

PROJECT REPORT

(Project Term January-May 2021)

AI-Enabled FinTech B2B Invoice Management

Submitted by

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INT 247

(B. Tech CSE)

Under the Guidance of

Dr. Sagar Pande

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LOVELY PROFESSIONAL UNIVERSITY

PHAGWARA, PUNJAB



L OVELY
P ROFESSIONAL
U NIVERSITY

DECLARATION

We hereby declare that the project work entitled Recognition AI-Enabled FinTech B2B Invoice management model an authentic record of our own work carried out as requirements of Project for the award of B. Tech degree in Computer Science and Engineering from Lovely Professional University, Phagwara, under the guidance of Sagar Pande, during August to November 2021. All the information furnished in this project report is based on our own intensive work and is genuine.

Name of Student : Akshay Kumar

Registration Number : 11909726

Akshay Kumar
Date: 29-03-2022

Abstract

In this project, we were asked to experiment with a real world dataset, and to explore how machine learning algorithms can be used to find the patterns in data. We were expected to gain experience using a common data-mining and machine learning library, and were expected to submit a report about the dataset and the algorithms used. After performing the required tasks on a dataset of my choice, herein lies my final report.

CERTIFICATE

This is to certify that the declaration statement made by this student is correct to the best of my knowledge and belief. They have completed this Project under my guidance and supervision. The present work is the result of their original investigation, effort, and study. No part of the work has ever been submitted for any other degree at any University. The Project is fit for the submission and partial fulfillment of the conditions for the award of B. Tech degree in Computer Science and Engineering from Lovely Professional University, Phagwara.

Name of the Mentor: Dr. Sagar Pande

School of Computer Science and Engineering,
Lovely Professional University,
Phagwara, Punjab.

ACKNOWLEDGEMENT

I am overwhelmed in all humbleness and gratefulness to acknowledge my depth to all those who have helped me to put these ideas, well above the level of simplicity and into something concrete.

*I would like to express my special thanks of gratitude to my teacher DR. SAGAR PANDE who gave me the golden opportunity to do this wonderful project on the topic **AI-Enabled FinTech B2B Invoice management model**, which also helped me in doing a lot of Research and i came to know about so many new things. I am thankful to them.*

Any attempt at any level can 't be satisfactorily completed without the support and guidance of MY parents and friends.

I would like to thank my Friends who helped me a lot in gathering different information, collecting data and guiding me from time to time in making this project, they gave me different ideas in making this project unique

Introduction:

The B2B world operates differently from the B2C or C2C world. Businesses work with other businesses on credit. When a buyer business orders goods from the seller business, the seller business issues an invoice for the same. This invoice for the goods contains various information like the details of the goods purchased and when it should be paid. This is known in accounting terminology as “Accounts Receivable”.

“Accounts Receivable represents money owed by entities to the firm on the sale of products or services on credit. In most business entities, accounts receivable is typically executed by generating an invoice and either mailing or electronically delivering it to the customer, who, in turn, must pay it within an established timeframe, called credit terms or payment terms.”

Seller business interacts with various businesses and sells goods to all of them at various times. Hence, the seller business needs to keep track of the total amount it owes from all the buyers. This involves keeping track of all invoices from all the buyers. Each invoice will have various important fields like a payment due date, invoice date, invoice amount, baseline date etc.

The buyer business needs to clear its amount due before the due date. However, in real-world scenarios, the invoices are not always cleared ie. paid in full amount by the due date. The date on which a customer clears the payment for an invoice is called the payment date.

Account receivables Department:

1. 1. In the ideal world, the buyer business should pay back within the stipulated time (ie the Payment Term). However, in the real world, the buyer business seldom pays within their established time frame, and this is where the Account Receivables Department comes into the picture.
2. Every business consists of a dedicated Account receivables Department to collect and track payment of invoices.
3. It consists of an Account receivables team that is responsible for:
 - Collecting payments from customers for their past due to invoices.
 - Sending reminders and follow-ups to the customers for payments to be made.
 - Looking after the entire process of getting the cash inflow.
 - Help the company get paid for the services and products supplied.

