CPSC532W: Probabilistic Programming, Homework 5

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Code for this assignment can be found here: https://github.com/namratadeka/cpsc532W/tree/main/CS532-HW5.

```python
class Env(dict):
    def __init__(self, params=(), args=(), outer=None):
        self.update(zip(params, args))
        self.outer = outer
    def get(self, var):
        return self[var] if (var in self) else self.outer.get(var)

class Procedure(object):
    '''A user-defined function.'''
    def __init__(self, params, body, env):
        self.params, self.body, self.env = params, body, env
    def __call__(self, *args):
        return evaluate(self.body, Env(self.params, args, self.env))

def standard_env():
    "An environment with some Scheme standard procedures."
    env = pmap(penv)
    env = env.update({'alpha' : ''})

    return env


def evaluate(exp, env=None): #TODO: add sigma, or something
    if env is None:
        env = standard_env()

    if isinstance(exp, str):
        if env.get(exp) is not None:
            return env.get(exp)
        return exp
    elif not isinstance(exp, list):
        return torch.tensor(exp).float()
    op, *args = exp
    if op == 'if':
        (test, conseq, alt) = args
        exp = (conseq if evaluate(test, env) else alt)
        return evaluate(exp, env)
    elif op == 'sample':
        evaluate(args[0], env)
        dist = evaluate(args[1], env)
        return dist.sample()
    elif op == 'observe':
        evaluate(args[0], env)
        dist = evaluate(args[1], env)
        obs = evaluate(args[2], env)
        return obs
    elif op == 'fn':
        params, body = args
        return Procedure(params, body, env)
    else:
        proc = evaluate(op, env)
        vals = [evaluate(arg, env) for arg in args]
        return proc(*vals)

    return
```

Figure 1: The HOPPL evaluator code.

1 Program 1 (Test cases)

All test cases passed.

