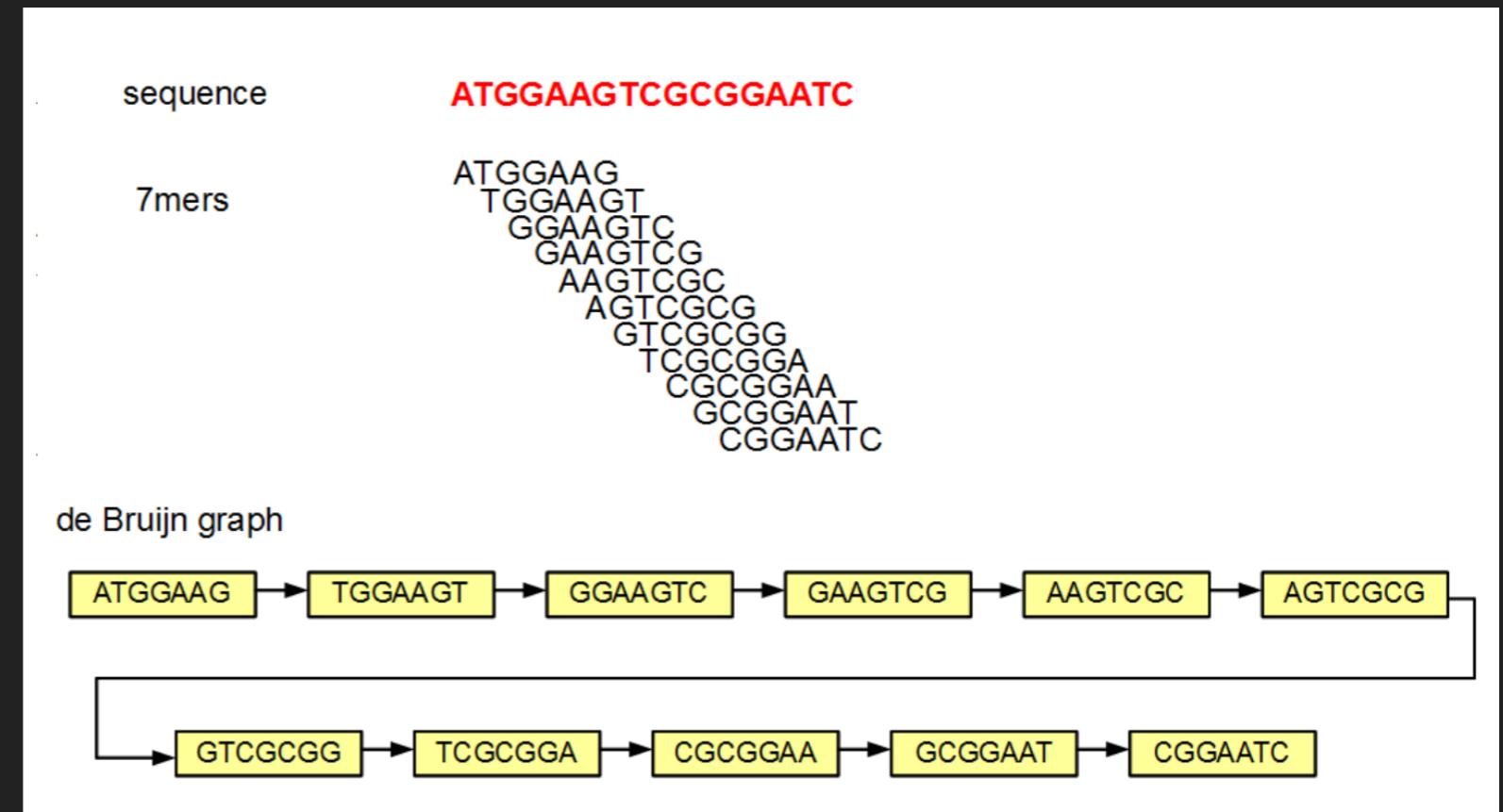

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY

DE NOVO TRANSCRIPTOME ASSEMBLY

- ▶ Trinity is a de bruijn graph assembler
- ▶ Trinity is written for use on short Illumina reads
- ▶ Short reads are broken into even shorter kmers
- ▶ kmers are constructed into a graph



TRINITY

- ▶ Paper: “Trinity: reconstructing a full-length transcriptome without a genome from RNA-Seq data”

Nature Biotechnology doi:
10.1038/nbt.1883

- ▶ Trinity takes place in three phases:

- ▶ Inchworm
- ▶ Chrysalis
- ▶ Butterfly



HOW IS TRANSCRIPTOME ASSEMBLY DIFFERENT FROM GENOME ASSEMBLY? (E.G. WHY USE A PURPOSE-BUILT TRANSCRIPTOME ASSEMBLER?)

Genome Assembly

- Uniform coverage
- Single contig per locus
- Double-stranded

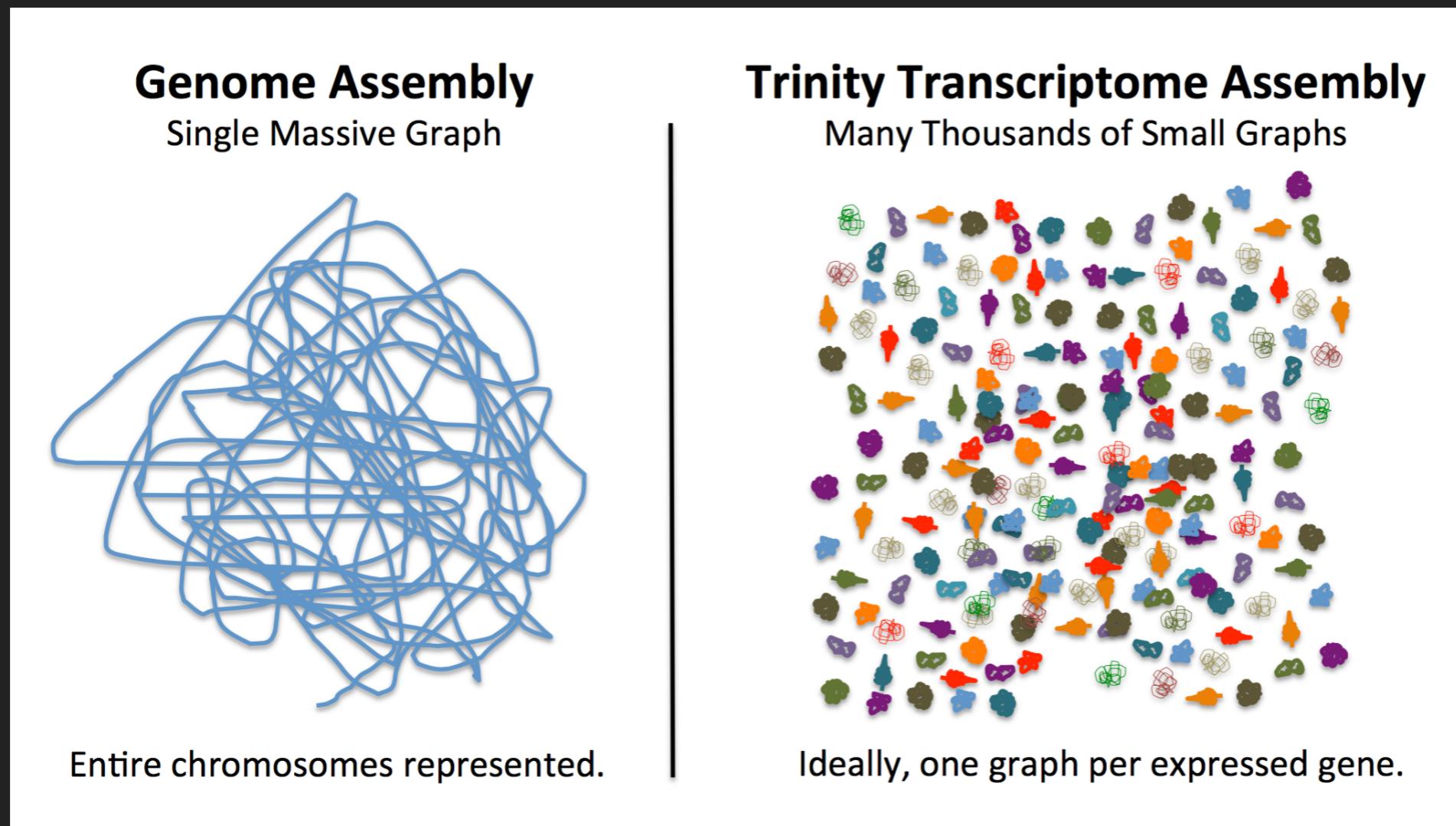
Transcriptome Assembly

- Exponentially distributed coverage levels
- Multiple contigs per locus (alt splicing)
- Strand-specific



