



BONSAPPS

AI-as-a Service for the Deep Edge

D5.2 Developer's Community

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Abbreviations

EC: European Commission
AI: Artificial Intelligence
ML: Machine Learning
LPDNN: Low-power Deep Neural Network framework
DoA: Description of Action
GA: Grant Agreement
SME: Small and Medium Enterprise
BMP: Bonseyes AI Marketplace
USF: User Support Framework
DPE: Developer Platform Environment
BSP: Board Support Package
CLI: Command Line Interface

Executive Summary

This document includes the current structure and content of the Bonseyes AI Marketplace's Developer's Community. It builds on the previous WP5's deliverable – D5.1 User Support Framework – extending the Bonseyes Marketplace (BMP) with new features and capabilities.

BonsAPPS intends to build a Developer's Community that can access and employ services and tools from the BMP to deploy AI capabilities in new use cases or applications. Further, the BMP provides guidelines and documentation for the developers to create new tools and services themselves that can be shared or sold in the BMP. Thus, creating a vibrant community at the European framework.

In this document, we provide an update on the BMP's AI Challenge and AI Marketplace verticals before getting deeper into the Developer's Community content. All content described in this document is accessible through the BMP's beta-version webpage: <https://beta.bonseyes.com/>.

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1 Introduction to BMP

The Bonseyes AI Marketplace is a web platform that connects researchers, developers, and companies to procure, collaboratively build, and trade AI Applications. Its goal is to facilitate collaboration between researchers and industry to speed up the process of building and deploying AI-based solutions to solve real-world challenges defined by the industry.

The Bonseyes AI Marketplace will provide to the researchers, data scientists, developers, and industries the various number of AI Artifacts, e.g., AI papers, datasets, assets, applications, and embedded boards. Users can search, browse, and bookmark AI Research from the collection, as well they can create, publish, download, sell and buy AI Artifacts from the AI Marketplace. Industries can create AI challenges and open a tender for its solution. On the other side, developers and data scientists can join the challenge with the aim to solve the challenge and monetize their expertise. Figure 1 depicts the numbers of available AI Artifacts on the AI Marketplace.

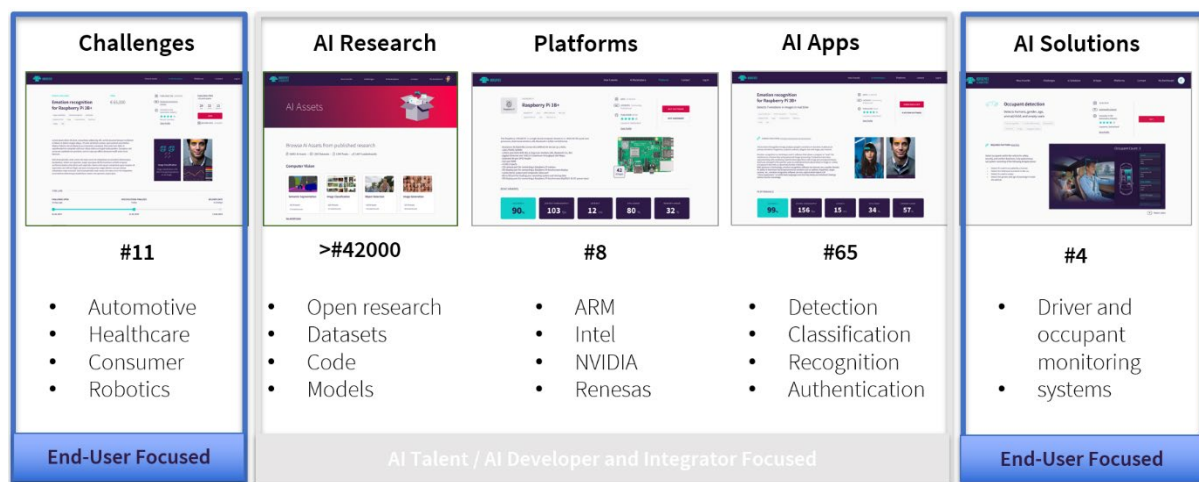


Figure 1 Marketplace Artifacts

The current version of Bonseyes AI Marketplace defines and targets following users for the BonsAPPS services layer:

- **Researchers:** is someone who conducts research, i.e., an organized and systematic investigation of the topics related to the domain of the AI. He is a publisher of the AI Research or AI Asset.
- **Innovators:** are individuals who represent a company, SME or academic institution that would like to solve a data-driven problem using AI technologies. Innovators are creators of the challenge, providing a description of the problem, data, resources constraints, and target performances.
- **Data Scientists:** are highly skilled professionals or researchers in the field of data science. They are the creators of AI Artifacts and AI Models that enables the creation of AI Apps as a solution to a challenge.
- **Developers:** are highly skilled professionals experienced with the deployment process of the AI Models into the various hardware platforms. They are creators of AI Applications that embed AI Models on specific Developer Platforms containing Target Hardware, which may include meeting non-functional requirements in embedded systems.
- **Integrators:** are highly skilled companies or professionals in the field of deployment and integration of the AI Apps into the final industry solution. They create AI Solutions that compose multiple AI Apps in conjunction with the supplementary user interface, platform integration, synchronization, and orchestration code.

For the BonsAPPS AI-as-a-Service layer (AlaaS) to be fully operative for third-party use, the technology development process described above must run in parallel to the development of appropriate mechanism guiding the users of AlaaS. Those mechanisms must be scalable and provide appropriate support to both end-users and AI Talents¹ in a way that does not require high-intensity involvement by technical experts. The BMP currently has the main verticals as shown in Figure 2:

- **AI Challenges:** AI Challenges are problems or specific use cases driven by the Industry or Academia, which do not yet have a solution [Section 2]. An AI Challenge needs to specify the description of the problem as well as the specifications that would be needed to solve such challenge, e.g., evaluation data and procedure, end-target deployment platform, throughput, accuracy, etc.
- **Marketplace:** Marketplace vertical of the Bonseyes AI Marketplace represents resource space where reusable AI Assets and AI Artifacts can be found. The main goal of the Marketplace is to provide reusable building components and industry-ready AI solutions. Resources on the Marketplace can be purchased or published for selling, through this functionality Marketplace provides value for both buyers and sellers, buyers can find an adequate component that can use in their AI Solution and cut the costs of development and integration and for the seller, Marketplace provides an opportunity to monetize their AI Artifacts and scale the sale.
- **Developer Community:** The developer community represents one of the major parts of the BMP with the goal to provide AI Research, namely, a collection of AI papers and associated open-source implementations, open-source data collections (datasets) in different modalities and for different domains [Section 4]. The Developer Community also provides User Support Documentation, which provides detailed user guides, developer guides and workflows to manipulate the AI Assets and AI Artifacts. Developer Community also provides networking opportunities through the community part to connect with the individuals or organizations that are part of the AI Marketplace.

