Bayesian Network Inference Program

Overview

This program performs inference on a Bayesian network using four algorithms:

1. Exact Inference
2. Prior Sampling
3. Rejection Sampling
4. Likelihood Weighting

It calculates probabilities for query nodes based on given evidence.

Usage

Command Format

```
python <script.py> "[<evidence1,value1><evidence2,value2>][query_node1,query_node2]" --algorithm <algorithm> --sample_count <count> --runs <num_runs>
```

Input Details

1. **Conditions**:
   - Specified in the format `<node,value>`.
   - Multiple pieces of evidence are enclosed in `[]` and separated by `><`.
2. **Query Nodes**:
   - Specified as a comma-separated list of variables within `[]`.
3. **Algorithm**:
   - Specifies the inference algorithm to use from:
     - `exact`: Performs exact inference.
     - `prior`: Uses prior sampling.
     - `rejection`: Uses rejection sampling.
     - `likelihood`: Uses likelihood weighting.
4. **Sample Count** (`--sample_count`):
   - Number of samples to generate for sampling algorithms (Default is set to `10,000`).
5. **Runs** (`--runs`):
   - Number of iterations to run for the algorithms. Default is set to `1`.

Testing Examples

The testing commands provided are examples and can be modified as needed to specify different evidence, query nodes, algorithms, sample sizes, and runs to get the desired results.

1. Exact Inference

To run Exact Inference for `Case 1`:

```
python script.py "[<A,f>][B,J]" --algorithm exact
```

2. Prior Sampling

To run Prior Sampling for `Case 2`:

```
python script.py "[<J,t><E,f>][B,M]" --algorithm prior --sample_count 10000 --runs 1
```

3. Rejection Sampling

To run Rejection Sampling for `Case 3`:

```
python script.py "[<M,t><J,f>][B,E]" --algorithm rejection --sample_count 10 --runs 5
```

4. Likelihood Weighting

To run Likelihood Weighting for `Case 1`:

```
python script.py "[<A,f>][B,J]" --algorithm likelihood --sample_count 1000 --runs 10
```

Output Format

The output is formatted as:

```
<node1,probability1><node2,probability2>...
```

Example:

```
<B,0.0010><J,0.0500>
```

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