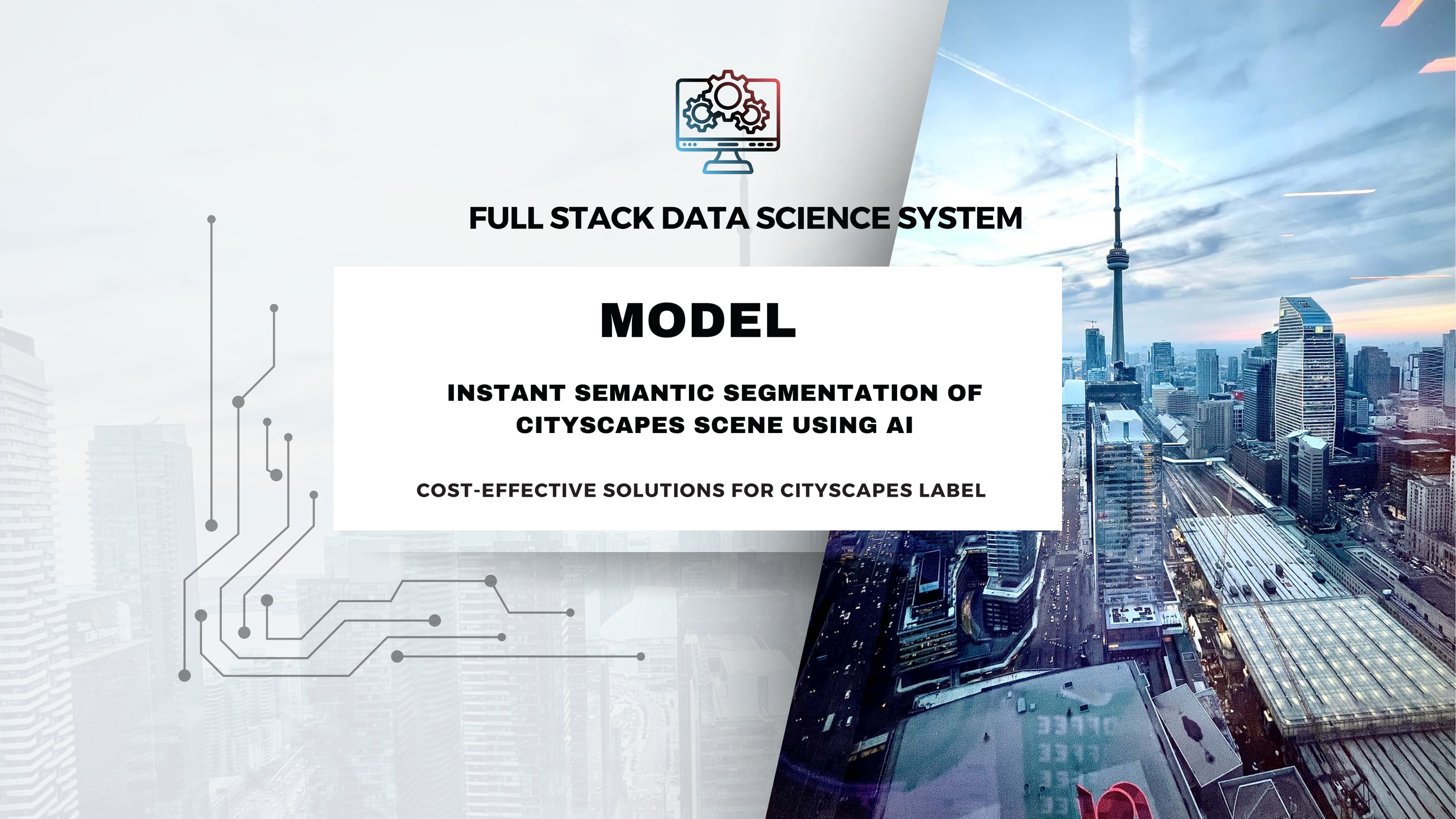

FULL STACK DATA SCIENCE SYSTEM

MODEL

INSTANT SEMANTIC SEGMENTATION OF CITYSCAPES SCENE USING AI

COST-EFFECTIVE SOLUTIONS FOR CITYSCAPES LABEL

OUR TEAM

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Model Architecture

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Professor: Vejey Gandyer

AGENDA

01
Problem Statement

02
Significant

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Past Projects

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Methodology - ML Canvas

05
Model Benchmarking

06
Model Deployment

07
Demo

08
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01 PROBLEM STATEMENT

E-Efficient city planning and infrastructure management

I - Instant semantic segmentation using AI

R - Real-time machine learning solution

A - Accurate categorization and segmentation of urban scene features

E - Empower stakeholders: urban planners, self-driving car developers, city infrastructure administrators

I - Informed decisions and preventive measures based on segmentation insights

02 SIGNIFICANT

- **Safety:** Accurate segmentation permits the identification of dangers such as traffic congestion or pedestrian overcrowding, allowing for prompt measures to improve safety.
- **Traffic Optimization:** Real-time segmentation helps analyze traffic flow patterns and identify bottlenecks, resulting in more effective traffic management tactics.
- **Understanding the geographical distribution:** of urban characteristics such as buildings, roads, and green areas allows for more informed decision-making when planning urban development initiatives.
- **Autonomous Systems:** Instant segmentation is critical for the operation of autonomous vehicles, drones, and other AI-powered systems in urban contexts, ensuring safe navigation and interaction with surroundings.

03 PAST PROJECT

Past Available Projects:

- **DeepLab:** Chen, Liang-Chieh, et al. "DeepLab: Semantic Image Segmentation with Deep Convolutional Neural Networks." A convolutional neural network (CNN) architecture developed for semantic image segmentation, achieving state-of-the-art performance on various datasets including Cityscapes. [Link]

Similar Projects:

- **Urban Scene Understanding:** Ye Yuan "Designing Convolutional Neural Networks for Urban Scene Understanding " Research efforts aim to develop AI systems capable of understanding complex urban scenes for applications such as urban planning, traffic management, and environmental monitoring. [Link]

Drawbacks:

- **Labeling Complexity:** Generating pixel-level annotations for large-scale datasets like Cityscapes is labor-intensive and time-consuming, posing challenges for scalability and dataset creation.

04 METHODOLOGY - ML CANVAS

1.Data collection

Involves using sources, like the Cityscapes dataset, the OpenStreetMap API, and web scraping tools, to obtain raw information on entities and observed results.

2.Model Development

Developing a U-Net model for semantic segmentation, trained via data generation techniques and category cross-entropy loss.
Preprocessing involves downsizing input photos and adding a black area to the right to meet model criteria.

3.Deployment

Creating a Streamlit application for real-time image segmentation, which allows users to upload images and view segmentation results.
Evaluation: Measuring model performance using test data from the Cityscapes dataset, including accuracy and user comments.

4.Monitoring

Monitoring involves tracking the ML system's impact in production using metrics such as user engagement, performance, business KPIs, user feedback, adoption rate, and model health.

