Quadratic optimization with quantum computing

Biweekely Presentation IV

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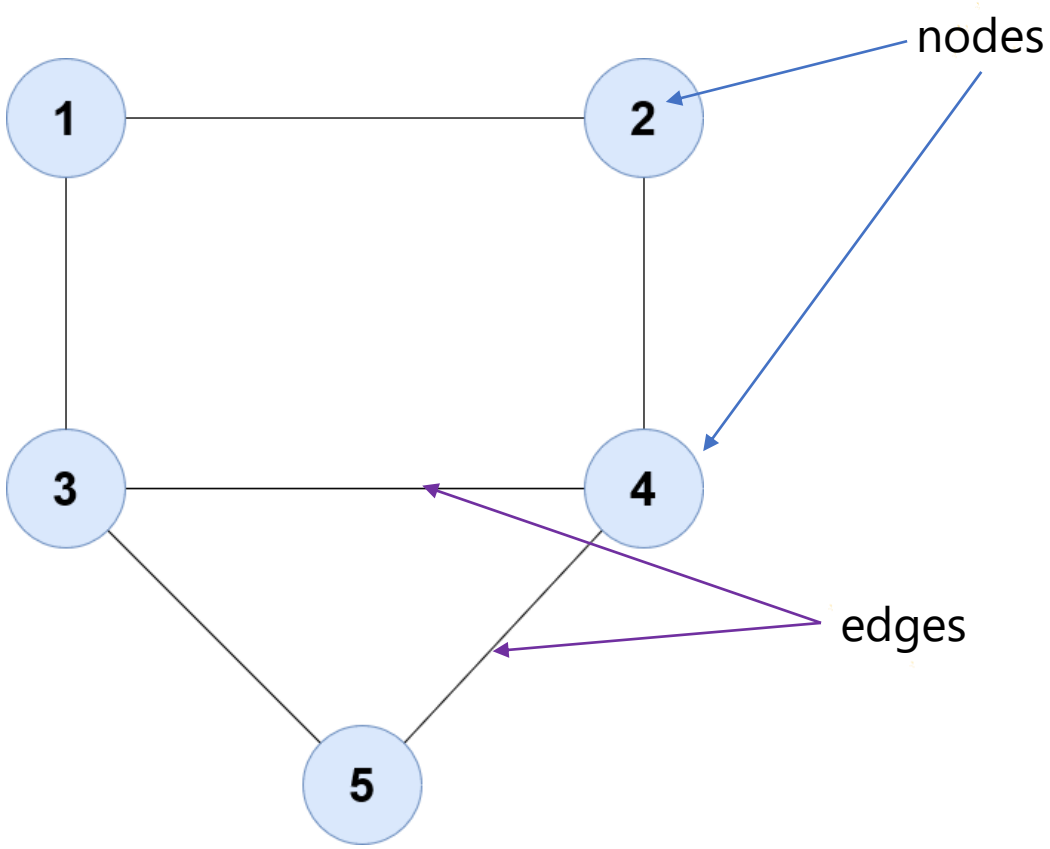
Max-Cut Problem

Goal: Divide nodes into two groups such that the number of edges between the groups are as large as possible



