Dynamic Programming Applications

Optimum Geometric Layout of Truss

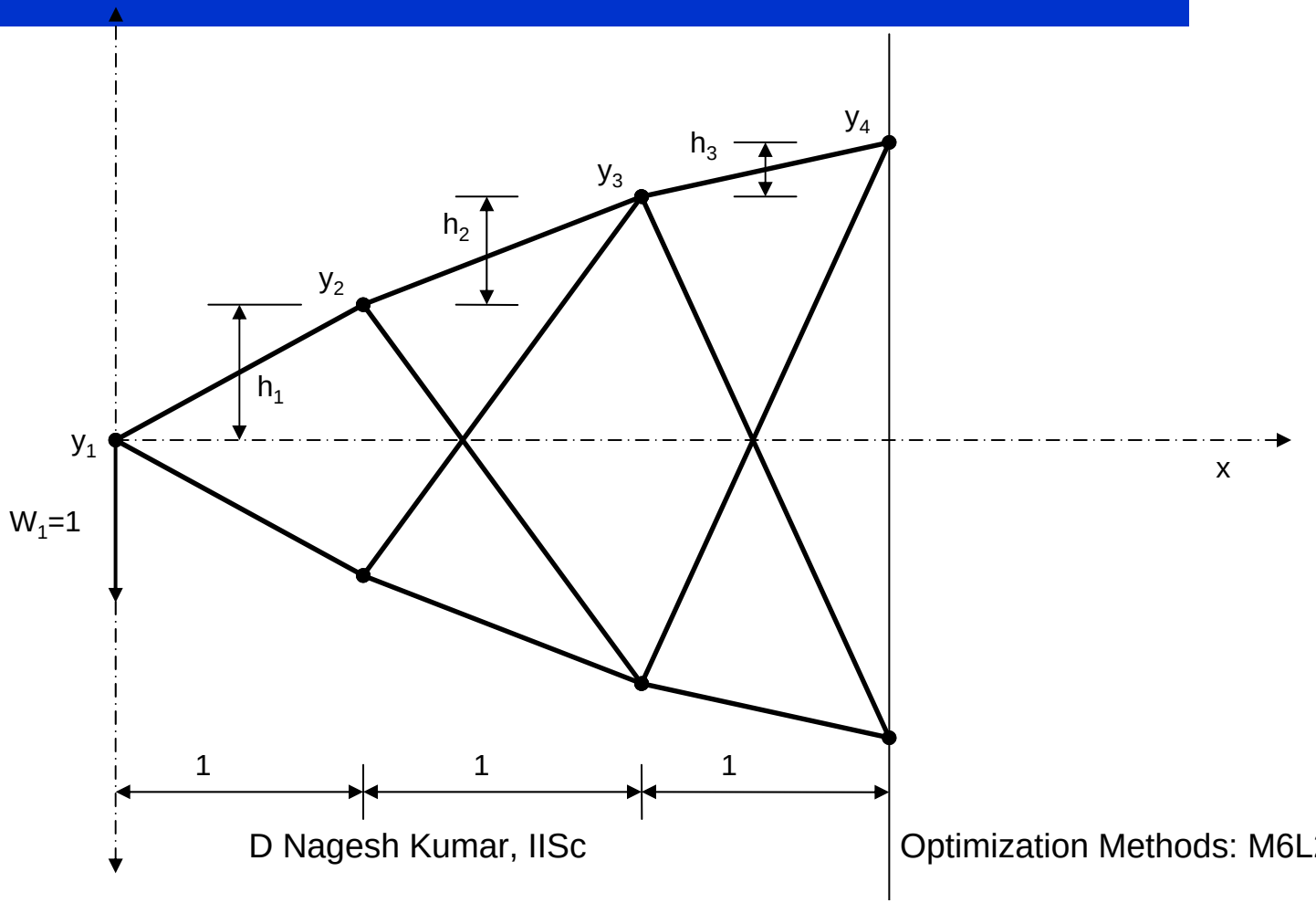
Objectives

- To discuss the design of elastic trusses
- To formulate the optimization problem as a dynamic programming model

Optimum Geometric Layout of Truss

- Consider a planar, pin jointed cantilever multi bayed truss
- Assume the length of the bays to be unity
- The truss is symmetric to the x axis
- Geometry or layout of the truss is defined by the y coordinates $(y_1, y_2, \ldots, y_n)$
- Truss is subjected to a unit load W_1

Optimum Geometric Layout of Truss …contd.



