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***CONVOLUTIONAL RECURRENT NEURAL NETWORK DAN  
CONNECTIONIST TEMPORAL CLASSIFICATION DALAM  
PENGENALAN AKSARA SUNDA KUNO***

**SKRIPSI**

Diajukan untuk Memenuhi Sebagian dari Persyaratan Memperoleh Gelar Sarjana  
Komputer pada Program Studi S1 Rekayasa Perangkat Lunak



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Gelar Sarjana Komputer pada Program Studi Rekayasa Perangkat Lunak di  
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## **PERNYATAAN KEASLIAN SKRIPSI DAN BEBAS PLAGIARISME**

Dengan ini saya menyatakan bahwa skripsi dengan judul “*Convolutional Recurrent Neural Network Dan Connectionist Temporal Classification* Dalam Pengenalan Aksara Sunda Kuno” ini beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

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Yang membuat pernyataan,



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Rizky Sanjaya Tandia

# **CONVOLUTIONAL RECURRENT NEURAL NETWORK DAN CONNECTIONIST TEMPORAL CLASSIFICATION DALAM PENGENALAN AKSARA SUNDA KUNO**

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## **ABSTRAK**

Aksara Sunda merupakan warisan budaya masyarakat Sunda sekaligus identitas yang perlu dilestarikan keberadaannya. Kondisi dokumen sejarah aksara Sunda yang semakin terdegradasi membuat urgensi digitalisasi dokumen semakin diperlukan. Penelitian seputar aksara Sunda maupun aksara non-latin lainnya sudah banyak dilakukan dengan model gabungan *Convolutional Neural Network* (CNN) dan *Recurrent Neural Network* (RNN) dengan hasil akurasi yang baik. Namun banyak penelitian berfokus pada aksara modern dan transliterasi level per karakter dimana pada karakteristik aksara Sunda kuno menghadapi tantangan lebih kompleks. *Connectionist Temporal Classification* (CTC) yang dipadukan dengan arsitektur CRNN juga terbukti meningkatkan akurasi pengenalan kata dibanding CRNN biasa pada kasus studi pengenalan huruf non-latin. Berdasarkan kekurangan yang ada, penelitian ini mengajukan model gabungan CRNN-CTC untuk pengenalan kata aksara Sunda kuno untuk dievaluasi efektivitasnya. Evaluasi dilakukan dengan metrik *Character Error Rate* (CER) dan *Word Error Rate* (WER) serta *Overall Accuracy* dengan perolehan terbaik pada model yang dimodifikasi didapat CER sebesar 22,87%, WER sebesar 64,49% dan akurasi sebesar 71,03%. Setelah penerapan *hyperparameter tuning* dengan label smoothing angka metrik berhasil diturunkan dengan CER sebesar 18,32%, WER sebesar 49,31% dan *accuracy* sebesar 77,14%. Pengujian pada set testing mendapat *accuracy* sebesar 75,1% dan sampel gambar di kertas HVS mendapat hasil *accuracy* sebesar 81%.

**Kata kunci:** Aksara Sunda, *Convolutional Recurrent Neural Network* (CNN), *Recurrent Neural Network* (RNN), *Connectionist Temporal Classification* (CTC), CER, WER.

# **CONVOLUTIONAL RECURRENT NEURAL NETWORK AND CONNECTIONIST TEMPORAL CLASSIFICATION IN SUNDANESE MANUSCRIPT RECOGNITION**

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## **ABSTRACT**

*The Sundanese script is a cultural heritage of the Sundanese people and an identity that must be preserved. The increasing degradation of historical Sundanese script documents highlights the urgency of document digitization. Research on the Sundanese script and other non-Latin scripts has been extensively conducted using a combination of Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN), yielding good accuracy results. However, most studies focus on modern scripts and character-level transliteration, while ancient Sundanese script presents more complex challenges. Connectionist Temporal Classification (CTC), when combined with the CRNN architecture, has been proven to improve word recognition accuracy compared to standard CRNN in non-Latin script recognition studies. Based on these limitations, this study proposes a CRNN-CTC model for word-level recognition of ancient Sundanese script to evaluate its effectiveness. The evaluation was conducted using Character Error Rate (CER), Word Error Rate (WER), and Overall Accuracy metrics, with the best results obtained from a modified model achieving CER of 22.87%, WER of 64.49%, and accuracy of 71.03%. After applying hyperparameter tuning with label smoothing, the error rates were further reduced, resulting in a CER of 18.32%, WER of 49.31%, and accuracy of 77.14%. Testing on the test set achieved an accuracy of 75.1%, while samples on HVS paper achieved an accuracy of 81%.*

**Keyword:** Sundanese Manuscript, Convolutional Recurrent Neural Network (CNN), Recurrent Neural Network (RNN), Connectionist Temporal Classification (CTC), CER, WER.



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