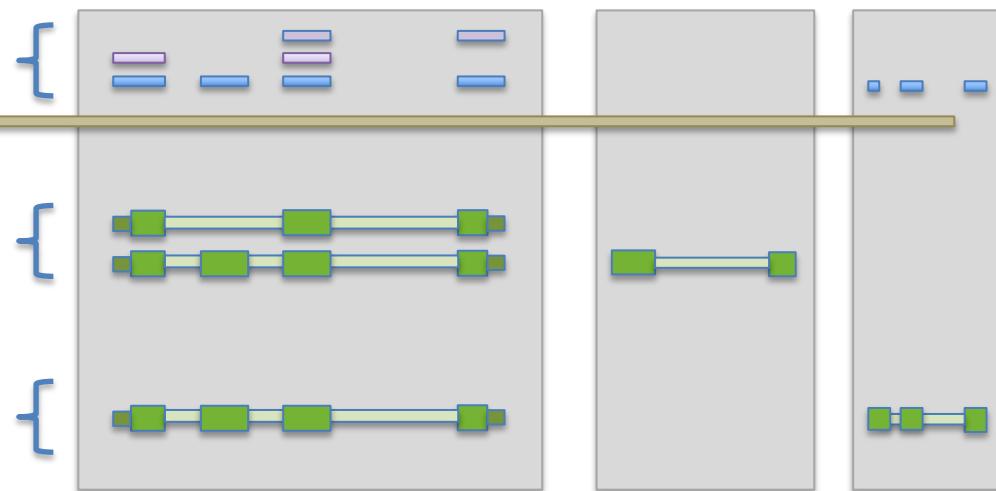




Tip - complete the annotation

Evidence

DNA



+  
MAKER evidence based

=> result



MAKER



What next ?



MAKER  
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Output = Annotation in gff3 format

