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授与した学位	博　士
専攻分野の名称	工　学
学位授与番号	博甲第　　　７１３３　　　号
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学位授与の要件	自然科学研究科　　　　　産業創成工学専攻 （学位規則第４条第１項該当）
学位論文の題目	A Study of Uniform Job Assignment Algorithms to Workers in User-PC Computing System （ユーザ PC コンピューティングシステムにおける均一ジョブのワーカ割当アルゴリズムに関する研究）
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学位論文内容の要旨

In this thesis, I propose several uniform job assignment algorithms for the User-PC computing (UPC) system and an YOLOv8 based stationery product recognition method.

I first present the static uniform job assignment algorithm in the UPC system. To minimize the makespan for completing all the jobs in the system, a set of linear equations are derived to find the number of jobs assigned to each worker, such that the CPU time to complete the assigned jobs becomes equal between the workers. I evaluated the proposal using uniform jobs in the code testing application APLAS, which tests the source codes submitted by students. Applying the proposal to six test codes and 578 source codes show that it reduced the makespan by up to 13% compared to the FIFO approach, demonstrating its effectiveness.

Next, I introduce the extension of the first static uniform job assignment algorithm. The proposal addresses the scenario where uniform jobs of various types are assigned concurrently, deriving modified multiple simultaneous linear equations to consider different uniform job applications. Then, the proposal finds the lower bound on makespan where every worker requires the same CPU time to complete the assigned jobs. For evaluation, 41 images in OpenPose, 32 parameter sets in OpenFOAM, and 578 source codes in APLAS were used, and these jobs were assigned to six workers in the UPC system using the proposal. The results show the makespan was reduced by the average of 5% compared to the results from the first static uniform job assignment algorithm, confirming the proposal's effectiveness.

Third, I further extend the second static uniform job assignment algorithm to handle uniform jobs whose CPU times are multiples of the CPU time of the unit job. The job who has the shortest CPU time is called the unit job for convenience. In physics or network simulations, which are typical scenarios, the CPU time is proportional to the inputs of the program such as the number of meshes or the number of iteration steps. For evaluation, I prepared 176 OpenFOAM jobs and 261 NS-3 jobs to assign to six workers in the UPC system. The results show that the proposal reduced the makespan compared to the second static uniform job assignment algorithm and others, demonstrating its effectiveness.

Finally, I present a design and implementation of a stationery product recognition method using the YOLOv8 model at two stages. To reduce the retraining time and improve the accuracy, the first-stage model is applied to recognize the category of the target object from the given image and the second-stage models recognize the product name/type among those in the category. For evaluation, I prepared 795 images of 45 different stationery products in 9 categories and trained the models, then I measured the training time, the retraining time, and the recognition accuracy. The experiment results show the difference of them between the proposal and the conventional one model case, which confirmed the proposal's effectiveness.

In this thesis, the applicant presented uniform job assignment algorithms for the User-PC computing system and an YOLOv8 based stationery product recognition method.

First, he presented the static uniform job assignment algorithm for the UPC system. To minimize the makespan for completing all the jobs in the system, a set of linear equations are derived to find the number of jobs assigned to each worker, such that the CPU time to complete the assigned jobs becomes equal between the workers.

Next, he introduced the extension of the static uniform job assignment algorithm. Multiple simultaneous linear equations are derived to consider different uniform-job applications, OpenPose, OpenFOAM, and APLAS at the same time. The proposal finds the lower bound on makespan where every worker requires the same CPU time to complete the assigned jobs.

Third, he extended the static assignment algorithm to uniform jobs whose CPU time can be multiples of the shortest time. This job is called the unit job for convenience. In physics or network simulations, which are typical uniform jobs, the CPU time is proportional to the inputs of the program such as the number of meshes or the number of iteration steps. In the proposal, the necessary number of unit job to satisfy the CPU time are prepared for each input job.

Finally, he presented the design and implementation of a stationery product recognition method using the latest YOLOv8 model at two stages. To reduce the retraining time and improve the accuracy, the first-stage model is applied to recognize the category of the target object from the given image and the second-stage models recognize the product name/type among those in the category.

The applicant has published one journal paper and two international conference papers to present the contributions.

From the overall evaluation of this thesis, the applicant has satisfied the qualification condition for the doctor degree in Engineering from the Graduate School of Natural Science and Technology at Okayama University.