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BARCODE EDUCATIONAL GUIDE

The Barcode Educational Guide provides an introduction to IDAutomation Barcode Products, barcode symbologies, and symbology standards.

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What products do we offer?

IDAutomation offers barcode automation components to generate barcodes in a variety of applications and environments, including mobile apps available in the Google Play Store and Apple App Store.

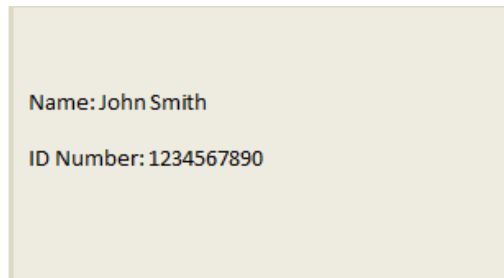
Popular barcode integration products include:

- Barcode Image Generator and [Label Software Application](#)
- [Barcode fonts](#), MICR, OCR, and Security fonts
- Barcode Components and [Barcode Generators](#)
- Barcode Data Decoder Verifier
- [QR Code Contact Generator](#)

How do barcodes work?

A **barcode** is a machine-readable representation of numerals and characters designed to eliminate manual entry and error.

Kimberly Morales works in Company A's data entry department where she manually enters (via keyboard entry) customer ID numbers from ID cards into a database search to pull up customer information. The department recognizes that keyboard entry errors cause an unnecessary slow-down in production.



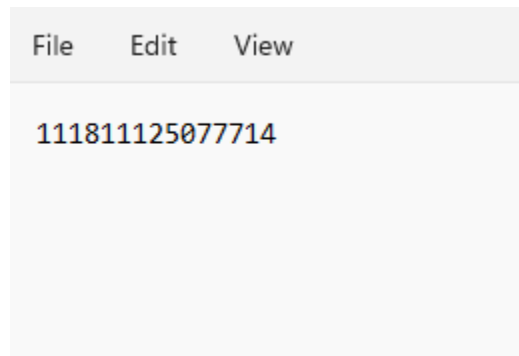
To solve this problem, the Kimberly and the department decide to implement barcode technology as a more efficient method for processing customer information. The department produces ID cards with barcodes that represent the customer ID number. Kimberly scans the barcode on the ID card to quickly run a search in the database.



This is just one of several reasons to implement barcode technology in your business.

Barcode fonts, components, and applications generate barcodes. Barcode scanners (often referred to as barcode readers), such as hand-held scanners and the [Barcode Data Decoder Verifier](#), scan data from barcodes directly into applications.

Bluetooth wireless and USB connected hand-held scanners link directly to the computer or device; or in the case of a wireless scanner, a base. Once a connection to the computer is established, open an application, such as a text editor, and scan the barcode to transmit the data.

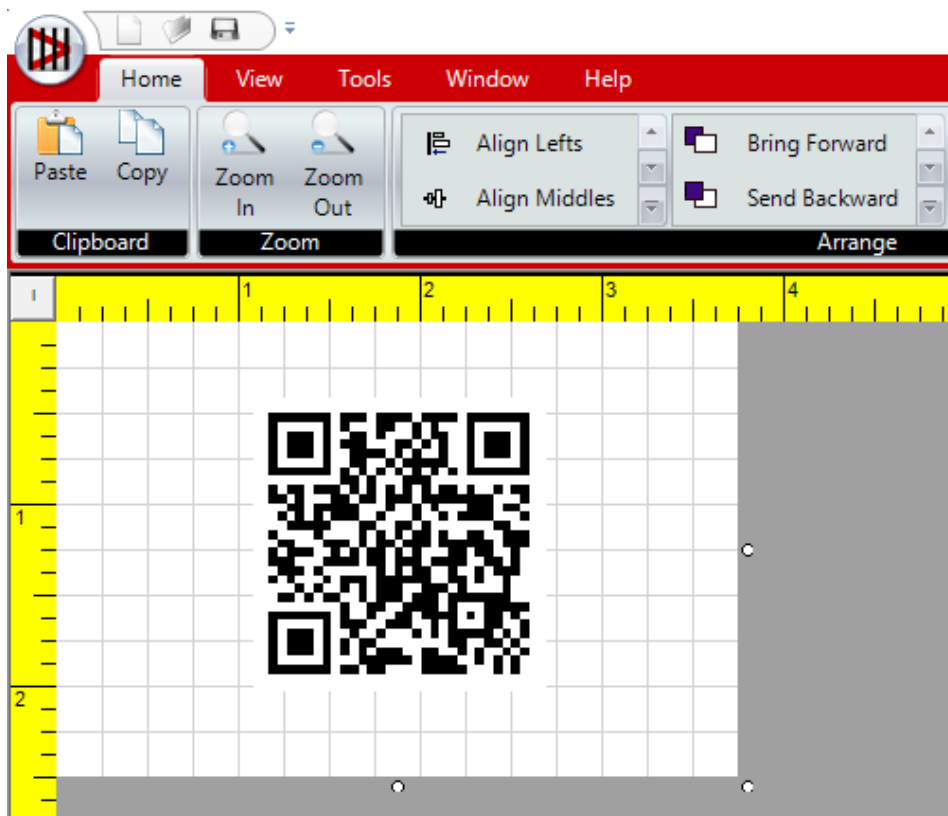


Barcode Applications

Barcode Applications are user-friendly standalone desktop applications designed to generate barcode images and barcode labels.

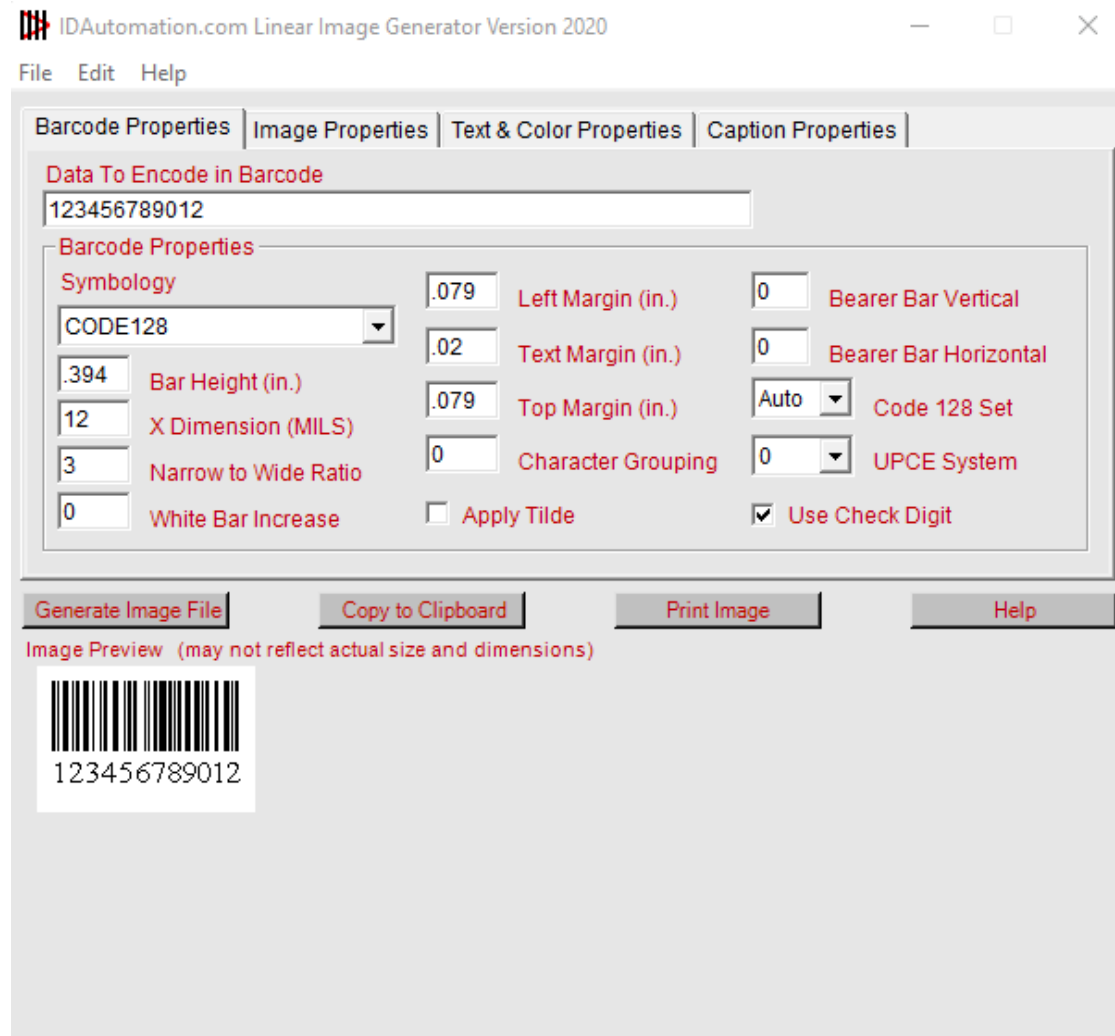
The Barcode Label Software

The [Barcode Label Software](#) produces barcodes on several label stock types. The software's simple, user-friendly label design interface makes it a popular product for warehouse printing and inventory tracking labels. The software generates barcode labels based on data embedded directly or connected to an external source such as an Excel spreadsheet, CSV file, or database table.



The Barcode Image Generator

The [Barcode Image Generator](#) creates barcodes through the user interface or via command line. It supports JPEG, EPS, TIFF, PNG, BMP, WMF and 1-bit per pixel monochrome bitmap image formats. Easily modify the barcode data, barcode type, height, color, margins, and save images with this easy-to-use product.



Barcode, OCR, MICR, and Security Fonts

A **font** is a specific size, weight, and style of a typeface.

[Barcode fonts](#) are font files that create barcodes—the most popular method for creating barcodes.

[OCR](#) fonts serve several purposes where automated systems need a standard character shape defined to properly read text without the use of barcodes. Some examples of OCR program font implementations include bank checks, passports, serial labels and postal mail.

[Security](#) fonts print secure text, names, and currency amounts on highly secure documents, such as a bank check, in a manner that cannot be easily altered and may prevent forgery.

[MICR E13B](#) and [MICR CMC7](#) fonts print characters on bank checks for magnetic recognition and optical character recognition systems.

About Barcode Fonts

To create a scannable barcode with a barcode font, it requires two components:

- Barcode font
- Barcode font encoder

A [font encoder](#) is formula inside of an add-in, plug-in, or source code that performs a calculation to convert data into a format that the barcode font understands. After the data passes through the font encoder, it is referred to as encoded data.

Imagine that you need to bake a cake for a friend's upcoming birthday party.



You (User)

Visualize the data as the cake mix, the font encoder as the oven, and the barcode font as the icing for the cake.



Cake mix (Data)



Oven (Font Encoder)

After the cake mix (data) is prepared, it is passed to the oven (font encoder) for baking (formatting).

Once the baking process is complete, the icing is applied (barcode font selected) to produce a finished birthday cake (or in this case, a delicious, scannable barcode).




Encoded Data



Scannable Barcode

Barcode encoding Illustration Example:

DATA	ENCODED DATA	ENCODED DATA WITH BARCODE FONT SELECTED
1234567890	í,BXnzuî	

[View the Online Font Encoder Application](#)

Barcode Components and Barcode Generators

Barcode Components dynamically create barcodes as graphic images in quite a few development environments using DLLs and Java classes.

These products are the most complex to use and are generally recommended for developers who want to integrate barcodes into their applications. Components are in the form of DLLs, class files, and other component files.