Max-Cut Problem

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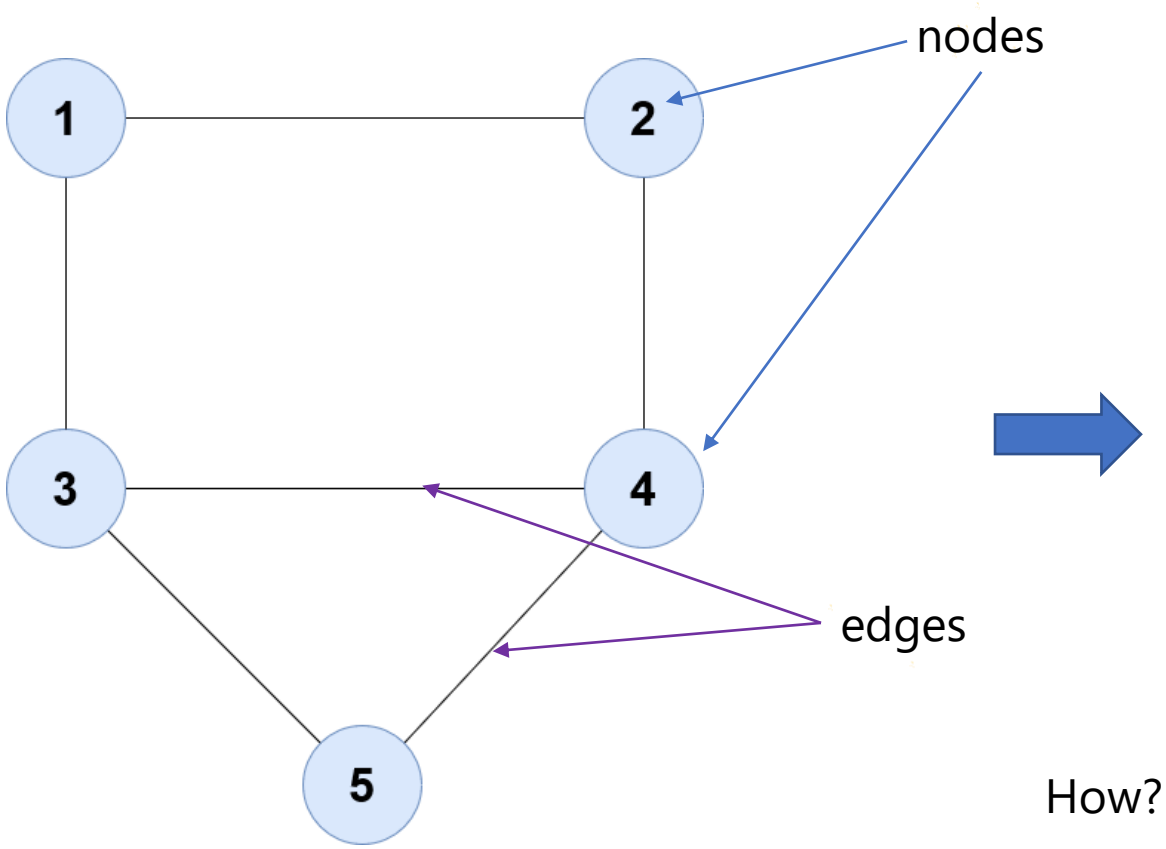