Problem Statement for ML:

- you will be building a web application to help the people working in the Accounts Receivable departments in their day-to-day activities.
- In the ideal world, the buyer business should payback within the stipulated time (i.e. the Payment Term). However, in the real world, the buyer business seldom pays within their established time frame, and this is where the Account receivables Department comes into picture.
- Every business consists of a dedicated Account receivables Department to collect and track payment of invoices.
- It consists of a Account receivables team that is responsible for :
 1. View the invoice data from various buyers.
 2. See various fields/attributes of the invoice(s) from a particular buyer.
 3. Perform Data Pre-processing on the invoice data.
 4. Get account-level analytics to easily visualize and interpret data-EDA and Feature Engineering.
 5. Get a prediction of when the invoice is going to get paid.

DATASET :

The dataset used is a sample of company invoice id and payment detail of the customer. The dataset that was used for this project is a subset of a much larger dataset.

The screenshot displays a Microsoft Excel spreadsheet with a dataset of company invoices and payments. The interface includes the standard Excel ribbon (File, Home, Insert, Page Layout, Formulas, Data, Review, View, Help) and a toolbar with various icons for formatting and data manipulation. A warning banner at the top indicates a potential data loss when saving in CSV format. The formula bar shows the active cell A1 containing the text 'business_code'. The spreadsheet itself has 26 columns (A to U) and 21 rows of data. The first row (A1) contains the header 'business_code'. The second row (A2) contains the header 'business_code'. The third row (A3) contains the header 'cust_num name_cus clear_date business_doc_id posting_d document document due_in_d invoice_c document posting_ic area_busi total_ope baseline cust_payn invoice_ic isOpen'. The subsequent rows (A4 to A21) contain numerical data for each of these fields, representing individual invoices and payments. The data is organized into a structured table format, with each row representing a single transaction record.

business_code	cust_num	name_cus	clear_date	business_doc_id	posting_d	document	document	due_in_d	invoice_c	document	posting_ic	area_busi	total_ope	baseline	cust_payn	invoice_ic	isOpen
U001	2.01E+08	WAL-MAR	#####	2020	1.93E+09	#####	20200125	20200126	20200210	USD	RV	1	54273.28	20200126	NAH4	1.93E+09	0
U001	2.01E+08	BEN E	#####	2019	1.93E+09	#####	20190722	20190722	20190811	USD	RV	1	79656.6	20190722	NAD1	1.93E+09	0
U001	2.01E+08	MDV/ trus	#####	2019	1.93E+09	#####	20190914	20190914	20190929	USD	RV	1	2253.86	20190914	NAA8	1.93E+09	0
CA02	1.4E+08	SYSC llc	#####	2020	2.96E+09	#####	20200330	20200330	20200410	CAD	RV	1	3299.7	20200331	CA10	2.96E+09	1
U001	2.01E+08	WAL-MAR	#####	2019	1.93E+09	#####	20191113	20191113	20191128	USD	RV	1	33133.29	20191113	NAH4	1.93E+09	0
CA02	1.4E+08	THE corp	#####	2019	2.96E+09	#####	20190920	20190920	20191004	CAD	RV	1	22225.84	20190924	CA10	2.96E+09	0
U001	2.01E+08	WAL-MAR	#####	2019	1.93E+09	#####	20191031	20191101	20191116	USD	RV	1	7358.49	20191101	NAH4	1.93E+09	0
U001	2.01E+08	TARG us	#####	2020	1.93E+09	#####	20200318	20200319	20200403	USD	RV	1	11173.02	20200319	NAA8	1.93E+09	1
U001	2.01E+08	WAL-MAR	#####	2019	1.93E+09	6/7/2019	20190605	20190607	20190622	USD	RV	1	15995.04	20190607	NAH4	1.93E+09	0
U001	2.01E+08	C&S WH s	#####	2019	1.93E+09	#####	20190219	20190220	20190307	USD	RV	1	28.63	20190220	NAC6	1.93E+09	0
U001	2E+08	AM	#####	2020	1.93E+09	#####	20200306	20200311	20200326	USD	RV	1	3525.59	20200311	NAA8	1.93E+09	1
U001	2.01E+08	BROOKS c	#####	2019	1.93E+09	1/2/2019	20190102	20190102	20190117	USD	RV	1	103147.4	20190102	NAA8	1.93E+09	0
U001	2E+08	SYSC corp	#####	2019	1.93E+09	#####	20190415	20190415	20190430	USD	RV	1	16381.45	20190415	NAA8	1.93E+09	0
U001	2.01E+08	GO corpor	#####	2019	1.93E+09	#####	20191017	20191017	20191101	USD	RV	1	19581.57	20191017	NAA8	1.93E+09	0
U001	2.01E+08	OK systems	#####	2020	1.93E+09	#####	20200415	20200415	20200430	USD	RV	1	121105.7	20200415	NAA8	1.93E+09	1
U001	2E+08	DECA corporation	#####	2020	1.93E+09	#####	20200423	20200423	20200426	USD	RV	1	3726.06	20200416	NAM2	1.93E+09	1
U001	2.01E+08	COST in	#####	2019	1.93E+09	#####	20191025	20191025	20191109	USD	RV	1	5181.51	20191025	NAA8	1.93E+09	0
U001	2.01E+08	ALBERT co	#####	2019	1.93E+09	#####	20191202	20191202	20191217	USD	RV	1	19082.14	20191202	NAA8	1.93E+09	0
U001	2.01E+08	WAL-MAR	#####	2019	1.93E+09	#####	20191114	20191115	20191130	USD	RV	1	12819.5	20191115	NAH4	1.93E+09	0
U001	2.01E+08	WAL-MAR	#####	2020	1.93E+09	#####	20200124	20200124	20200208	USD	RV	1	53349.54	20200124	NAH4	1.93E+09	0