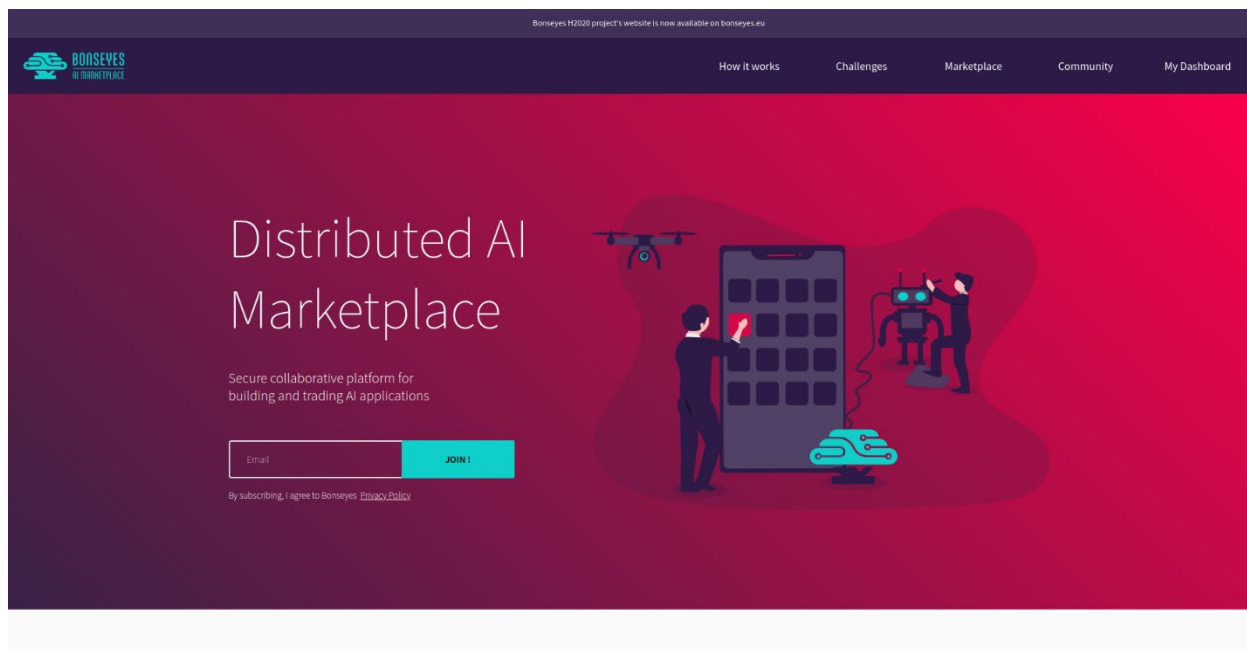


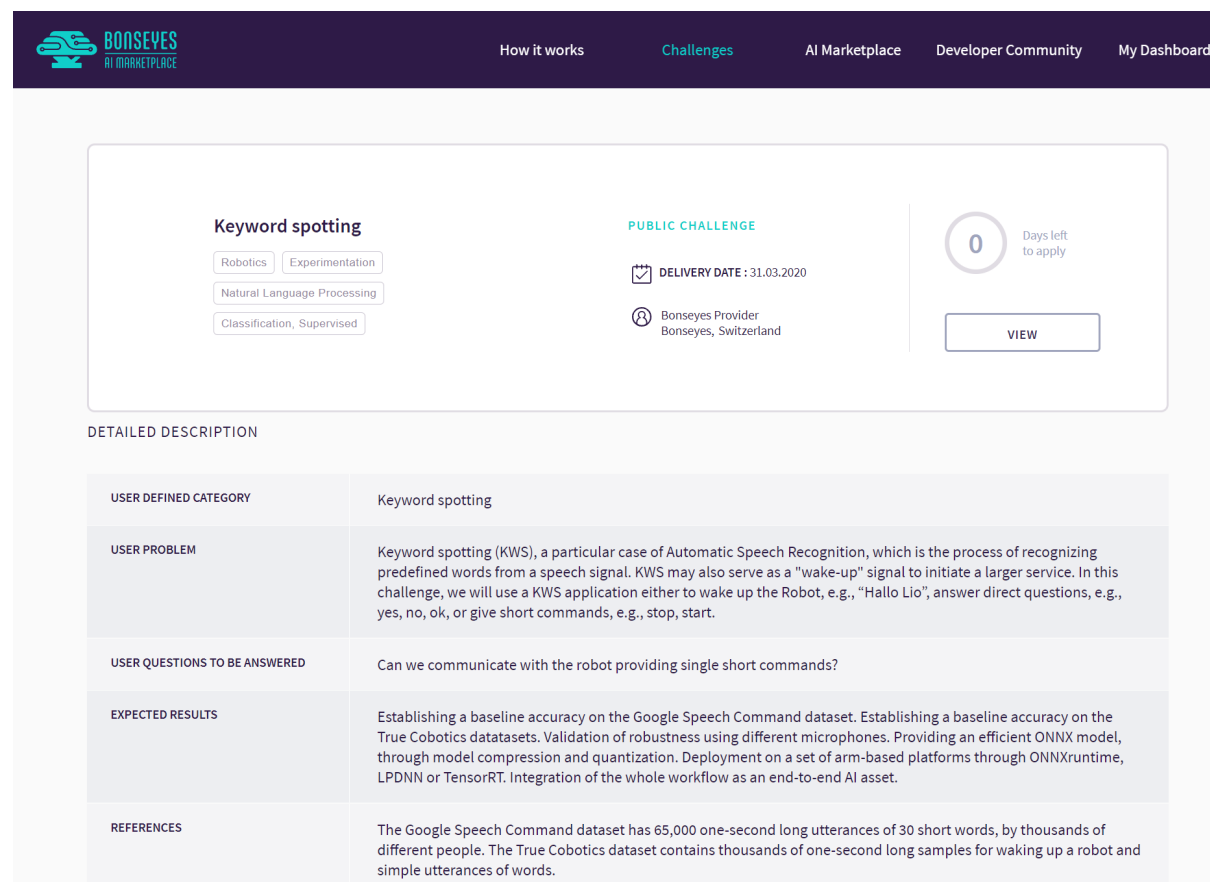
Figure 2 Bonseyes AI Marketplace homepage