THE MACHINE LEARNING CANVAS

Designed for: GBC | Designed by: KV_Team | Date: APR 1, 2024 | Iteration: Cityscapes Scene Using AI

- Semantic segmentation of cityscape scenes using AI.
- Objects/Features to be color segmented
- Real-time observations.

- Algorithms: CNNs, U-Net
- Preprocessing: Data augmentation, normalization
- Evaluation Metrics: IoU, pixel accuracy
- Deployment: Local, cloud

PREDICTION TASK

The prediction job focuses on correctly detecting objects and characteristics in urban settings collected by vehicle-mounted cameras. The goal of using the Cityscapes dataset is to perform semantic segmentation on the photos, differentiating components such as roads, buildings, automobiles, pedestrians, and signage. The model's goal is to assign each pixel in the image to a distinct category based on the sort of item or surface it represents. The model's ability to get precise segmentation findings can help with jobs like urban planning, infrastructure management, and autonomous driving.

DECISIONS

Choosing the right machine learning algorithms and preprocessing techniques is crucial. This involves selecting models like CNNs or U-Net and employing techniques such as data augmentation and normalization. Evaluation metrics like IoU and pixel accuracy are important for assessing model performance. Additionally, decisions about deployment options, including local or cloud deployment, need consideration to ensure successful implementation.

VALUE PROPOSITION

its potential to transform urban planning and infrastructure management. By offering real-time, precise semantic segmentation of urban photos, our AI-powered system enables stakeholders such as urban planners, self-driving car developers, and city administrators to make educated decisions quickly. It improves city planning efficiency, makes autonomous car navigation safer, and allows for proactive infrastructure repair, all of which lead to better urban living experiences and resource usage.

- Transformation in urban planning and infrastructure management
- Real-time, precise semantic segmentation
- Stakeholders: Urban planners, self-driving car developers, city administrators, VR application developers
- Benefits: Improved efficiency, safer navigation, proactive infrastructure repair, better urban living experiences

DATA COLLECTION

Cityscapes dataset. The Cityscapes dataset (dataset main page) features labelled videos captured from vehicles driving throughout Germany. This version is a processed subsample prepared for the Pix2Pix paper. The dataset includes still images from the original videos, as well as semantic segmentation labels provided beside the original image. This is one of the most useful datasets for semantic segmentation tasks.The dataset contains 2975 training picture files and 500 validation image files. Each image file is 256x512 pixels and is a composite of the original photo on the left and the labelled image

DATA SOURCES

Lite Version
https://www.kaggle.com/datasets/dansbecker/cityscapes-image-pairs

Full Version:
https://www.cityscapes-dataset.com/

- Cityscapes dataset: Labeled videos from vehicles in Germany
- Processed subsample for Pix2Pix paper
- Still images and semantic segmentation labels
- 2975 training and 500 validation image files
- Each image: 256x512 pixels, composite of original and labeled image

IMPACT SIMULATION

To assess the tool's effectiveness through simulation, deploy the model in a variety of scenarios and evaluate performance. Key indicators like accuracy and cost-benefit analysis assess its influence. Fairness limitations are critical for avoiding biased outcomes.

- Safety: traffic congestion
- geographical distribution
- autonomous vehicles
- VR Glasses Application development

MAKING PREDICTIONS

Making predictions entails deploying models that can effectively classify numerous aspects in real-time photos. Considerations include identifying the best timing for real-time or batch forecasts, allocating time for featurization, and post-processing. Furthermore, the compute target must be carefully chosen to provide efficient inference while preserving accuracy.

BUILDING MODELS

The focus is on designing and deploying efficient models. This includes assessing the number of models needed for production and creating update schedules to keep them relevant. Time allocation should take into account the complexity of featurization and analysis, ensuring accurate and effective segmentation outcomes in real-time circumstances.

- Efficient model design and deployment
- Assessing the required number of models
- Consideration of featurization and analysis of complexity
- Aim for accurate and effective segmentation in real-time

FEATURES

These characteristics include high-resolution photos of urban aspects like buildings, roads, automobiles, pedestrians, and plants. Furthermore, the model may use contextual information such as location, weather, and time of day to improve segmentation accuracy.

- High-resolution urban photos
- Segmentation of buildings, roads, vehicles, pedestrians, and plants
- (Version2 Project)Utilization of contextual information (location, weather, time of day) for improved accuracy

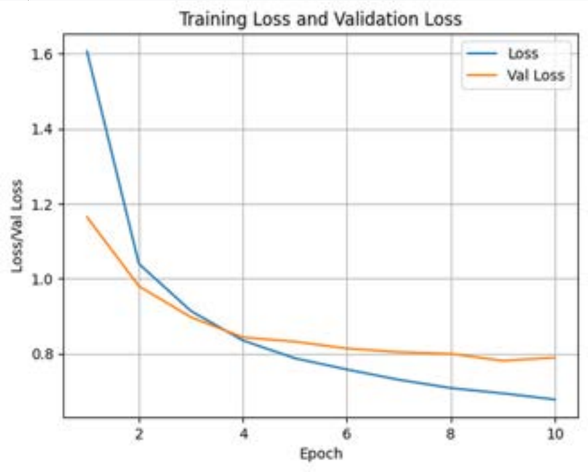
MONITORING

To monitor our model's performance, we track key metrics such as accuracy, precision, recall, and F1-score over time. We employ techniques like cross-validation on validation datasets to evaluate the model's generalization capacity and detect overfitting. In addition, we examine the model's predictions on unseen data to discover any disparities or biases.

- Key metrics: Accuracy, precision, recall, F1-score
- Cross-validation on validation datasets
- Evaluation of generalization capacity and detection of overfitting
- Examination of model predictions on unseen data for disparities or biases

OWNML.CO

05 MODEL BENCHMARKING



Our Dataset: Cityscapes Dataset (small version)

