New Computational Physics to Include

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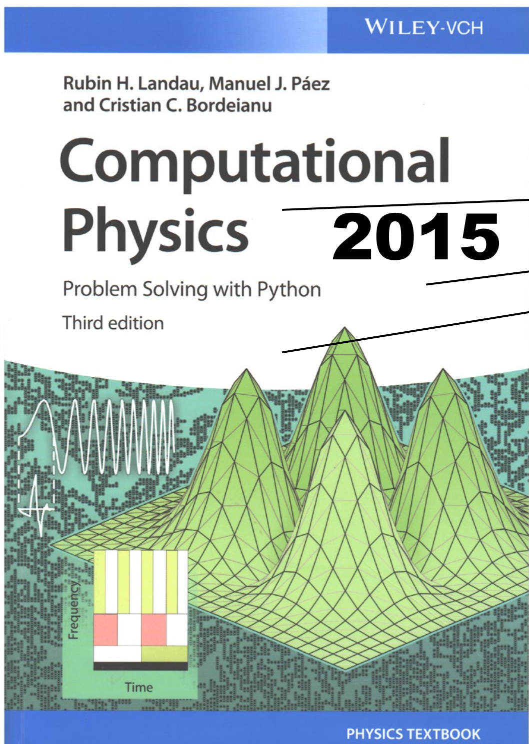


2015

2024

4th Ed!

Additions to New Edition

Neural Networks and Artificial Intelligence

(Data Mining)