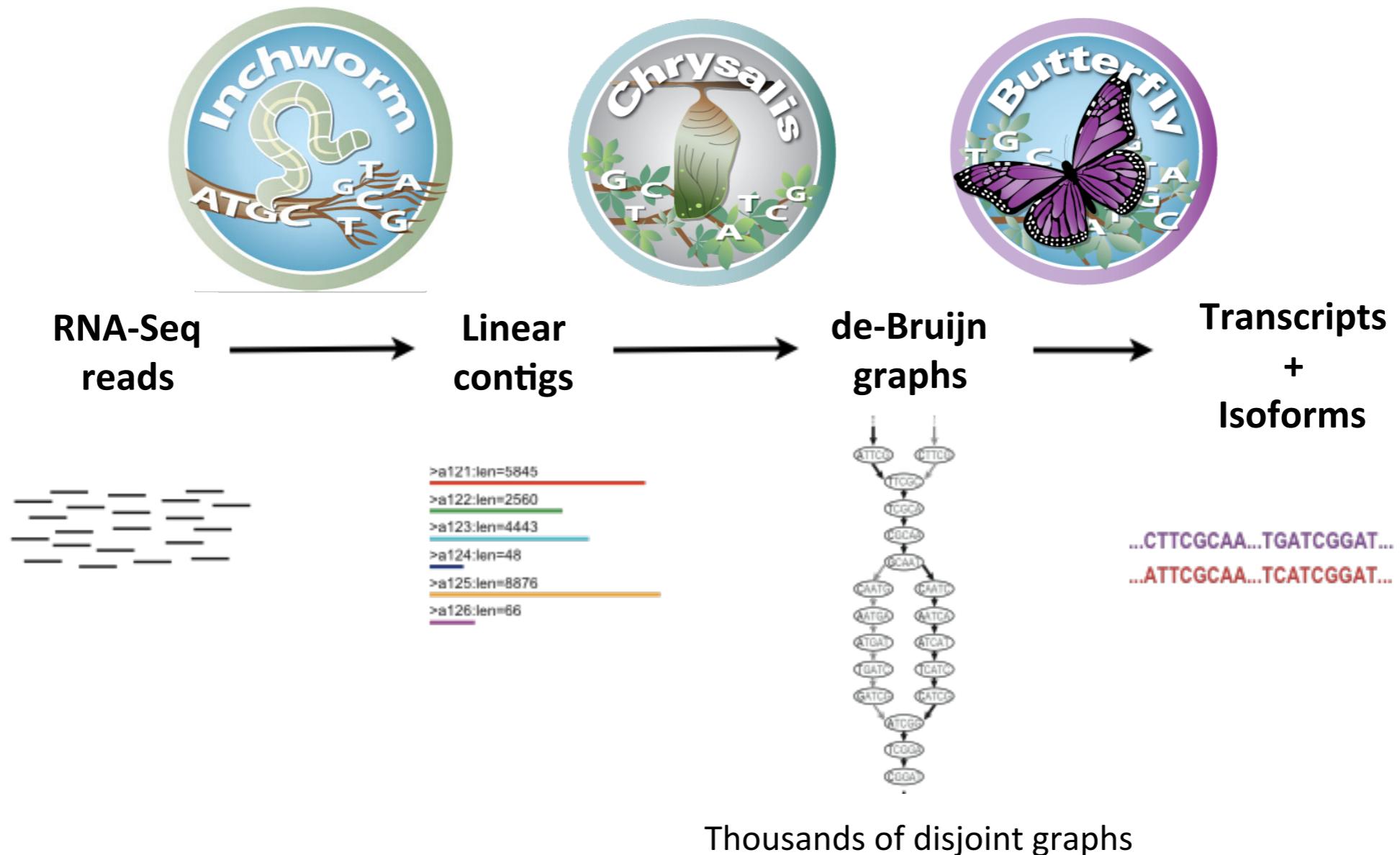
Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

HOW IS TRANSCRIPTOME ASSEMBLY DIFFERENT FROM GENOME ASSEMBLY? (E.G. WHY USE A PURPOSE-BUILT TRANSCRIPTOME ASSEMBLER?)



DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY

Trinity – How it works:



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

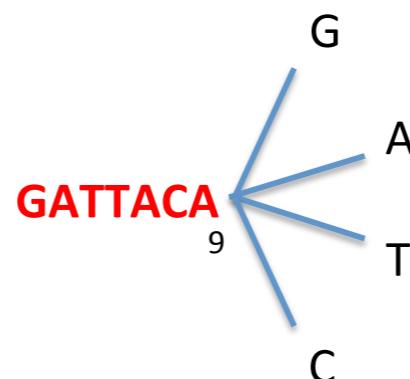


Inchworm Algorithm

Decompose all reads into overlapping Kmers (25-mers)

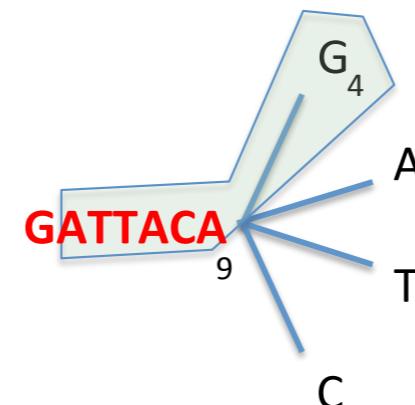
Identify seed kmer as most abundant Kmer, ignoring low-complexity kmers.

Extend kmer at 3' end, guided by coverage.





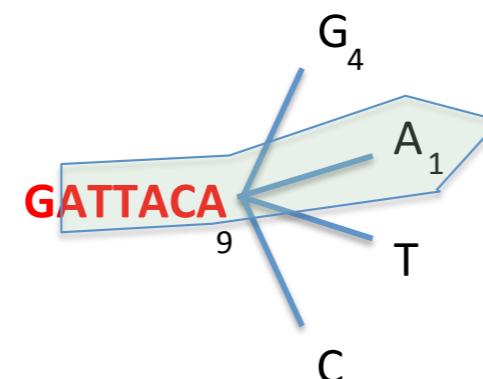
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



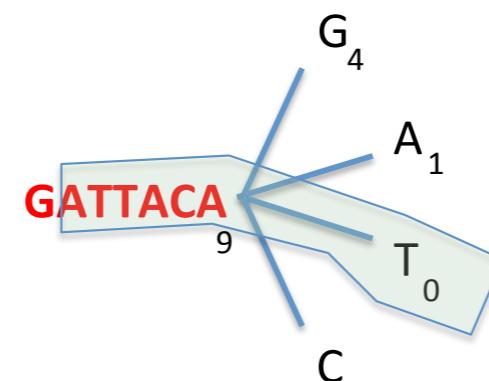
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



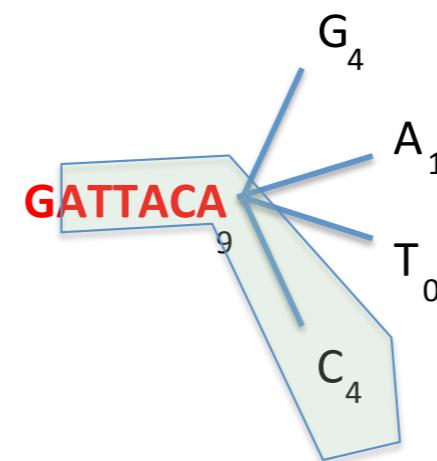
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