¹ AI Talents are researchers, PhDs/post-docs, engineers/developers, or data scientists that have capabilities to resolve AI challenges

2 AI Challenges

AI challenges are problems or specific use cases driven by the Industry or Academia, which do not yet have a solution. Currently, the Bonseyes AI Marketplace offers the users to visualize open AI Challenges. In future releases, the users will be also able to create and publish their own AI Challenges.

An AI Challenge, as shown in Figure 3, needs to specify the description of the problem as well as the specifications that would be needed to solve such challenge. An initial page displays all current open AI challenges with a few descriptive keywords, the due date, and the provider. By clicking into the specific AI Challenge, detailed descriptions are provided about the problem, the evaluation data and procedure, end-target deployment platform, throughput, accuracy, etc.



BONSEYES AI MARKETPLACE

How it works Challenges AI Marketplace Developer Community My Dashboard

Keyword spotting

Robotics Experimentation

Natural Language Processing

Classification, Supervised

PUBLIC CHALLENGE

DELIVERY DATE : 31.03.2020

Bonseyes Provider
Bonseyes, Switzerland

0 Days left to apply

VIEW

DETAILED DESCRIPTION

USER DEFINED CATEGORY	Keyword spotting
USER PROBLEM	Keyword spotting (KWS), a particular case of Automatic Speech Recognition, which is the process of recognizing predefined words from a speech signal. KWS may also serve as a "wake-up" signal to initiate a larger service. In this challenge, we will use a KWS application either to wake up the Robot, e.g., "Hallo Lio", answer direct questions, e.g., yes, no, ok, or give short commands, e.g., stop, start.
USER QUESTIONS TO BE ANSWERED	Can we communicate with the robot providing single short commands?
EXPECTED RESULTS	Establishing a baseline accuracy on the Google Speech Command dataset. Establishing a baseline accuracy on the True Cobotics datasets. Validation of robustness using different microphones. Providing an efficient ONNX model, through model compression and quantization. Deployment on a set of arm-based platforms through ONNXruntime, LPDNN or TensorRT. Integration of the whole workflow as an end-to-end AI asset.
REFERENCES	The Google Speech Command dataset has 65,000 one-second long utterances of 30 short words, by thousands of different people. The True Cobotics dataset contains thousands of one-second long samples for waking up a robot and simple utterances of words.

Figure 3 AI Challenge for Keyword Spotting

2.1 Industry Challenges

The ten AI Challenges proposed in the BonsAPPs 1st Open Call are currently published in the BMP. These are the following:

- Automotive:
 - A1: Gaze Detection
 - A2: Body Part Tracking
 - A3: Gesture Recognition
- Manufacturing:
 - M1: Defect Detection
 - M2: Object Detection

- Healthcare:
 - H1: Remote Vital Signs
 - H2: Heart Rate Detection
 - H3: 3D Body Detection
- Robotics:
 - R1: Collision Avoidance
 - R2: Keyword Spotting

These AI Challenges are explained in more detail in the deliverable AI as-a-Service (AlaaS) [D1.2].

3 AI Marketplace

The AI Marketplace vertical contains four elements:

- AI Assets
- AI Apps
- AI Solutions
- Developer Platforms (a.k.a. platforms)

To date, AI Assets and Developer Platforms are already accessible through the BMP. Thus, the rest of this section focuses on these two artifacts. AI Apps and AI Solutions will be added during 2022 and will be available for the 2nd Open Call beneficiaries.

3.1 AI Assets

A BMP AI Asset represents an implementation of a research paper employing deep learning techniques. AI Assets are composed of two elements:

3.1.1 AI Asset Runtime Containers

An AI Asset Container provides a set of services and standardized building components that facilitates and accelerates the development of AI systems for the resource constrained low power devices. A BMP AI Asset Runtime Container provides a complete Python-based workflow for end-to-end deployment of deep learning models to supported embedded hardware target platforms, which are described in Section 3.2.

The AI Asset Runtime Container provides dependency profiles for target environments. Thereby, the containers for deep learning provide a stable set of pre-installed software packages and a definition of a virtualized host environment to ensure compatibility when executing and running BMP AI Asset Runtime Containers on various host systems.

A common problem in deployment to the deep edge is that when training and optimizing models in a cloud or host environment, often a model is created with a set of dependencies that does not match the target hardware platform environment. These dependency differences can create subtle and accumulative errors which make exact replication of models at deployment difficult. Moreover, debugging model performance becomes complex and sometime impossible. Additionally, specialized tools are often required to program specialized hardware architectures, which may require a very specific dependency set to function correctly.

To alleviate these developer “pain points”, the AI Asset container provides dependencies profiles for target environments for edge and deep edge platforms such as Raspberry Pi, NVIDIA Jetson devices and STM or RISC-V MCU-based computing platforms. The dependency profile contains versioning

information of common middleware and driver components so that the BMP AI Asset Container can mirror the target deployment environment as closely as possible.