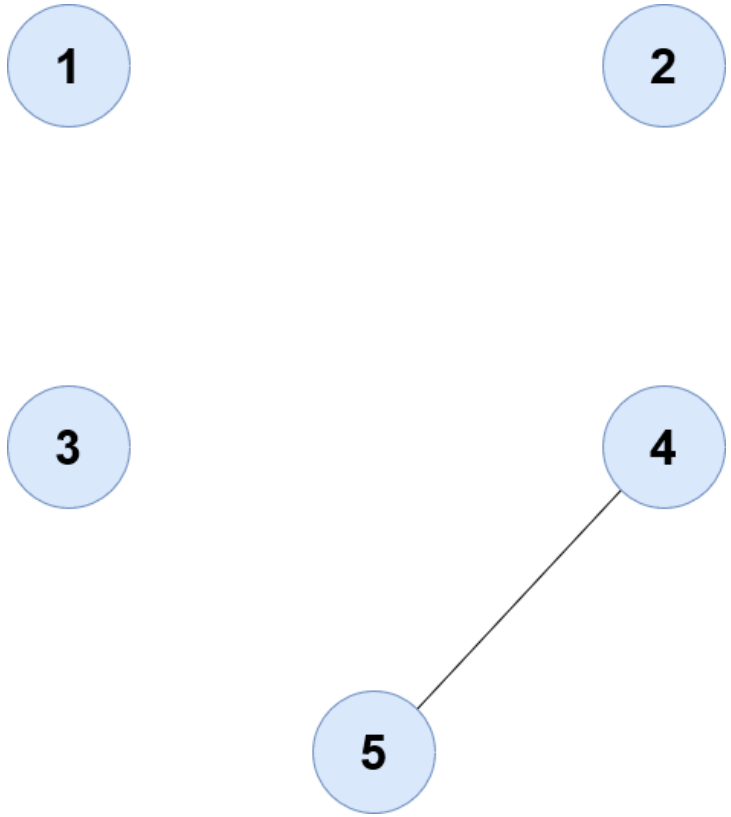
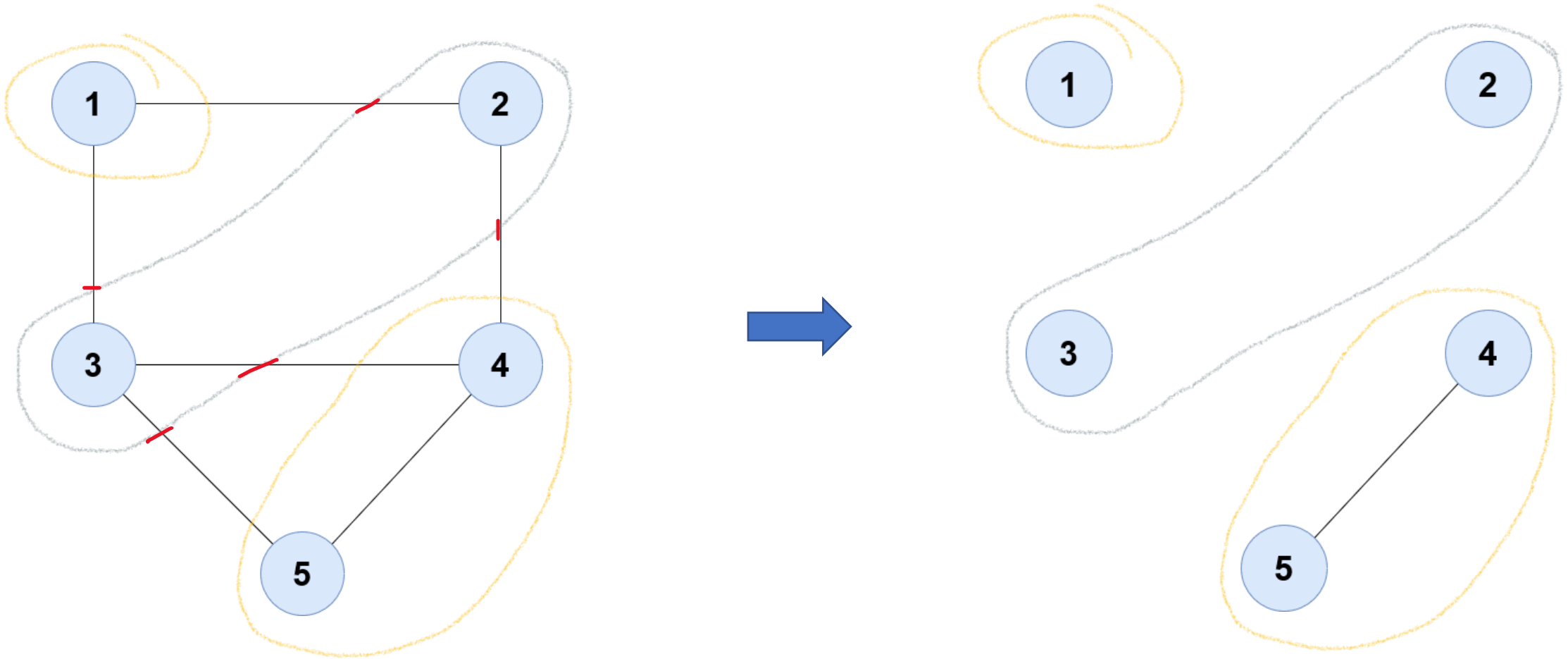