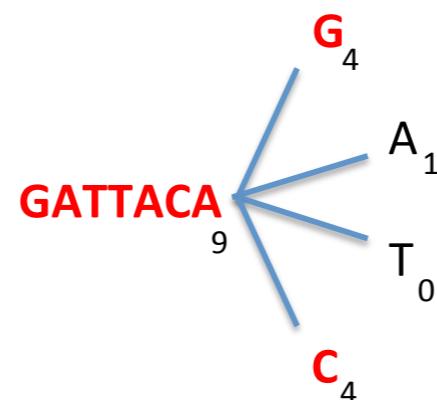
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



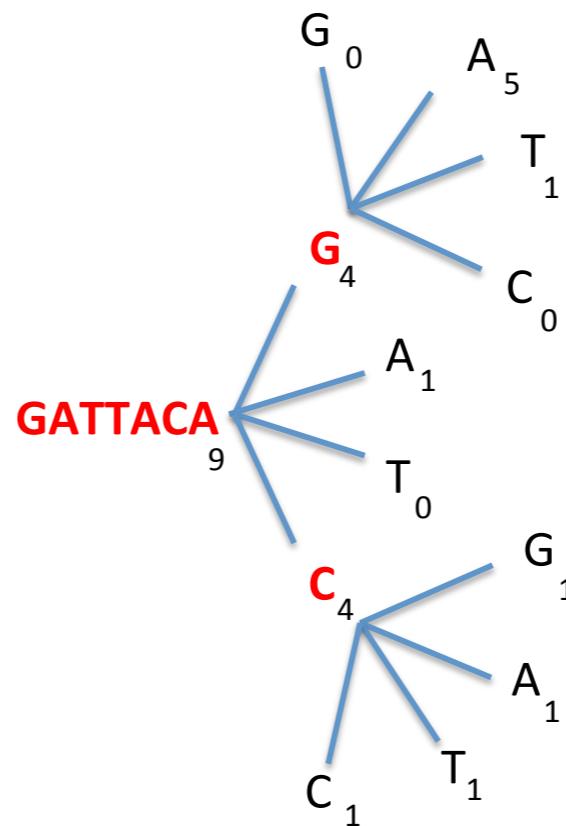
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



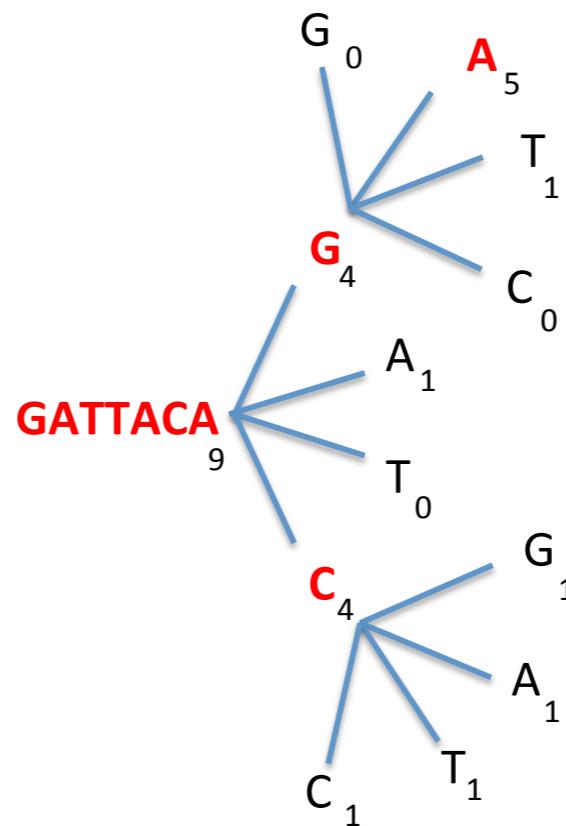
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



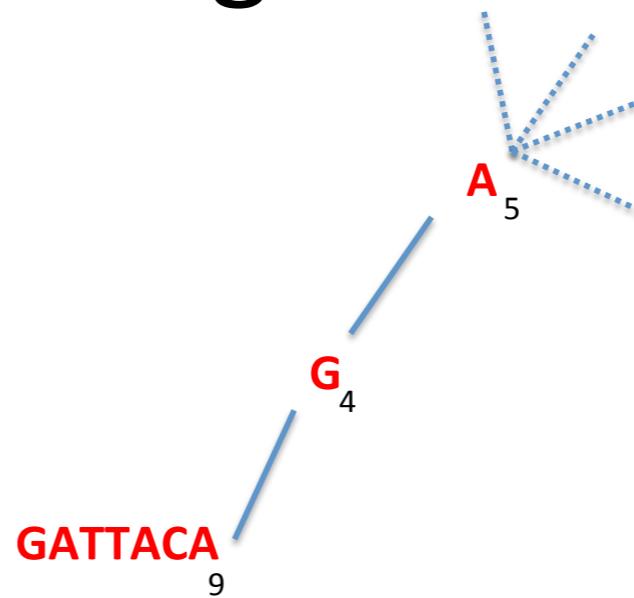
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



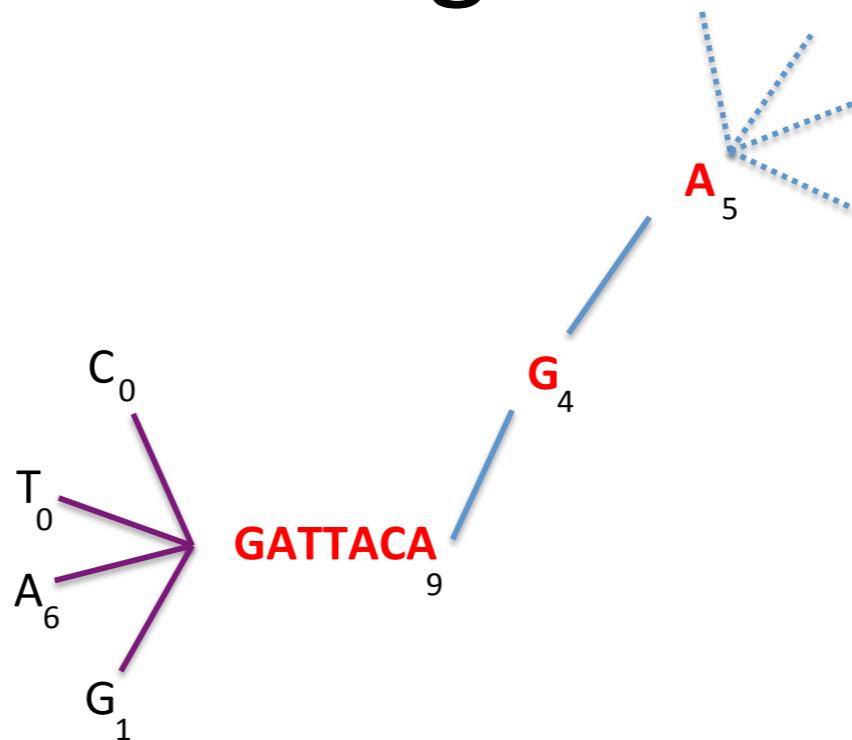
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



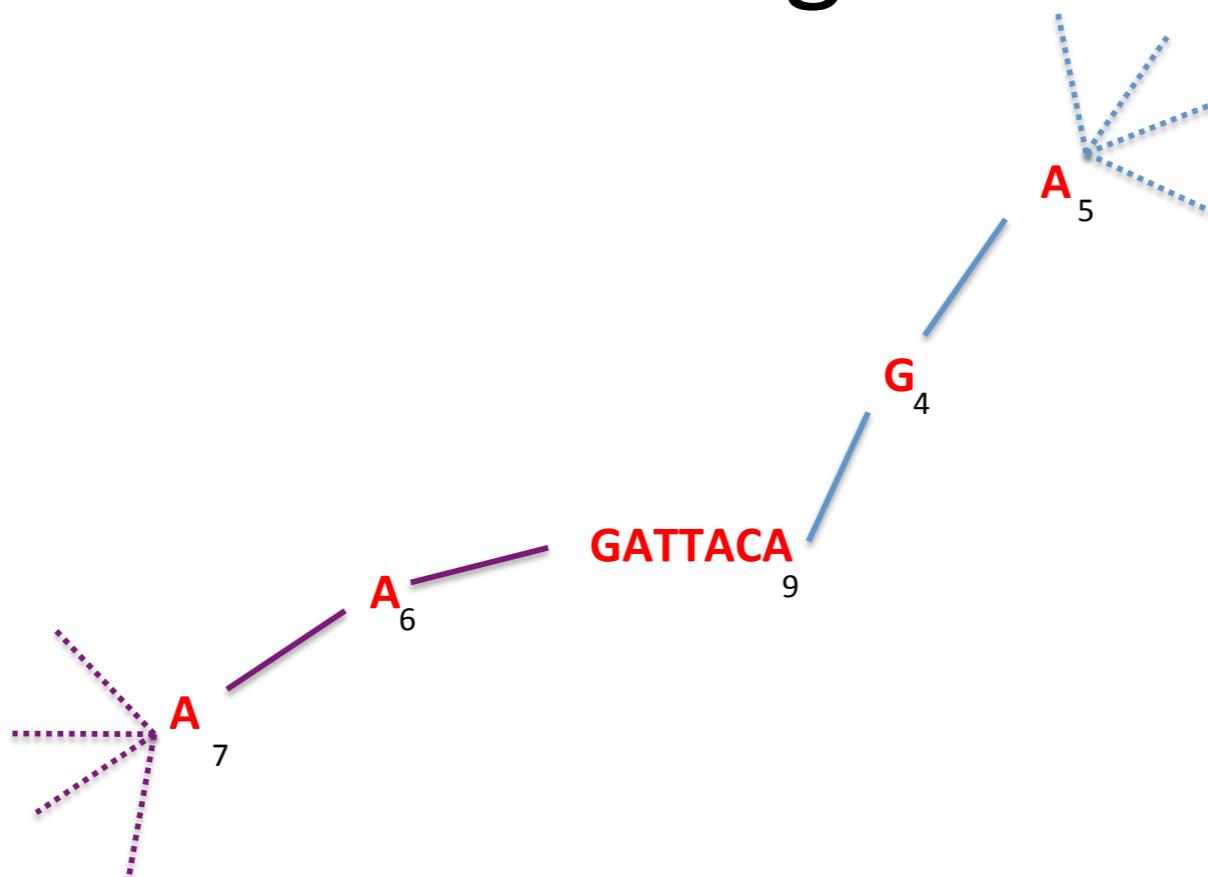
Inchworm Algorithm



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf



Inchworm Algorithm



Report contig:**AAGATTACAGA**....

Remove assembled kmers from catalog, then repeat the entire process.

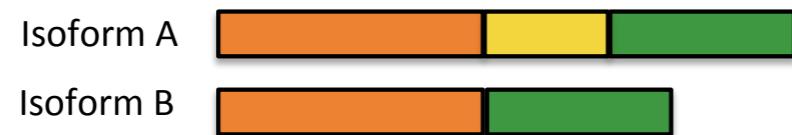
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DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY



Inchworm Contigs from Alt-Spliced Transcripts

Expressed isoforms



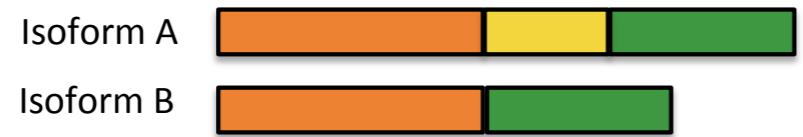
Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY



Inchworm Contigs from Alt-Spliced Transcripts

Expressed isoforms



Expression

(low)
(high)