Currently, we support the following deployment platforms:

- **Workstation / Server / Laptop (x86_64):** AMD/Intel CPU and NVIDIA GPU
- **NVIDIA Jetson devices (aarch64):** Jetson Xavier AGX, Jetson Xavier NX, Jetson Nano
- **Raspberry Pi (arm64v8):** Raspberry Pi3, Raspberry Pi4
- **RISC V Architectures:** Greenwaves GAP8 Multicore processor
- **STM Platforms:** STM32MP157A-DK1 and STM32H7A3

Supported dependency profiles for deployment platforms include:

- **x86_64 GPU:**
 - ubuntu18.04_cuda10.2_python3.6_tensortrt7.0.yml
 - ubuntu20.04_cuda11.4_python3.8_tensortrt8.0.yml
- **x86_64 CPU:**
 - ubuntu18.04_python3.7.yml
- **NVIDIA Jetson:**
 - Jetpack4.4.yml
 - Jetpack4.6.yml
- **Raspberry Pi:**
 - rpi_arm64v8.yml

Supported software version management includes:

- Python
- PyTorch
- CMake
- OpenCV
- NumPy
- GCC
- CUDA, cuBLAS, and cuDNN
- LPDNN
- TensorRT and ONNX-TensorRT
- ONNX and ONNX Runtime
- Nemo –Dory optimization frameworks

3.1.2 AI Assets Framework

The AI Asset deployment framework enables accelerated deployment of deep learning models to resource constrained low power embedded systems (edge and deep edge). These containers deliver powerful and easy-to-deploy building blocks for creating complex AI models that can be deployed on cyber-physical systems. By taking care of many of end-to-end tooling dependencies and providing standardized interfaces, BMP AI Asset Runtime Containers enable users to focus on producing optimal solutions while allowing faster feedback during the implementation of end user requirements.

In summary, the ultimate goal is to ease the deployment of AI based solutions to the edge and deep edge by applying the services provided within the Bonseyes AI Marketplace.

AI Asset services include:

- **Models:** Provides model storage and model summaries.
- **Training:** Provides ability to retrain model or create new trackable experiments.
- **Evaluation:** Provides ability to evaluate models using different engines, input sizes and backbones.

- **Export:** Provides ability to export pretrained Pytorch models to ONNX or TensorRT formats.
- **Optimization:** Provides ability to perform compression and quantization using ONNXRuntime and TensorRT.
- **Data processing:** Provides ability to process data in a form of image, video, camera stream or as a HTTP worker.
- **Benchmarking:** Provides ability to evaluate all models and get detailed information about accuracy and model performance on target device, e.g., latency, memory consumption, CPU/GPU usage, etc.
- **Test:** Provides a framework for automated testing of implemented features.

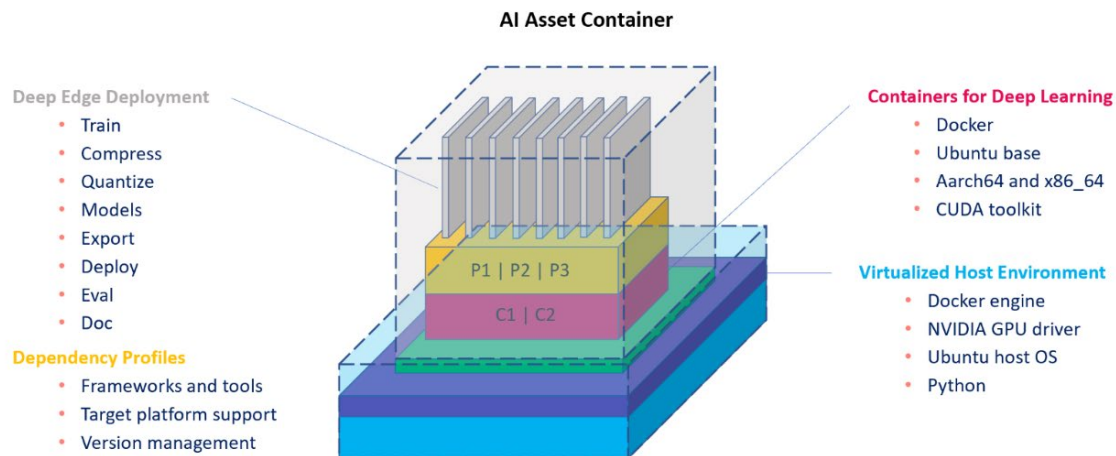


Figure 4: AI Asset container architecture

At this development stage, two AI Asset examples are accessible through the BMP:

- ❑ Whole body pose detection – 133 keypoints
https://bonseyes.gitlab.io/assets/bonseyes_openpifaf_wholebody
- ❑ 3D face landmark detection – 68 keypoints
https://bonseyes.gitlab.io/assets/bonseyes3ddfa_v2

The AI Asset workflow and its usage will be explained in Section 6 while the creation of new AI Assets will be explained in Section 7.

3.2 Developer Platforms

A Developer Platform is a digital package containing the full software stack (operating system, drivers, middleware components, etc.) and documentation required to procure, set up and control target hardware for the execution of AI Apps (de Prado et. Al.). Moreover, the platform provides a cross-compilation environment and tooling that can create executables for the target hardware on the developer workstation.

The Developer Platforms packages, or Board Support Package (BSP), are composed of various components:

- **Support docker:** the container used to build the platform package and setup target hardware.
- **Builder docker:** the container used to cross-compile binaries for the target hardware.
- **Manager docker:** the container used to control the target hardware.
- **Clean metadata:** the full metadata that is used for the listing on the marketplace.

Currently, the following platforms are supported:

Table 1 Supported Developer Platforms

Name	Vendor	Version
x86_64-ubuntu18	Ubuntu	V1.0
x86_64-ubuntu20	Ubuntu	V1.0
raspberrypi4b_64-ubuntu20	Raspberry Pi	V1.0
raspberrypi3b+_64-ubuntu20	Raspberry Pi	V1.0
jetson_nano-jetpack4.4	Nvidia	V1.0
jetson_xavier-jetpack4.5	Nvidia	V1.0
imx8m_nano_evk-yocto_imx_5.10.9_1.0.0	NXP	V1.0
intel_nuc-ubuntu18	Intel	V1.0
GAP8 RISC-V processor	Greenwaves	V1.0
STM32MP157a-dk1	ST Microelectronics	V1.0
STM32H7A3	ST Microelectronics	V1.0

A Developer Platform Environment (DPE) is a package wrapping the Developer Platform and providing the environment to help the user employ a developer platform. A DPE has the objective of walking the user through the steps of building a Developer Platform, setting up the embedded hardware and test a sample application on it to make sure of the correct operation of the system.

Each DPE contains two elements:

- **Board Support Package (BSP):** Developer Platform packages containing docker images, drivers, and toolchains for the target embedded platform.
- **Sample application:** "Hello-world" sample application to test the correct operation of the of the DPE workflow.

A BSP contains the following files:

- Platform-sources.zip
- Docker-images/
 - PlatformName-manager.tar
 - PlatformName-support.tar
 - PlatformName-builder.tar

BSPs are given as zip files and can be downloaded from the BMP through the Bonseyes CLI tool, which will be explained in Section 5.

4 Developer's Community

The Developer's Community vertical of the BMP contains four elements as depicted in Figure 5:

- AI Research
- AI Datasets
- Community
- Documentation

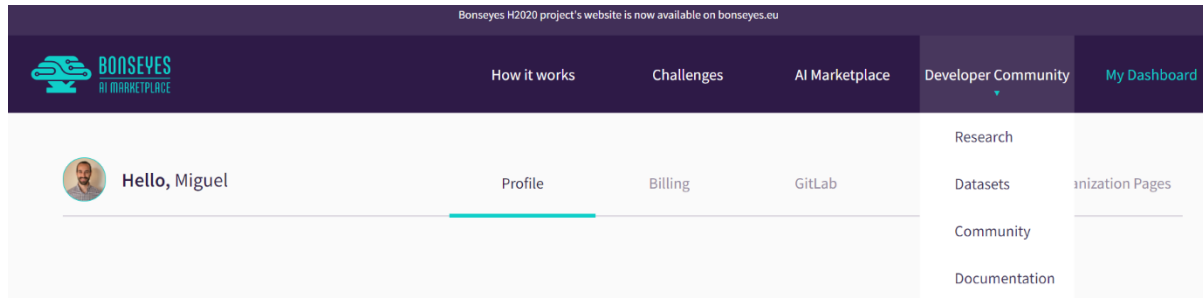


Figure 5: Developer's Community vertical

4.1 AI Research

Research in the domain of Artificial Intelligence represents scattered resources across the internet, making searching, finding, and following specific research artifacts hard. To mitigate that problem, Bonseyes AI Marketplace acts as an aggregator platform, allowing anyone with an interest in it to find, browse and follow latest research in the AI domain. Research resources on the BMP are split into two categories:

- Research that represents papers and associated implementations of the papers,
- Datasets that provide references to the publicly available collections of domain data.

From developers' and data scientist perspective, they represent a starting point that can help in the process of AI systems development.

To facilitate and accelerate the development of the AI systems, BMP will provide a collection of the AI research that will be categorized by AI category (e.g., Computer Vision, Natural Language Processing), each category is sub-categorized by the AI task, e.g., Image Classification, Scene Segmentation, see Figure 6.

For the specific AI task, related AI Research works are ordered based on the benchmark results. Benchmarks are data-driven and consist of specific dataset and evaluation metrics to assess the model performances, e.g., latency, memory consumption, CPU/GPU usage, power consumption etc. AI Research is ordered by most credible benchmarks, providing leaderboard details of the evaluated models. Following that approach, AI Talents can quickly find the state-of-the-art AI Research works.

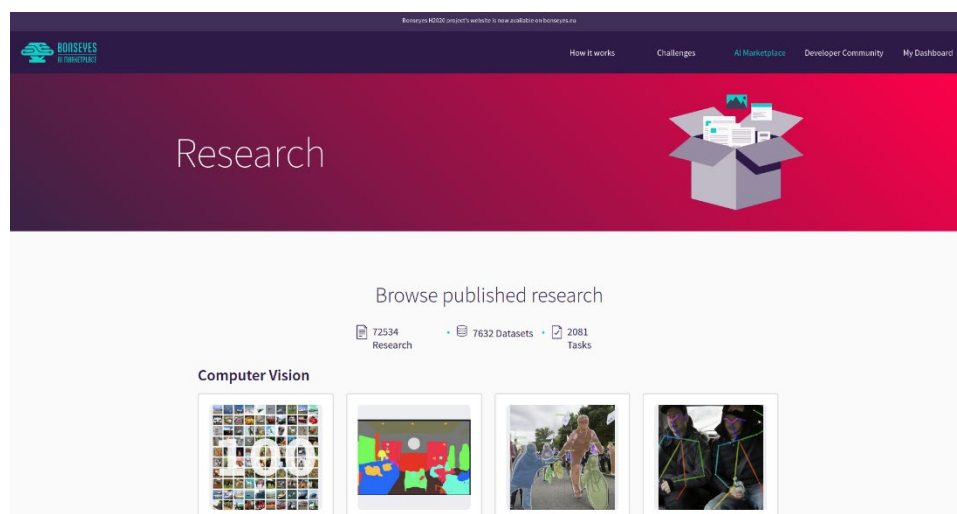
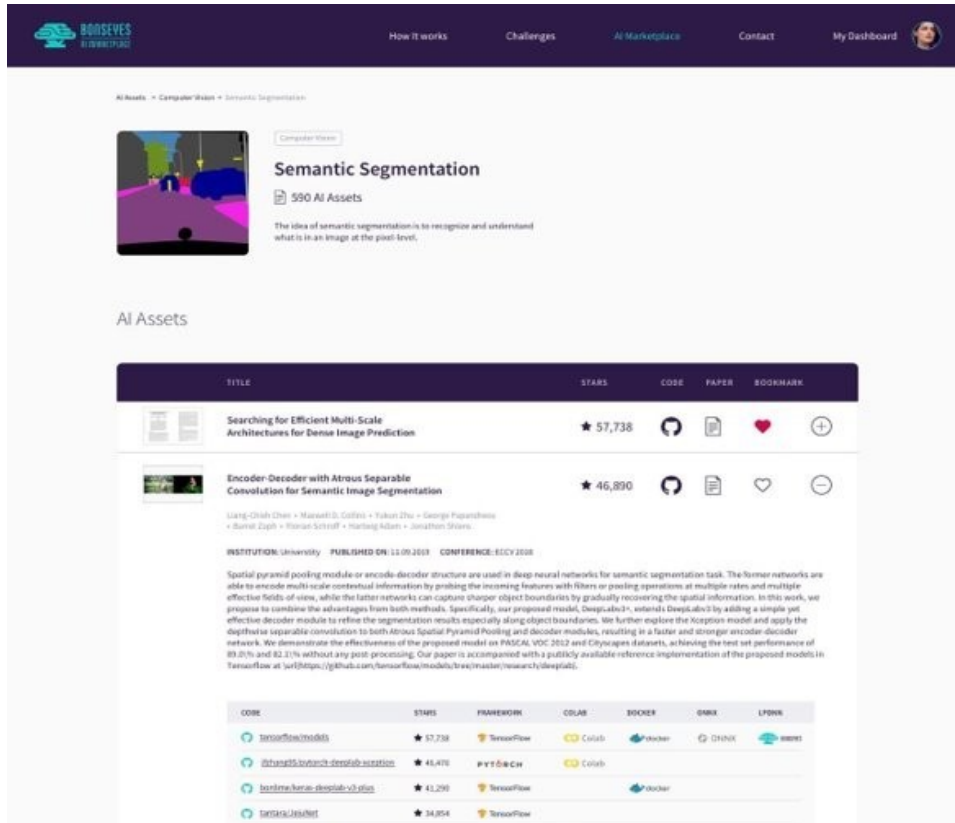