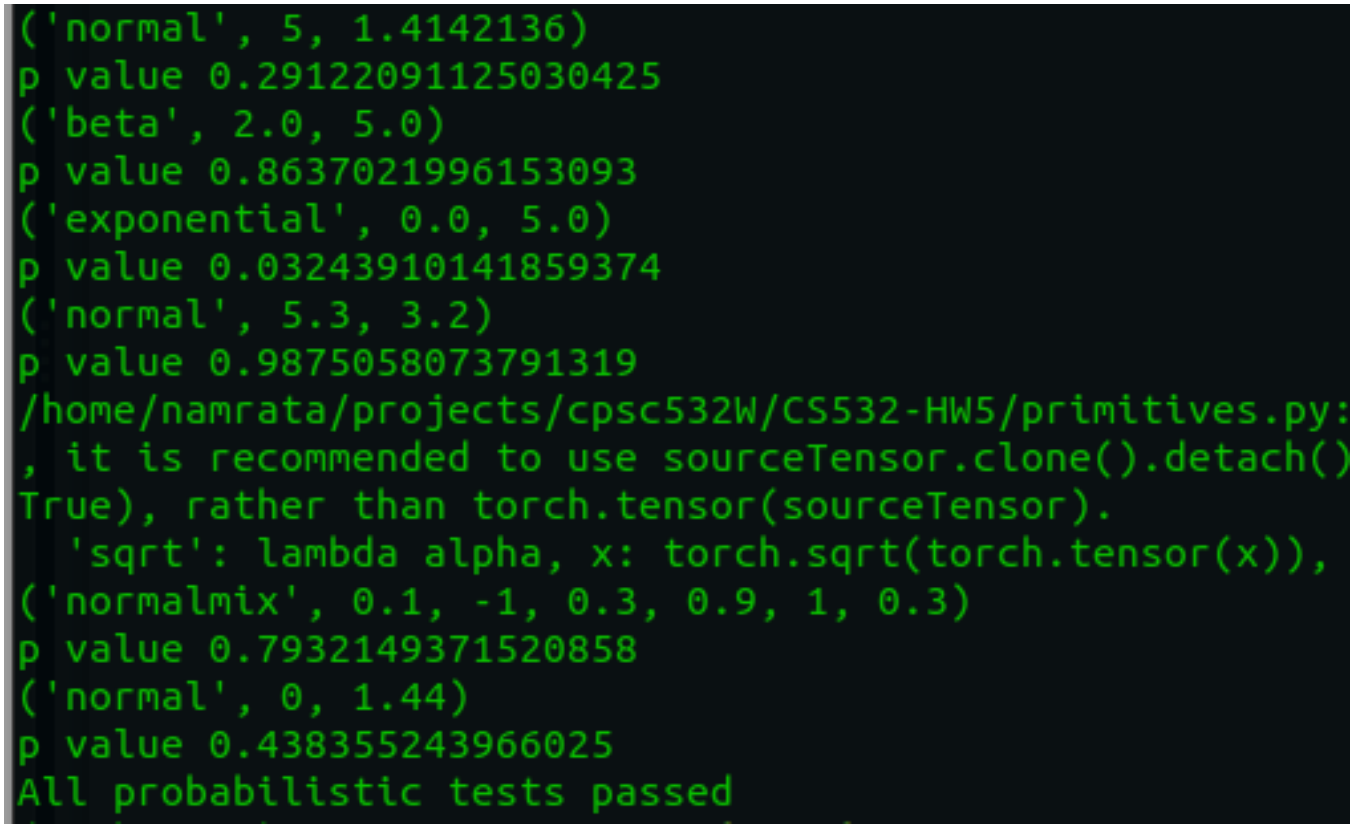

Figure 2: Screenshot showing passing all probabilistic tests.