Our Model: U-Net

Our Accuracy: 78.2%

CITYSCAPES DATASET

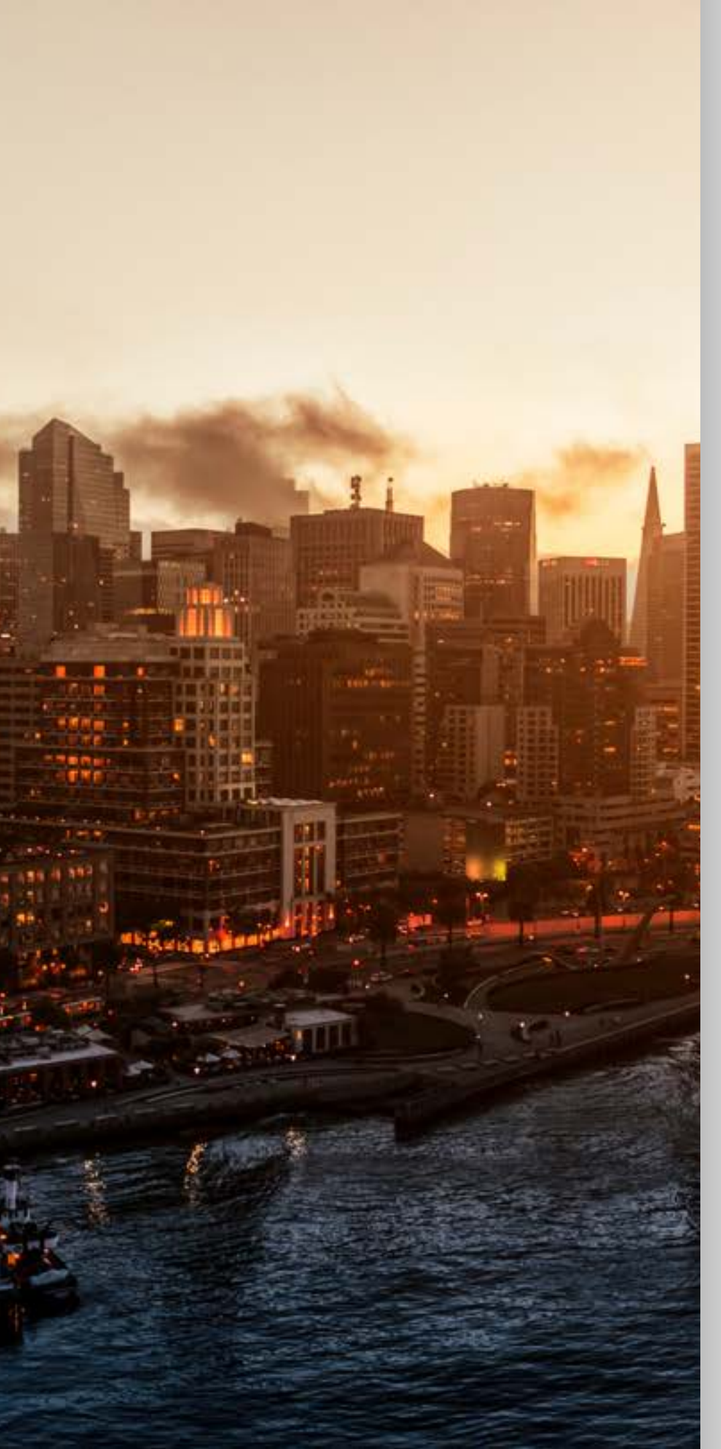
Compare to Cityscapes Benchmark

State-of-the-art model: GEELY-ATC-SEG

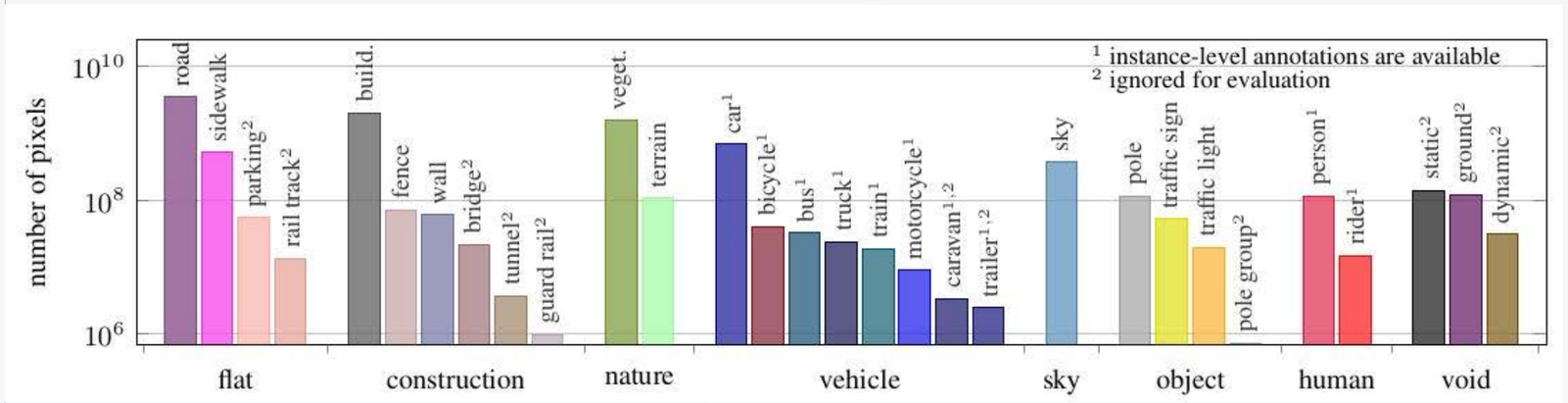
Accuracy: 86.7%

Similar model: DeeplabV3

Accuracy: 82.1%



DATA IMBALANCE



Bias on pixel area in the dataset. For example, in the Vehicle class, cars outnumber other vehicles. This leads to false negatives for other vehicles that have fewer pixels compared to cars.

DATA BIAS

01

Bias on location

The Cityscapes dataset focuses on European countries. Using this dataset may result in significant accuracy loss when testing on different continents (e.g., Southeast Asia, and Africa).

02

Bias on culture

For example, most European countries have developed transportation systems that do not exist in some countries (trams) or are less likely to be observed (bicycles). Some things, such as motorcycles and Tuk-Tuks, are more likely to be spotted in Asia than Europe, resulting in greater detection errors. This also applies to structures, people, and traffic signs.

03

Bias on pre-processing images

Due to restricted resources, we can only train on a reduced size of Cityscapes photos. This results in low accuracy for high-resolution photos.

06 MODEL DEPLOYMENT

Model Deployment involves transitioning from a development environment to a production-ready system capable of serving predictions at scale.

1.Python Coding for Computer Vision Task

We conduct our work using python language

2. Streamlit Web Application

We use Streamlit library for develop a simple application for proofing our concept

Benefit: Streamlit have a python logic. Thus, this library is easier to learn compare to other libraries.

Streamlit

3. Docker

After finish building our application, we use Docker to store up our work and send it into the cloud server