Figure 6: Research landing page on the Bonseyes AI Marketplace

The Bonseys AI Marketplace procures additional information for AI Research, which provides insights of the deployment capabilities of the AI models. The insights are depicted in Figure 7 and are the following:

- Community relevance of the implementation by presenting GitHub stars
- ML framework that has been used for the implementation
- Google's Colab implementation for the quick demonstration
- Dockerization of the implementation
- Interoperability by means of ONNX model formats
- Support of the ONNX model in the Bonseys's inference engine: LPDNN.



The screenshot displays the Bonseys AI Marketplace interface. At the top, there's a navigation bar with links: How it works, Challenges, AI Marketplace, Contact, and My Dashboard. The main content area features a 'Semantic Segmentation' AI Asset. Below the asset title, it shows '590 AI Assets' and a brief description: 'The idea of semantic segmentation is to recognize and understand what is in an image at the pixel-level.' Below this, there's a table titled 'AI Assets' with columns: TITLE, STARS, CODE, PAPER, and BOOKMARK. The table lists several AI assets, including 'Searching for Efficient Multi-Scale Architectures for Dense Image Prediction' (57,738 stars) and 'Encoder-Decoder with Atrous Separable Convolution for Semantic Image Segmentation' (46,890 stars). Below the table, there's a section for 'Deployment capabilities' with a table showing the supported frameworks for each asset.

CODE	STARS	FRAMEWORK	COLAB	DOCKER	ONNX	LPDNN
tensorflow/models	57,738	TensorFlow	Colab	Docker	ONNX	LPDNN
zhengshengli/deeplabv3-segnet	46,890	PYTORCH	Colab			
tensorflow/tensorflow-deeplabv3-plus	41,290	TensorFlow		Docker		
tensorflow/tensorflow	34,054	TensorFlow				

Figure 7: Deployment capabilities of AI Research works

Information of the deployment capabilities eases the process of finding suitable AI Research for industrialization using the proposed deep learning deployment framework based on the AI Asset Container [Section 3.1.1].

4.2 Datasets

Datasets represent a publicly available collection of data that can be in different modalities and for different domains. On the BMP, datasets will provide general information of the dataset and references to the dataset sources. On the Datasets page, AI Talents can explore and find suitable datasets in order to develop models that solve specific AI Challenges.

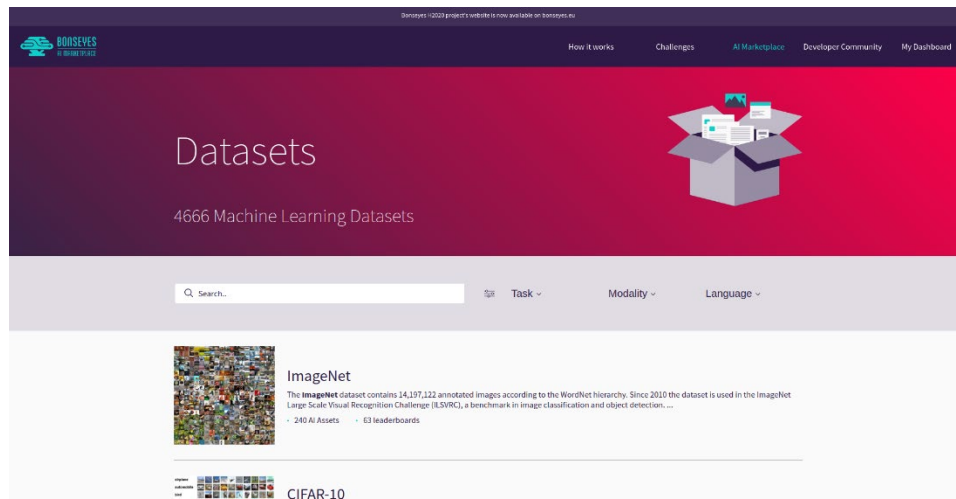


Figure 8: Dataset landing page on the Bonseyes AI Marketplace

4.3 Community

The community part of the Developer's Community provides a networking capability to the Organizations willing to solve AI Challenges and work with top AI Talents on the market for this purpose. Furthermore, it also provides the opportunity for the AI Talents to connect and collaborate with other AI Talents or monetize their knowledge helping Organizations to build AI Solutions. Organization profile provides general information, contacting points and connected profiles. Profile provides general information of the person, short biography, related Organization and contact points.

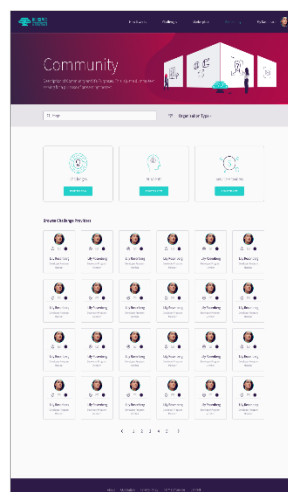


Figure 9: Community page on the Bonseyes AI Marketplace

4.4 Blog

As part of the Developer's Community, BMP will provide a community-driven blog that will present articles and tutorials, e.g., MOOCs [D5.3]. Articles that are going to provide text-based content discussing specific topics and tutorials will represent a practical step-by-step guide.

4.5 Documentation

Bonseyes AI Marketplace documentation is divided in three different blocks:

- **Setup:** The setup process walks the user through the installation of the Bonseyes CLI tool, which is the command line interface that will enable users and developers to interact with the Bonseyes AI Marketplace.
- **User Guide:** The User Guide represents the reference developer's documentation that explains how the user can start using the BMP. It provides comprehensive guide how to use and manage AI Artifacts on the local workstation and further insights of the AI Marketplace.
- **Developer Guide:** The Developer Guide will expand the User Guide for the user to develop or create new AI Artifacts. This guide is intended for AI Talents with expertise in the field of deep learning.