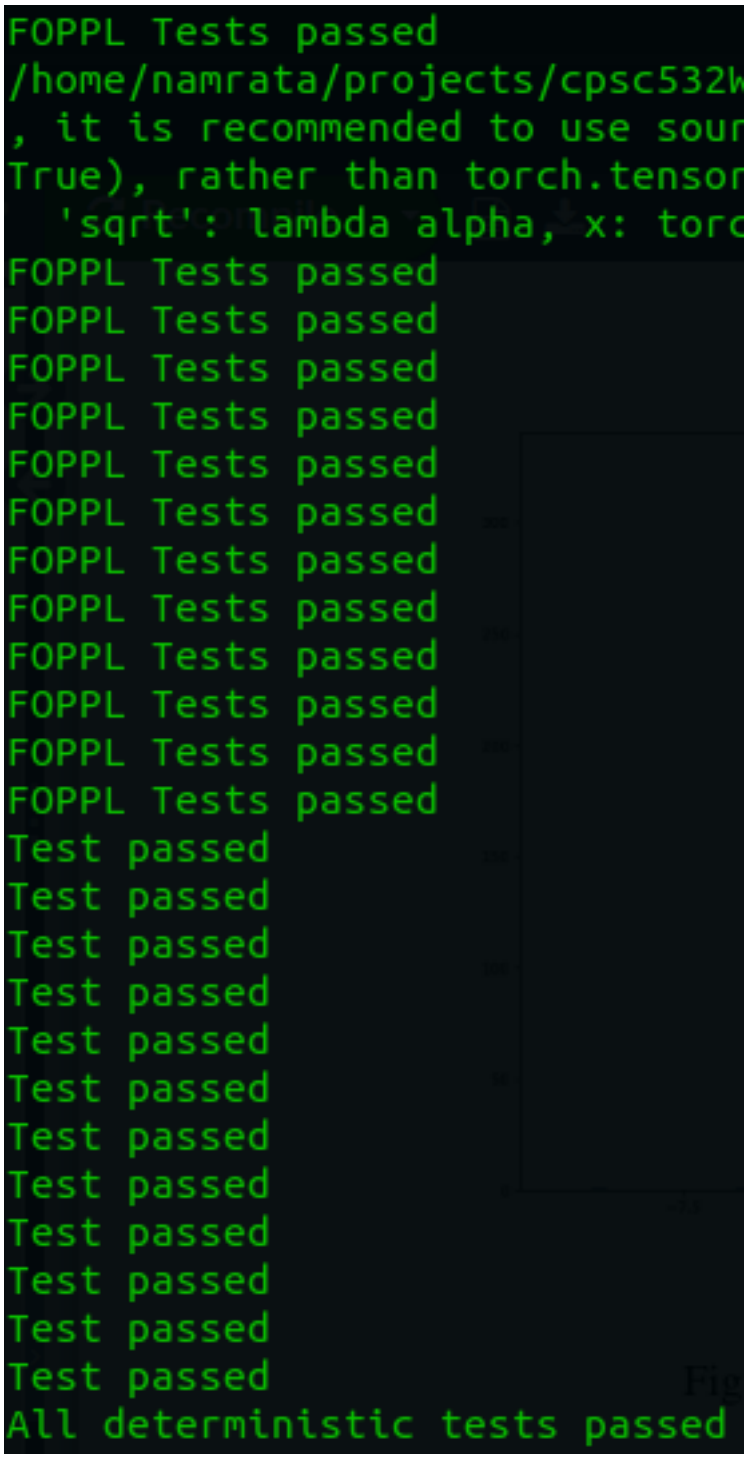

Figure 3: Screenshot showing passing all deterministic tests.