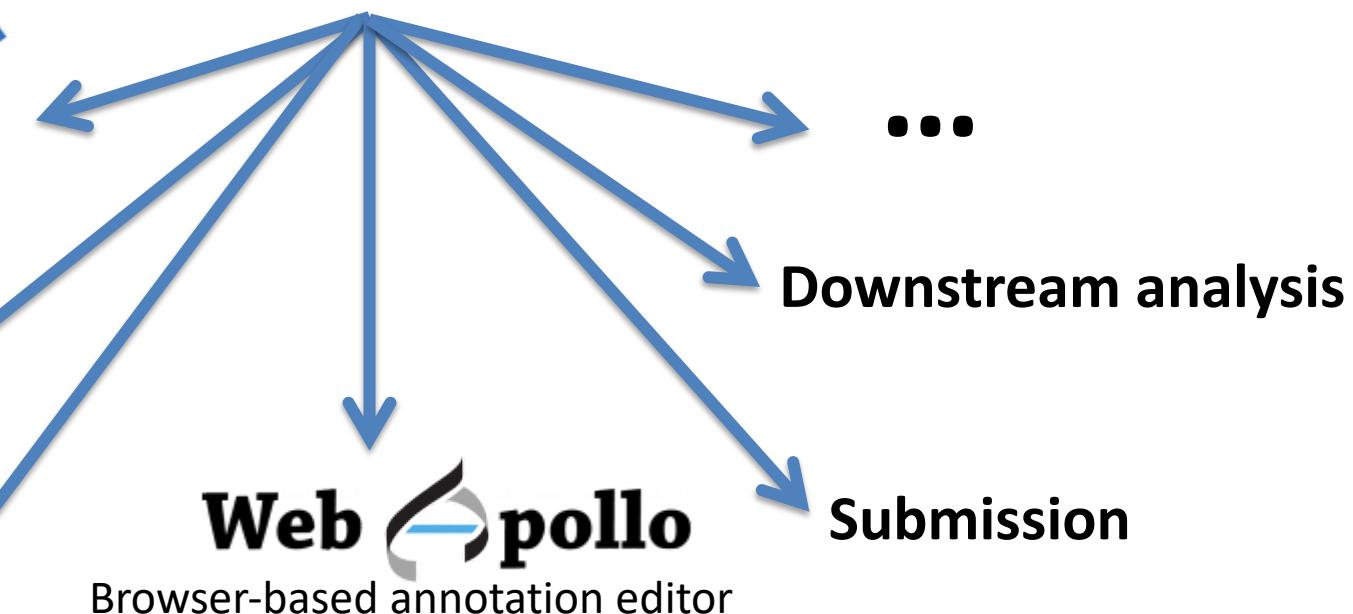


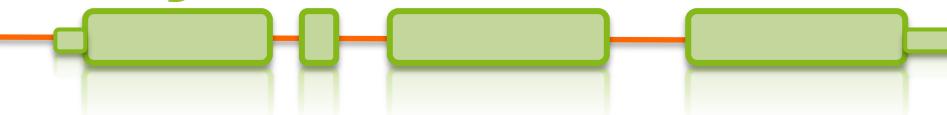
Genome browser

**CHADO**  
Biological  
database schema

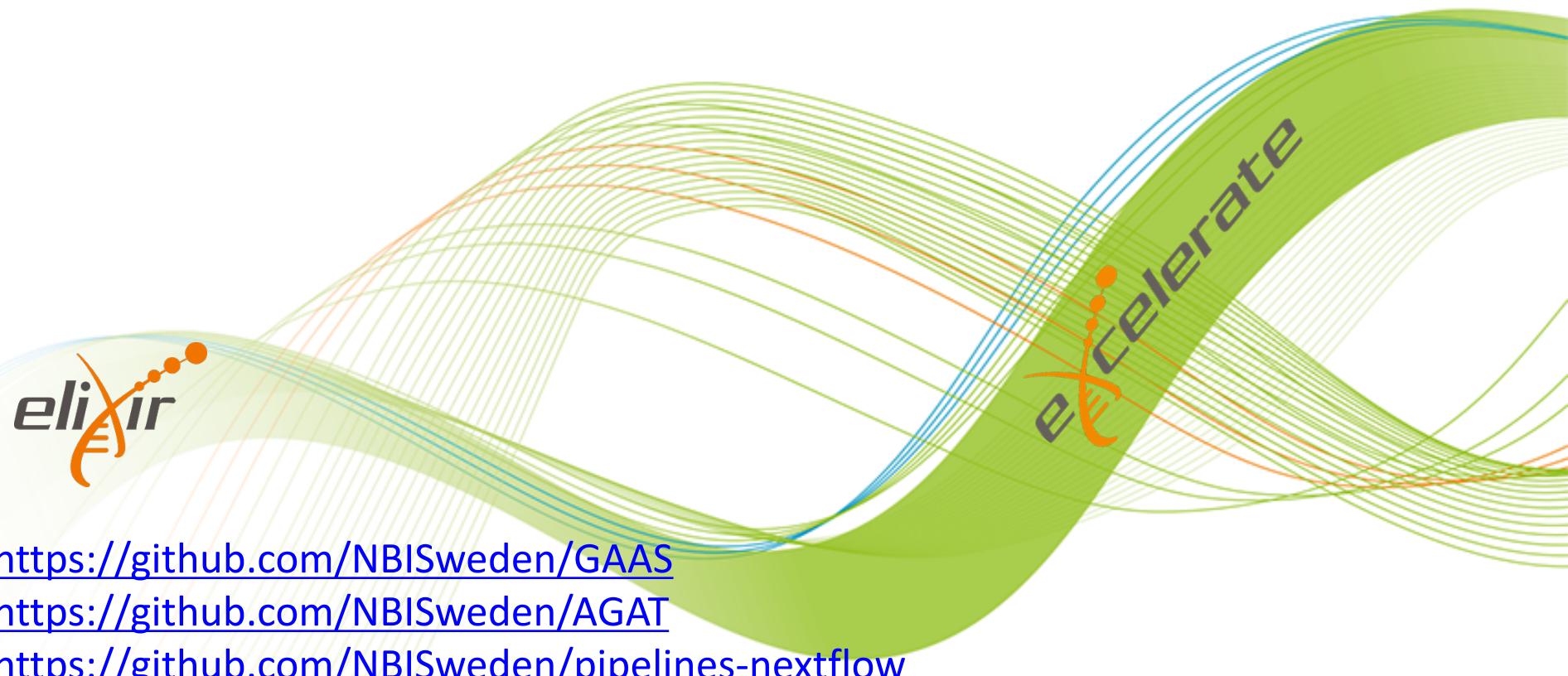


Tripal: Chado web interface





***THE END***



<https://github.com/NBISweden/GAAS>

<https://github.com/NBISweden/AGAT>

<https://github.com/NBISweden/pipelines-nextflow>