CPSC 532W Homework 6

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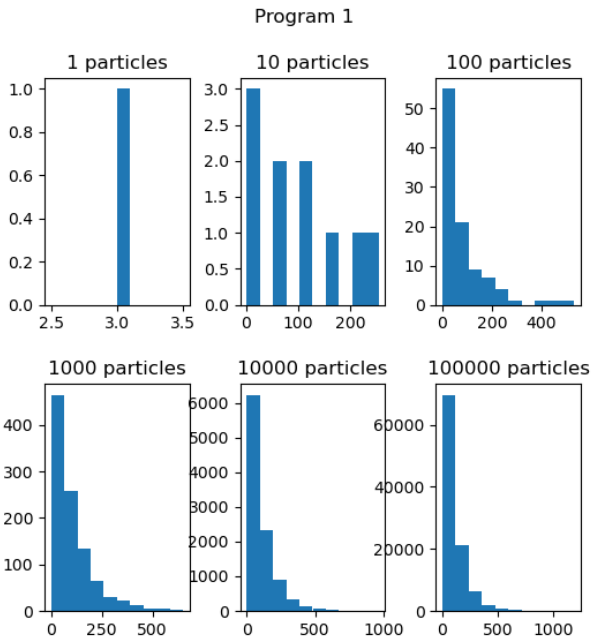
All the code can be found on: `https://github.com/n6graham/cpsc532_hw6`.

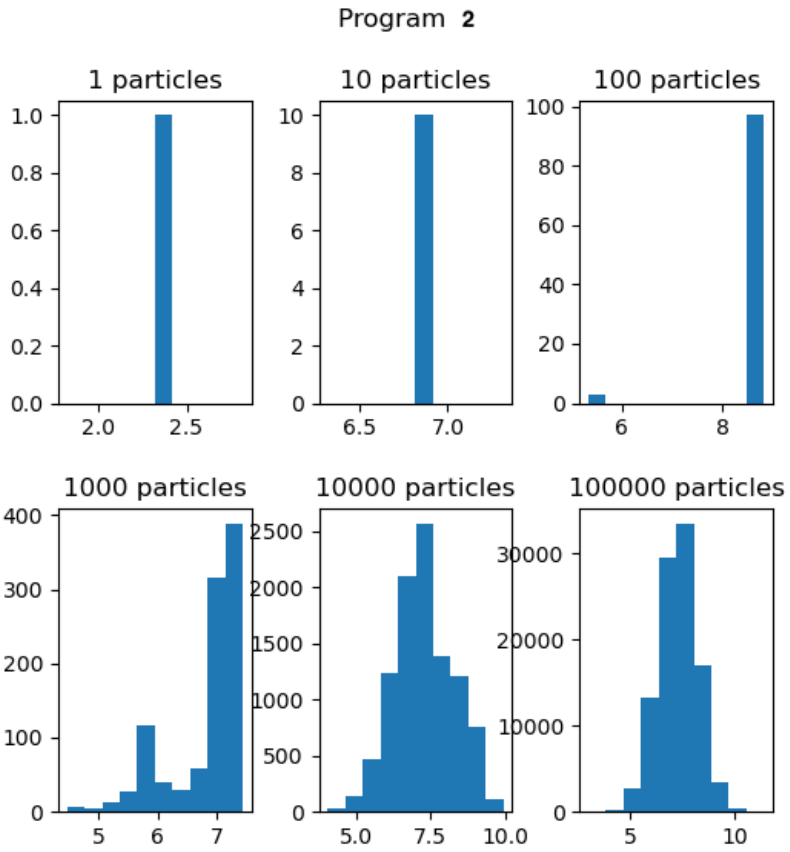
1 Program 1

Program 1			
Number of particles	Z (evidence)	Mean	Variance
1	1	3	nan
10	1	99.1000	7639.2109
100	1	80.4600	8960.1699
1000	1	101.5100	10413.6953
10 000	1	99.5248	9983.4941
100 000	1	99.4249	10061.4521