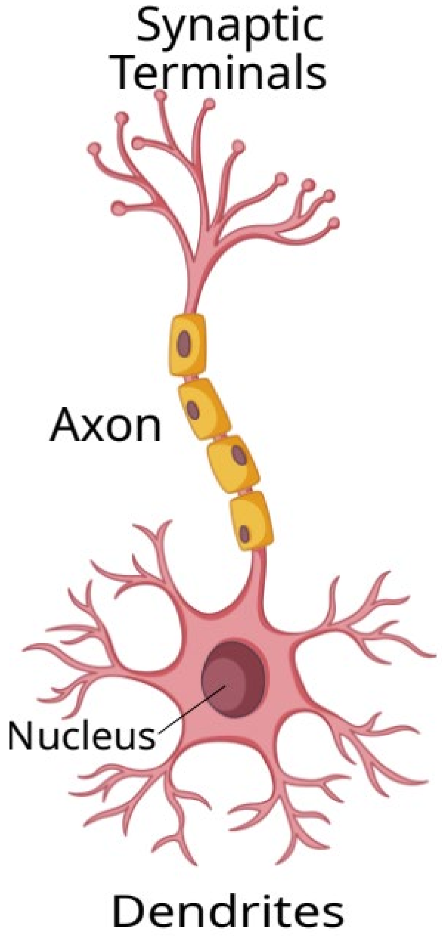
Quantum Computing

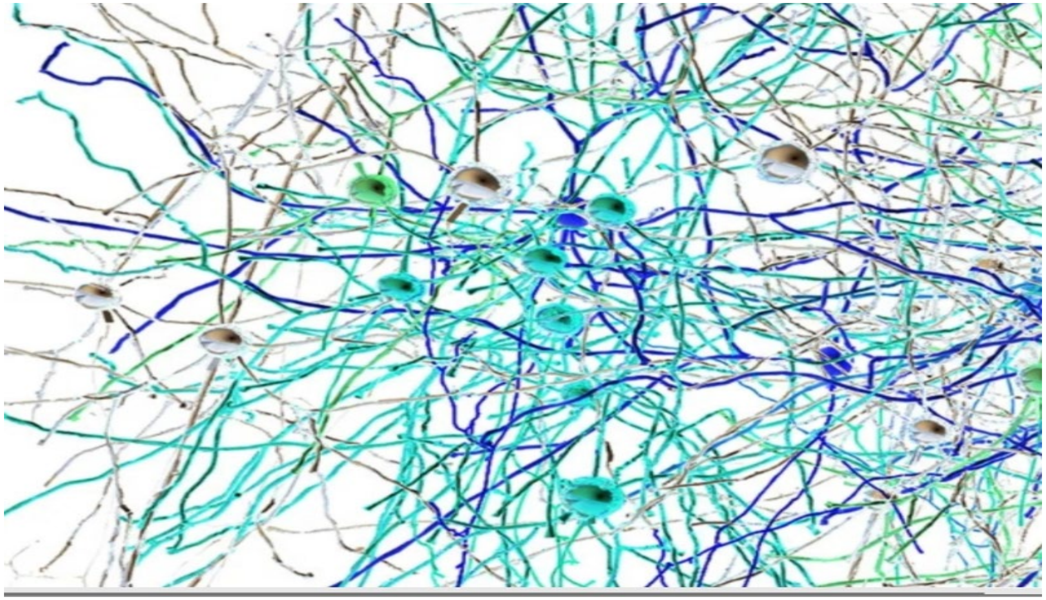
Principal Components

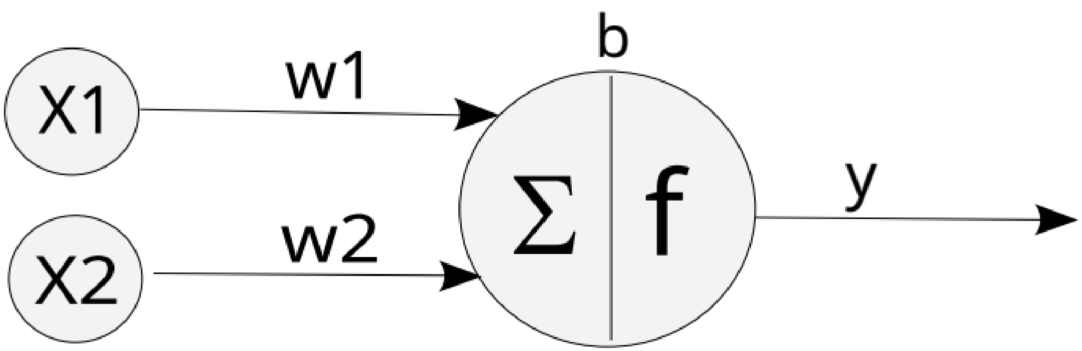
(Data Mining)

(General Relativity)

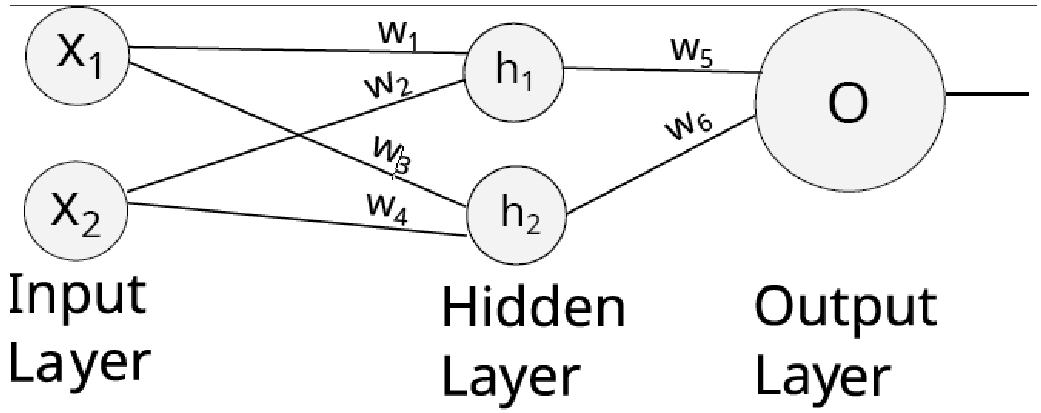
Neural Networks and Artificial Intelligence