4. Google Cloud Platform

We choose Google Cloud Platform to deploy our model by using Cloud Run Service

Google Cloud

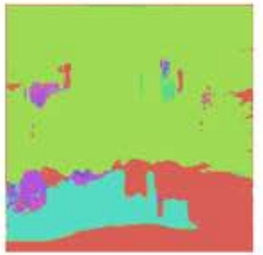
Cloud Run

Step 4: Deploy our application on Google Cloud Platform

User

Cityscapes image

Google Cloud



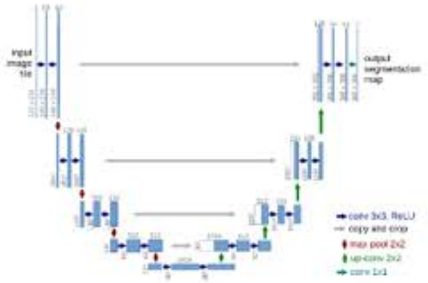
Prediction image

Step 3: create our Docker image of our application (container) using Docker

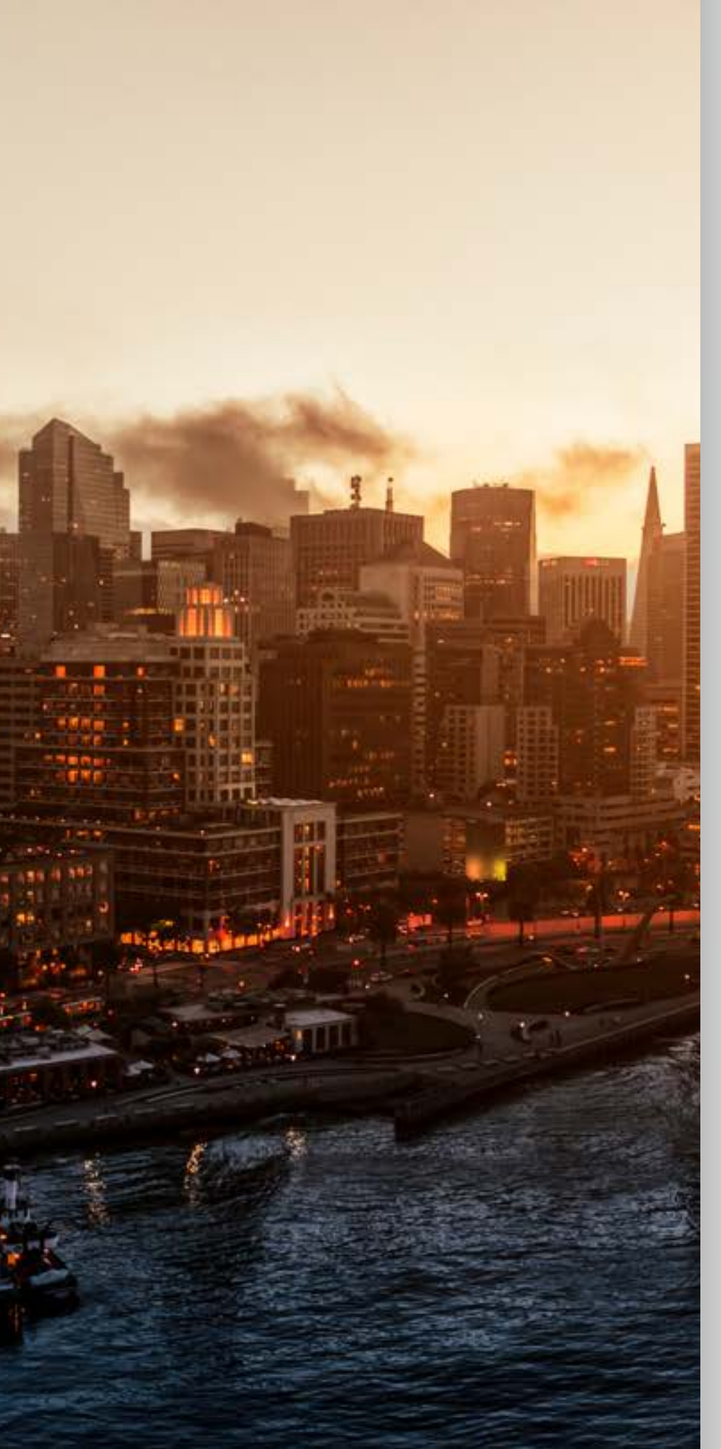
Step 2: Write our application (receive input from user, and release output) using Streamlit

Cityscapes image

Step 1: Build our model (U-Net) using Python



Prediction image

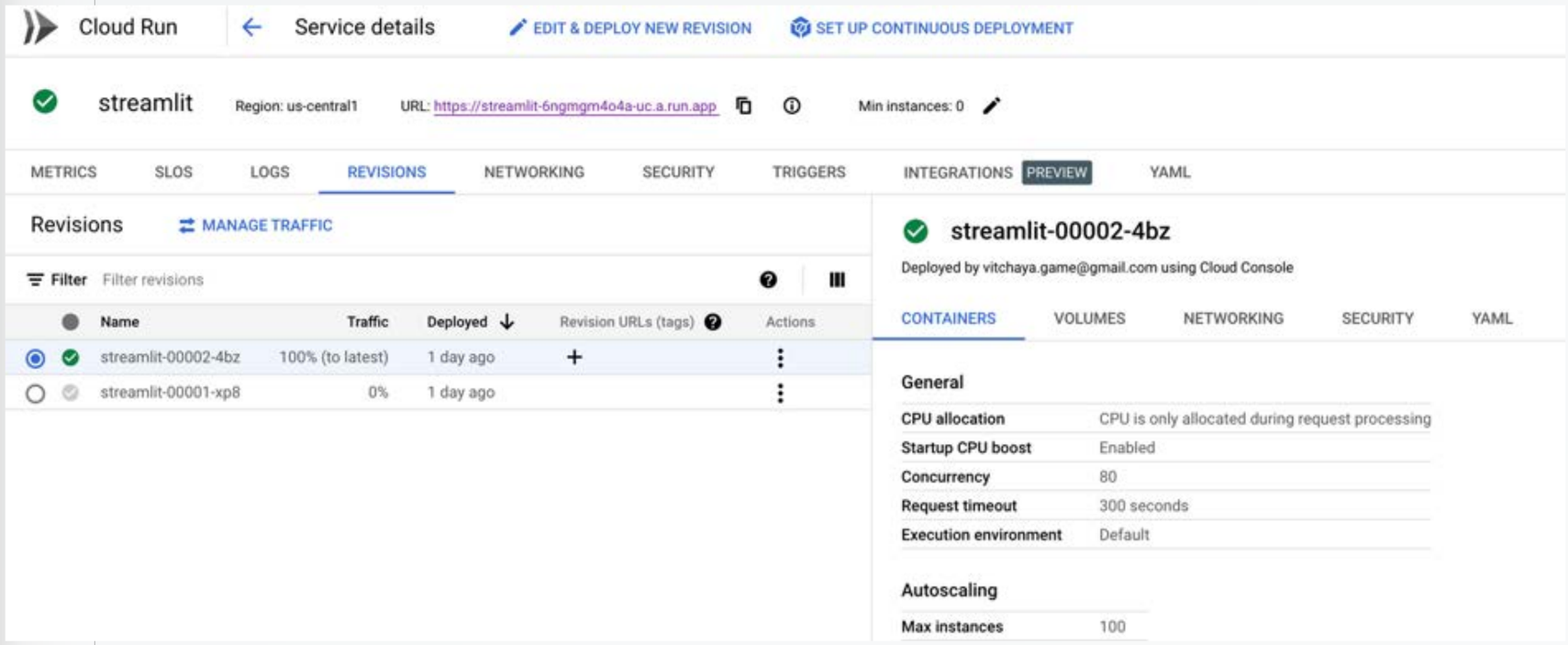


07 DEMO

RUNNING... Stop

Made with Streamlit

07 DEMO (CONT)



https://streamlit-6ngmgm4o4a-uc.a.run.app

07 DEMO (CONT)

Limitation

- Our model run pretty slow on Google Cloud Platform due to limited resource (we have only CPU for demo)
- Our model can provide only 256*256 maximum pixel of prediction image
- Our model also have less accuracy compare to Cityscapes benchmark due to limited resource on training the model

