GATB: a software toolbox for genome assembly and analysis

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GATB
The Open Source Toolbox for Genomic Assembly & Analysis

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1. What is GATB?

Motivation
NGS technologies produce terabytes of data. Efficient and fast NGS algorithms are essential to analyze them.

Objective
The Genome Assembly Tool Box (GATB)

- is an open-source software
- provides an easy way to develop efficient and fast NGS tools
- is based on data structure with a very low memory footprint
- allows complex genomes to be processed on desktop computers

2. Software Solution

The GATB philosophy proposes a 3-layer construction to analyze NGS datasets

1. GATB-CORE: a C++ library holding all the services needed for developing software dedicated to NGS data.
2. GATB-TOOLS: a set of elementary NGS tools mainly built upon the GATB library (k-mer counter, contig, scaffold, variant detection, etc.).
3. GATB-PIPELINE: a set of NGS pipeline that links together tools from the previous layer.

3. Compact de Bruijn graph data structure

The core data structure of GATB is a de Bruijn graph that encodes the main information from the sequencing reads.

Strength of GATB
GATB makes this graph compact by using a Bloom filter (a space efficient probabilistic data structure) and by using a CFP additional structure that avoids false positive answers from the Bloom filter due to its probabilistic nature.

4. Workflow

Here is a typical workflow when working with GATB

GATB-CORE transforms the reads into a de Bruijn graph, saves it in a HDF5 file that can be opened by other tools developed with the GATB-CORE API.

5. GATB helps you as a NGS user

GATB's de Bruijn graph: a basis for families of tools

- Data error correction
- Assembly
- Biological motif detection

Several tools based on GATB are already available

- Bloocoo: K-mer spectrum based read error corrector for large datasets
- Minia: Short read assembler based on a de Bruijn graph. Results are of similar contiguity and accuracy to other de Bruijn assemblers (e.g. Velvet)
- DiscoSNP: Discover Single Nucleotide Polymorphism (SNP) from non-assembled reads
- TakeABreak: Detects inversion breakpoints without a reference genome by looking for fixed size topological patterns in the de Bruijn graph

6. GATB helps you as a NGS developer

The GATB C++ library gives you the opportunity to quickly develop new NGS tools that fit your needs.

Major facts about the GATB C++ library

- Object oriented design
- Simple and powerful de Bruijn graph API
- Simple and powerful multithreading model
- HDF5 usage for data storage
- Full Doxygen documentation including many code samples
- Test suite that checks the correct behavior of the library

Publications

G. Rizk, D. Lavenier, R. Chikhi, DISK: k-mer counting with very low memory usage, Bioinformatics, 2013 Mar 1;29(5):652-3
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For more details on GATB: http://gatb.inria.fr

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