3. Data Compression, AEP and Lossless Source Coding

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Source coding

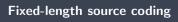
System

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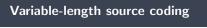
System

 ${\bf Definition}\ 1\ ({\bf Discrete}\ {\bf Memoryless}\ {\bf Source}\hbox{:}\ {\bf DMS})$

3

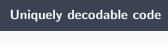


 $Definition\ 2\ (fixed\text{-length code})$



Definition 3 (variable-length code)





Definition 4 (unique decodability)

Prefix-free code

Definition 5 (prefix-free code)

Condition of optimal code

Lemma 6

Lemma 7

Lemma 8

* <u>Proof</u>:



Huffman Code Algorithm

1.

Optimality of Huffman code

Lemma 9

* Proof:



Prerequisites: Weak Law of Large Numbers

Theorem 10 (Weak Law of Large Numbers (WLLN))

For proof of WLLN, we using markov inequality.

Theorem 11 (Markov inequality)

Prerequisites: Weak Law of Large Numbers

* <u>Proof</u>:

Asymptotic Equipartition Property (AEP)

Theorem 12 (Asymptotic Equipartition Property (AEP))

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Weak typical set

Definition 13 (weak typical set)

Weak typical set

Corollary 14

Weak typical set

Corollary 15





Fixed-length block coding

References

- T. M. Cover and J. A. Thomas. Elements of Information Theory, Wiley, 2nd ed., 2006.
- Gallager (2008), Principles of Digital Communication, Cambridge University Press.
- Lecture notes for EE623: Information Theory (Fall 2024)