08 Q|A

PRESENTING DATA SCIENCE-DRIVEN SOLUTIONS

INSTANT SEMANTIC SEGMENTATION OF CITYSCAPES SCENE USING AI

Cost-Effective Solutions for Cityscapes Label

Members

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2. Vitchaya Siripoppohn #101481464

Professor

Moe Fadaee

April 2024

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PRESENTING DATA SCIENCE-DRIVEN SOLUTIONS

Cost-Effective Solutions
for Cityscapes Label

SWOT Analysis For Overall Company

S	W	O	T
Strengths	Weaknesses	Opportunities	Threats
• **Advanced Technology**: Utilization of state-of-the-art deep learning techniques, specifically the U-Net architecture, for accurate semantic segmentation. • **Scalability**: Flexibility to handle large-scale urban datasets and computational demands, ensuring adaptability to diverse project requirements.	• **Data Dependency**: Reliance on high-quality labeled datasets for training, potentially limiting model performance in scenarios with insufficient or biased data. • **Computational Resources**: Requirement for significant computational resources, including GPUs and cloud infrastructure, leading to high operational costs.	• **Market Demand**: Growing demand for AI-driven solutions in urban planning, transportation, and smart city initiatives, presenting opportunities for product expansion and market penetration. • **Collaborative Partnerships**: Collaboration with urban planning authorities, transportation agencies, and technology firms to develop tailored solutions and access new markets.	• **Technological Advancements**: Rapid advancements in AI and computer vision technologies by competitors, posing a threat of obsolescence and loss of market relevance. • **Data Privacy Regulations**: Increasing regulations regarding data privacy and security, requiring compliance measures and potentially impacting data access and model training.

STRATEGIC CASE

INSTANT SEMANTIC SEGMENTATION: UNLOCKING URBAN INTELLIGENCE

"IMAGINE A CITY WHERE EVERY STREET CORNER, EVERY INTERSECTION, AND EVERY BUILDING IS INTELLIGENTLY ANALYZED IN REAL-TIME, REVOLUTIONIZING THE WAY WE PERCEIVE AND MANAGE URBAN ENVIRONMENTS. TODAY, WE'LL DIVE INTO THE STRATEGIC IMPORTANCE OF INSTANT SEMANTIC SEGMENTATION, A GROUNDBREAKING TECHNOLOGY POISED TO RESHAPE OUR CITIES AND PAVE THE WAY FOR A SMARTER, MORE CONNECTED FUTURE."

01 Functional Capabilities

- **Real-time Analysis**: Instant understanding of urban scenes through fast video processing.
- **Accurate Detection**: Precise identification of vehicles, pedestrians, and hazards.
- **Urban Segmentation**: Detailed classification of roads, buildings, and sidewalks.

02 Technical Feasibility

- **Advanced Algorithms:** Cutting-edge techniques for efficient segmentation.
- **Scalable Computing**: High-speed processing for large datasets.
- **Integration**: Seamless compatibility with existing systems.

03 Environmental Sustainability

- **Resource Optimization**: Efficient model architectures and hardware deployment to minimize resource consumption.
- **Carbon Footprint Reduction**: Optimizing data processing to reduce energy usage and carbon emissions.

04 Secure and Trusted Solutions

- **Data Privacy:** Robust encryption and access controls to protect sensitive data.
- **User Confidence:** Transparent and ethical practices to maintain user trust.

05 Strategic Advantage

- **Market Leadership**: Offering innovative AI solutions for urban challenges.
- **Smart City Initiatives**: Empowering data-driven decisions for improved urban living.

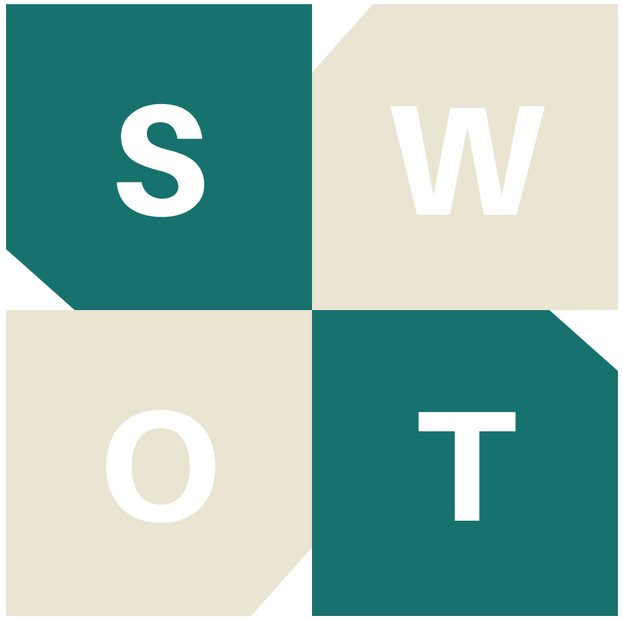
Cost-Effective Solutions for Cityscapes Label

STRATEGIC CASE

INSTANT SEMANTIC SEGMENTATION: UNLOCKING URBAN INTELLIGENCE

STRENGTHS

- Real-time scene analysis for dynamic urban environments
- **Accurate detection and classification of objects, infrastructure, and potential hazards**
- Granular segmentation of urban elements like roads, buildings, and sidewalks
- Enables data-driven insights for urban planning, traffic management, and autonomous driving



WEAKNESSES

- Computationally intensive, **requiring powerful hardware** for real-time performance
- Handling occlusions, varying lighting conditions, and viewpoint changes can be challenging
- Requires large, diverse datasets for training robust models

OPPORTUNITIES

- Integration with existing smart city infrastructure and initiatives
- Potential for market leadership by offering cutting-edge AI solutions
- **Enabling new applications** like predictive maintenance and infrastructure monitoring

THREATS

- Concerns around data privacy, security, and ethical use of sensitive data
- Competition from other emerging technologies like LiDAR and radar-based systems
- Regulatory challenges and public acceptance of AI-driven decision-making systems

Cost-Effective Solutions
for Cityscapes Label

ECONOMIC CASE

INSTANT SEMANTIC SEGMENTATION:
A COMPELLING INVESTMENT

"OUR CITIES ARE ECONOMIC ENGINES, BUT INEFFICIENCIES LURK BENEATH THE SURFACE. TRADITIONAL URBAN PLANNING METHODS STRUGGLE TO KEEP PACE, LEADING TO COSTLY DISRUPTIONS, WASTED RESOURCES, AND MISSED OPPORTUNITIES. CITYSCOPE AI'S REAL-TIME SEMANTIC SEGMENTATION OFFERS A REVOLUTIONARY SOLUTION, UNLOCKING BILLIONS IN POTENTIAL ECONOMIC BENEFITS FOR CITIES, BUSINESSES, AND CITIZENS ALIKE. ARE YOU READY TO LEARN HOW?"

01 Cost-Benefit Analysis

- **Functionality Optimization**: Maximizing value while minimizing costs for economic viability.
- **Infrastructure Investment**: Evaluating hardware, software, and maintenance requirements for scalability.