Sections 5-7 further develops these three blocks in detail.

5 Developer's Community: Setup

The setup process is the first step that the user or developer needs to perform to start working with the BMP tools. The setup process is divided in several steps:

5.1 Environment requirements

The user needs to have a workstation with a linux-based operating system. We recommend the users Ubuntu 18 or higher. If the user does not have this environment, the provided documentation guides the user to download a Virtual Machine with the right Ubuntu OS image.

Further, a few software packages need to be installed in the workstation to be able to execute the BMP workflows. These packages are Docker, Git and Python.

All steps and associated documentation are found here:

<https://beta.bonseyes.com//doc/pages/setup.html>

5.2 Bonseyes CLI tool

Once all requirements have been satisfied, the user needs to install the Bonseyes CLI tool, which is the command line interface that will enable users and developers to interact with the Bonseyes AI Marketplace. A simple command in the terminal of the Ubuntu workstation allows the installation.

All steps and associated documentation are found here:

<https://beta.bonseyes.com//doc/pages/setup.html#install-bonseyes-tool>

5.3 Log in to the BMP

Finally, the user is asked to create an account in the BMP (if not yet done) and connect their Ubuntu workstation to it to enable the download of artifacts.

All steps and associated documentation are found here:

<https://beta.bonseyes.com//doc/pages/setup.html#log-in-to-the-marketplace>

6 Developer's Community: User Guide

The User Guide represents the reference developer's documentation that walks through the different workflows of the BMP. The user guide is intended for any user with or without knowledge in deep learning or developer platforms. It provides a comprehensive guide how to use and manage AI Artifacts on the local workstation and AI Marketplace.

6.1 Challenge

This step of the documentation shows the user how to join an AI Challenge in the BMP and download it in the local workstation. Users can join AI Challenges to find the specifications of such challenge and see the specifications that would be needed to solve it. Joining an AI Challenge is more oriented towards a later step in the Developer Documentation: Create an AI Asset.

All steps and associated documentation are found here:

https://beta.bonseyes.com/doc/pages/user_guides/challenge_index.html

6.2 Platform

The Developer Platforms were explained in Section 3.2. In this section, we describe the workflow to use a DPE and set up a Developer Platform. The DPE workflow consists of three steps:

6.2.1 Buy/Obtain a DPE

DPEs are available in the BMP and can be obtained or bought. A DPE comes in the form of zip file and user can download them to their local workstation by following the documentation at: https://beta.bonseyes.com/doc/pages/user_guides/platform_index.html#buy-platform

6.2.2 Setup

The mains steps of the setup process are the following:

1. Decompress files
2. Load docker images
3. Build DPE
4. Set up target hardware

For some platforms, a web-based wizard is provided which guides the user through the necessary steps to build and setup the platform:

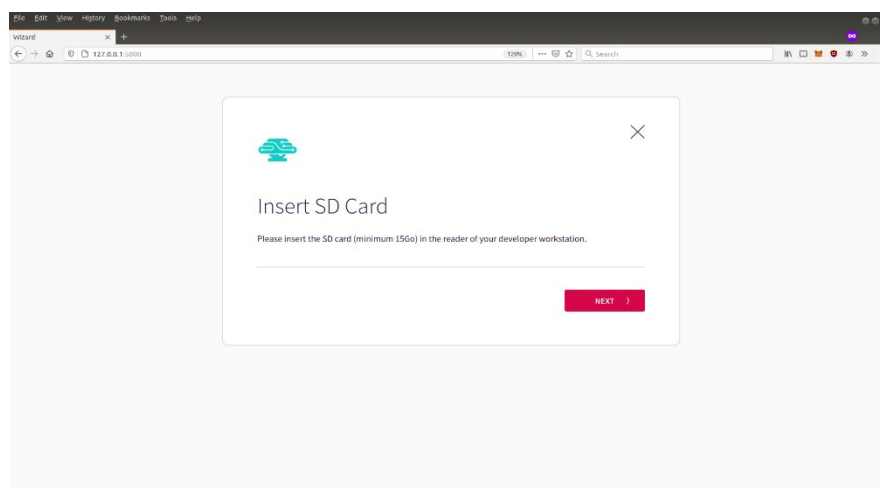


Figure 10: Wizard to flash target hardware

To deploy and AI Asset on some platforms, the user may need to flash the embedded board first with an SD card. This workflow provides detailed information about the process as well as troubleshooting in case of technical problems with the SD card.

All steps and associated documentation are found here:

https://beta.bonseyes.com/doc/pages/user_guides/platform_index.html#setup-platform

6.2.3 Test

A “Hello-world” sample application is provided to test the correct operation of the of the DPE workflow. The main steps of the test process are the following:

1. Cross-compile application for target platform
2. Copy binary on the target platform through Bonseyes CLI tool
3. Execute binary on the target platform

All steps and associated documentation are found here:

https://beta.bonseyes.com//doc/pages/user_guides/platform_index.html#test-platform

6.3 AI Assets

AI Assets were explained in Section 3.1. In this section, we describe the workflow to employ an AI Asset on a Developer Platform.

6.3.1 Requirements

To be able to deploy an AI Asset on a Developer Platform, the user may need certain hardware requirements or install some software packages in the host platform. We recommend the users to have an Nvidia GPU available for a smoother experience while running the processes. Nonetheless, any x86 or aarch64 CPU is also supported.

All steps and associated documentation are found here:

https://beta.bonseyes.com//doc/pages/user_guides/ai_asset_index.html#requirements

6.3.2 Setup

Manipulation of developed AI Assets can be done using AI Assets CLI that allows users to initialize AI Asset container on target platform and control them.

