```
In [11]:   from daphne import daphne
           import os, json
           import numpy as np
           import torch
           from torch import tensor
           import pandas as pd
           import matplotlib.pyplot as plt
```

```
In [34]:   def ast_helper(fname,directory):
               sugared_fname = '../prob_prog/hw/hw6/CS532-HW6/{}/{}'.format(directory,fname)
               desugared_ast_json_fname = '/Users/gw/repos/prob_prog/' + sugared_fname.replace('.daphne','.json')
               if os.path.isfile(desugared_ast_json_fname):
                   with open(desugared_ast_json_fname) as f:
                       ast = json.load(f)
               else:
                   #note: the sugared path that goes into daphne desugar should be with respect to the daphne path!
                   ast = daphne(['desugar-hoppl-cps', '-i', sugared_fname])

                   with open(desugared_ast_json_fname, 'w') as f:
                       json.dump(ast, f)

               return ast


           i=4
           fname = '{}.daphne'.format(i)
           exp = ast_helper(fname,directory='programs')
           %cat programs/4.daphne
```

```
(let [mu (sample (normal 1 (sqrt 5)))
      sigma (sqrt 2)
      lik (normal mu sigma)]
   (observe lik 8)
   (observe lik 9)
   mu)
```

```
In [35]:   import smc
           import importlib
           importlib.reload(smc)
```

Out[35]:   `<module 'smc' from '/Users/gw/repos/prob_prog/hw/hw6/CS532-HW6/smc.py'>`

```
In [45]:   particle_counts = [1,10,100,1000,10000,100000]
           fig, axes = plt.subplots(nrows=len(particle_counts),figsize=(30,20))
           # fig.tight_layout()
           plt.subplots_adjust(left=None, bottom=None, right=None, top=None, wspace=None, hspace=0.5) # https://stackover

           for idx, n_particles in enumerate(particle_counts):
               logZ, particles = smc.SMC(n_particles, exp)
               samples_array = np.array([sample.item() for sample in particles])
               mean = samples_array.mean()
               var = samples_array.var()
               pd.Series(samples_array).plot.hist(ax=axes[idx], bins=50, title='Program {} | {} particles | mean {:1.3f} |
```

```
In SMC step 0, Zs:  []
In SMC step 1, Zs:  [-5.426987590543291]
In SMC step 2, Zs:  [-5.426987590543291, -7.7169570978697495]
In SMC step 0, Zs:  []
In SMC step 1, Zs:  [-4.409021968208568]
In SMC step 2, Zs:  [-4.409021968208568, -3.281747838494585]
In SMC step 0, Zs:  []
In SMC step 1, Zs:  [-5.44325713520603]
In SMC step 2, Zs:  [-5.44325713520603, -2.7813596798573204]
In SMC step 0, Zs:  []
In SMC step 1, Zs:  [-5.348063793569588]
In SMC step 2, Zs:  [-5.348063793569588, -3.34402504427412]
In SMC step 0, Zs:  []
In SMC step 1, Zs:  [-5.384503472706044]
In SMC step 2, Zs:  [-5.384503472706044, -2.8596724029796277]
In SMC step 0, Zs:  []
In SMC step 1, Zs:  [-5.406247981671558]
In SMC step 2, Zs:  [-5.406247981671558, -2.857562885985456]
```


Program 4.daphne | 1 particles | mean 3.920 | var / std 0.000e+00 / 0.000e+00 | Evidence: logZ -13.144 / Z 1.957e-06

Program 4.daphne | 10 particles | mean 6.160 | var / std 0.000e+00 / 0.000e+00 | Evidence: logZ -7.691 / Z 4.570e-04

Program 4.daphne | 100 particles | mean 6.865 | var / std 1.919e-01 / 4.380e-01 | Evidence: logZ -8.225 / Z 2.680e-04

Program 4.daphne | 1000 particles | mean 6.497 | var / std 2.420e-01 / 4.919e-01 | Evidence: logZ -8.692 / Z 1.679e-04

Program 4.daphne | 10000 particles | mean 7.209 | var / std 8.558e-01 / 9.251e-01 | Evidence: logZ -8.244 / Z 2.628e-04

Program 4.daphne | 100000 particles | mean 7.225 | var / std 7.930e-01 / 8.905e-01 | Evidence: logZ -8.264 / Z 2.577e-04