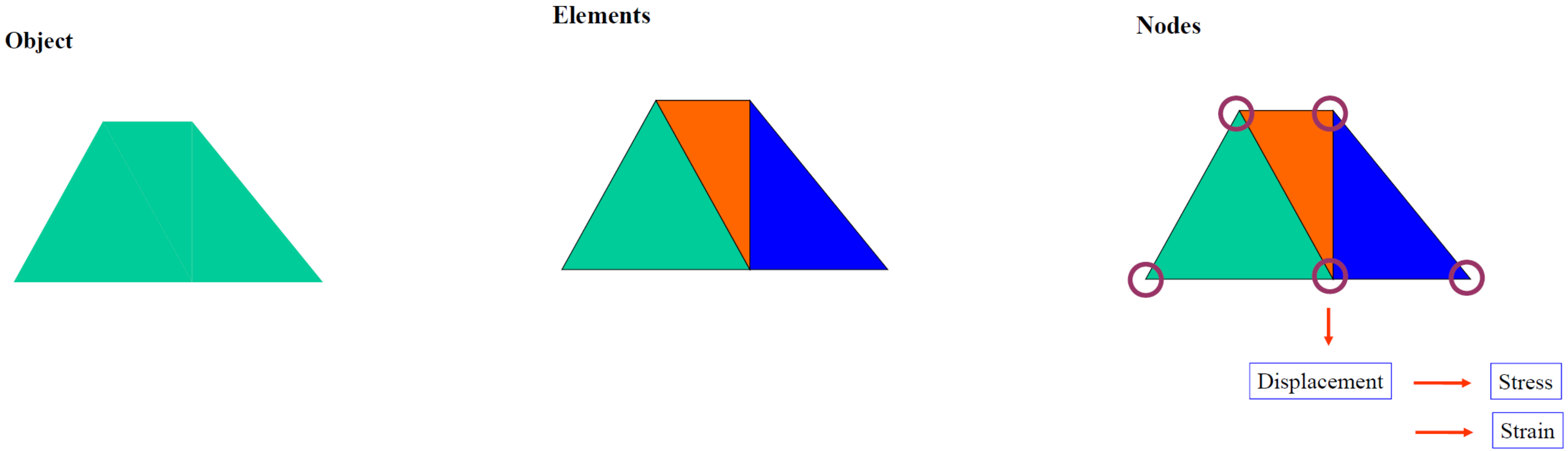
Discretization



Principles of FEA

The finite element method (FEM), or finite element analysis (FEA), is a computational technique used to obtain ***approximate solutions of boundary value problems in engineering.*** Boundary value problems are also called ***field problems. The field*** is the domain of interest and most often represents a physical structure. The ***field variables are the dependent variables of interest governed*** by the differential equation. **The *boundary conditions are the specified values of the field*** variables (or related variables such as derivatives) on the boundaries of the field.

Lecture No 39 Topic: FINITE ELEMENT ANALYSIS

- **Preprocessing**

– Define the geometric domain of the problem.
– Define the element type(s) to be used.
– Define the material properties of the elements.
– Define the geometric properties of the elements (length, area, and the like).
– Define the element connectivities (mesh the model).
– Define the physical constraints (boundary conditions). Define the loadings.

- **Solution**

– computes the unknown values of the primary field variable(s)
– computed values are then used by back substitution to compute additional, derived variables, such as reaction forces, element stresses, and heat flow.

- **Postprocessing**

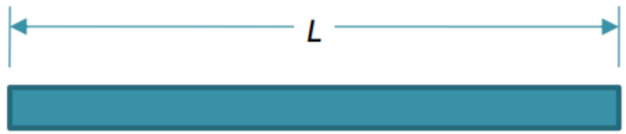
– Postprocessor software contains sophisticated routines used for sorting, printing, and plotting selected results from a finite element solution.

Stiffness Matrix

The primary characteristics of a finite element are embodied in the element ***stiffness matrix. For a structural finite element, the*** stiffness matrix contains the geometric and material behavior information that indicates the resistance of the element to deformation when subjected to loading. Such deformation may include axial, bending, shear, and torsional effects. For finite elements used in nonstructural analyses, such as fluid flow and heat transfer, the term *stiffness matrix is also used, since* ***the matrix represents the resistance of the element to change when subjected to external influences.***

Simple Bar Analysis

Consider a simple bar made up of uniform material with length L and the crosssectional area A. The young modulus of the material is E.



Since any bar is modeled as spring in FEM thus we've: