CNC Career Connections

If you like working with the XY-Plotter ...

What jobs relate to this activity?

CNC Operator. Typical salary: $22,000 to $60,000 per year.

Machinist. Typical salary: $24,000 to $58,000 per year.

Computer Programmer / Software Developer. Typical salary: $39,000 to $122,000 per year.

Engineer. Typical salary: $40,000 to $103,000 per year.

What jobs in this field are available locally?

A recent search for CNC positions near South Bend, Indiana turned up 100 open positions, 700 open positions for machinists, and more than 1000 open positions for computer programmers and software developers.

What skills and certifications would employers expect me to have to get started?

Most positions will require:

- Professional conduct in the workplace, good time-management skills, and ability to work with a team
- Attention to detail, a strong work ethic, and willingness to learn
- Written and verbal communication skills

Entry level CNC and Machining positions may require the following:

- A high school diploma or GED
- Experience working with machines and tools.
- Knowledge of how to use tools such as rulers, calipers, bore gauges, dial indicators, micrometers, optical comparators, et cetera.
- Ability to solve problems involving fractions and decimals, geometry, and trigonometry.
- Ability to read blueprints, sketches, drawings, manuals, and specifications.

Entry level Programming and Engineering positions may require the following:

- A bachelor's or master's degree in a related field
- Ability to write technical documentation
- Familiarity with several programming languages
- Familiarity with SQL, HTML, standard software packages
- Familiarity with micro-controllers, programmable logic controllers

Where can you get training to get into this field?

- High School Career and Technical Education courses such as Architectural Drafting and Design, Construction Technology, Information Technology, and Precision Machine Technology.
- Local Colleges and Universities offer certificates and degrees in Advanced Automation and Robotics, Computer Science, Database Management, Design Technology, Electronics, Engineering, Manufacturing Technology, Organizational Leadership, Supply Chain Management.

Programming in G-Code

Many CNC machines in local businesses are controlled using G-Code. CNC stands for "Computer Numerical Control". Many different kinds of parts can be manufactured using these machines.

The XY-Plotter can only draw pictures, but it is a simple example of a CNC machine.

To make your own design, first draw it on centimeter grid paper. The XY-Plotter can draw curves, but it is a good idea to begin with lines. Next, write coordinates that describe the location of each point. Remember that every centimeter is 10 millimeters. Finally, type your program following the sample format shown below.

G1 tells the pen to move in a straight line from where it was to the location described in the command. Z indicates the vertical direction. X and Y indicate movement in the horizontal coordinate plane.

Here is a sample program. Lines in parentheses are comments.

```
(Set millimeters as units)
G21


(pen up)
G1 Z0
(move to (40,40))
G1 X40 Y40
(pen down)
G1 Z90
(draw a straight line to (45,40))
G1 X45 Y40
(draw a straight line to (45,35)
G1 X45 Y35
G1 X40 Y35
G1 X40 Y40

G1 Z0
G1 X60 Y35
G1 Z90
G1 X65 Y35
G1 X75 Y50
G1 X75 Y45
G1 X65 Y30
G1 X60 Y30

G1 Z0
G1 X25 Y35
G1 Z90
G1 X20 Y35
G1 X10 Y50
G1 X10 Y45
G1 X20 Y30
G1 X25 Y30

G1 Z0
G1 X35 Y55
G1 Z90
G1 X40 Y50
G1 X35 Y45
G1 X30 Y50
G1 X35 Y55

G1 Z0
G1 X50 Y55
G1 Z90
G1 X55 Y50
G1 X50 Y45
G1 X45 Y50
G1 X50 Y55

G1 Z0
G1 X25 Y55
G1 Z90
G1 X25 Y20
G1 X15 Y5
G1 X25 Y10
G1 X30 Y5
G1 X40 Y10
G1 X45 Y5
G1 X55 Y10
G1 X60 Y20
G1 X60 Y55
G1 X50 Y65
G1 X35 Y65
G1 X25 Y55

(Pen Up)
G1 Z0
(Go Home)
G1 X0 Y0
```

Step-By-Step Directions for Programming the XY-Plotter

Step 1: Draw a picture.
On the graph paper, draw a picture made of straight lines. These lines can be vertical, horizontal, or diagonal, but should not be curved. They can be connected or separate. Keep your first drawing simple, ideally with around 20 lines.

Step 2: Label the Coordinates. Draw an X and Y axis onto your picture, and use it to label the points at the start and end of each line (any time the pen changes direction).

Step 3: Begin Typing your Code.
Open a new text file. Type:

- G21 (This sets the units to millimeters.)
- G1 Z0 (This picks the pen up off the paper.)
- G1 X45 Y50 (This would move the pen to the point (45,50). You should replace these numbers with the coordinates of your first point.)
- G1 Z90 (This lowers the pen to touch the paper.)
- G1 X55 Y60 (This would move the pen to the point (55,60), thereby drawing a line from (45,50) to (55,60). You should replace these numbers with the coordinates of your next point.)
- Keep working through the path a pen would need to take to draw your picture.
- To avoid bugs in your program, please remember: The code is case sensitive. Only use capital letters. The code reads spaces. There should be a space after each letter-number pair, but not a space between the letter and the number.
- If you do not want to draw a line between two points, use G1 Z0 to pick up the pen before moving to the next point. Make sure to use G1 Z90 to lower the pen, or the plotter will draw your design in air instead of on paper. To make a closed shape like a square, you must revisit your first point.
- Make sure that your 0 is in fact a zero, and not an upper case letter O.

Step 4: Export your Code.
Save the file with your first name, underscore, the picture's name, such as Mary_Octopus. Make sure one copy stays on your computer, and save another to the usb drive.

Step 5: Troubleshoot and Debug.
Copy your code to the text field in the XY-Plotter Simulator on the web page. If there are any mistakes, make changes to fix them. Remember to copy the final version of your code back into your text file and save it.

Step 6: Upload your program to the XY-Plotter and watch it draw your amazing design!