Graphical representation

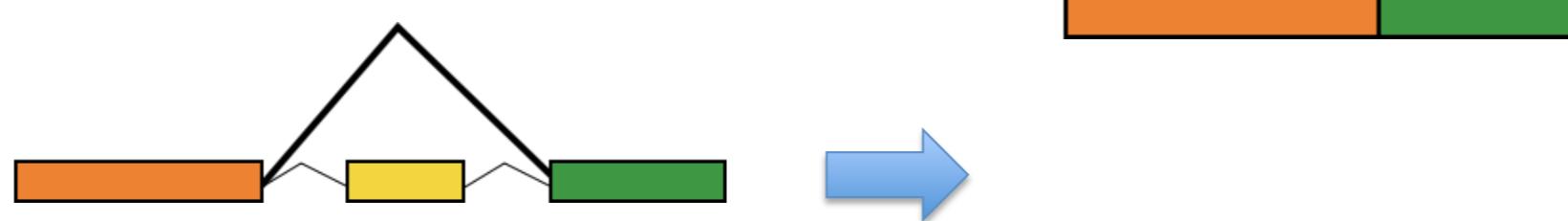


Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY



Inchworm Contigs from Alt-Spliced Transcripts

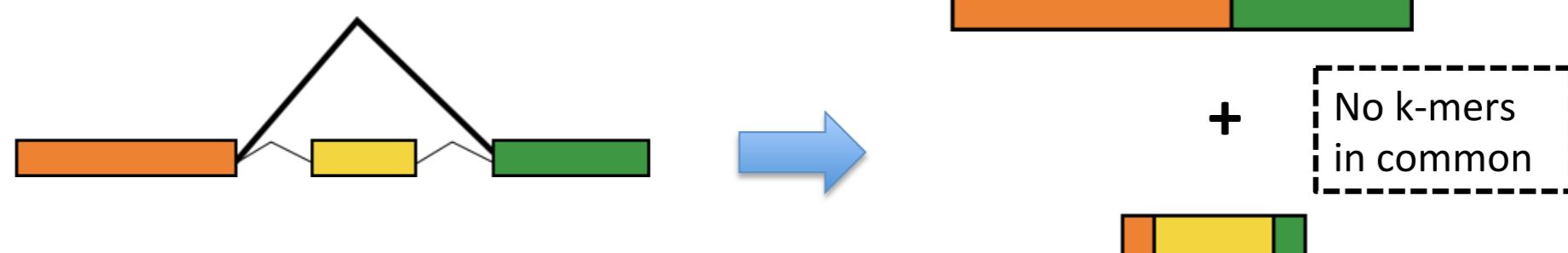


Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY



Inchworm Contigs from Alt-Spliced Transcripts

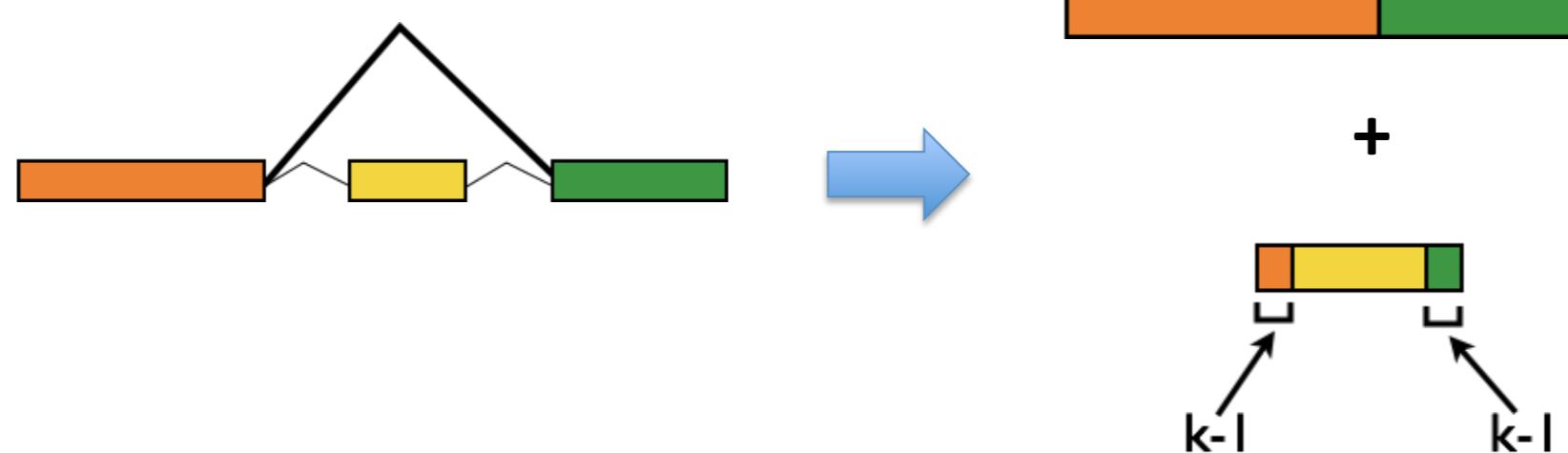


Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY

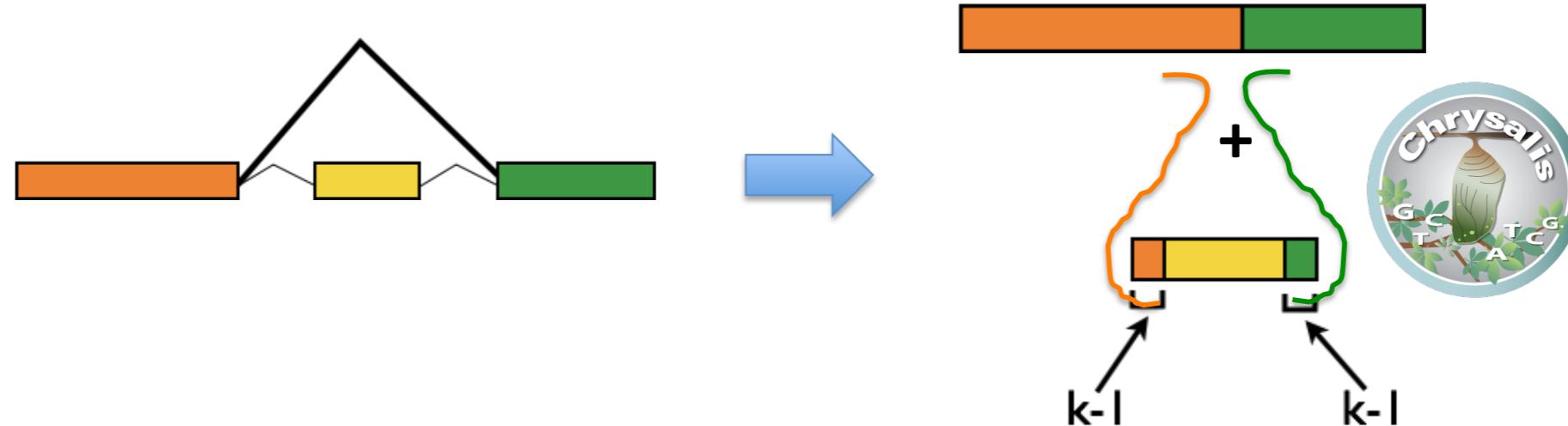


Inchworm Contigs from Alt-Spliced Transcripts



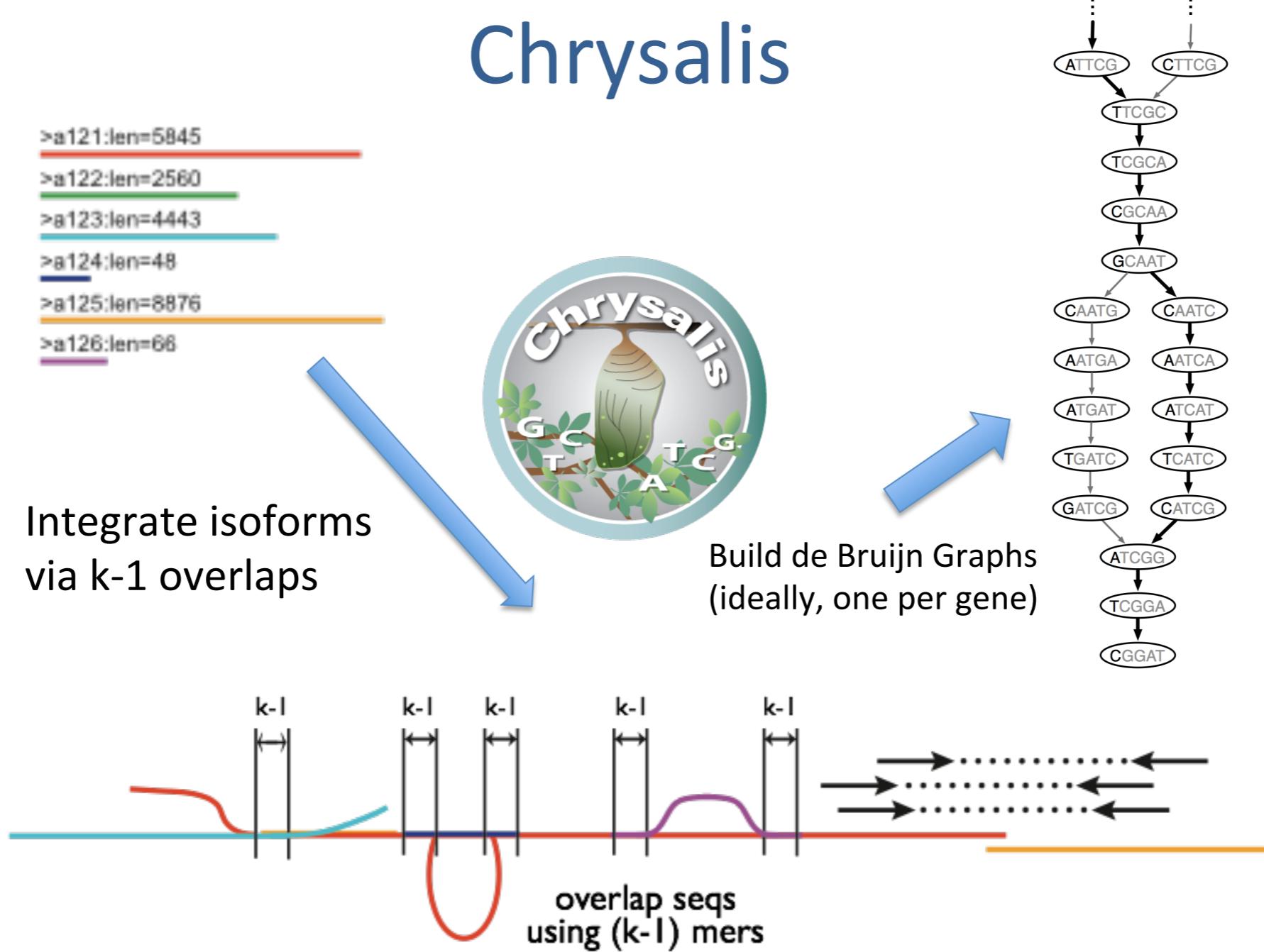
Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

