2025

BRICS SKILLS COMPETITION

(BRICS+ FUTURE SKILLS & TECH CHALLENGE)

Application of AI Technology

BRICS-FS-56

Technical Description

(International Final_Online)

May, 2025

Contents

1. Introduction

1.1 Event Name and Description of Skills Competition

1.1.1 Event Name

Application of AI technology event of the 2025 BRICS Skills Competition (BRICS+ Future Skills Challenge).

1.1.2 Description

The application of artificial intelligence technology event of the 2025 BRICS Skills Competition will be held, it focuses on the basic theories, technical applications and practical skills of artificial intelligence, aiming to assess students' abilities in data processing, algorithm design, programming implementation, model training, etc. This competition is mainly aimed at majors related to the new generation of information technology. The specific modules examined include four modules: image processing t, application of machine learning, application of deep learning, and application development of NLP. Achieve the goal of cultivating internationalized, highly skilled, future-oriented technical and skilled talents. The competition is provided with a competition environment and assessment system by a professional artificial intelligence skills competition platform. Contestants complete the task assessment through offline methods. The international finals of this competition are individual matches.

The participants of this skills competition are full-time students currently enrolled in higher vocational colleges and technical colleges. They should use Python and be

based on mainstream AI frameworks at home and abroad such as OpenCV, TensorFlow, and PyTorch. Using classic machine learning algorithms, open-source algorithms of computer vision, convolutional neural networks (CNN), recurrent neural networks (RNN), long short-term memory networks (LSTM), and other technologies, complete the application and development of models related to OpenCV image processing, machine learning, deep learning, natural language processing, and other modules. The assessment content is as follows:

Module A: Image Processing Technology

Using OpenCV, the basic operations of images, image processing, and the extraction and analysis of image features are accomplished. Including but not limited to reading and display, image format conversion, acquisition of basic image attributes, image saving, image filtering, color space conversion, edge detection, etc.

Module B: Application of Machine Learning Algorithms

It mainly examines the application of classic algorithms of machine learning, data preprocessing, feature engineering, model selection and optimization, model evaluation and other knowledge contents, including but not limited to data understanding and preprocessing, feature engineering, model selection and optimization, model evaluation and verification, etc.

Module C: Application of Deep Learning Technology

The main focus is on the development of models in the fields of image classification, object detection, and semantic segmentation, based on deep learning frameworks such as TensorFlow and Pytorch. Deep learning technologies include but not limited to dataset invocation, data preprocessing, deep network construction, model training, model testing, and model application.

Module D: Application Development of Natural Language Processing

Based on practical problems, it examines text classification, sentiment analysis, machine translation, question-answering systems, text generation, etc. Including but not limited to text cleaning, word segmentation and annotation, feature extraction of bag-of-words models, model selection and optimization, evaluation and validation, etc.

1.2 The Relevance and Significance of this Document

This document contains the standards required for this skills competition, as well as information on the evaluation principles, methods and procedures for managing the competition.

Every expert and contestant must understand and comprehend this technical description.

2. Skill Standards

2.1 A General Description of Skill Standards

Skill standards stipulate knowledge, understanding and specific skills, which are the best practices in technical and professional performance internationally. It will reflect the global consensus on what relevant job roles or occupations represent in industry and enterprises.

The skills competition aims to reflect the international best practices described by the skills standard and the extent to which they can be achieved. Therefore, this standard serves as a guide for the training and preparation required for skills competitions.

This standard is divided into different sections with titles and reference numbers.

Each part is assigned a percentage of the total score to indicate its relative importance in the criteria. This is usually referred to as "weight". The total score of all percentages is 100. The weight determines the distribution of scores in the scoring criteria.

Through the competition questions, the scoring scheme only evaluates the skills listed in the standards. They will reflect the standards as comprehensively as possible under the constraints of the skills competition.

The scoring scheme will be conducted within the possible range. A 5% variation is allowed, but the weights allocated by the standard norms must not be changed.

2.2 Skill Standards

Part	weight(%)
Module A: Image Processing Technology	**20**
Contestants need to know and understand: ①Gain an in-depth understanding of the basic architecture, functional modules and usage methods of the OpenCV. ② Master the basic operations in OpenCV, such as image reading, image display and image saving. Knowledge of image processing and computer vision ③ Be familiar with the basic concepts, principles and methods of digital image processing, including image preprocessing, feature extraction, object detection, image segmentation, etc. ④ Understand the basic principles and applications of computer	

vision, such as image recognition, image matching, 3D reconstruction, etc. ⑤ Proficient in Python programming language, able to write efficient and standardized code. ⑥ Be familiar with commonly used algorithms and data structures and be able to apply them to solve practical problems.	
Contestants should be able to: ① Be capable of flexibly applying the functions in the OpenCV for image processing and analysis. ② Be familiar with common functions in OpenCV, such as image transformation, filtering, edge detection and feature extraction. ③ Possess the ability to independently complete image processing or computer vision projects. ④Be capable of designing and implementing image processing algorithms or systems based on actual needs. ⑤ Be capable of analyzing specific problems and proposing reasonable solutions. ⑥ Be good at applying the knowledge learned to solve practical problems, and possess innovative thinking and practical ability.	
Module B: Application of Machine Learning Algorithms	**30**
Contestants need to know and understand: ①Supervised learning, unsupervised learning, reinforcement learning. ② Classification tasks, accuracy rate, precision rate, recall rate, F1	

score, ROC-AUC. ③ Regression tasks, mean square Error (MSE), mean absolute Error (MAE). ④ Clustering tasks, contour coefficient, Davies-Bouldin index. ⑤ Overfitting and underfitting, solutions and techniques for overfitting and underfitting. ⑥ Algorithm selection and optimization, linear model, Support Vector Machine (SVM) : Suitable for small datasets and high-dimensional features.	
Contestants should be able to: ① Quickly identify task types (classification, regression, clustering, etc.) and clearly define the input and output forms. ② Discover potential problems through data distribution and characteristic statistics (such as mean and variance). ③ Select appropriate evaluation indicators based on business requirements. ④ Proficient in handling missing values and detecting outliers. ⑤ Key features can be screened through methods such as correlation coefficient, mutual information, and SHAP value. ⑥ Be capable of selecting models based on data scale and task complexity. ⑦ Master parameter adjustment methods such as grid search and Bayesian optimization, and understand key parameters. ⑧ Master verification methods such as K-fold cross-validation and	

the one-of-a-kind method to avoid overfitting. ⑨ Model defects can be located through methods such as confusion matrices and error sample visualization.	
Module C: Application of Deep Learning Technology	**30**
Contestants need to know and understand: ①Master the basic principles of deep learning, including neural networks, activation functions, loss functions, optimization algorithms, etc. ②Understand the training process of deep learning models, including data preprocessing, model training, and hyperparameter adjustment, etc. ③Based on the case background, master the basic knowledge of related fields, such as computer vision, natural language processing, speech recognition, etc. ④Keep abreast of the cutting-edge technologies and research trends in the relevant field.	
Contestants should be able to: ①Model building and training can be carried out using deep learning frameworks such as TensorFlow and PyTorch to build and train models. ② Be familiar with common problems and solutions in the model training process, such as overfitting, underfitting, gradient vanishing, etc. ③Master skills such as data cleaning, preprocessing, feature	

extraction and feature selection. ④ Be capable of designing reasonable feature engineering schemes based on task requirements to enhance model performance. ⑤ Be familiar with the evaluation metrics of deep learning models, such as accuracy rate, recall rate, F1 score, AUC, etc. ⑥ Be capable of optimizing the model based on the evaluation results, including adjusting hyperparameters and improving the model structure, etc. ⑦Be capable of designing and implementing complete deep learning cases based on the requirements of the competition or actual needs. ⑧ Be familiar with the model deployment process and be capable of deploying the trained model to actual application scenarios.	
Module D: Application Development of Natural Language Processing	**20**
Contestants need to know and understand: ①Master basic techniques such as word segmentation, part-of-speech tagging, named entity recognition (NER), and syntactic analysis. ② Understand the application scenarios of NLP tasks such as text classification, sentiment analysis, and text generation. ③ Be familiar with the principles and applications of pre-trained language models (such as BERT, GPT, T5). ④ Master the model evaluation metrics (such as accuracy rate, F1	