All steps and associated documentation are found here:

https://beta.bonseyes.com//doc/pages/user_guides/ai_asset_index.html#setup

Detailed usage instructions are provided in official AI Asset CLI docs:

https://bonseyes-opensource.gitlab.io/aiassets_cli/

6.3.3 Usage

The AI Asset CLI tool allows the user to experiment with an AI Asset. The AI Asset CLI tool allows users to access the services provided by deployment framework such as:

- **Installation:** Download and initialize specified demo AI Asset locally
- **Train:** Train network and produce AI model based on available configuration files
- **Export:** Export pretrained models from PyTorch format to ONNX and/or TensorRT format(s)
- **Optimize:** Optimize exported models by performing PTQ (post training quantization)
- **Process:** Process data in image, video or camera stream format
- **Benchmark:** Evaluate exported and pretrained AI models against a dataset.

All steps and associated documentation are found here:

https://beta.bonseyes.com//doc/pages/user_guides/ai_asset_index.html#usage

6.4 AI App

AI Applications can be obtained or bought from the BMP. This feature is not available to date. It will be added right after the end of the 1st support programme.

7 Developer's Community: Developer Guide

The Developer Guide represents the reference developer's documentation that provides step-by-step details in order to create AI Assets or AI Artifacts. The developer guide is intended for users with the computer science or machine learning backgrounds. Developer guides provide a comprehensive guide on how to configure and setup local environment, use BMP Tools, create AI Assets and AI Artifacts, and interact with the Bonseyes AI Marketplace.

7.1 AI Artifact Package

AI Artifact package represents a directory with the AI Artifact sources. AI Artifact package always must contain a metadata file called *package.yml*, and, depending on the type of package, it can contain other metadata files.

Details of the metadata file structure and how to create AI Artifact package are found here:

https://beta.bonseyes.com//doc/pages/dev_guides/package_index.html

7.2 AI Challenge

AI Challenge is a description of a problem that can be solved applying deep learning algorithms. AI Challenge details are defined in the metadata file *challenge.yml*. Challenge creation can be divided into following steps:

1. Create AI Artifact package,
2. Create challenge metadata, and connect challenge with the Data Tool available on the AI Marketplace,
3. Upload and publish the challenge on the Bonseyes AI Marketplace.

The steps how to define challenge metadata and upload challenge to the BMP are found here:

https://beta.bonseyes.com//doc/pages/dev_guides/challenge_index.html

7.3 AI Asset

BMP AI Asset represents an implementation of the research paper employing the deep learning deployment-centric framework [AI Asset Container](#). AI Asset Container provides a set of services and standardized building components that facilitates and accelerates the development of AI systems for the resource constrained devices.

AI Asset creation can be divided into the following steps:

1. Setup
2. New boilerplate project creation
3. Local development workflow
4. Train implementation
5. Model catalog creation
6. Model export implementation
7. Model optimization implementation
8. Algorithm implementation
9. Data processing implementation

10. Benchmark implementation
11. AI Asset CLI integration
12. Testing

Detailed description on how to successfully complete each step can be found here:

https://gitlab.com/bonseyes/bonseyes-cli/-/blob/doc/aiasset_dev_guides_v1/doc/pages/dev_guides/ai_asset_index.rst

7.4 Data Tool

DataTool is a dataset wrapper that will ease the process of obtaining data, analysis, splitting and preparation. Goal of the DataTool is to provide reusable building component that will enable manipulation with the dataset.

DataTool is created by using DataTool template generator and following the implementation protocol:

https://beta.bonseyes.com//doc/pages/developer_guides.html#data-tool

7.5 Evaluation Tool

Evaluation Tool allows to download pre-processed data to be used in the challenge. Details of the Evaluation Tool are defined in the metadata file *evaluation_tool.yml*. Evaluation Tools depends on the Data Tool and provide standardized and challenge defined evaluation of the AI Assets and AI Apps. Evaluation Tool is distributed in a form of a docker container. Evaluation Tool creation is a process of following steps:

1. Create the evaluation tool script,
2. Dockerize the evaluation tool,
3. Create the evaluation tool metadata.

Guide how to create Evaluation Tool are found:

https://beta.bonseyes.com//doc/pages/developer_guides.html#evaluation-tool

7.6 Platform

Platform is an AI Artifact that facilitate the process of setup and configuration of the hardware platform. It is a software stack package that installs the operating system for the hardware, required system packages and configurations to enable heterogenous computing and support deployment of the AI Assets and AI Apps. Platform support packages sources that are downloaded from the BMP provide the following:

- Documentation of the platform,
- Docker for setup target hardware, target manager server and cross compilation environment.

In order to create the support packages, it is required to create a platform build that contains:

- A builder docker with the cross-compilation environment,
- A manager docker used to control a target hardware,
- All support files required to setup the target hardware.

After platform creation, platform can be uploaded and published on the BMP through the Bonseyes CLI Tool.

The guide on how to create and upload a developer platform are found:

https://beta.bonseyes.com//doc/pages/dev_guides/platform_index.html

7.7 AI App

AI App is a runtime independent source code of an AI model that implements deep learning algorithm execution. AI Apps are distributed in form of model binary (weights), model config (graph description) and deployment config.

In order to create AI App using Bonseyes framework the following steps are required

1. Model creation:
https://beta.bonseyes.com/doc/pages/dev_guides/ai_app_index.html
2. Algorithm creation:
https://beta.bonseyes.com/doc/pages/dev_guides/ai_app_index.html#algorithm
3. Interface creation:
https://beta.bonseyes.com/doc/pages/dev_guides/ai_app_index.html#interface
4. Deployment tool configuration:
https://beta.bonseyes.com/doc/pages/dev_guides/ai_app_index.html#deployment-tool

8 Conclusions

This document has introduced the current structure and content of the Bonseyes AI Marketplace's Developer's Community. Building on the previous User Support Framework deliverable [D5.1], this document adds new features and capabilities to the BMP. We have started with an introduction of the BMP, continue with the new capabilities from the user perspective side, e.g., developer platform setup and AI Asset experimentation, and then finalize with the developer perspective side, e.g., creation of new AI Artifacts or AI Assets, adding new developer platforms, or using data tools or AI Apps. All content described in this document is accessible through the BMP's beta-version webpage: <https://beta.bonseyes.com/>.

The BMP Developer's Community will be continuously updated during the course of the project. Next releases aim to:

- ❖ Improve the status of the current AI Assets and Developer Platforms based on the feedback from the 1st Support Programme.
- ❖ Increase the content available in the BMP.
- ❖ Add support for the creation of Data Tools, Evaluation Tools, AI Applications and AI Solutions through the BMP.

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