Chrysalis Re-groups Related Inchworm Contigs



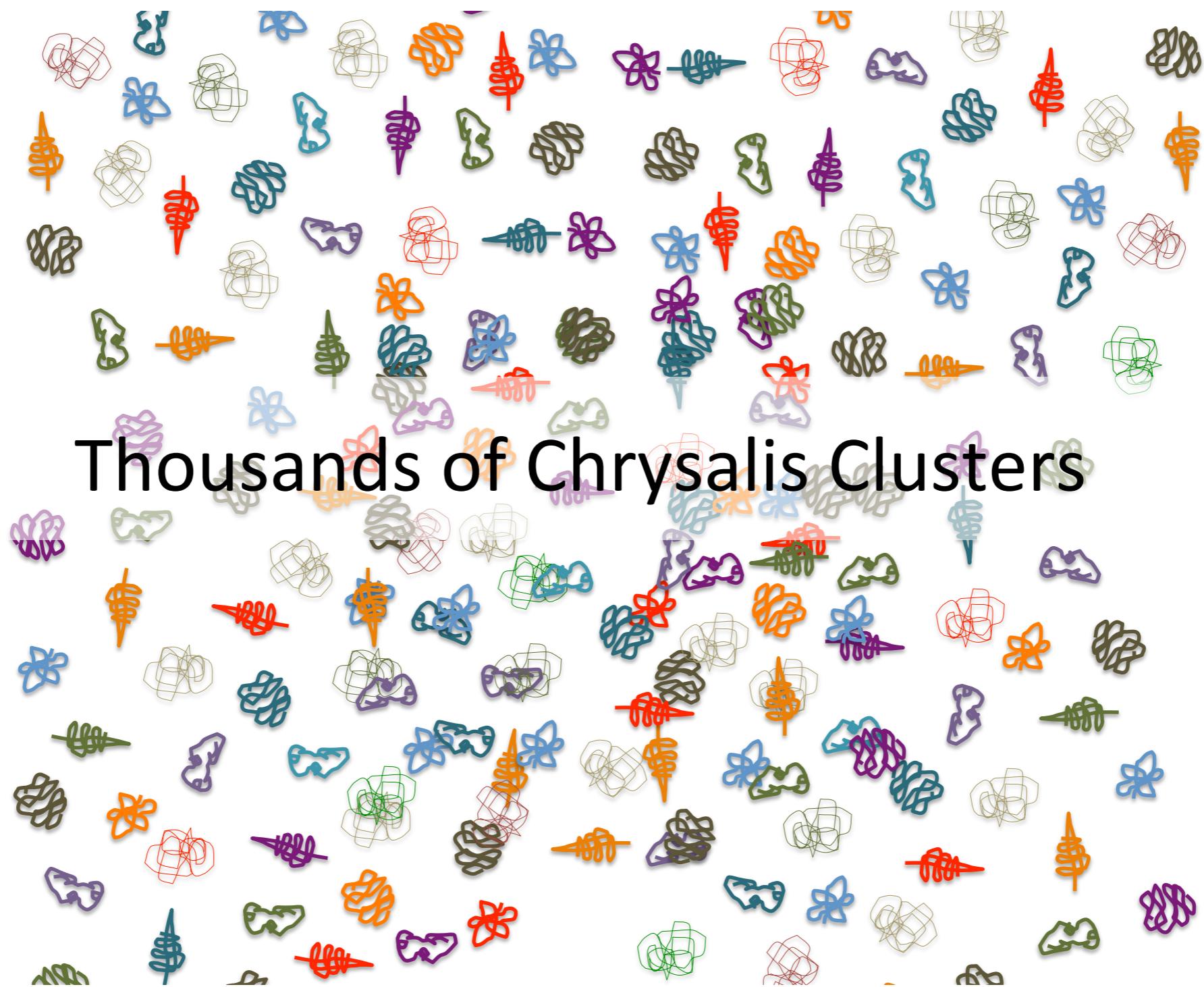
Chrysalis uses $(k-1)$ overlaps and read support to link related Inchworm contigs

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY



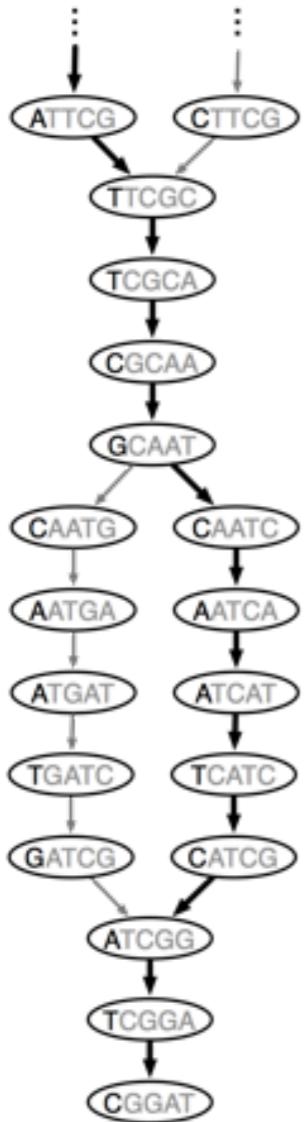
Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY



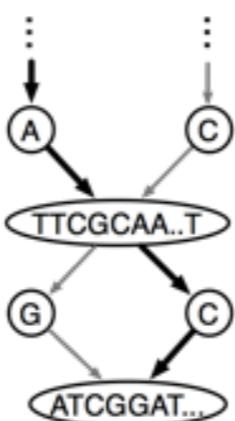
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DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY



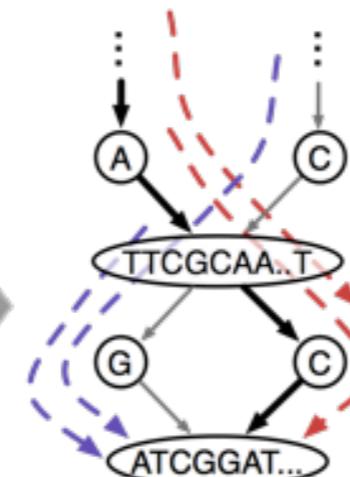
de Bruijn
graph

compacting



compact
graph

finding paths



compact
graph with
reads

..CTTCGCAA..TGATCGGAT...
..ATTTCGCAA..TCATCGGAT...

sequences
(isoforms and paralogs)



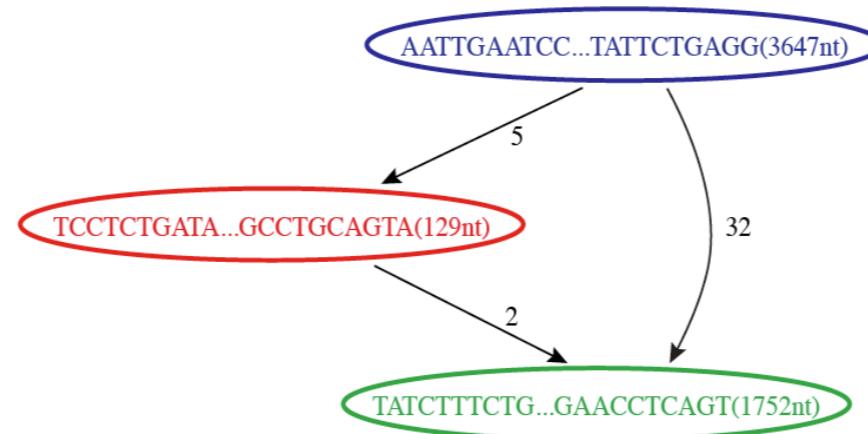
Butterfly

Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY

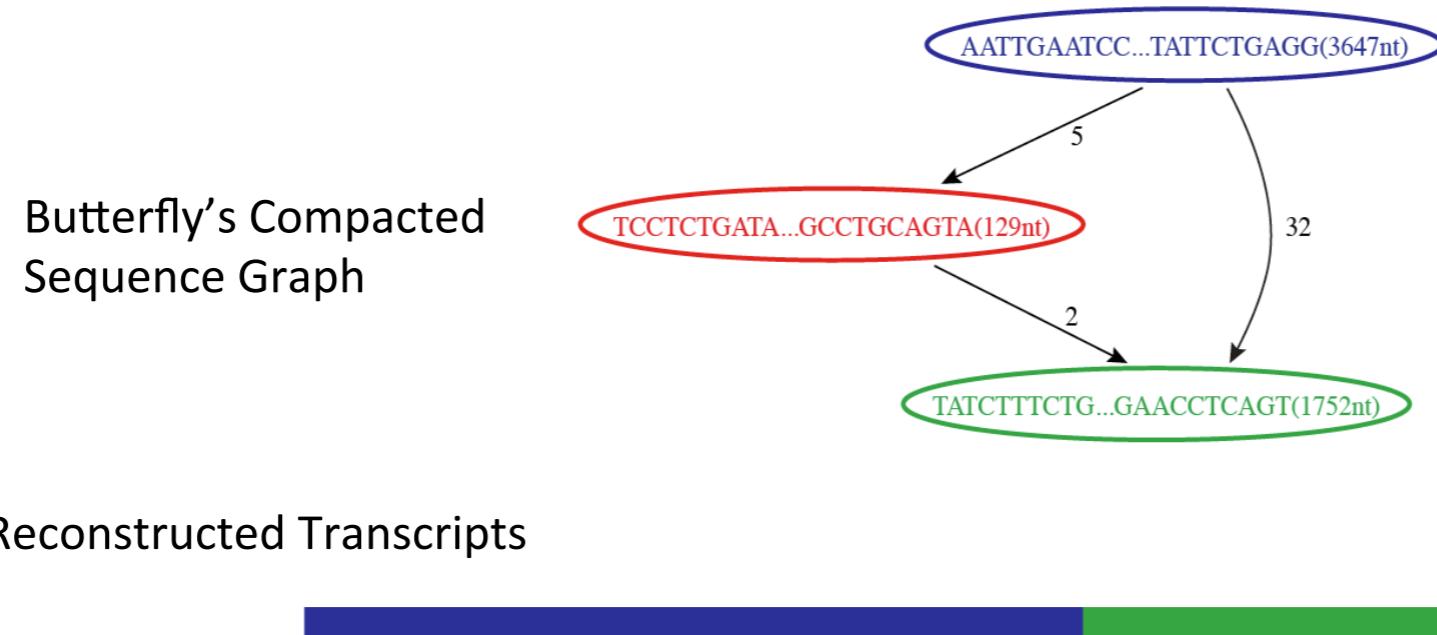
Butterfly Example 1: Reconstruction of Alternatively Spliced Transcripts

Butterfly's Compacted
Sequence Graph



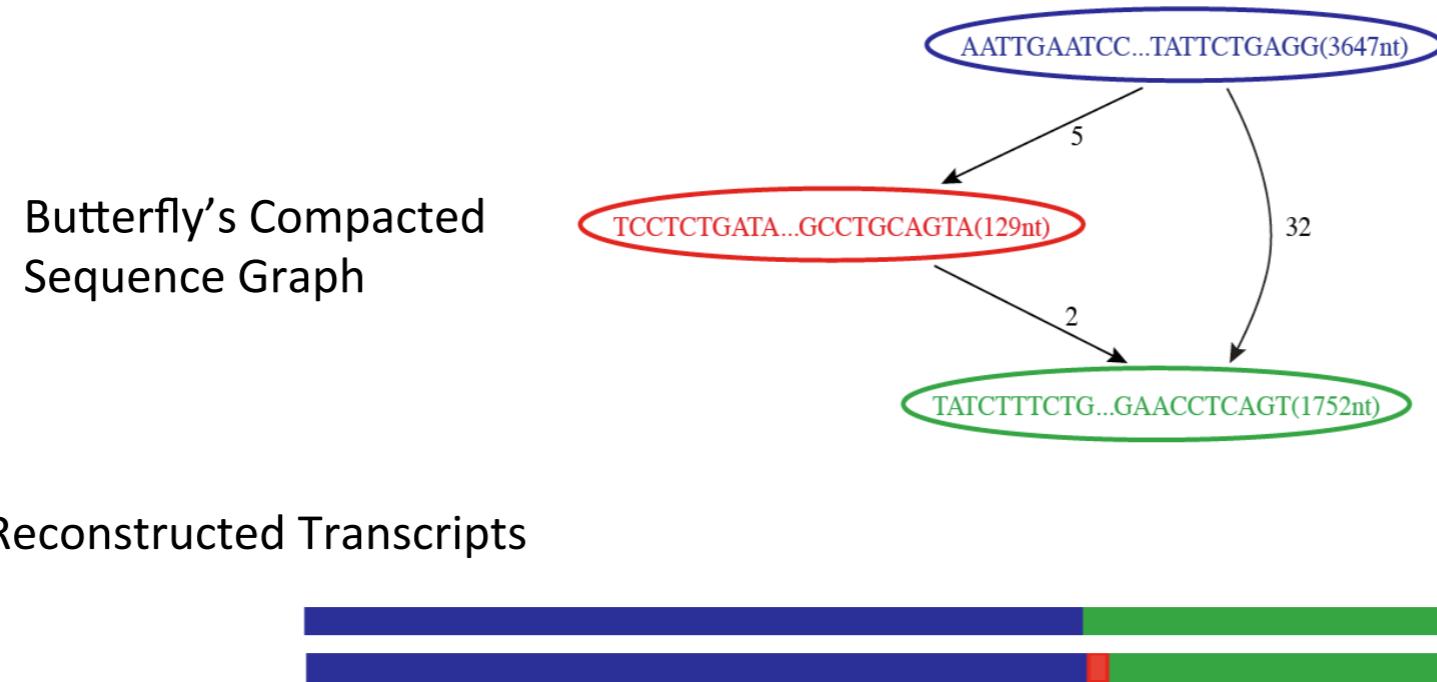
Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

Reconstruction of Alternatively Spliced Transcripts



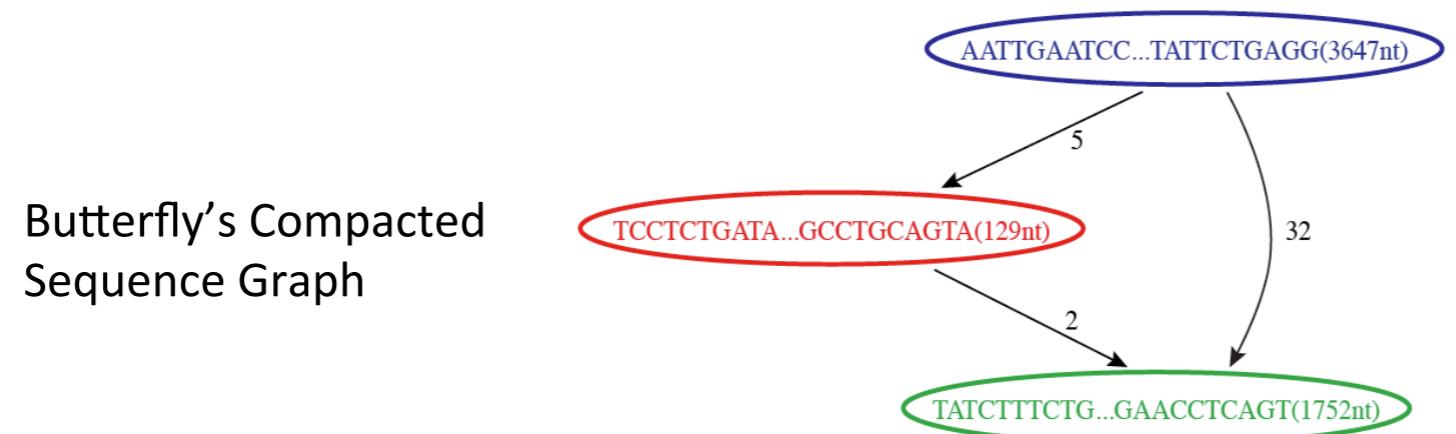
Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

Reconstruction of Alternatively Spliced Transcripts



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

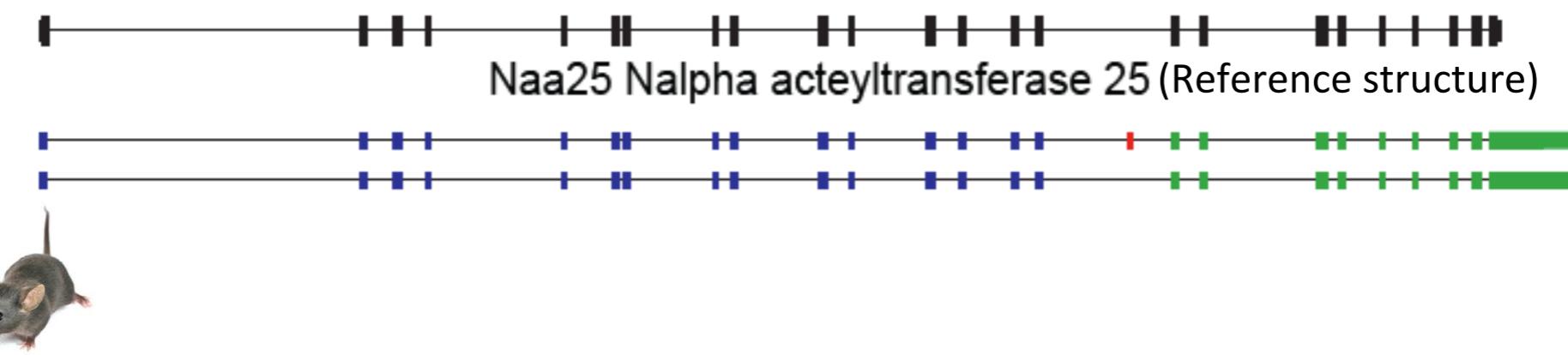
Reconstruction of Alternatively Spliced Transcripts