score, BLEU value, etc.). ⑤ Understand model compression techniques (such as pruning and quantization) to reduce model size and inference time. ⑥ Be capable of deploying the trained model to achieve real-time inference.	
Contestants should be able to: ① Proficient in Python programming language and familiar with common libraries such as NLTK, spaCy, and Transformers. ②Be capable of using deep learning frameworks such as TensorFlow and PyTorch for model training and deployment. ③ It can clean, label and preprocess large-scale text data, including noise removal and text normalization, etc. ④Master data augmentation techniques, such as synonym replacement and back translation. ⑤ Be capable of selecting the appropriate model according to the task requirements and conducting Fine-tuning. ⑥Be capable of optimizing model performance by adjusting hyperparameters, using learning rate scheduling and other methods.	

3. Scoring Scheme

3.1 Scoring Method

The scoring of this competition will be automatically conducted by the examination system, and then the review will be completed on-site by the judging

panel. If a contestant cheats or engages in other violations during the competition, the referee will handle the situation based on the contestant's violation. Those with serious circumstances will have their results disqualified.

3.2 Scoring Rules

1. Those with higher total scores will rank higher.

2 For those with the same total score, the ranking will be in the order of Module B, Module C, Module D, and Module A. The candidate with the higher score in each module will be ranked higher. For details of each module, please refer to 4.4 of this article.。

3.3 Evaluation Basis

During the competition design process, the selection of standards and evaluation methods will be determined through the scoring scheme and competition questions.

Evaluation basis, including but not limited to:

- Utilizing image processing techniques, complete image operations；
- Proficient in applying classic machine learning algorithms;
- Build deep learning models and develop deep learning applications;
- Achieve the development of natural language processing application cases.

4. Test Project

4.1 Common Precautions

Whether it is a single module or a series of independent or related modules, the competition questions can evaluate the application of the knowledge, skills and

behaviors defined in the standard.

In combination with the scoring scheme, the purpose of the competition questions is to provide a comprehensive, balanced and realistic opportunity for the evaluation and scoring based on the standard. The relationship between the competition questions and the scoring scheme and the standard will be a key indicator of quality, just like the relationship between the standard and actual work performance.

The competition questions do not include aspects outside the standard and do not affect the balance of the scoring within the standard.

The evaluation of knowledge and understanding in the competition questions is only conducted through the application of it in actual work.

4.2 Competition Question Format/Framework

The competition questions consist of four independent and interrelated modules:

Module A: Image processing technology

Module B: Application of machine learning algorithms

Module C: Application of deep learning technology

Module D: Development of natural language processing applications

4.3 Time Allocation and Score Weighting for Each Module

Modules	Time（min）	Score Weight（%）
Module A: Image Processing Technology	360	20
Module B: Application of Machine Learning Algorithms		30

Module C: Application of Deep Learning Technology		30
Module D: Application Development of Natural Language Processing		20
Total	360	100

4.4 Contents and Scoring Criteria of Each Module

This event consists of four modules, including: Module A: Image Processing Technology; Module B: Application of Machine Learning Algorithms Module C: Application of Deep Learning Technology Module D: Natural Language Processing Application Development, comprehensively assessing the contestants' basic theories, practical skills and innovation capabilities in artificial intelligence, thereby enhancing their professional qualities and employability.

Module A: Image processing technology, mainly based on the OpenCV, completes basic image operations, regenerates classic image processing algorithms, such as edge detection, histogram equalization, filtering and denoising, etc., and verifies their robustness on different types of image data.

Module B: Application of Machine Learning Algorithms. Contestants need to use Python and mainstream machine learning libraries (such as Scikit-learn, TensorFlow Lite, Pandas, etc.) to complete the full-process development from data preprocessing, feature engineering to model training and evaluation.