DATA DICTIONARY :

business_code: company code of the account

cust_number: customer number given to all the customers of the account

name_customer: name of the customer

clear_date: date on which the customer clears an invoice, or in simple terms, makes the full payment

business_year: the year in which the invoice was created

doc_id: a unique identifier of an invoice

posting_date: the date on which the particular invoice was entered in the ERP database

document_create_date: the date on which the invoice document was created

document_create_date.1: normalized version of document_create_date (we'll use this to split the data)

due_in_date: the date on which the customer is expected to clear an invoice

invoice_currency: the currency of the invoice amount in the document of the invoice

document type: represents the type of document, eg, D1 represents invoice

posting_id: key indicator to identify whether on AR terms is invoice, deduction, credit memo based on its value. Applicable for SAP ERP

area_business: business area in sap is defined as an organisational area within the financial accounting module

total_open_amount: the amount that is yet to be paid for that invoice

baseline_create_date: the date on which the invoice was created

cust_payment_terms: business terms and agreements between customers and accounts on discounts and days of payments

invoice_id: unique number assigned when a seller creates an invoice

isOpen: indicator of whether an invoice is open or closed. isOpen = 1, means that the invoice is still open

Artificial Intelligence in billing and invoice processing

Artificial Intelligence (AI) is finding its way into almost any aspect of work operations in a wide range of industries. Robots and Chatbots have become the norm. Machine learning has enabled computers to carry out heavy and complex tasks almost instantly. When it comes to business, AI has influenced many of its facets by automating many of the processes involved. Thankfully, **billing and invoice processing** – one of the most burdensome and complicated tasks in business – **has seen some major changes since the introduction of AI.**

All the accounting software comes with features that will automate most of the accounting work. It's obvious that all the businesses must be exchanging some kind of invoices quite frequently. Managing this is a time-consuming and complicated job. Also, it is error-prone and open to misinterpretations. Therefore, highly skilled or specialized personnel should manage this whole process manually. However, not every organization can afford to shell out bucks to hire a professional for bookkeeping.

This is why billing software solutions have risen to such prominence in business enterprises. **Artificial Intelligence has revolutionized the traditional way of billing and invoicing.** Applying AI to accounting has huge potential as it can reduce a lot of calculations and manual operations.

AI in invoice processing

It is estimated that about 80% to 90% of invoices processed are paper-based. And most of this invoice processing is done manually or semi-automatically. Various AI-powered accounting software supports features such as invoice segregation, data extraction, invoice generation, etc.

The AI-powered software scans and feeds to the system any invoice it receives if it's on paper. If the invoices are electronic, the system just needs to analyze them by reading

all the characters and numbers written on the invoice with the help of AI. So, automated invoice processing is the state of art in the fintech industry.

Extraction

Once invoices get lucid, the AI algorithm starts extracting and validating data fields. Generally, this doesn't need any verification, but it is always better to be absolutely sure because one small mistake in the billing process can have unforgiving outcomes. So, to be on the safer side, having a supervisor to review wouldn't hurt.

Invoice Generation

As stated earlier, most of the businesses generate invoices manually or semi-automatically. But AI can make this process fully automated. Accounting software can at least auto-fill some of the details on the invoice like amounts, organization's details, date, product or service ID, tax codes, etc. Moreover, if vendors and buyers have an integrated system, then this could be done in an even quicker and easier way.