Optimum Geometric Layout of Truss …contd.

- Consider a particular bay *I*
- Assume the truss is statically determinate
- Forces in the bars of bay *i* depend only the coordinates y_{i-1} and y_i
- Cross sectional area of a bar can be determined, once the length and force in it are known
- Cost of the bar can thus be determined.

Optimum Geometric Layout of Truss …contd.

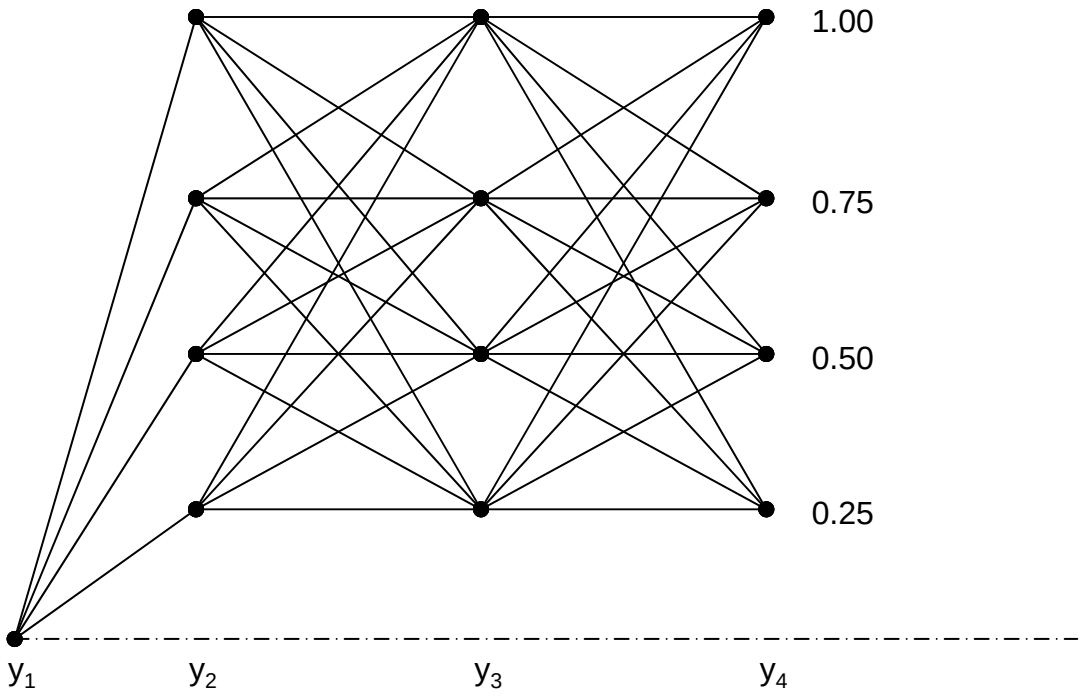
- The optimization problem is to find the geometry of the truss which will minimize the total cost from all the bars
- For the three bay truss, the relation between y coordinates can be expressed as

$$y_{i+1} = y_i + d_i \qquad \text{for } i = 1,2,3$$

- This is an initial value problem since the value y_1 is known

Optimum Geometric Layout of Truss …contd.

- Let the y coordinate of each node is limited to a finite number of values say 0.25, 0.5, 0.75 and 1



Optimum Geometric Layout of Truss …contd.

- As shown in the figure, there will be 64 different possible ways to reach y_4 from y_1
- This can be represented as a serial multistage initial value decision problem and can be solved using dynamic programming

Thank You