Cost-Effective Solutions
for Cityscapes Label

02 Economic Rationale

- **Cost Savings**: Streamlining urban planning and traffic management for significant cost reductions.
- **Revenue Generation:** Creating new revenue streams through smart city solutions.
- **Productivity Gains**: Enhancing decision-making efficiency for increased productivity.

03 Environmental Sustainability

- **Energy Efficiency**: Implementing energy-optimized algorithms to reduce operational costs.
- **Lifecycle Management**: Promoting sustainable practices throughout the tool's lifecycle.

04 Secure and Compliant Solutions

- **Cybersecurity Investment**: Allocating resources for robust security measures.
- **Regulatory Compliance**: Adhering to data protection regulations to avoid legal consequences.

05 Quantifying the Impact

- **Urban Planning**: Estimated annual cost savings of $160 million.
- **Traffic Management**: Projected annual revenue increase of $100 million.
- **Autonomous Driving**: Potential annual cost savings of $300 million.

ECONOMIC CASE

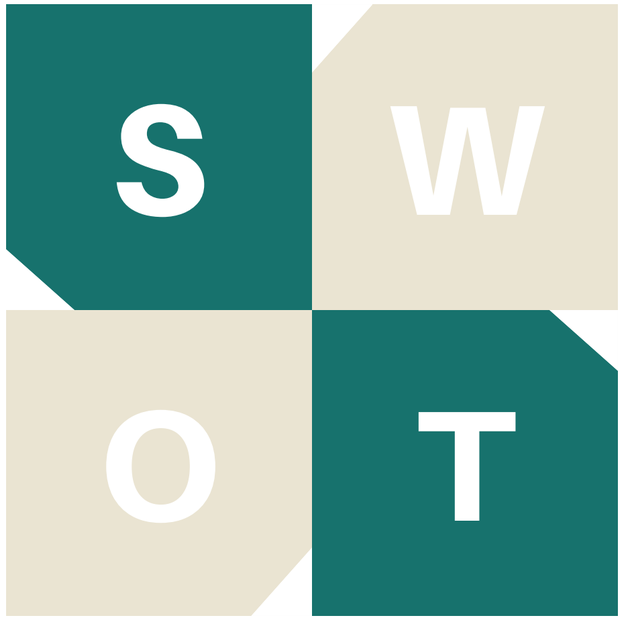
INSTANT SEMANTIC SEGMENTATION: A COMPELLING INVESTMENT

STRENGTHS

- Real-time scene analysis capability for dynamic urban environments
- Accurate detection and classification of objects, infrastructure, and hazards
- Granular segmentation of urban elements like roads, buildings, and sidewalks
- Enables data-driven insights for urban planning, traffic management, and autonomous driving
- Cutting-edge technology with potential for market leadership[1]

OPPORTUNITIES

- Integration with existing smart city infrastructure and initiatives
- Enabling new applications like predictive maintenance and infrastructure monitoring
- Expanding into emerging markets for smart city solutions
- Partnering or co-branding with other technology companies



WEAKNESSES

- Computationally intensive, requiring powerful hardware for real-time performance
- Handling occlusions, varying lighting conditions, and viewpoint changes can be challenging
- Requires large, diverse datasets for training robust models
- Potential subjectivity and bias in the analysis if not conducted comprehensively

THREATS

- Competition from other emerging technologies like LiDAR and radar-based systems
- Concerns around data privacy, security, and ethical use of sensitive data
- Regulatory challenges and public acceptance of AI-driven decision-making systems
- Potential market shifts or disruptions impacting demand for the technology

FINANCIAL CASE

INSTANT SEMANTIC SEGMENTATION: A PROFITABLE INVESTMENT

"UNLOCKING THE POTENTIAL OF URBAN PLANNING AND TRAFFIC MANAGEMENT THROUGH CUTTING-EDGE AI TECHNOLOGY!"

01 Financial Benefits

- **Urban Planning Efficiency**: Expected revenue increase of **$12 million** from optimized resource allocation.
- **Traffic Management Optimization**: Projected cost savings of **$8 million** through improved traffic flow.
- **Autonomous Driving Safety**: Potential cost avoidance of **$15 million** due to enhanced road safety.

02 Financial Projections

- **Revenue Forecast**: Anticipated annual revenue of **$1,000,000** from tool implementation.
- **Return on Investment (ROI): 100% ROI** within the first year, with further growth potential.
- **Net Present Value (NPV)**: Positive NPV of **$18 million** over 5 years, indicating profitability.
- **Internal Rate of Return (IRR)**: IRR **of 25%**, surpassing the required rate of return.

03 Environmental Considerations

- **Sustainability Incentives**: Potential tax credits or subsidies for eco-friendly AI implementation.
- **Energy Efficiency**: Cost savings from implementing energy-efficient algorithms and hardware.

04 Cost Analysis (Security & Privacy)

- **Development and Deployment**: Initial investment of **$500,000** for AI model development and setup.
- **Ongoing Maintenance**: Annual cost of **$50,000** for model refinement and infrastructure maintenance.
- **Security and Privacy**: Budget allocation of **$100,000** for encryption protocols and compliance measures.

Data Protection Measures

- **Data Encryption**: Industry-standard encryption protocols for data transmission and storage.
- **Access Control**: Role-based permissions to ensure data privacy and prevent unauthorized access.
- **Compliance**: Adherence to **GDPR and ISO 27001 standards** for data protection and security.

05 Financial Viability

- **Scalability**: Flexible cost structure to accommodate market demands and scalability.

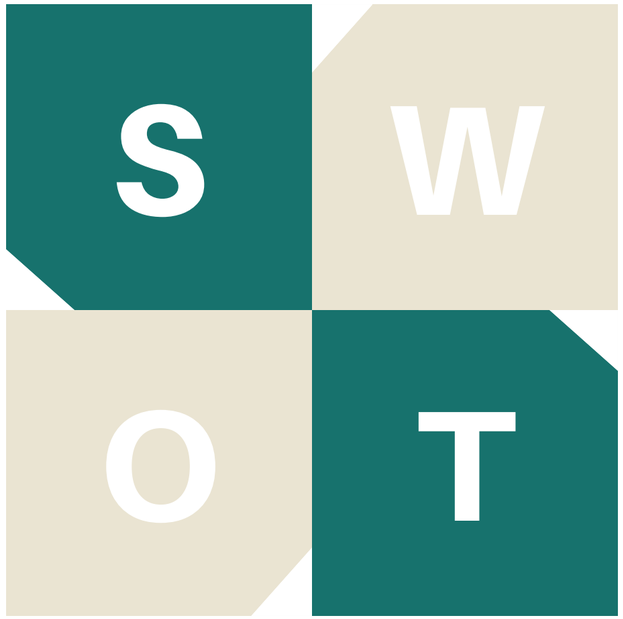
Cost-Effective Solutions for Cityscapes Label

FINANCIAL CASE

INSTANT SEMANTIC SEGMENTATION: A PROFITABLE INVESTMENT

STRENGTHS

- Cutting-edge technology with potential for market leadership
- Enables data-driven insights for optimizing urban planning, traffic management, and autonomous driving
- Potential for significant cost savings and revenue generation
- Scalable and flexible architecture for integration with existing systems