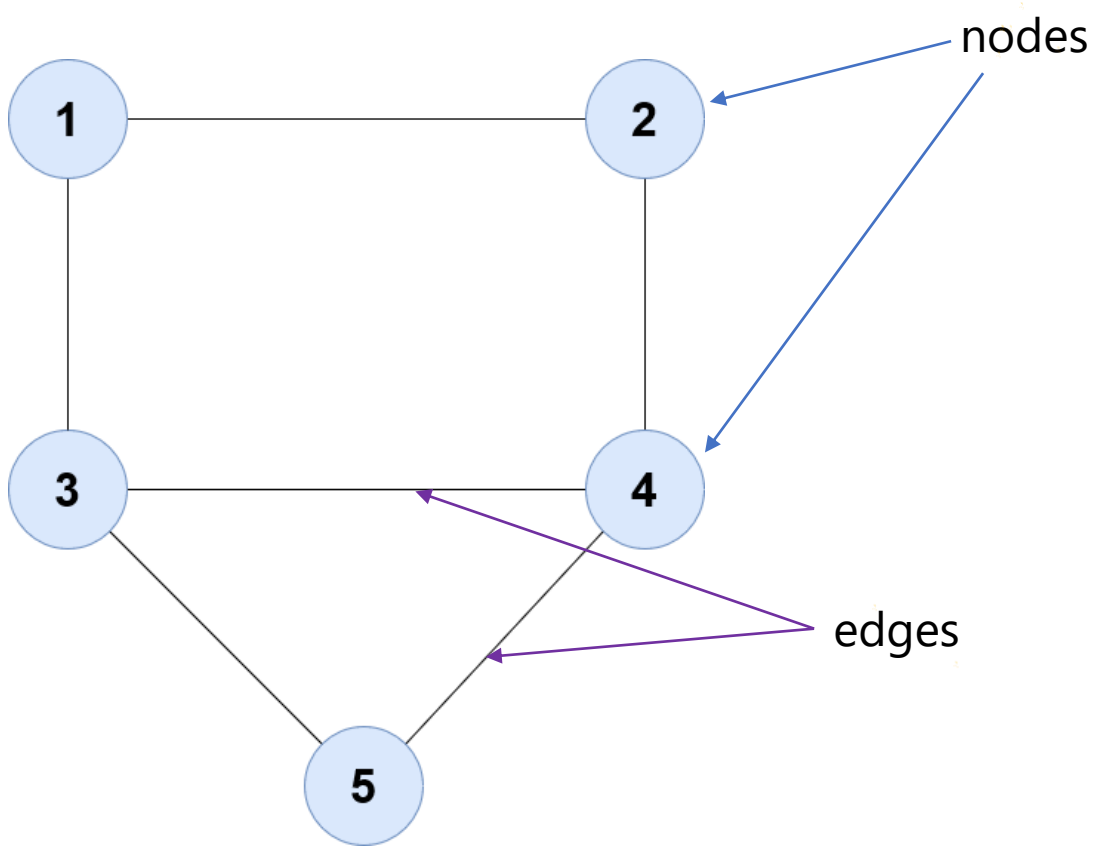


How?

Max-Cut Problem



Max-Cut Problem



Goal: Separate the nodes into two sets while the largest amount of edges are cut

Binary variables

$x_j = 1$ if node j is in Set 1 and

$x_j = 0$ if in Set 2

$$\begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

Cost function:

$$f(\mathbf{x}) = \sum_{(i,j)\epsilon E} -x_i - x_j + 2x_i x_j$$

x_i	x_j	Cost
1	1	0
1	0	+
0	1	+
0	0	0

Quantum annealing simulation

Variational bosonic solver

Updates x Shots

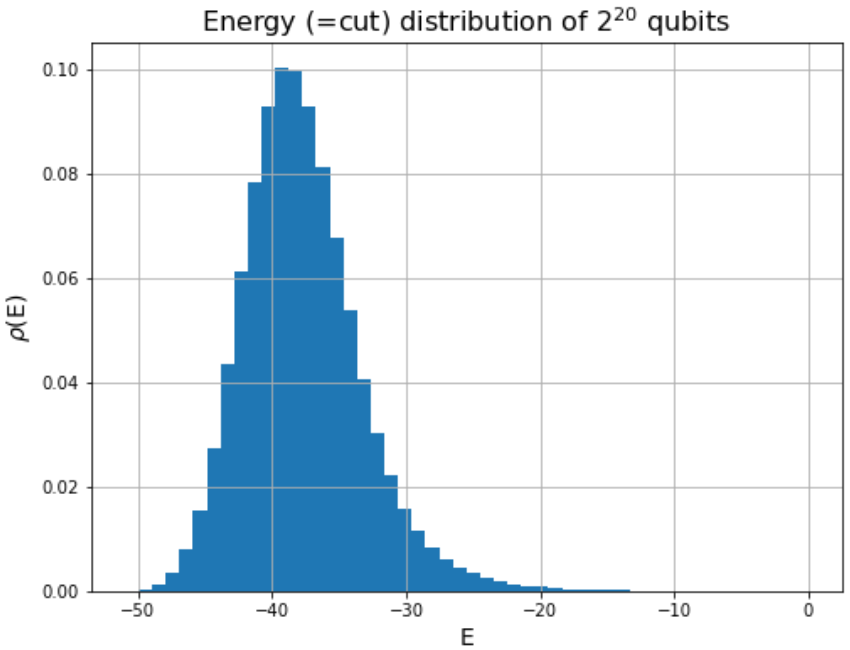
Learning rate

Mini-batch gradient descent

Epochs x Batch size

Learning rate

Progress


Energy (=cut) distribution of 2^{20} qubits
0.10
0.08
0.06
0.04
0.02
0.00
ρ(E)
−50
−40
−30
−20
−10
0
E