Module C: Application of Deep Learning Technology

Based on convolutional neural networks, recurrent neural networks, etc., and with TensorFlow, Pytorch, etc. as frameworks, deep neural networks were built and

deep models were trained to complete the application development such as image recognition, image classification, and semantic segmentation.

Module D: Contestants are required to use Python and mainstream NLP tool libraries (such as NLTK, spaCy, Transformers, etc.) to complete the entire development process from data cleaning, model training to server-side deployment.

The scoring criteria for the competition are based on knowledge points or individual questions. Each question is assigned a score, and the total score for each module follows the 4.3-point weighting configuration.

Module Number	Module Name	Job Area
A	image processing techniques	1.Image reading and display: Read the image using cv2.imread(), display the image using cv2.imshow(), save the image using cv2.imwrite() ; 2.Image transformation: including color space transformation, such as between RGB and grayscale, using the cv2.cvtColor() function ; 3. Boundary filling: Fill the edges of an image. Common methods include copy boundary, reflection boundary, and convolution boundary ; 4. Image scaling: Resize the image using the cv2.resize() function ; 5. Image filtering: Remove noise from a given image using mean filtering, Gaussian filtering, median filtering, etc. 6. Edge detection: Accurately detect edges using the Canny edge detection algorithm in combination with

		Gaussian filtering and double-threshold processing. 7.Threshold segmentation: Use cv2.threshold() to implement global or adaptive threshold segmentation. 8. Contour detection: Use cv2.findContours() to extract the target contour and draw the contour boundary. 9. Object detection: Use OpenCV related functions to build a pedestrian detector.
B	Application of machine learning algorithms	1. Use Logistic Regression, Support vector Machine (SVM), and K-nearest neighbor (KNN) to implement binary or multi-classification tasks (such as the classification of the iris dataset). 2. Compare the performance of different classifiers (accuracy rate, recall rate, F1 score). 3. Use linear regression, decision tree regression, and random forest regression to predict housing prices or stock prices. Analyze the importance of features and the problems of model overfitting/underfitting. 4. Use K-Means and hierarchical clustering to cluster the customer data (such as the RFM model). Non-spherical data are processed using DBSCAN or Gaussian Mixture Model (GMM). 5. Use Principal Component Analysis (PCA) and t-SNE to visualize high-dimensional data (such as dimensionality

		reduction of handwritten digits in MNIST).
C	Application of deep learning technology	1. Use the convolutional neural Network (CNN) to perform multi-category classification on the given data set (such as CIFAR-10, ImageNet subset). 2. Implement the application of techniques such as data augmentation (rotation, flipping, etc.) and transfer learning (fine-tuning based on pre-trained models). 3. Use models such as YOLO and Faster R-CNN to detect specific objects (such as pedestrians and vehicles) in images. 4. Mark the detection boxes, calculate the mean average accuracy (mAP), and optimize the balance between detection speed and accuracy. Image segmentation 5. Semantic segmentation or instance segmentation is implemented using models such as U-Net and DeepLab. Evaluate the pixel-level classification accuracy and explore multi-scale feature fusion techniques. 6. Use generative adversarial networks (Gans) or diffusion models to generate images of specific styles (such as art paintings and medical images). 7. Use image recognition technology to achieve lane line detection, traffic sign recognition and pedestrian warning.
D	Development	1. Utilize classic machine learning algorithms to conduct

	of natural language processing applications	sentiment analysis (positive/negative/neutral) or topic classification (sports/technology/entertainment) on news, comments and other texts. 2. Evaluate the model using assessment indicators such as accuracy rate and F1 score. 3. Extract entities such as names of people, places and organizations from the text. 4. Use the Transformer architecture (such as T5, M2M100) to achieve Chinese-English translation and evaluate the BLEU score. 5. Use the Seq2Seq model and the GPT series models to generate summaries, dialogue responses or poems based on the input and evaluate the ROUGE score.