Barcode Components:

- [.NET Barcode Generator](#)
- [Java Component](#)
- [ASP.NET Server Control](#)
- [.NET Forms Control](#)
- [SaaS Generator](#)

Barcode Generators:

Developed by IDAutomation.com, Inc., Barcode Generators dynamically create barcodes in various applications without using barcode fonts, DLLs, or plug-ins. Source code builds the barcode using a combination of Unicode and system fonts or other tools native to the particular application. Barcode Generator products include:

- [Crystal Reports](#)
- [Excel](#)
- [Access](#)
- [JavaScript](#)
- [Oracle Reports](#)
- [FileMaker](#)
- [Google Sheets | Docs](#)
- [PHP](#)
- [ASPX](#)

Barcode Symbologies

A barcode symbology (barcode type) is a protocol for arranging the bars and spaces that make up a particular kind of barcode. IDAutomation offers several symbologies as fonts, applications, and components. There are two major symbology types:

- 1D (One-Dimensional) Barcodes
- 2D (Two-dimensional) Barcodes

1D

[One-dimensional \(1D\) barcode](#) symbologies represent data in the form of spaced vertical lines, such as Code128, Code 39, and UPC.



- Holds less than 85 characters (symbology specific character limit)
- A majority of industries are set up to use Linear barcodes (Linear scanner).
- Creates a wide barcode.

2D

[Two-dimensional \(2D\) barcode](#) symbologies have patterns of squares, dots, hexagons, and other geometric shapes. Data Matrix, PDF417, and QR Code are 2D barcodes that hold more data and consume less space than 1D barcodes.



- Encodes hundreds of characters
- Requires a 2D barcode scanner
- Creates a smaller barcode than 1D with the same data.

Barcode Standards

Choosing the appropriate barcode symbology depends on several factors, including:

- Standards and mandates
- Purpose and use
- Type of data to encode
- Printing and/or decoding methods

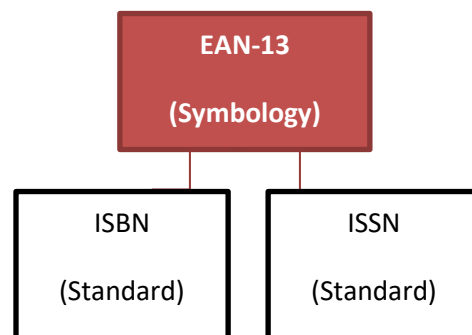
There are several types of barcode standards for different purposes. Each symbology (or barcode type) is a standard that defines the printed symbol and how a device, such as a barcode scanner, reads and decodes the printed symbol.

If an industry standard is already established for the intended implementation, the standard should be implemented. For example, the distribution industry requires companies to place a UPC barcode on distributable items.



If a standard does not exist for an implementation, the implementor has the choice to select between several standards. For example, if a warehouse employee wants to keep track of items in a warehouse for internal use, the warehouse employee may choose to implement a Code 39 barcode without abiding by a specific guideline.

Industry standards are typically established when multiple parties or companies are involved in the ID process. The standard is not necessarily the same as the barcode symbology. Barcode standards define how to use the barcode symbology in a particular situation. For example, the two standards to create ISBN barcodes for books and generate ISSN barcodes for periodicals both use EAN-13, but have different methods depending on the specific ISBN & ISSN standards.



One-Dimensional Barcodes (1D)

Identified by its vertical lines, 1D barcode types remain some of the most recognized visual images in the world. Many industries continue to focus on 1D barcode types for handling data. Popular 1D barcode types include:

- Code 39 (Code 3 of 9)
- Code 128
- Interleaved 2 of 5 (I2 of 5)
- UPCA and UPCe
- EAN8 and EAN13
- DataBar
- Intelligent Mail Barcode

Code 39

[Code 39](#) (also known as the 3 of 9 Barcode, Code 3 of 9 and Barcode39) is a common barcode type used for various labels, such as name badges, inventory and industrial applications. The symbology of the Code 39 Character Set consists of barcode symbols representing numbers 0-9, upper-case letters A-Z, the space character and the following symbols: - . \$ / + %. There is an Extended Code 39 that encodes lower case characters.



The Code 39 barcode is the easiest of the alpha-numeric barcodes to use and is designed for character self-checking, thus eliminating the need for check character calculations. A check character is a character added to the end of a block of transmitted data to check the accuracy of the transmission.

Code 128



The [Code 128](#) barcode is a high-density 1D symbology that encodes text, numbers, numerous functions, and the entire 128 [ASCII character set](#) (from ASCII 0 to ASCII 128.) It is commonly used in several implementations; and is also referred to as ISBT-128, GS1-128, UCC-128, EAN-128, and USS Code 128 (barcodes standards for Code 128).

It produces three major character sets: Code 128 A, Code 128 B, and Code 128 C. A fourth set, Code 128 Auto, is the most efficient and uses a combination of A, B, and C.

- Set A encodes numbers 0-9, uppercase A-Z, and control characters, and special characters.
- Set B encodes numbers 0-9, uppercase A-Z, lowercase a-z, and special characters.
- Set C encodes numeric data.

Interleaved 2 of 5



[Interleaved 2 of 5](#) (ITF) is a numeric barcode symbology that encodes number pairs in a high-density barcode format. Interleaved 2 of 5 is designed for character self-checking which eliminates the requirement for check characters; although some ITF specifications require check characters to maximize data integrity. ITF barcodes contain an even number of digits, as a single ITF barcode character represents two numbers to achieve a higher density.

The ITF barcode character set consists of barcode symbols representing double-digit characters 00 to 99 in addition to start and stop characters. The complete printed ITF barcode contains a leading [quiet zone](#), a start character (the few first bars of a barcode), Interleaved 2 of 5 barcode representing encoded data, a stop character (the last few bars of a barcode), and a trailing quiet zone.

UPCa, UPCe, EAN8, EAN13



[UPC and EAN](#) barcode symbologies have been in use since the 1970s to encode Global Trade Item Numbers (GTIN). The symbologies uniquely identify a product for retail checkout or tracking purposes. UPC-A is the standard retail price code barcode in the United States. EAN (European Article Number) is the European version. UPC, UCC, EAN, JAN, GTIN-8, GTIN-12 and GTIN-13, ISBN and Bookland are barcode standards based on UPC and EAN.

UPC and EAN barcodes appear on distributable items such as canned goods, magazines, books, and other products. A more advanced barcode type, DataBar, has replaced UPC/EAN.

DataBar



The [DataBar](#) barcode symbology is the latest 1D barcode type designed for space-constrained identification from GS1, formerly EAN International. DataBar is the perfect symbology for storing items too small to allow for traditional barcode types, or when additional information required (product weight, expiration dates, country of origin and serial numbers). It resolves many problems in point of sale in grocery and healthcare industries.

Intelligent Mail



USPS [Intelligent Mail Barcode](#) (IMB) includes a height-modulated barcode designed for use in high speed, automated, mail sorting machines to combine [PLANET](#) and [POSTNET](#) barcode symbology information into a single barcode to track mailings, request address-quality services (including updated address-change information) and return-mail service.

1D Barcode Facts

- 1D Barcodes use start and stop characters to determine the beginning and end of barcodes.
- 1D Barcode cannot hold/encode an enormous amount of data.
- 1D Barcode Scanners are less expensive than 2D Barcode Scanners.
- 1D Barcodes may require a check character calculation.
- Code 128 and Code 39 are very popular Linear barcodes types.
- Code 128, Code 39, and Code 93 can encode alphanumeric data.
- Code 39, Interleaved 2 of 5, and POSTNET do not require check digits.
- PLANET is a Postal barcode type that is the reverse bar height of POSTNET.
- UPCe encodes eleven digits and produces an eight-character barcode.
- UPCa encodes eleven digits and produces a twelve-character barcode.
- SSCC18, SCC14, Intelligent Mail Container are standards of Code 128.
- Interleaved 2 of 5 and Code 128 C encode numeric data in pairs.
- DataBar includes several subsets including: Limited, Expanded, and Omni-Directional.

