Numerical Control (NC) machine

Introduction

- CNC: Computer Numerical Control
- Production of machined parts whose production is controlled by a computer.
- Computer uses a controller to drive each axis of the machine tool. (X,Y,Z)
- Controls direction, speed, and length of time motor rotates.

Introduction

- A programmed path is loaded into the computer and then executed.
- Program consists of numeric point data (X,Y,Z), along with machine control and function commands.
- Numerical Control (NC) & Computer Numerical Control (CNC) mean the same.

Introduction

- A major manufacturing development in past 60 years.
- Resulted in:
  - new manufacturing techniques
  - higher production levels
  - higher quality
  - stabilization of manufacturing costs

Evolution of CNC

- Single items produced by crafts people
- Interchangeable Parts
  - Eli Whitney (Cotton Gin)
  - Manual labor was still the most cost effective method.
- WW II manufacturers could not maintain quantity & quality parts.

Evolution of CNC

- Machinists could produce superior quality but not at high volume that was required.
- As quantity increased, quality decreased due to human factors
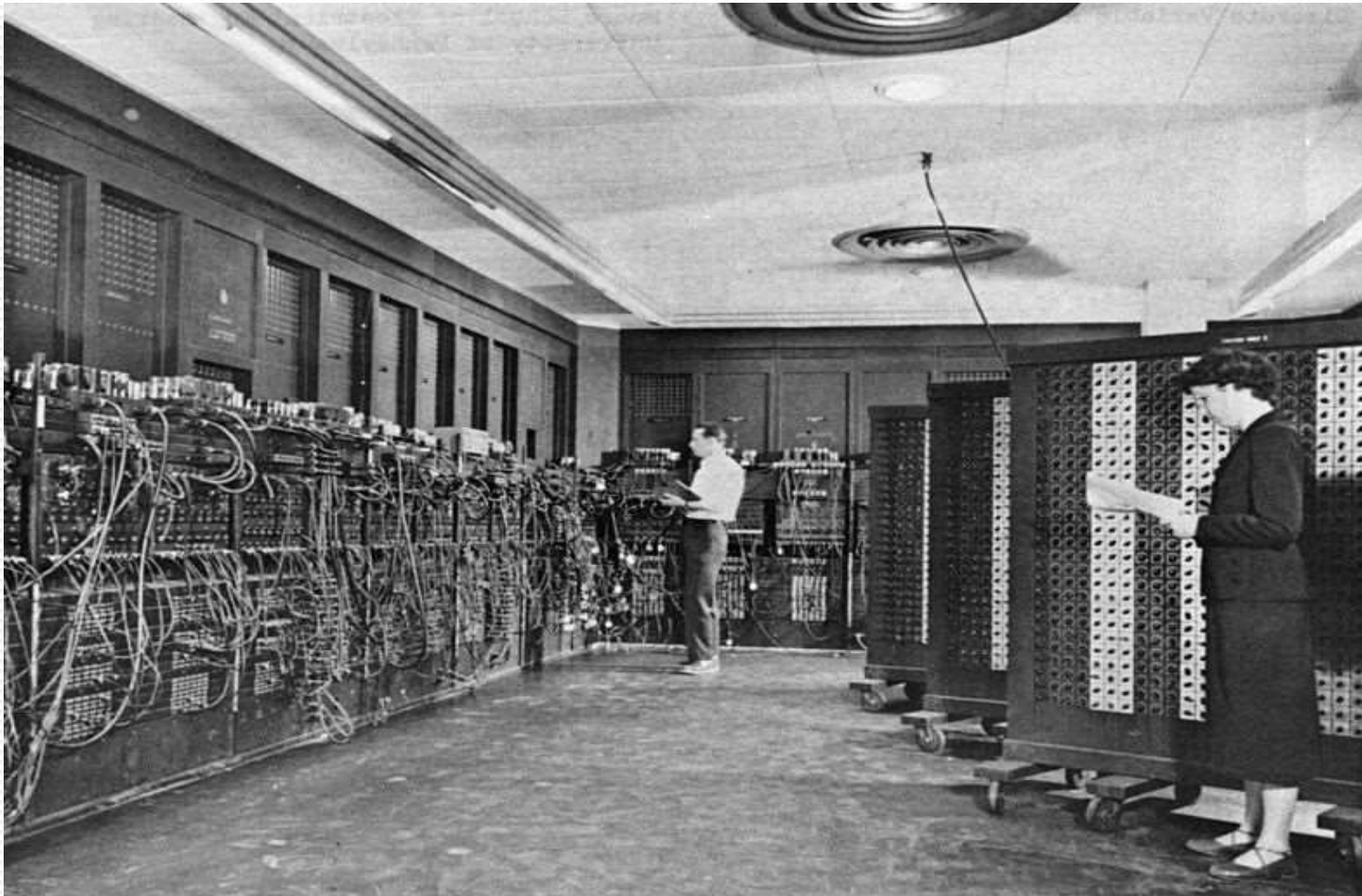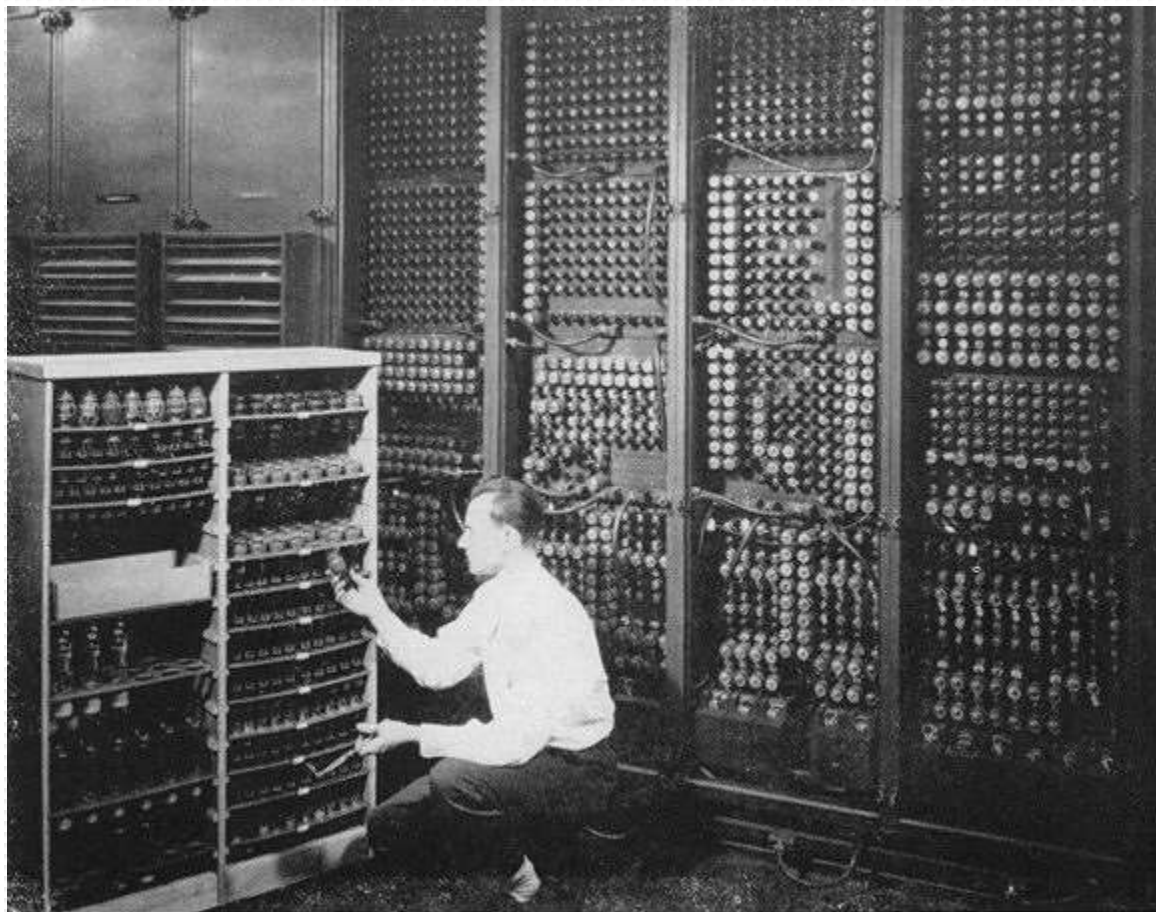
Evolution of CNC

- ENIAC – developed by the United States Army Ballistic Research Lab & University of Pennsylvania
- First digital computer.
- Vacuum tube technology. (30,000)
- Used to calculate artillery tables.
- Programming involved setting hundreds of switches and cables.

ENIAC
Electronic Numerical Integrator And Computer

ENIAC

Replacing a bad tube meant checking among ENIAC's 19,000 possibilities.

CNC & WW II

- Need to manufacture large amount of products for the war.
- Need for quantity and quality.
- U.S. Air Force set up companies to develop and produce NC systems to handle volume and repeatability.
- Repeatability: the ability to perform the same operation over & over within specified parameters.

Specific Goals

- Increase production
- Improve quality & accuracy of machined parts.
- Stabilize manufacturing costs.
- Speed up production & assembly operations.

NC Timeline

- 1949 - First contract awarded for NC machine.
- 1951 - servo system for machines developed.
- 1952 - tape-fed machine was created.

History

- Development of G codes - Punch tape input (Cartesian Coordinate System)
- 1970's Development of computer chips
  - Cheaper processing power
  - Smaller computers
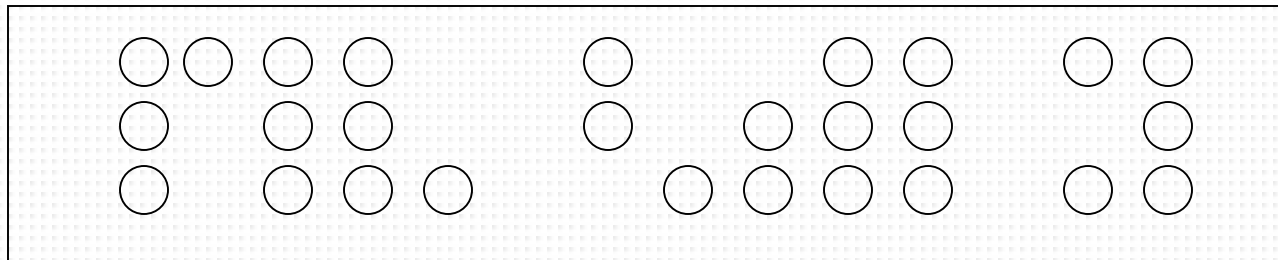 - More reliable

Paper Tape Control

Paper Tape Control

Paper Tape Control

- Strip of paper tape with holes in it.
- Machine read pattern of holes and performed the required operation.

Paper Tape Control

- Disadvantages
  - Difficult to identify parts of program.
  - Programs could be quite large.
  - Stored on large bulky reels.
  - Fragile, could rip easily.