

SequenceJuxtaposer: Fluid Navigation For Large-Scale Sequence Comparison in Context

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Overview

- 1 Introduction
- 1 Previous Work
- 1 Interaction Metaphor
- 1 SequenceJuxtaposer
- 1 Conclusion and Future Work



Introduction

- 1 Sequence visualization tool
 - 1 Exploration and comparison
- 1 Accordion Drawing
 - 1 Stretch and shrink rubber sheet
 - 1 Borders tacked down



Introduction Video

See [SequenceJuxtaposer Video](#) for more details.



Previous Work

- 1 Accordion Drawing
 - 1 TreeJuxtaposer [Munzner 03]
- 1 Sequence Browsers
 - 1 Ensembl [Hubbard 02], UCSC Genome Browser [Kent 02], NCBI [Wheeler 02]
 - 1 MacClade [Maddison 92], VISTA [Mayor 02], phylo-VISTA [Shah 03]
 - 1 Artemis [Rutherford 00], LalnView [Duret 96], BARD [Spell 03], PipMaker [Schwartz 00]



Accordion Drawing

- 1 SequenceJuxtaposer guarantees 3 key properties
 - 1 Context
 - 1 Visibility
 - 1 Frame Rate



Guaranteed Context

- 1 Focus+Context
 - 1 Combine overview and detail into single view
 - 1 More information visible simultaneously
 - 1 Avoid getting lost while exploring
 - 1 Major information visualization research theme
- 1 Navigation metaphor
 - 1 Rubber sheet with borders tacked down



Guaranteed Visibility

- 1 Highlight marks always visible
 - 1 Never fall outside of current view window
 - 1 Never hidden by something in front
 - 1 Never vanish, even if smaller than one pixel
- 1 Requires efficient algorithms
 - 1 Explicitly checking all items too slow
 - 1 Linear in number of pixels, not number of items
 - 1 Details in TreeJuxtaposer paper [Munzner et al, Siggraph03]



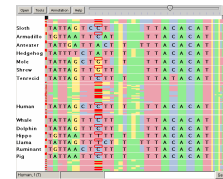
Guaranteed Frame Rate

- 1 Need realtime update
 - 1 Focus+Context interaction must be fluid
 - 1 20-30 frames per second
- 1 Computer graphics challenge
 - 1 Progressive rendering



SequenceJuxtaposer

- 1 Fluid comparison of multiple sequences
- 1 Handles DNA and RNA sequence data
- 1 Provides searching, difference calculation



SequenceJuxtaposer Video

Bur Anzeigen wird der Quelltext
dekomprimiert „MP3+4 Video“
entpackt.



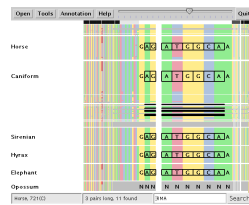
Algorithm Complexity

- 1 Sublinear:
 - 1 Runtime algorithms
- 1 Linear:
 - 1 User-initiated actions
- 1 Subquadratic:
 - 1 Preprocessing algorithms



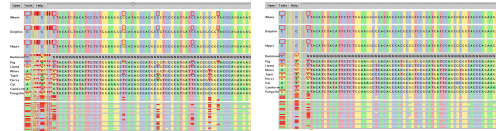
Searching

- 1 Search for motifs
 - 1 Protein/Codon search
 - 1 Regular expressions supported
- 1 Results marked with guaranteed visibility



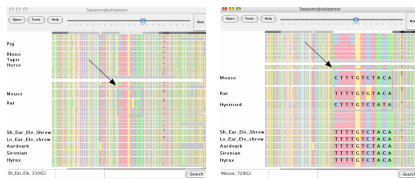
Differences

- 1 Explore differences between aligned pairs
 - 1 Slider controls difference threshold in realtime
- 1 Results marked with guaranteed visibility



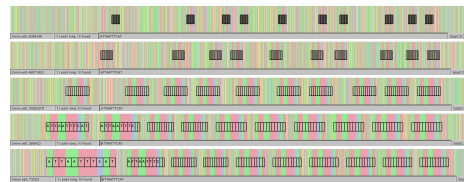
Interaction

- 1 Resizing
 - 1 Expand or contract rectangular areas
 - 1 Drag visible rubberband interactively



Interaction

- 1 Animated transitions
 - 1 Grow and shrink groups
 - 1 Allow user to track visual landmarks



Drawing

- 1 Very high information density
- 1 Avoid overdrawing in compressed areas
- 1 Progressive rendering
 - 1 Draw for fixed time, check for user interaction
 - 1 Priority queue to draw items in order of current onscreen size

Drawing Video

Zur Anzeige wird der QuickTime™
Dateikompressor „H.264 Video“
benötigt.

Results and Performance



- 1 Java prototype using OpenGL, GL4Java
- 1 Memory for AD data structures
 - 1 significant, but linear
 - 1 paper: 1.7 million base pairs
 - 1 current: 20 Mbp

Conclusion



- 1 Accordion Drawing for sequences
 - 1 Powerful new information visualization technique
- 1 Guarantees
 - 1 Context for maintaining orientation
 - 1 Visibility of landmarks: searches, differences
 - 1 Frame rate for realtime response to interaction
- 1 Fluid exploration of big datasets

Future Work



- 1 Performance
 - 1 Memory, speed
- 1 Annotation
- 1 Editing
- 1 Connecting trees and sequences
- 1 Other data types
 - 1 BACs (bacterial artificial chromosomes)

Open Source



- 1 Freely available from <http://olduvai.sourceforge.net>
 - 1 SequenceJuxtaposer
olduvai.sf.net/sj
 - 1 TreeJuxtaposer
olduvai.sf.net/tj

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