Two-Dimensional Barcodes (2D)

Two-Dimensional Barcodes have been around a long time. However, the general public has recently become aware of them due to the rise of smart phones and mobile devices that scan the popular, QR Code. Well-known 2D barcodes include:

- Data Matrix
- QR Code
- Aztec
- PDF417
- MaxiCode

Data Matrix



[Data Matrix](#) is an exceptionally efficient 2D barcode symbology that uses a small area of square modules with a unique perimeter pattern. The pattern helps the barcode scanner determine cell locations to decode the symbol. Characters, numbers, text, and actual bytes of data may be encoded, including Unicode characters and images.

The encoding and decoding process of Data Matrix is very complex. All current implementations, approved by ANSI/AIM BC11 and the ISO/IEC 16022 specification, are standardized on the ECC200 error correction method. Error Correction allows the barcode to sustain damage and accurately scan without error. IDAutomation 2D Data Matrix barcode products support ECC200 by default and are based on the ANSI/AIM BC11 and the ISO/IEC 16022 specifications. The Reed-Solomon error correction algorithms of ECC200 allow the recognition of barcodes that are up to 60% damaged.

QR Code



[QR Code](#) (Quick Response code) is the most popular 2D barcode symbology. Like Data Matrix, it also uses a small area of square modules with a unique perimeter pattern to determine cell locations and decode the QR Code symbol. Based on the ISO/IEC 18004:2006 standard, QR Code encodes characters, numbers, text, and actual bytes of data may be encoded, including Unicode characters and images. Its most popular use is to provide simple access to online information through the camera on a mobile device, such as a smartphone.

Aztec



[Aztec](#) barcodes are very efficient two-dimensional (2D) symbologies that use square modules with a unique finder pattern in the middle of the symbol, which helps the barcode scanner to determine cell locations to decode the symbol. Characters, numbers, text and bytes of data may be encoded in an Aztec barcode. The IDAutomation implementation of the Aztec barcode symbol is based on the ISO standard version released into the public domain by its inventor, Honeywell.

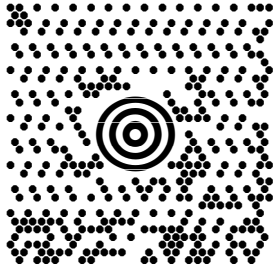
PDF417



The [PDF417](#) (Portable Data File - 4 bars 17 units) is a high-density 2D barcode symbology capable of encoding text, numbers, files, and actual data bytes. Large amounts of text and data can be stored securely and inexpensively when using the PDF417 barcode symbology.

The printed symbol consists of several Linear rows of stacked codewords. A codeword is a horizontal strip made up of dark and light bars. Each codeword represents 1 of 929 possible values from one of three different clusters. A different cluster is chosen for each row, repeating after every three rows. Because the codewords in each cluster are unique, the scanner is able to determine what line each cluster is from. PDF417 uses Reed Solomon error correction instead of check digits. This error correction allows the symbol to endure some damage without causing loss of data.

MaxiCode



[MaxiCode](#) is an international 2D barcode symbology that is currently used by UPS on shipping labels for world-wide addressing and package sortation. MaxiCode symbols are fixed in size and made up of offset rows of hexagonal modules arranged around a unique finder pattern.

MaxiCode symbols encode two messages; a primary message and a secondary message. The primary message encodes the postal code, country code and the class of service number. The secondary message usually encodes address data, but it encodes other types of information as well.

Facts About 2D Barcodes

- The Department of Defense uses Data Matrix Barcodes.
- UPS uses MaxiCode barcodes.
- 2D Barcodes can encode hundreds of characters.
- 2D Barcodes require a 2D scanner to scan them.
- With the same data, 2D Barcodes are smaller symbols compared to 1D barcodes.
- Instead of check digits, 2D barcodes use Error Correction.
- MicroPDF417 and MacroPDF417 are symbologies derived from PDF417.
- Acuity CiMatrix / Siemens invented the Data Matrix ECC200 symbology and placed it in the public domain.

References

- [IDAutomation Barcode Glossary](#)
- [ASCII Chart | ISO 1252 Latin-1 Char Set](#)
- [GS1 AI \(Application Identifier\) & Element String Specification Reference](#)
- [GS1.org](#)
- [UTF-8 Barcode Unicode Character Encoding](#)
- [Denso Wave QRCode.com](#)