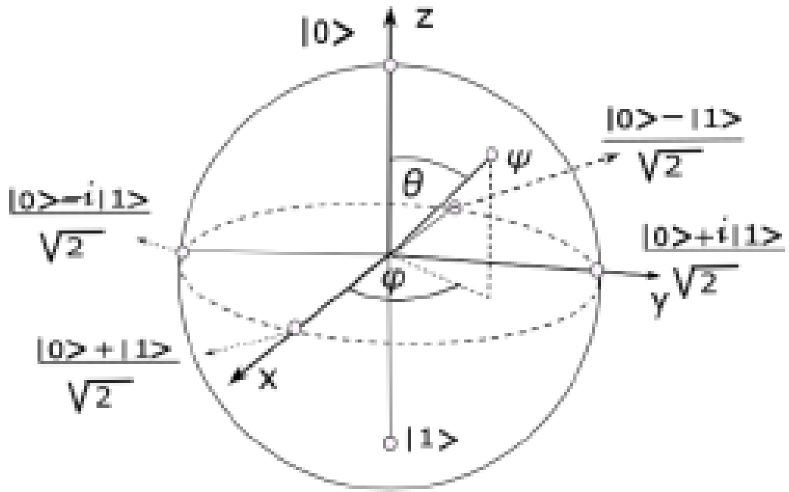
Neural Networks and Artificial Intelligence




```
# Neuron.py:  An AI neuron

import numpy as np
def f(x) : return 1./ (1. + np.exp(-x))     # Activation function
class Neuron :
    def __init__(self, weights, bias) :
        self.weights = weights
        self.bias = bias
    def feedforward(self, inputs) :                # Process input
       Sum = np.dot (self.weights , inputs) + self.bias
       return f(Sum)
weights = np.array([-1., 1.])                      # w1 = -1, w2 = 1
bias = 0
n = Neuron(weights ,bias)
x = np.array([12  ,8])                             # x1 = 12 , x2 = 8
print(n.feedforward(x))
# output: 0.0179862099620915б
```

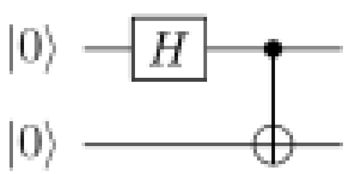
Quantum Computing



Hadamard gate H**:** converts qubits that are eigenstates of Z to ones that are eigen-states of X:

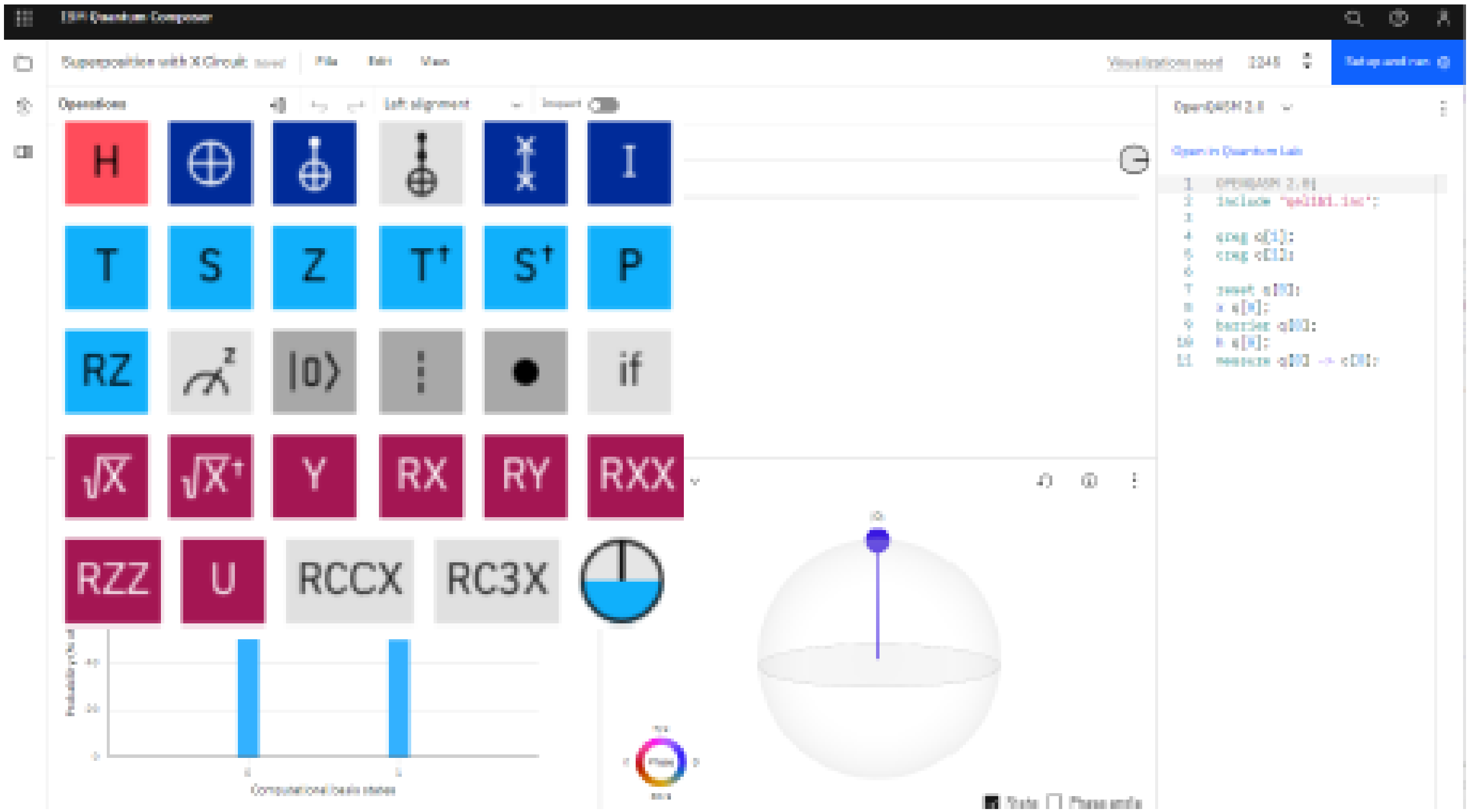
$$H\,|0\rangle = \frac{1}{\sqrt{2}}\big(\,|0\rangle + |1\rangle\,\big) \;\equiv\; |+\rangle\,, \quad H\,|1\rangle = \frac{1}{\sqrt{2}}\big(\,|0\rangle - |1\rangle\,\big) \;\equiv\; |-\rangle\,, \qquad (12.48)$$

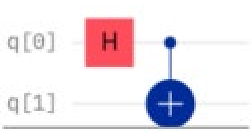
$$H = \big(\,|+\rangle\,\langle 0| \;+\; |-\rangle\,\langle 1|\,\big) = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}. \qquad (12.49)$$

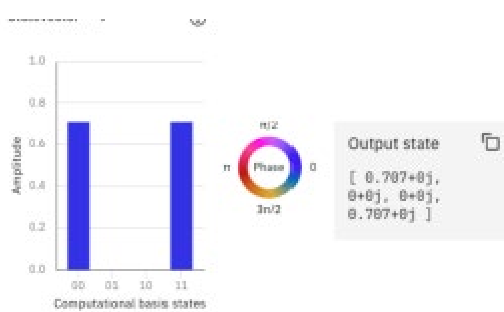


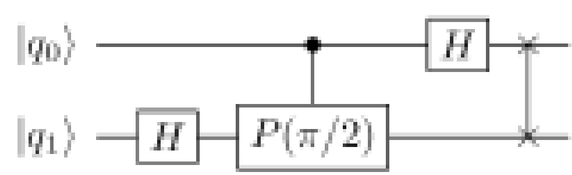
A quantum circuit for creating an entangled state $|\beta_{00}\rangle$.