4.5 About Test Project

The test project will be announced on the website (http://www.brskills.com/jzzy/productjs.html).

4.6 About the Change of Test Project

Before the official competition, the test project will be modified by 30%.

5. Skills Management and Communication

5.1 Panel

The panel is composed of the chief expert, deputy chief expert and expert

members. They are responsible for jointly revising the technical documents of this competition and daily management.

5.2 Forum

For any questions related to software and hardware preparations, deployment of the examination environment, etc. before the competition, the participants can enter the WeChat group or QQ group on the artificial intelligence platform to provide feedback. The training and communication for this competition, including before, during and after the competition, will also be carried out through WeChat groups or QQ groups.

The online communication will use the international version of WeChat as the instant messaging tool and Zoom (alternative: the international version of Tencent Meeting) as the meeting tool.

6. Safety Requirements

Safety is a prerequisite for the smooth development of all skills competitions, and it is the core issue that must be considered in the preparation and holding of the competition. Effective measures must be taken to ensure the personal safety of all personnel during the competition.

7. Materials and Equipment

7.1 List of Infrastructure

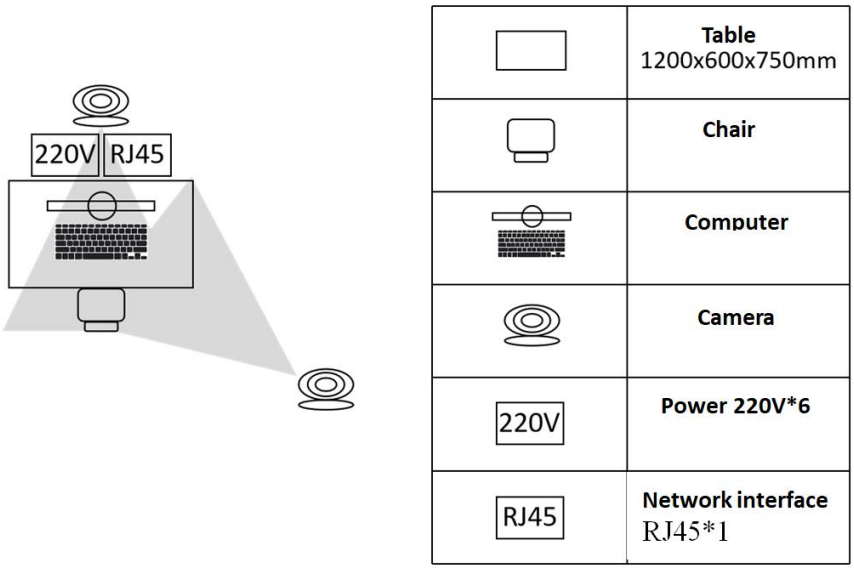
The infrastructure list provides a detailed list of all the equipment and facilities that the participants need to prepare. Please refer to "Infrastructure List for the 2025

BRICS Skills Competition Online Competition - Application of AI Technology " for more information.

7.2 List of Competition Equipment

Number	Platform Name	Quantity	Remark
1	Guoji Beisheng Online Examination System	1	
2	Anaconda	1	

7.3 Suggested Layout of the Competition Area and Workstations



7.3.1 Exam placement requirements

Exam tables should be arranged in a quiet, distraction-free, well-lit and unobstructed environment, and the computer for the examination should be placed in the middle of the examination table. There is a seat for one person in front of the examination table, and the national flag is placed on the examination table.

7.3.2 Layout requirements for mobile monitoring equipment

The center line of the mobile monitoring device 1 is required to be at an angle of 45° to the plane of the competition operation display, which can monitor the competition operation display and the side faces of the players. The monitoring distance is guaranteed to be able to monitor a range of 1 meter around the test site and a height of about 1.5 meters.

The mobile monitoring device 2 is placed on the examination table, and its center line is required to be at an angle of about 45° to the plane of the competition operation monitor. It is required to present the complete monitor competition screen to the maximum extent (the monitor competition screen fills the screen of the mobile monitoring device 2 as much as possible).