2 Program 2

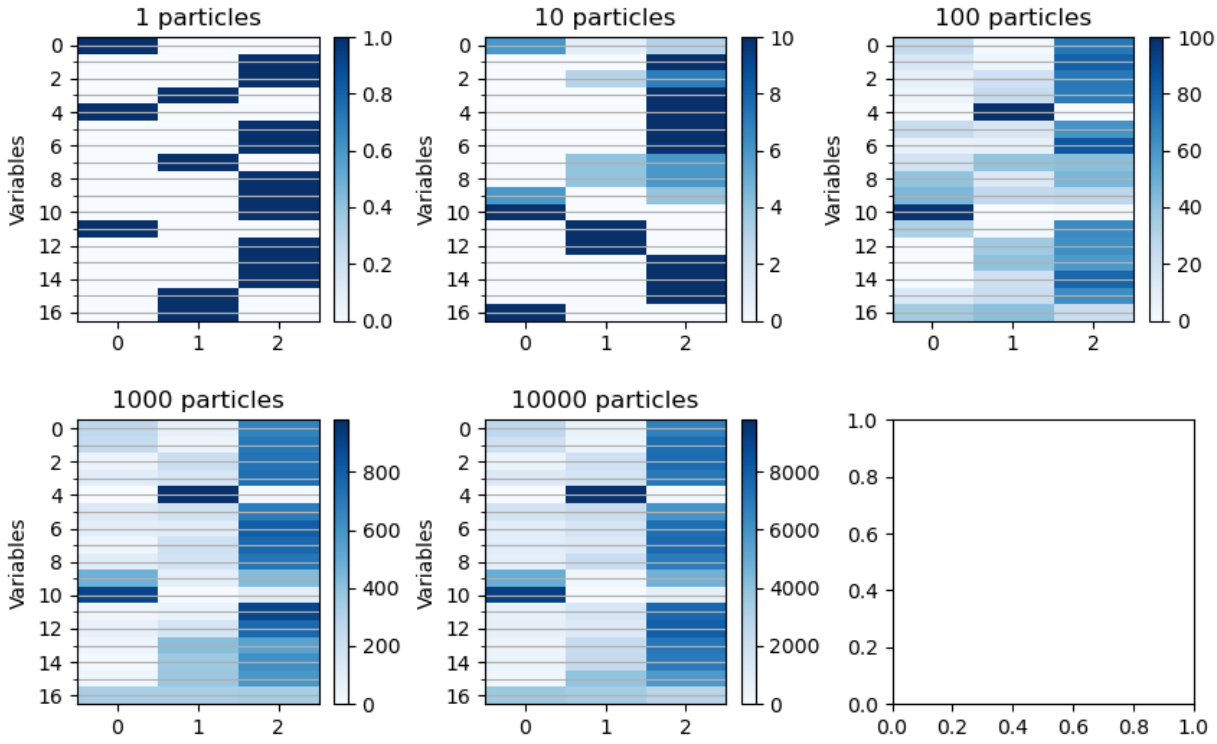
Program 2			
Number of particles	Z (evidence)	Mean	Variance
1	3.5531e-10	2.3191	nan
10	0.0016	6.8162	2.5264e-13
100	0.0007	8.7266	0.3422
1000	0.0002	6.8198	0.4003
10 000	0.0002	7.2663	0.9606
100 000	0.0003	7.2832	0.8407