Tweaking invoice processing through AI for optimal cash flow

Business owners always keep tabs on who pays early or on time and who delays it. However, just keeping track of who's paying on time and who isn't will not provide any actionable information. With AI-enabled invoice and billing software, you can get detailed reports of all your accounting history.

For instance, if an **AI system has all your accounting records**, it will generate data on the timeliness of payments, customer longevity, methods of payments used, and who made the payment. An individual, a group, or an organization. This will enable business owners to **make data-driven decisions** that will induce better-invoicing outcomes.

AI makes it easier to detect and prevent invoice frauds

Frauds always happen when money is in the center. So it's obvious that fraudsters also target business enterprises. There are many ways to detect fraud. But with **AI-powered billing software**, you can go one step ahead and **prevent fraud from occurring** in the first place. Instead of being reactive, you can approach scams in a proactive way.

AI can check customer information, payment details, invoice details, and other relevant data before initiating a payment. AI can learn from looking at historical data of both valid and fraudulent invoices. And it can make decisions whether to commence the payment procedure or mark it for review. This could prove to be an effective way of preventing invoice fraud.

AI streamlines incoming payments

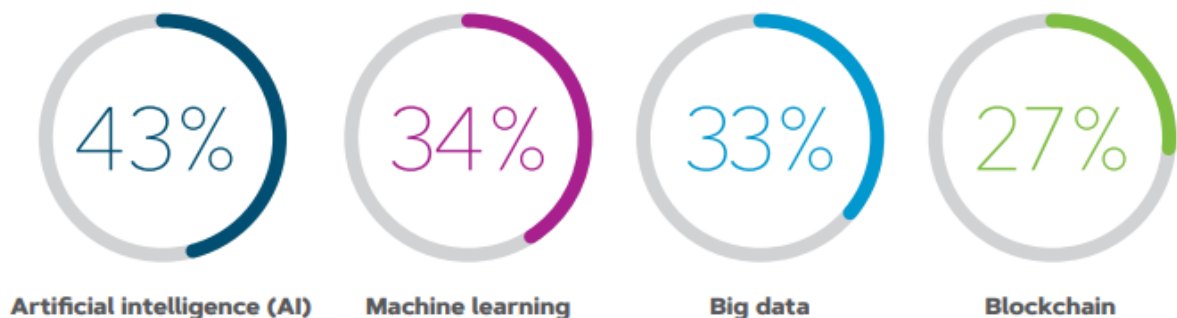
In manual and many semi-automated billing processes, accounting personnel has a tedious task of matching invoices to customers' payments. **AI-enabled billing systems can consume data from historical records.** They can learn how payments have been harmonized before so that it can predict how to match future invoices more relevantly. Not only this, but it can also assist you in finding any anomalies, inconsistencies, and disparities within the invoices.

Future of B2B Fintech

“I’d like to learn more honestly. We have only recently...begun to rely on technology to drive efficiency in our company”. would love to embrace more technology.”

New research sponsored by AvidXchange shows compelling new insights on the future of financial technology (fintech) in the business-to-business (B2B) space. In the past few years, B2B fintech has transformed from simple, on-premises accounting systems that help organizations manage their financial data to cloud-based, dynamic solutions that leverage disruptive technologies to transform financial processes. Among the most talked about innovations are artificial intelligence (AI), machine learning, blockchain and big data. While the research reveals that B2B companies are becoming more knowledgeable and open to adopting these technologies that promise to change the way they work, it also shows that most businesses are unaware of how these technologies play a part in daily processes and provide newfound advantage. Here we take a closer look at how these technologies are impacting the B2B fintech space and how they are being embraced by its customers:

How familiar are you with each of the following technologies used in accounts payable automation?



Research respondents are most familiar with AI as an emerging technology—43 percent are aware of its use in fintech applications, such as AP automation. This is likely a result of the revolutionary change AI has already created across industries: Robots have transformed manufacturing and Siri has changed the way we interact with our devices. Just as it has in the consumer space, the technology is helping to alter the way humans and machines interact in the B2B world, too. In fintech, the technology enables work in real time and creates deep personalization that helps to build customer relationships. Many B2B companies are already leveraging AI to improve operations, including financial services, with eighty-three percent of businesses citing it as a strategic priority. Among numerous benefits, the technology can boost labor productivity by up to 40