IBM Quantum Computer



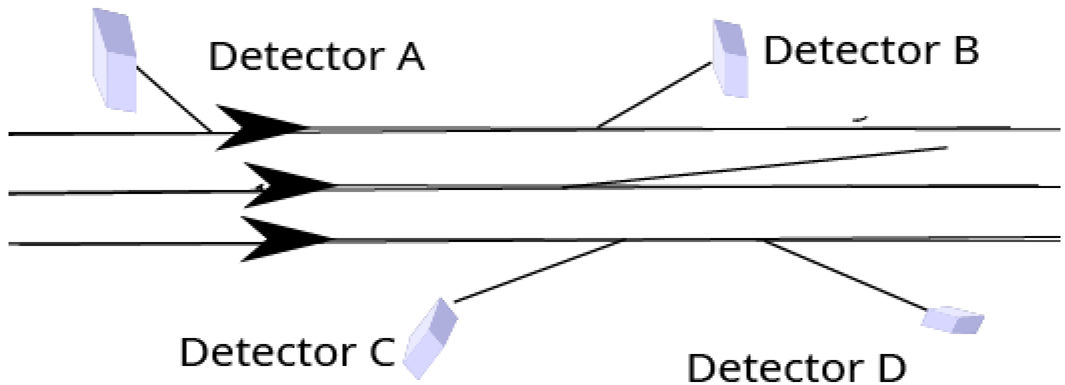




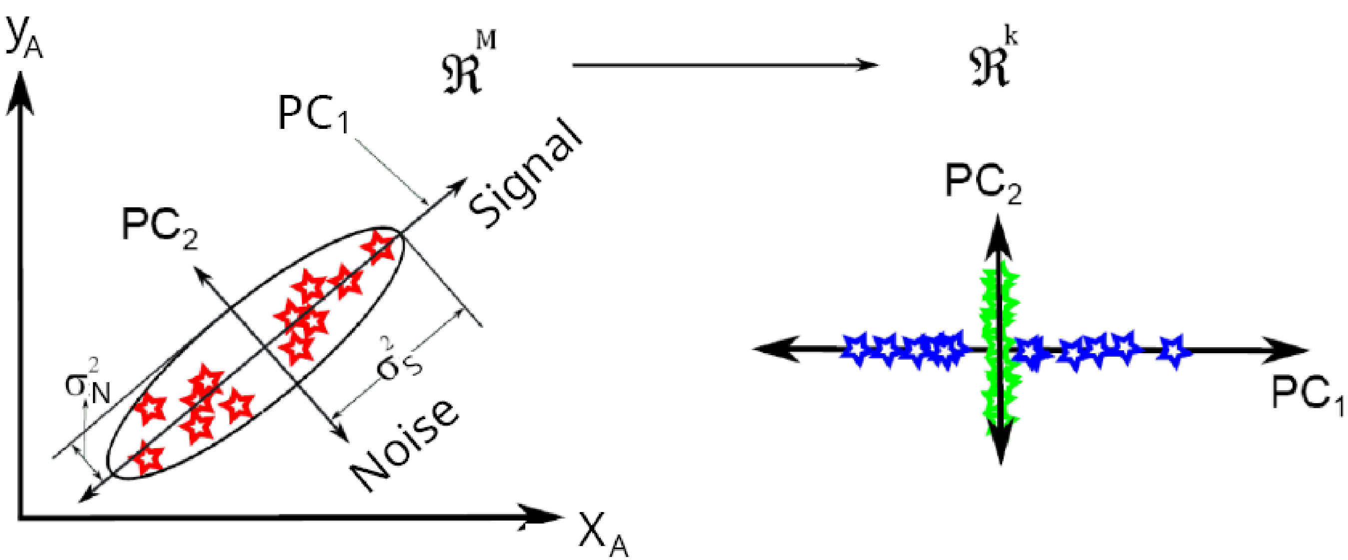


Quantum Fourier transform circuit for 2-qubits.

Principal Components Analysis



$$\mathbf{X}' = [x'_a \quad y'_a \quad x'_b \quad y'_b \quad x'_c \quad y'_c \quad x'_d \quad y'_d].$$



Successive KL Reconstructions (Frame 0001)