WEAKNESSES

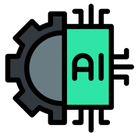
- Computationally intensive, requiring powerful hardware
- Handling occlusions, lighting variations, and viewpoint changes is challenging
- High development, deployment, and maintenance costs
- Potential subjectivity and bias in analysis if not conducted comprehensively

OPPORTUNITIES

- Expanding into emerging markets for smart city solutions
- Partnering or co-branding with other technology companies
- Leveraging sustainability incentives and tax credits for eco-friendly AI implementation
- Potential for new revenue streams through innovative commercial applications

THREATS

- Regulatory challenges and public acceptance of AI-driven decision-making systems
- Potential market shifts or disruptions impacting demand[2]
- Environmental impact and sustainability concerns related to energy consumption



Cost-Effective Solutions for Cityscapes Label

COMMERCIAL CASE

INSTANT SEMANTIC SEGMENTATION: UNLOCKING MARKET POTENTIAL

IMAGINE EFFORTLESSLY NAVIGATING COMPLEX CITY STREETS, AIDED BY CUTTING-EDGE AI TECHNOLOGY THAT ANALYZES SCENES IN REAL-TIME. THIS IS THE POTENTIAL OF SEMANTIC SEGMENTATION, REDEFINING URBAN INTERACTION. JOIN US AS WE EXPLORE THE COMMERCIAL VIABILITY OF OUR TOOL, SHAPING THE FUTURE OF URBAN PLANNING AND TRANSPORTATION. LET'S REVOLUTIONIZE CITIES TOGETHER.

01 Competitive Advantage

- **User-Friendly Interface**: Intuitive platform for rapid adoption and minimizing training requirements.
- **Scalability**: Seamless scalability to handle increasing data volumes and computational demands.
- **Flexibility**: Modular architecture for customization and integration with diverse commercial systems.

02 Technical Compatibility

- **Interoperability:** Compatibility with existing commercial systems and platforms across industries.
- **Integration Support**: Dedicated technical resources for smooth integration and ongoing maintenance.

03 Environmental Responsibility

- **Energy Optimization**: Implementation of energy-efficient algorithms and hardware for reduced operational costs.
- **Sustainable Practices**: Promotion of sustainable practices throughout the tool's lifecycle.

04 Trusted and Secure Solutions

- **Data Security**: Robust encryption and access control mechanisms for data protection.
- **Privacy Protection**: Stringent privacy protocols and transparent data handling practices.

05 Market Positioning

- **Target Industries**: Urban planning, transportation, logistics, construction, smart city initiatives.
- **Value Proposition**: Data-driven decision-making, resource allocation optimization, operational efficiency enhancement.
- **Competitive Landscape**: Differentiated by technology, scalability, user-friendly interface.

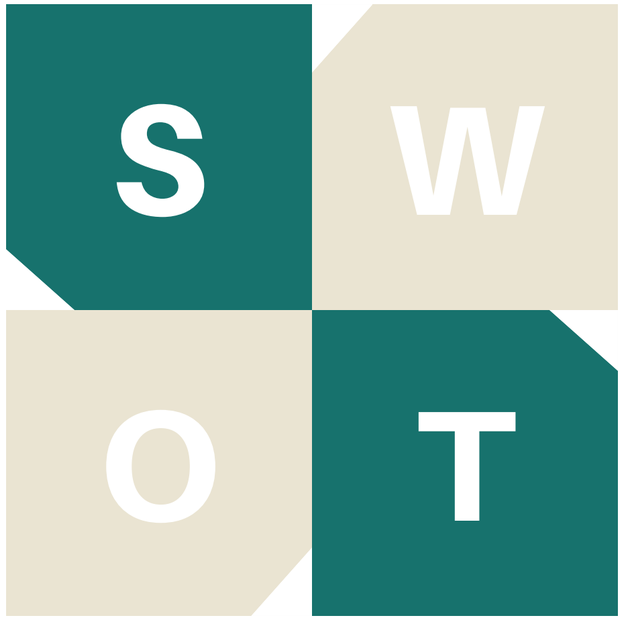
Cost-Effective Solutions
for Cityscapes Label

COMMERCIAL CASE

INSTANT SEMANTIC SEGMENTATION: UNLOCKING MARKET POTENTIAL

STRENGTHS

- Real-time scene analysis capability for dynamic urban environments
- Accurate detection and classification of objects, infrastructure, and hazards
- Scalable to handle increasing data volumes and computational demands



WEAKNESSES

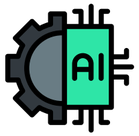
- Computationally intensive, requiring powerful hardware for real-time performance
- Handling occlusions, varying lighting conditions, and viewpoint changes can be challenging
- Requires large, diverse datasets for training robust models

OPPORTUNITIES

- Integration with existing smart city infrastructure and initiatives
- Enabling new applications like predictive maintenance and infrastructure monitoring
- Expanding into emerging markets for smart city solutions

THREATS

- Competition from other emerging technologies like LiDAR and radar-based systems
- Concerns around data privacy, security, and ethical use of sensitive data
- Regulatory challenges and public acceptance of AI-driven decision-making systems



Cost-Effective Solutions for Cityscapes Label

MANAGEMENT CASE

Cost-Effective Solutions
for Cityscapes Label

INSTANT SEMANTIC SEGMENTATION: ENSURING SUCCESSFUL DELIVERY

IMAGINE AN AI TOOL RESHAPING URBAN ANALYSIS, STREAMLINING DECISIONS, AND SPARKING INNOVATION. TODAY, WE DELVE INTO ITS STRATEGIC, ECONOMIC, AND OPERATIONAL DIMENSIONS, UNVEILING ITS POTENTIAL TO REDEFINE URBAN INTELLIGENCE. JOIN US ON THIS JOURNEY INTO THE REALM OF AI-DRIVEN URBAN DEVELOPMENT.

01 Functional Management

- **Agile Methodology**: Iterative approach for adaptability and risk mitigation.
- **Clear Roles: Defined** responsibilities for efficient coordination.
- **Milestone Tracking**: Comprehensive plan for progress monitoring.

02 Technical Resource Allocation

- **Expertise Allocation**: Personnel with AI, deep learning, and computer vision skills.
- **Computational Infrastructure**: Cutting-edge hardware and cloud resources.
- **Data Management**: Robust pipelines for large-scale urban datasets.

03 Environmental Stewardship

- **Energy-Efficient Algorithms**: Reduce computational demands.
- **Green Computing**: Explore renewable energy sources.
- **Sustainable Practices**: Minimize waste and resource use.

04 Robust Security and Privacy

- **Data Governance**: Frameworks, access controls, encryption.
- **Compliance**: Adherence to regulations, and regular audits.
- **Risk Mitigation**: Proactive identification and mitigation.

05 Delivery Excellence and Stakeholder Engagement

- **Multidisciplinary Expertise**: AI, urban planning, project management.
- **Stakeholder Collaboration**: Effective communication.
- **Continuous Testing**: Quality assurance for reliability.