percent by automating mundane tasks that take up valuable time, for instance freeing customer service agents in call centers and back-office staff from tasks such as gathering preliminary information, tracking order status, processing invoices, and transcribing voice to text. By automating this work, companies cut hiring costs and free staff for more fulfilling, strategic responsibilities. AI is also used to audit financial transactions, detect fraud, and evaluate credit and overall financial history to make a recommendation of loan and credit offerings. Companies like Finiata leverage the technology to provide financing and credit solutions, and others like Onfido use it for identity verification for secure employee on-boarding. Given these results, it's not surprising that the AI market is predicted to grow to \$190 billion by 2025. Nearly one-quarter of CXOs believe AI will have the biggest positive impact on their organization in the next five years. Eighty-four percent of businesses say AI will enable them to obtain or sustain a competitive advantage, and seventy-five percent say AI will allow them to move into new businesses and ventures.

AI Market predicted to grow to
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43% of research respondents
are aware of AI's use in
fintech applications

83% of businesses say
AI is a strategic
priority

AI can boost labor
productivity by up to **40%**

BLOCKCHAIN

“...there is growing interest in blockchain applications in the B2B space, as the technology promises to help keep transactions safe and greatly reduce administrative costs. It’s already widely used in peer-to-peer payment services—supporting millions of transactions per day...”

Coined “the technology of trust” by Goldman Sachs, blockchain is a distributed network of records data that can record payments and other transactions quickly and in a highly transparent, verifiable and permanent way. It relies on cryptocurrencies, such as bitcoin, as a medium of exchange. There’s limited knowledge of blockchain’s abilities among B2B fintech users with just more than a quarter of research respondents aware of its use in fintech. However, there is growing interest in blockchain applications in the B2B space as the technology promises to help keep transactions safe and greatly reduce administrative costs. It’s already widely used in peer-to-peer payment services—supporting millions of transactions per day—and supply chain tracking and promises to offer B2B companies far more fintech advantages, transforming e-commerce. Exciting examples of blockchain at work include a blockchain integration deal between U.S.-based shipping company UPS and e-commerce company Inception to develop a platform to facilitate B2B transactions. The platform, called inception Zippy, will work as an online catalog for businesses. Another example of a blockchain-powered platform that offers tremendous potential is Coinheres, an e-commerce platform that utilizes US dollars, Euros, as well as cryptocurrencies. The platform makes it simple and safe to buy and sell, and rewards those who use the platform or share E-coinmerce information on social media to get more users. On the supply chain management front Blockchain is growing as big business users, including Deloitte, BMW and PricewaterhouseCoopers move to utilize the network to track supply flow. “...there is growing interest in blockchain applications in the B2B space, as the technology promises to help keep transactions safe and greatly reduce administrative costs. It’s already widely used in peer-to-peer payment services—supporting millions of transactions per day...”

MACHINE LEARNING AND BIG DATA Companies of all sizes are continually inundated with massive amounts of data. Traditionally, they have relied on trained analysts and data scientists to harness the information and produce insights and analytics that are important components of business intelligence. Now machine learning and big data technology, also known as predictive analytics, can help. About one-third of AvidXchange research respondents are aware of the use of machine learning and big data in the B2B fintech space, but adoption is on the rise. IDC reports that worldwide revenues for big data and business analytics will surpass \$203 billion in 2020. The fintech industry is one of the biggest drivers of its growth. According to PWC, the industry is among the best positioned to take advantage of the technologies. Because it can analyze historical data, spot habits and make predictions, the technology can forecast financial trends, predict market risk, reduce fraud (and even delay a potentially fraudulent transaction until a human makes a decision), and identify future opportunities. It can also produce actionable insights gleaned from advanced reporting and data analytics tools, resulting in in-depth visibility

to give high-level members of an organization strategic insights. An example of a company leveraging machine learning is Ever String Technology. Ever String deploys machine learning to identify, extract, and model data so that users in the B2B space can accurately identify business opportunities, for instance aggregating companies in a specific market and identifying target buyers. AvidXchange uses the technology to not only automate AP and payment processes, but to help companies improve cash flow by reviewing historical payment data and using predictive analytics to receive electronic payments sooner on approved invoices. Deloitte Global predicts that large and medium sized businesses will double their machine learning implementations and pilot projects this year. By 2020, that number will likely double again as machine learning APIs and hardware becomes available in the cloud, making it more accessible to smaller companies, too.