2 Program 2

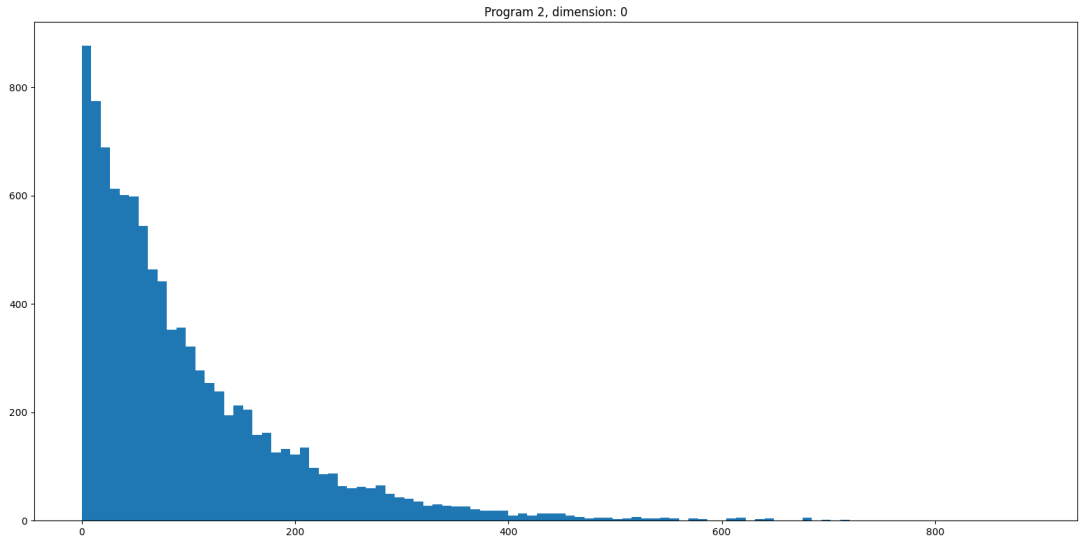

Figure 4: Prior histogram for Program 2. Mean=1, Variance=99.4094

3 Program 3

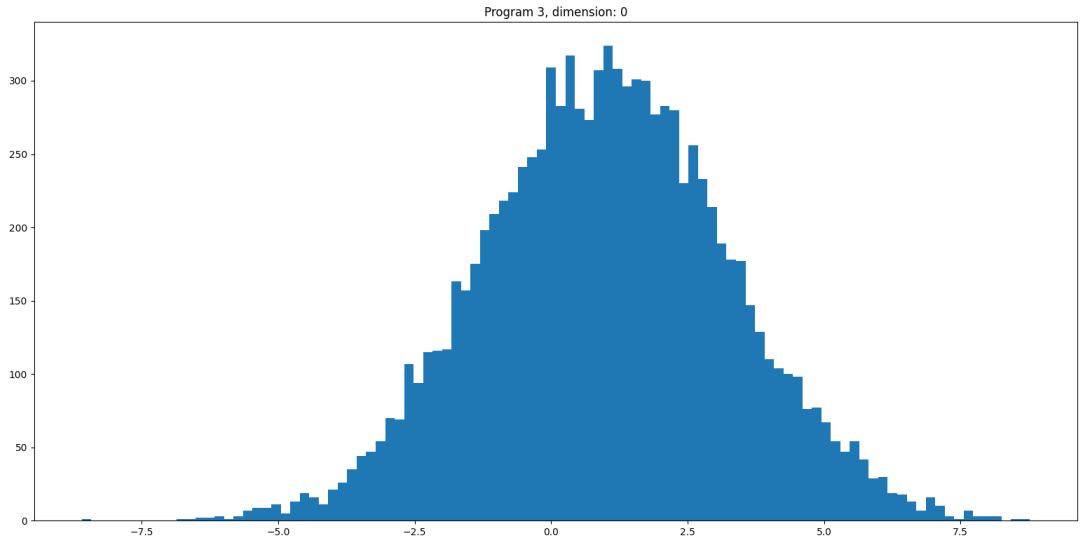

Figure 5: Prior histogram for Program 3. Mean=2, Variance=1.0106

4 Program 4

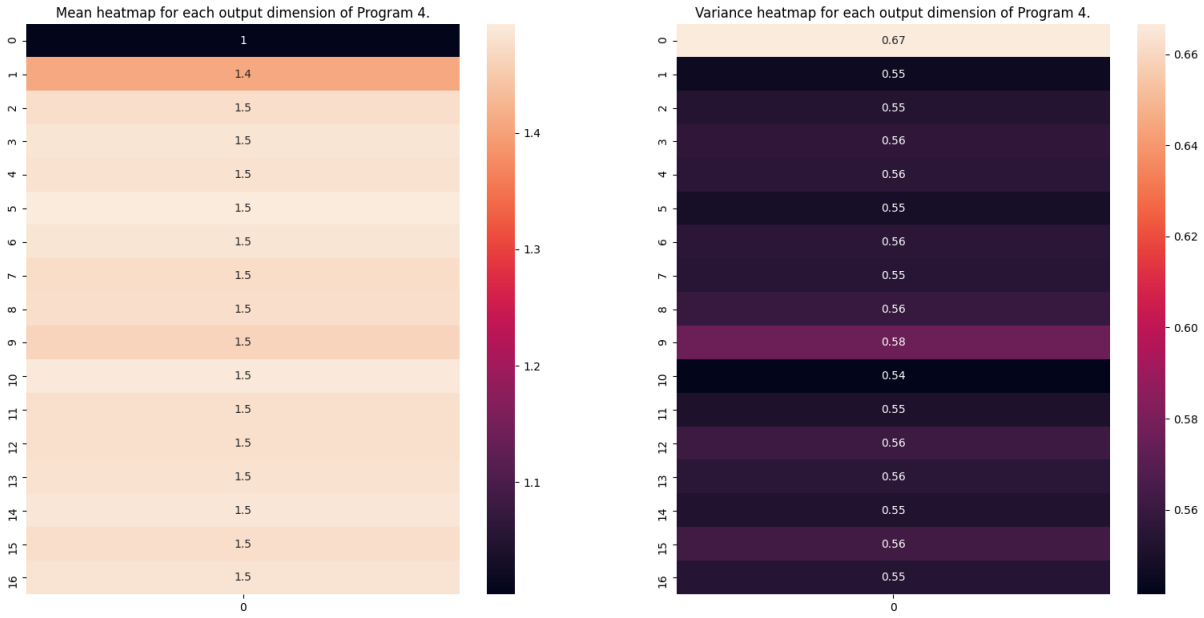

Figure 6: Heatmaps for prior means and variances for Program 4.