Reconstructed Transcripts

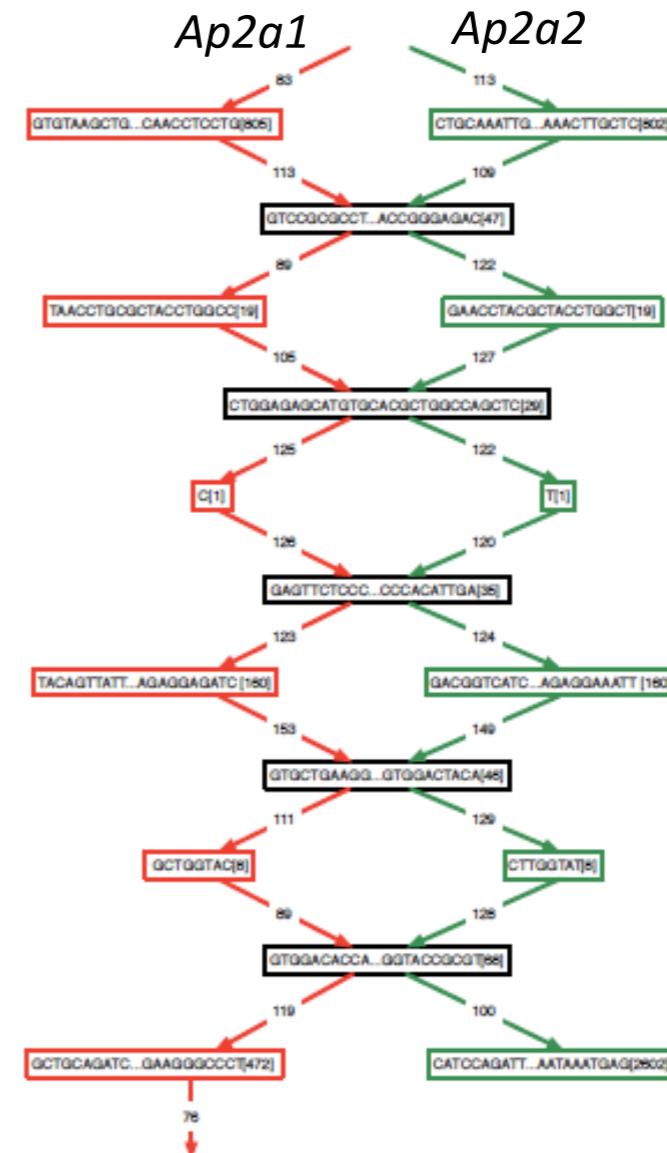


Aligned to Mouse Genome



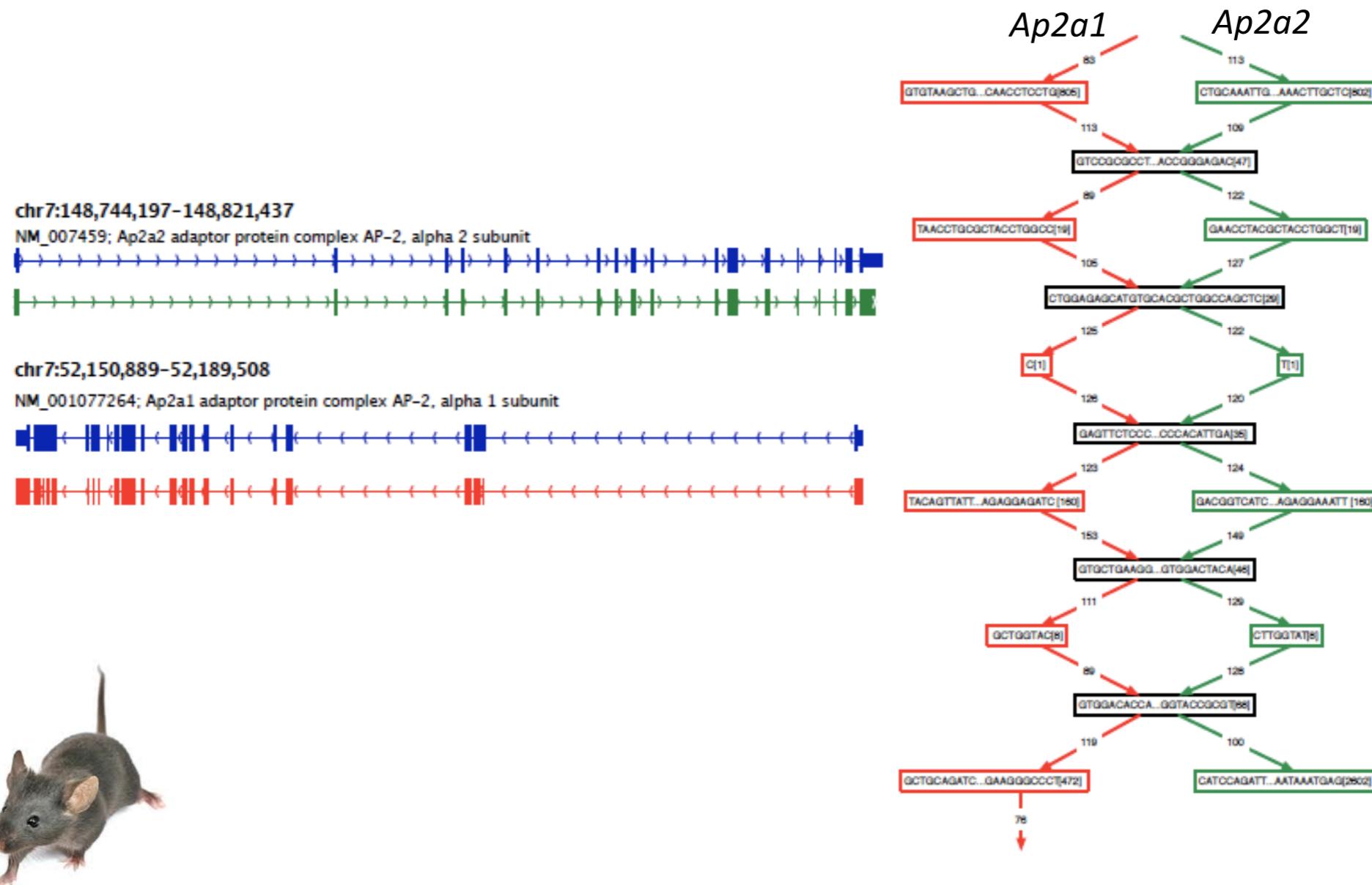
Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

Butterfly Example 2: Teasing Apart Transcripts of Paralogous Genes



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

Teasing Apart Transcripts of Paralogous Genes



Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

DE NOVO TRANSCRIPTOME ASSEMBLY WITH TRINITY

Trinity output: A multi-fasta file

Trinity slides from: https://github.com/trinityrnaseq/RNASeq_Trinity_Tuxedo_Workshop/blob/master/docs/rnaseq_workshop_slides.pdf

HANDS-ON

- ▶ Go to [https://github.com/
SmithsonianWorkshops/
2020-01-28-NMNH-RNAseq/tree/
master/Materials](https://github.com/SmithsonianWorkshops/2020-01-28-NMNH-RNAseq/tree/master/Materials)

- ▶ Click on “3a_De novo assembly
with Trinity.md”