BIG DATA AND BUSINESS ANALYTICS

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1. Prediction Model

In the study, three classification algorithms were used: logistic regression (LR), random forest, and extreme gradient boosting (XGB). A brief description of the classification algorithms is given below.

1.2. Logistic Regression

Logistic regression is one of the widely used statistical classification algorithms for binary and multiclass problems. For predicting the probability of the class label, logistic function is used. The functional form of the hypothesis is

$$Y = C^T(X)$$

1.2 Random Forest

Random forest is an ensemble-based classification and regression model initially proposed by Zhang [19]. Random forest can be used for feature selection as well. It uses the bootstrapping data sampling method for partitioning of the data into training and testing sets. The model iteratively generates the trees for every bootstrap. The final prediction is made using the mean vote for each class. It is the combination of all generated decision trees. A decision tree is the hierarchical classification algorithm. The selection of the decision node is made using entropy, information gain, gain ratio, and Gini-index, respectively. In our study, we used information gain and entropy, as shown in the following equations:

$$E(Y) = \sum_{i=1}^n -p_i \log_2 p_i,$$
$$E(X, Y) = \sum_{n \in X} P(n) E(n),$$

1.3. Extreme Gradient Boosting

Extreme gradient boosting (XGB) algorithm is an ensemble-based classification and regression technique. It is the regularized form of the gradient boosting algorithm. Gradient boosting algorithm due to the data imbalance sometimes suffers from model overfitting. However, in the XGB algorithm, the regularization parameter reduces the risk the model overfitting. Like random forest, XGB is also a tree-based ensemble classifier. The boosting data resampling method

attempts to enhance the model accuracy by minimizing the misclassification error [19]. It is an iterative approach. The records that were not successfully predicted in the previous iteration were used in the next iteration for training the model. The model will repeat the process until the model achieved an optimal result.

The regularization parameter reduces the variance in the model by increasing the weights of the misclassified instances. The increase in weight decreases the model underfitting. However, for reducing the bias of the model, penalty regularization was used to control the model overfitting without leading to a high misclassification rate. The XGB algorithm is the combination of several parameters. The optimal combination of parameters enhances the performance of the model. For parameter optimization, the grid search technique was used. The parameter used in the XGB algorithm is represented in table.

1.4. Performance Evaluation

The performance of the model was evaluated using the standard evaluation measures such as accuracy, precision, sensitivity, specificity, and *F*-score, respectively. Area under curve and receiver operating characteristic (ROC) were also used for comparing the classifiers. It is one of the widely used tests for exploring the trade-off between true-positive (sensitivity) and false-positive rate (specificity) for the diagnostic test.

$$\text{accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}},$$

where the accuracy of the model represents the proportion of the test records that is correctly classified.

$$\text{Sensitivity} = \frac{\text{TP}}{\text{TP} + \text{FN}}.$$

Sensitivity is the proportion of the positive class labels that is correctly predicted. It is also known as the true-positive rate (TPR) or positive-predicted value (PPV).

$$\text{Specificity} = \frac{\text{TN}}{\text{TN} + \text{FP}}.$$

Sensitivity also known as the true-negative rate (TNR) or negative-predicted value (NPV) is the proportion of the negative class labels that are correctly predicted as negative.

$$\text{F - score} = \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}},$$

where *F*-score is the harmonic mean of precision and recall.

Source Code File Link: <https://github.com/AKSHAY89350/MLProject>

CONCLUSION

Are innovations like these essential to the B2B market? We asked Chief Growth Officer Dan Drees at AvidXchange to share his thoughts based on his own experience and his company's research. This is what he had to say: "These fintech trends are undoubtedly influencing the B2B market right now, most of which are similar to what we've seen in the consumer market but will ultimately have a much more powerful effect on the role of finance. Organizations are recognizing the importance of leveraging innovations when scaling and developing a long-term competitive advantage. It's only a matter of time before these technologies are considered mainstays rather than emerging, so business leaders should take steps now to identify how their teams can utilize fintech to help drive growth."

Invoice and bill processing, tweaking invoice process, detecting and preventing frauds, as well as streamlining incoming payments are just a few ways in which **AI-powered accounting tools can drastically change accounting and bookkeeping for good**. However, we should highlight that no matter how powerful or smart these AI tools become, there shouldn't be any loss for humans. AI should function as an assistant to humans rather than a replacement. Therefore, even the most advanced accounting or billing software will hasten and ease up the tedious and time-consuming tasks so the accounting staff can focus on higher-level responsibilities.

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