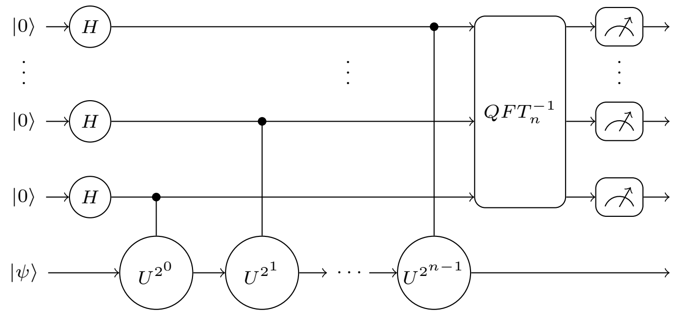
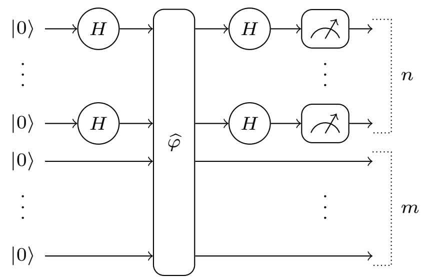


$$
\begin{aligned}
&\mathrm{QFT}_n^{-1}[1,\ldots,n] \\
&\quad \cdot \left(\prod_{k=0}^{n-1} \Lambda\left(U^{2^k}\right)[n-k, n+1, \ldots, n+\ell]\right) \\
&\quad \cdot \left(H^{\otimes n} \otimes I^{\otimes \ell}\right) |0\cdots 0\rangle \otimes |\psi\rangle
\end{aligned}
$$

FIGURE 1. The quantum circuit for n-bit estimation of the eigenvalue associated with the eigenvector $|\psi\rangle$ of U. The diagrammatic form is shown on the left, while the inline form is given on the right (measurement operators are omitted). Both utilize the inverse quantum Fourier transform as subroutines.



$$\mathcal{M}_2 \ (H^{\otimes n} \otimes I_m) \ \widehat{\varphi} \ (H^{\otimes n} \otimes I_m)$$

FIGURE 2. A proposed quantum circuit for the Hidden Kernel Problem for semilattices. The equivalent inline formula is given to the right. The mathematical formalism for measuring a subset of qubits is taking the partial trace of the outer product of the output vector over the *unmeasured* qubits. This measurement operator is represented by $\mathcal{M}_2$

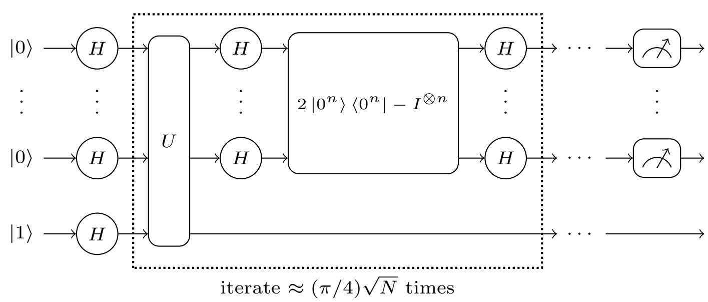
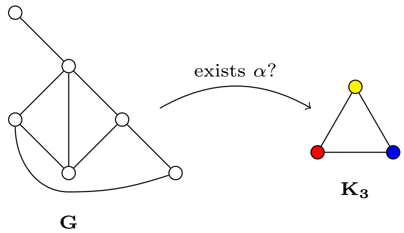


FIGURE 3. The quantum circuit for Grover's algorithm, with the function f encoded as the operator U. The central component is an amplitude amplification procedure which is required to be iterated approximately $(\pi/4)\sqrt{N}$ times. Geometrically, a single application corresponds to a rotation of a state vector towards the solution vector.



$$R_{ij} = \begin{cases} \{(a,b) \in K_3^2 \mid a \neq b\} & \text{if } x_i - x_j \text{ in } \mathbf{G}, \\ K_3^2 & \text{otherwise} \end{cases}$$

$$\text{constraint } C_{ij} = \big((x_i, x_j)\ ;\ R_{ij}\big)$$

$$\mathcal{C} = \big\{C_{ij} \mid 1 \leq i, j \leq 6\big\}$$

FIGURE 4. The Constraint Satisfaction Problem corresponding to graph 3-colorability, CSP($\mathbf{K_3}$). The left shows the standard relational homomorphism formulation of the problem, and the right shows the equivalent system of constraints given as input to CSP($\mathbf{K_3}$), where the 6 vertices of $\mathbf{G}$ are labelled with the variables $x_1, \ldots, x_6$.