BNPlib for density estimation:

A nonparametric C++ library

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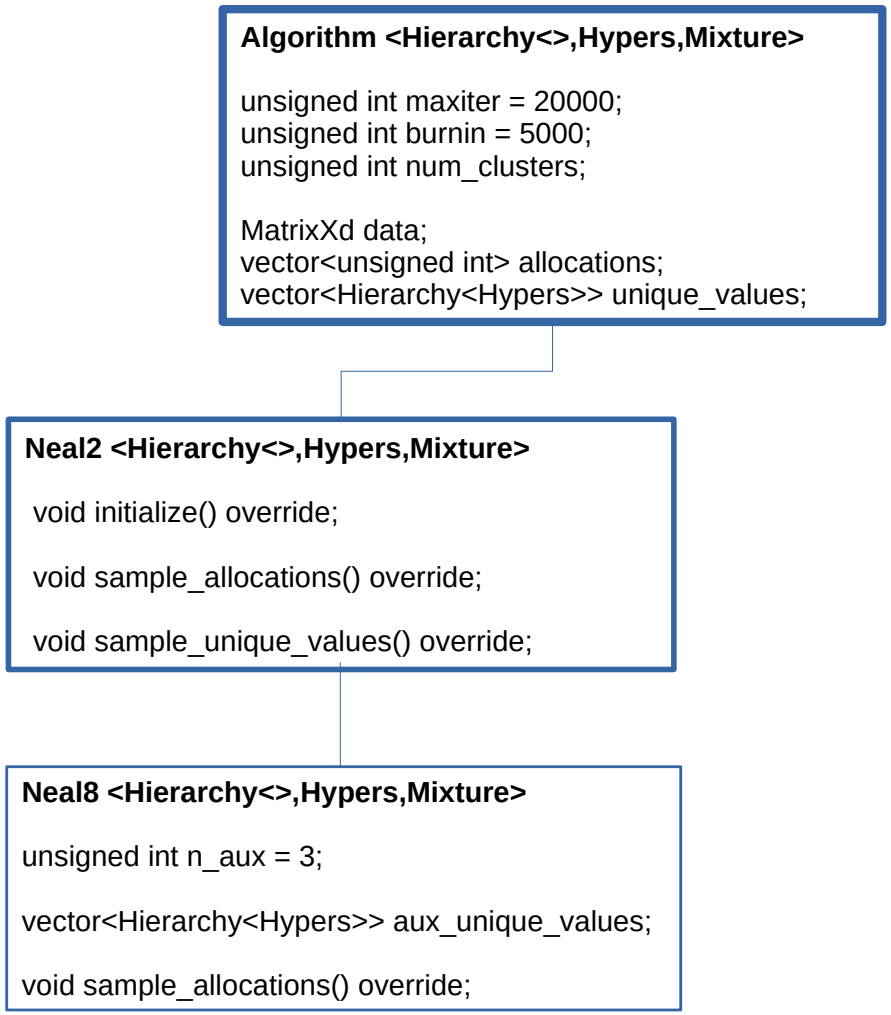
https://github.com/poliprojects/BNPlib

Algoritmhs

- Structure: `Algorithm<Hierarchy<>, Hypers, Mixture>`
- Multivariate data supported



Hierarchies (`Hierarchy`)

- Template parameter for `Algorithm`: common interface needed

HierarchyNNIG <Hypers>

```
vector<MatrixXd> state;
shared_ptr<Hypers> hypers;

VectorXd eval_marg(MatrixXd datum);
VectorXd like(MatrixXd datum);
void sample_given_data(MatrixXd data);
void draw();
vector<double> normal_gamma_update(VectorXd data,
      double mu0, double alpha0, double beta0, double lambda0);
```

state(2, MatrixXd(1,1))

check in Algorithm Constructor
if data is univariate

HierarchyDummy <Hypers>

```
vector<MatrixXd> state;
shared_ptr<Hypers> hypers;

VectorXd eval_marg(MatrixXd datum);
VectorXd like(MatrixXd datum);
void sample_given_data(MatrixXd data);
void draw();
std::vector<Eigen::MatrixXd> dummy_update(MatrixXd data,
      VectorXd mu0, MatrixXd lambda0);
```

Hyperparameters (`Hypers`)

- Template parameter for `Hierarchy`

HypersFixedNNIG

double mu0, lambda, alpha0, beta0;

HypersDummy

VectorXd mu0;
MatrixXd lambda0;

Mixtures (`Mixture`)

- Template parameter for `Algorithm`: common interface needed

DirichletMixture

double totalmass;

double const prob_existing_cluster(int card, unsigned int n)
double const prob_new_cluster(unsigned int n, unsigned int n_unique)

PitYorMixture

double strength;
double discount;

double const prob_existing_cluster(int card, unsigned int n)
double const prob_new_cluster(unsigned int n, unsigned int n_unique)

Factory

- To choose the `Algorithm` at runtime

```
template<class AbstractProduct, typename... Args>
class Factory{
private:
    std::map<Identifier, Builder> storage;
    //[...]
public:
    static Factory& Instance();
    std::unique_ptr<AbstractProduct> create_object(
        const Identifier &name, Args... args) const;
    void add_builder(const Identifier &name,
        const Builder &builder);
    //[...]
}
```

Protocol Buffers API aka (protobuf)

- For multivariate data storage
- Model in output.proto:

```
message Par_Col {
    repeated double elems = 1;
}
message Param {
    repeated Par_Col par_cols = 1;
}
message UniqueValues {
    repeated Param params = 1;
}
message IterationOutput {
    repeated int32 allocations = 1;
    repeated UniqueValues uniquevalues = 2;
}
message ChainOutput {
    repeated IterationOutput chain = 1;
}
```

Collectors

- To save data with the `protobuf` structures