

Chapter 6

The Puccini-Beyoncé-Weyl Theorem and the Halting Problem for Dancing Machines

6.1 Dancing Machines

The Puccini-Beyoncé-Weyl Theorem is one of the most important theorems in the theory of computation.

It is was proved jointly by

Giacomo Puccini (1858–1929)
Beyoncé Knowles-Carter (1981–), and
Hermann Weyl (1885-1955).

This theorem has to do with the *undecidability* of the *halting problem for dancing machines*, a 3D generalization of Turing machines.

A *dancing machine* is a generalization of a Turing machine where the tape is replaced by a 3D *cubic grid*.

The reading/dancing head can make *six possible moves*:

1. left or right
2. up or down
3. forward or backward

Formally, it is defined by a 17-tuple $(K, \Sigma, \Gamma, \dots)$

The proof of the undecidability of the halting problem for dancing machines proceeds by zig-zag induction.

The proof is very hard and is left as an impossible exercise.