Additional Numerical Experiment Results

March 29, 2024

1 Numerical Experiments on Product States with 6 qubits

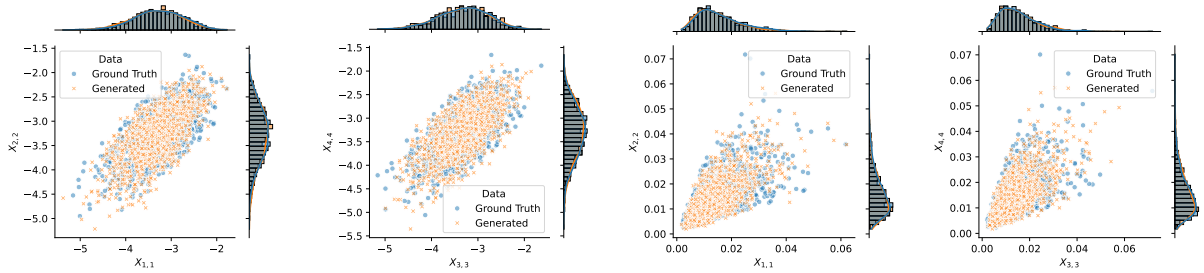

Figure 1: Unconditional generation of product states with 6 qubits. Each qubit is i.i.d. sampled with eigenvalues bounded between 1 and 3. Each figure shows an observable for comparison between unconditionally generated samples and their corresponding ground truth samples. From Left to Right: **(1)** Real value of matrix entries in the dual space (Real($X_{1,1}$) v.s. Real($X_{2,2}$)) **(2)** Real value of matrix entries in the dual space (Real($X_{3,3}$) v.s. Real($X_{4,4}$)) **(3)** Real value of matrix entries in the primal space (Real($X_{1,1}$) v.s. Real($X_{2,2}$)) **(4)** Real value of matrix entries in the primal space (Real($X_{3,3}$) v.s. Real($X_{4,4}$))

2 Numerical Experiments on Pairwisely Entangled States with 6 qubits

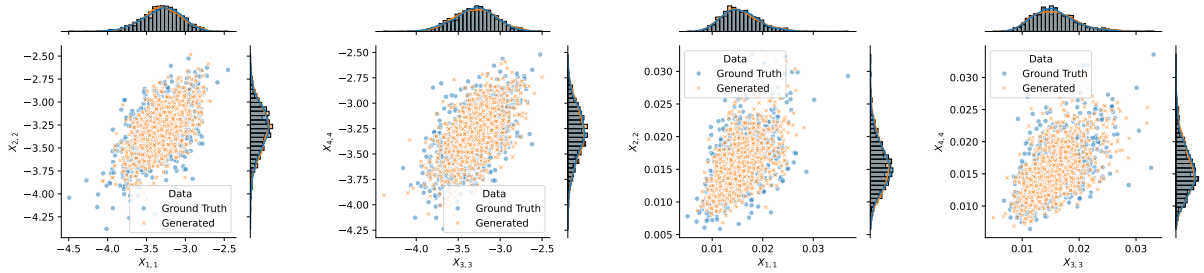

Figure 2: Unconditional generation of pairwisely-entangled states with 6 qubits. The product states are generated as tensor products of 6 single qubit quantum state density matrix. Each qubit is i.i.d. sampled with eigenvalues bounded between 1 and 3. The pairwisely entangled states are generated from the product states by imposing entanglement on qubit pairs $\{1,2\},\{3,4\},\{5,6\}$. The entanglement matrices are sampled from the Haar measure of $U(4)$. Each figure shows an observable for comparison between unconditionally generated samples and their corresponding ground truth samples. From Left to Right: **(1)** Real value of matrix entries in the dual space (Real($X_{1,1}$) v.s. Real($X_{2,2}$)) **(2)** Real value of matrix entries in the dual space (Real($X_{3,3}$) v.s. Real($X_{4,4}$)) **(3)** Real value of matrix entries in the primal space (Real($X_{1,1}$) v.s. Real($X_{2,2}$)) **(4)** Real value of matrix entries in the primal space (Real($X_{3,3}$) v.s. Real($X_{4,4}$))

3 Numerical Experiments on Maximally-entangled Quantum States with 4 qubits

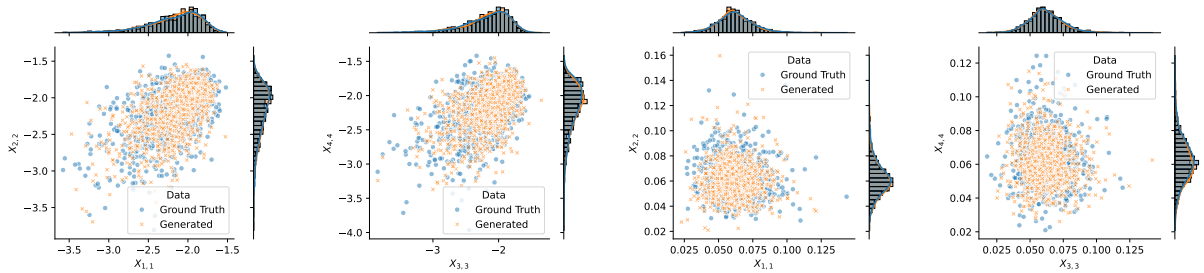

Figure 3: Unconditional generation of maximally-entangled quantum states with 4 qubits. Entanglement matrix U are sampled from Haar measure of $U(16)$ instead of pairwisely from all pairs of qubits. Each figure shows an observable for comparison between unconditionally generated samples and their corresponding ground truth samples. From Left to Right: **(1)** Real value of matrix entries in the dual space (Real($X_{1,1}$) v.s. Real($X_{2,2}$)) **(2)** Real value of matrix entries in the dual space (Real($X_{3,3}$) v.s. Real($X_{4,4}$)) **(3)** Real value of matrix entries in the primal space (Real($X_{1,1}$) v.s. Real($X_{2,2}$)) **(4)** Real value of matrix entries in the primal space (Real($X_{3,3}$) v.s. Real($X_{4,4}$))