MANAGEMENT CASE

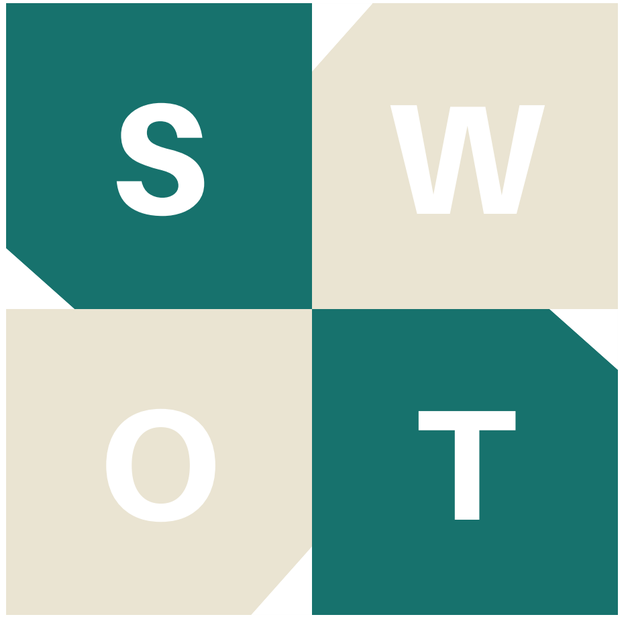
INSTANT SEMANTIC SEGMENTATION: ENSURING SUCCESSFUL DELIVERY

STRENGTHS

- Agile and iterative project management methodology to adapt to changing requirements
- Clear roles and responsibilities within the cross-functional project team
- Comprehensive project plan with well-defined milestones and timelines
- Strategic allocation of AI, computer vision, and software engineering expertise

OPPORTUNITIES

- Integration with existing smart city infrastructure and initiatives
- Leveraging sustainability incentives and tax credits for eco-friendly AI implementation
- Potential for new revenue streams through innovative commercial applications



WEAKNESSES

- Potential subjectivity and bias in the analysis if not conducted comprehensively
- Handling occlusions, lighting variations, and viewpoint changes can be challenging
- High computational demands and associated energy consumption
- Requires large, diverse datasets for training robust AI models

THREATS

- Concerns around data privacy, security, and ethical use of sensitive data
- Regulatory challenges and public acceptance of AI-driven decision-making systems
- Potential market shifts or disruptions impacting demand for the technology

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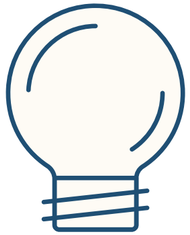
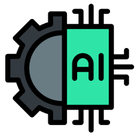
Challenge vs Solution



- Complex urban environments present diverse objects for segmentation.
- Varied lighting, occlusions, and weather add complexity.

- Utilize U-Net architecture for tailored semantic segmentation.
- Augment dataset with diverse urban scenes for model generalization.
- Apply rotation, flipping, and scaling for scenario simulation.
- Implement transfer learning for fine-tuning and leveraging related domain knowledge.



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Monetization Example: Real-Case Scenario

Google Cloud Platform (GCP)

Initial Cost Estimate

Virtual Machine (VM) Specification:

- Instance Type: n1-standard-4 (4 vCPUs, 15 GB memory)
- Operating System: Ubuntu 20.04 LTS
- Storage Type: Standard Persistent Disk
- Storage Size: 100 GB

Price Breakdown:

- VM Cost: $0.184 per hour for n1-standard-4 instance type.
- Storage Cost: $0.04 per GB per month for standard persistent disk storage.

Total Monthly Cost Calculation:

1. VM Cost: $0.184/hour * 24 hours/day * 30 days/month = $132.48 per month.
2. Storage Cost: $0.04/GB/month * 100 GB = $4.00 per month.

Total Monthly Cost:

- Total Monthly Cost = VM Cost + Storage Cost
- Total Monthly Cost = $132.48 + $4.00 = $136.48

Revenue Estimate

Number of Subscribers:

- Acquired 500 subscribers within the first month.
- Projected subscriber growth rate: 20% monthly.

Flexible Subscription Packages:

- Basic Package: $10/month for standard features.
- Premium Package: $20/month for additional advanced functionalities.
- Custom Package: Tailored pricing based on specific client requirements.

Company Income (Revenue):

- Monthly income from subscriptions: $5,000 (500 subscribers * $10/month).
- Projected monthly revenue growth: 20%.

Return on Investment (ROI) for Company:

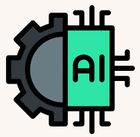
- Initial investment: $50,000 for development and deployment.
- Monthly revenue: $5,000.
- ROI calculation: ($5,000 / $50,000) * 100 = 10% monthly ROI.

Cost Savings for Customers:

- Estimated cost savings for customers: 20% on infrastructure expenses.
- Example: Customer saves $1,000 monthly on infrastructure costs.

Return on Investment (ROI) for Customers:

- Customer investment: Monthly subscription fee.
- Cost savings from optimized infrastructure: $1,000.
- ROI calculation: ($1,000 / Monthly subscription fee) * 100.



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Forecast the one-year income related to the Financial Case

Revenue Streams

- Urban Planning Efficiency: Estimated revenue of $12 million.
- Traffic Management Optimization: Projected revenue of $8 million.
- Autonomous Driving Safety: Potential revenue of $15 million.

Total Revenue = $12 million + $8 million + $15 million = $35 million

Cost Savings

- Estimated cost savings from improved urban planning, traffic management, and autonomous driving safety initiatives: $35 million

Total Income

- Total Income = Total Revenue + Cost Savings
- Total Income = $35 million + $35 million = $70 million

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Industry Analysis

IDC Forecasts Revenue for Artificial Intelligence Software Will Reach $307 Billion Worldwide in 2027

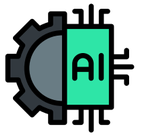
NEEDHAM, Mass., December 20, 2023 – A recent forecast from International Data Corporation (IDC) shows that the worldwide artificial intelligence (AI) software market will grow from $64 billion in 2022 to nearly $251 billion in 2027 at a compound annual growth rate (CAGR) of 31.4%. The forecast for AI-centric software* includes Artificial Intelligence Platforms, AI Applications, AI System Infrastructure Software (SIS), and AI Application Development and Deployment (AD&D) software (excluding AI platforms). However, it does not include Generative AI platforms and applications, which IDC recently forecast will generate revenues of $55.7 billion in 2027.

Source: IDC Forecasts Revenue for Artificial Intelligence

McKinsey: AI could increase corporate profits by $4.4 trillion a year, according to new research

Much of the value of generative AI will come from growth in productivity across the economy—so long as employees affected by the technology shift to new work activities. We estimate that generative AI could increase labor productivity by 0.1% to 0.6% annually through 2040. Combined with other technologies, work automation could add an extra 0.2 to 3.3 percentage points to productivity growth.

Source: McKinsey



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THANK YOU

FOR YOUR NICE ATTENTION

April 2024

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