

CS207 Design and Analysis of Algorithms

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Greedy Method

Greedy Method

- ▶ Works for some optimization problems, not all
- ▶ A greedy choice is one that looks best at the moment
- ▶ Steps:
 - ▶ Formulate a solution in which we make a *greedy* choice and are left with one subproblem.
 - ▶ Prove that there is always an optimal solution reachable through the greedy choice; that is, the greedy choice is safe
 - ▶ Devise a way to combine an optimal solution to the subproblem with the greedy choice to obtain an optimal solution to the original problem

Encoding

- ▶ Suppose a text of n symbols is to be encoded.
- ▶ Say the text is made up of an alphabet of m symbols
- ▶ Each symbol can be assigned a $\lceil \log m \rceil$ -bit code. This is fixed length encoding. If the text is encoded using these codes, the encoding would take $n \lceil \log m \rceil$ bits.
- ▶ A variable length encoding might use fewer bits. Symbols that occur more frequently in the text could be assigned shorter encodings. For example, in English 'e' is the most frequently used letter.
- ▶ A prefix-free code (sometimes, also called a prefix code) is an encoding of the symbols such that no code is a prefix of another code.

Encoding

- ▶ A:010 B:1 C:01 is not a prefix-free code, because 01 is a prefix of 010. In this encoding, 0101 cannot be uniquely decoded; it could be either AB (010.1) or CC (01.01)
- ▶ A:0 B:10 C:11 is a prefix-free code. Decoding algorithm: If the next bit is 0, then we have a A. If the next two bits are 10, then we have a B. If the next two bits are 11, then we have a C. There is no other possibility. Also, these three conditions are mutually exclusive. 1010111111010 decodes to 10.10.11.11.11.0.10=BBCC CAB
- ▶ The problem is: Given an alphabet and the relative frequencies of its symbols in a particular, find an encoding that minimises the length of the encoding of the text.

See <https://www.cs.princeton.edu/wayne/kleinberg-tardos/pearson/04Huffman.pdf>