3 Program 3

Program 3			
N	Z	Mean	Variance
1	5.54e-23	$\begin{pmatrix} 1.0 & 2.0 & 1.0 & 1.0 & 2.0 \\ 1.0 & 0.0 & 2.0 & 2.0 & 2.0 \\ 2.0 & 0.0 & 2.0 & 2.0 & 2.0 \\ 2.0 & 0.0 \end{pmatrix}$	$\begin{pmatrix} 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 \end{pmatrix}$
10	5.11e-20	$\begin{pmatrix} 0.6 & 1.3 & 1.0 & 1.7 & 1.0 \\ 2.0 & 2.0 & 2.0 & 1.0 & 0.0 \\ 0.0 & 2.0 & 2.0 & 2.0 & 2.0 \\ 2.0 & 1.0 \end{pmatrix}$	$\begin{pmatrix} 0.8 & 0.6 & 0.6 & 0.2 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 \end{pmatrix}$
100	3.26e-20	$\begin{pmatrix} 1.6 & 1.6 & 1.9 & 1.8 & 1.0 \\ 1.3 & 1.6 & 1.7 & 1.8 & 1.6 \\ 0.5 & 1.6 & 1.6 & 1.7 & 1.8 \\ 1.6 & 0.6 \end{pmatrix}$	$\begin{pmatrix} 0.6 & 0.6 & 0.2 & 0.3 & 0.0 \\ 0.8 & 0.5 & 0.5 & 0.1 & 0.7 \\ 0.8 & 0.2 & 0.2 & 0.2 & 0.2 \\ 0.2 & 0.5 \end{pmatrix}$
1000	5.98e-20	$\begin{pmatrix} 1.5 & 1.6 & 1.7 & 1.7 & 1.0 \\ 1.5 & 1.8 & 1.8 & 1.7 & 1.1 \\ 0.1 & 1.6 & 1.7 & 1.8 & 1.9 \\ 1.5 & 1.0 \end{pmatrix}$	$\begin{pmatrix} 0.7 & 0.6 & 0.4 & 0.4 & 0.0 \\ 0.6 & 0.3 & 0.2 & 0.3 & 1.0 \\ 0.2 & 0.5 & 0.4 & 0.2 & 0.1 \\ 0.4 & 0.7 \end{pmatrix}$
10 000	5.98e-20	$\begin{pmatrix} 1.5 & 1.6 & 1.7 & 1.7 & 1.0 \\ 1.5 & 1.8 & 1.8 & 1.7 & 1.1 \\ 0.1 & 1.6 & 1.7 & 1.8 & 1.9 \\ 1.5 & 1.0 \end{pmatrix}$	$\begin{pmatrix} 0.7 & 0.6 & 0.4 & 0.4 & 0.0 \\ 0.6 & 0.3 & 0.2 & 0.3 & 1.0 \\ 0.2 & 0.5 & 0.4 & 0.2 & 0.1 \\ 0.4 & 0.7 \end{pmatrix}$
100 000		)(	)(

4 Program 3


1 particles
10 particles
100 particles
1000 particles
10000 particles
Variables

5 Snippets of code

In SMC.py, I filled in resample-particles.

```
    def resample_particles(particles, log_weights):
        inds = []

        d = dist.Categorical(logits=torch.tensor(log_weights))

        for i in range(len(particles)):
            inds.append(d.sample())

        new_particles = [ particles[i] for i in inds ]

        new_weights = torch.logsumexp(torch.tensor(log_weights),0)

        logL = torch.log(torch.tensor(len(log_weights), dtype=float))

        logZ = new_weights - logL

        return logZ, new_particles

```

I modified SMC to get the particles and weights, and check the addresses are all the same.

```
    if 'done' in res[2]: #this checks if the calculation is done
                    particles[i] = res[0]
                    if i == 0:
                        done = True  # and enforces everything to be the same as the first particle
                        address = ''
                    else:
                        if not done:
                            raise RuntimeError('Failed SMC, finished one calculation before the other')
                else:
                    address = res[2]['alpha']
                    particles[i]=res
                    weights[i]= res[2]['logW']
                    assert address == particles[0][2]['alpha']

```

Inside evaluator.py I modified sigma for the ‘observe’ case.

```
elif op == 'observe':
            alpha = evaluate(args[0], env=env)
            d = evaluate(args[1], env=env)
            c = evaluate(args[2], env=env)
            k = evaluate(args[3], env=env)

            sigma = {
                'type' : 'observe',
                'logW':d.log_prob(c),
                'alpha': alpha
                     #TODO: put any other stuff you need here
                     }

```