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FAST: Fast Analysis of Sequences Toolbox

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ABSTRACT

The Fast Analysis of Sequences Toolbox (FAST) is a set of UNIX utilities (for example fasgrep, fascut, fashead and fastr) for sequence bioinformatics modeled after the UNIX textutils (such as grep, cut, head, tr, etc). FAST workflows are designed for "inline" (serial) processing of flatfile biological sequence record databases per-sequence, rather than per-line, through UNIX pipelines. The default data exchange format is multifasta (specifically, a restriction of BioPerl FastA format). FAST is designed for learnability, interoperability, interface consistency, rapid prototyping, fine-tuned control, and reproducibility. FAST tools expose the power of Perl and BioPerl to users in an easy-to-learn command-line paradigm. As a primary goal, the abstract should render the general significance and conceptual advance of the work clearly accessible to a broad readership. References should not be cited in the abstract.Refer to
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Keywords: Text Text Text Text Text Text Text Text

1 INTRODUCTION

The field of molecular biology has changed significantly with the advent of next generation sequencing technology. It is now commonplace to analyze gigabases worth of data per experiment. Traditionally programs were developed for visualization and for basic sequence manipulation by a GUI interface (**Smith et al.**, 1994; **Rampp et al.**, 2006). Most available bioinformatic toolkits are designed for specific types of data or analysis requiring several toolkits to be installed. Moreover, each toolkit often requires a different file format making data analysis difficult.

The FAST utilities are modeled after the standard Unix toolkit(**Peek**, 2001), follow the Unix philosophy of "do one thing and do it well" (**Stutz**, 2000), and are written in PERL using bioperl packages (**Stajich et al.**, 2002). This makes FAST utilities easy to adopt if you are familiar with the Unix toolkit and allows fast sequence analysis even on large datasets. FAST utilities have a uniform interface requiring FASTA formatted files and are capable of reading data from STDIN. This allows quick prototyping of sequence analysis problems by piping data between several utilities. Additionally, fasconvert can convert to/from

fasta from/to several formats increasing the flexibility and usability of FAST. Extensive documentation has been developed for each utility along with useful error messages following the recommendations of **Seemann** (2013) to increase usability. Lastly, FAST is open source, which makes it available to anyone free of cost. This is in line with the call to make science more assessable, open, and reproducible by other scientists and the public (**Groves and Godlee**, 2012).

FAST is split into three categories selection, transformation, and annotation and analysis. The selection category contains utilities designed to select sequences and sites from alignments based on several different criteria. For example fasgrep selects sequences by matching a regular expression to the ID, description, or sequence. The transformation utilities are used to modify the ID, description, sequence, or order of sequences using several criteria. For example, fastaxsort sorts sequences within a multifasta file based on NCBI taxonomy (**Benson et al.**, 2009; **Sayers et al.**, 2009). The annotation and analysis category contains utilities to calculate sequence composition, codon usage, sequence length, and basic population genetic statistics. Additionally these utilities can also append the results of the analysis to the sequence description, which then can be used as selection criteria by the utilities in the selection category.

Some utilities within FAST have overlapping function with those found within other toolkits. For example sequence composition, sequence translation, and codon usage are available in the EMBOSS package (**Rice et al.**, 2000). Another example is the Bioinformatics Toolbox (**White et al.**, 2014) that has utilities to select only unique sequences and extract sequences from Genbank files based on gene name, which have overlapping function with fasuniq and gbfeat2fas respectively. However, the utilities in EMBOSS (**Rice et al.**, 2000) and Bioinformatics Toolbox (**White et al.**, 2014) lack a uniform interface, are not modeled after the Unix toolkit, and do not have the ability to use regular expressions to select and manipulate sequences. However, FAST also contains several utilities that have unique functionality. For example gbalncut takes a multiple sequence alignment annotated with a genomic feature and a genbank file and allows you to select certain regions of the alignment such as all the exons or the coding sequence. Another example is fastaxsort that allows sorting of a multifasta file based on NCBI taxonomy (**Benson et al.**, 2009; **Sayers et al.**, 2009).

2 DESCRIPTION

Learnability of the FAST tools is helped by making interface components such as specific options, consistent with the standard UNIX tools amd across the FAST suite. Learning one FAST tool generally helps the user anticipate how to use others. In addition, specification of numerical ranges, regular expressions and other useful parameters follows standard Perl and UNIX conventions, all with the intent of making the tools fast and easy to learn.

FAST is compatible with the zero-based indexing if the sequence identifier is thought as the zeroth field of the identifier line. This field must exist in Data selection in FAST is one-based as is conventional BioPerl coordinates and bioinformatics generally.

2.1 SELECTION UTILITIES

2.2 TRANSFORMATION UTILITIES

2.3 ANNOTATION AND ANALYSIS UTILITIES

2.4 USABILITY AND SCALABILITY

3 DISCUSSION

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3.1 DATA SHARING

Frontiers supports the policy of data sharing, and authors are advised to make freely available any materials and information described in their article, and any data relevant to the article (while not compromising confidentiality in the context of human-subject research) that may be reasonably requested by others for the purpose of academic and non-commercial research. In regards to deposition of data and data sharing through databases, Frontiers urges authors to comply with the current best practices within their discipline.

DISCLOSURE/CONFLICT-OF-INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

The statement about the authors and contributors can be up to several sentences long, describing the tasks of individual authors referred to by their initials and should be included at the end of the manuscript before the References section.

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SUPPLEMENTAL DATA

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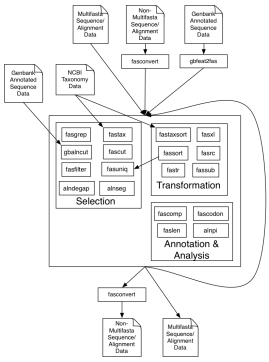

Figure 1. Enter the caption for your figure here. Repeat as necessary for each of your figures

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FIGURES