Edge-File Data Format

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1. Data Structure of a File

This document briefly explains the data structure for an edge-file. With this data structure, each edge-file consists of a number of edges, each edge consists of a sequence of linked edgels, and each edgel consists of 3 major quantities: strength, orientation, and position (see Figure 1). These data have very different characteristics and are saved in 5 different formats: 1-byte integer, 2-byte integer, 3-byte integer, 4-byte integer, and single-floating number.

As shown in Figure 1, the first 128 bytes of an edge-file are used as the **header**. The following 8 bytes indicate the **total number of edges** and the **total number of edgels**: the total number of edges (4-byte integer) tells how many linked-edge-records are kept in this file, and the total number of edgels (4-byte integer) is useful in allocating memory for edgels during the load-in process.

Different linked-edge-records have different numbers of edgel-records. The first 3 bytes of a linked-edge-record keeps the **number of edgels** (3-byte integer) of this edge. Then it is followed by a sequence of edgel-records. Each edgel-record keeps 3 basic quantities of the edgel: **strength**, which is proportional to the contrast of the edgel; **orientation**, which indicates the orientation of the tangential vector of the edgel; and **position**, which indicates the location of the edgel center.

A single-floating number is used to represent the strength of edgel. The edgel orientation is also a real number, but because its value only varies from 0 to 2π, there is no need to represent this quantity in a 4-byte single-floating number. Instead, orientation is encoded in a 2-byte integer with resolution $\frac{2\pi}{65536}$ radians. For example, 1043 is used to represent 0.1 radians. ($1043.0378 = 0.1 * \frac{65536}{2\pi}$). Similarly, the position of edgel, (x, y), can also be encoded in integers instead of single-floating numbers. Currently, the resolution of position is chosen to be $\frac{1}{128}$ pixels. In this case, 111.11 is represented by 14222 ($14222.08 = 111.11 * 128$). With this resolution, if the total columns (or rows) of the image is smaller than 512, then a 2-byte integer is enough to represent the x-coordinate (or the y-coordinate) of edgel position (because $2^{16} = 512 * 128$). On the other hand, if there are more than 512 columns (or rows) in this image, then 3-byte integers should be used.

2. Five types of data formats

There are 5 types of data formats in an edge-file: 1-byte integer, 2-byte integer, 3-byte integer, 4-byte integer, and single-floating number. Their formats are shown in Figure 2. All integers are broken into a sequence of 1-byte data before being saved in an edge-file. The format for a single-floating number is the standard IEEE single-precision format.

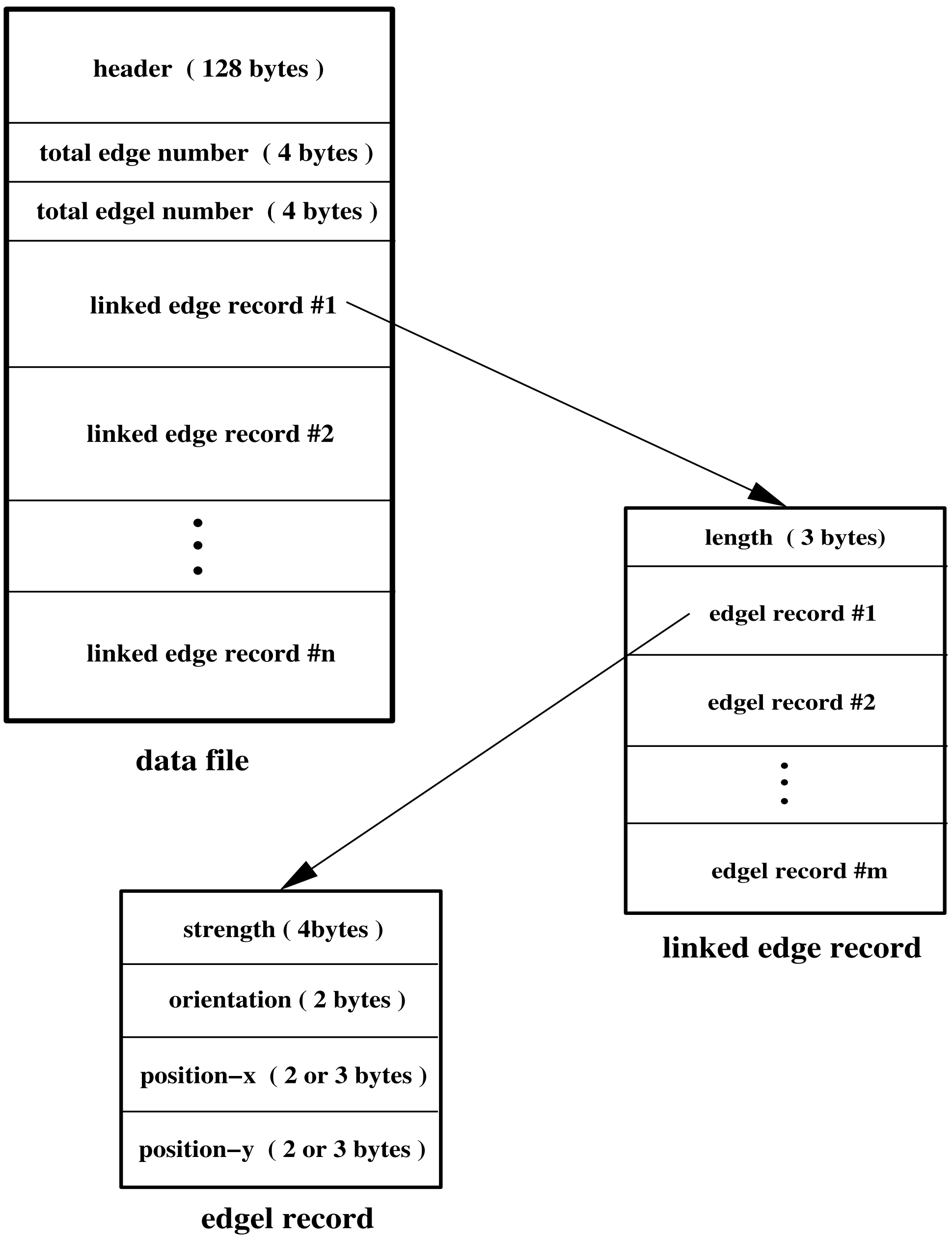

Figure 1. Basic structure of an edge-file

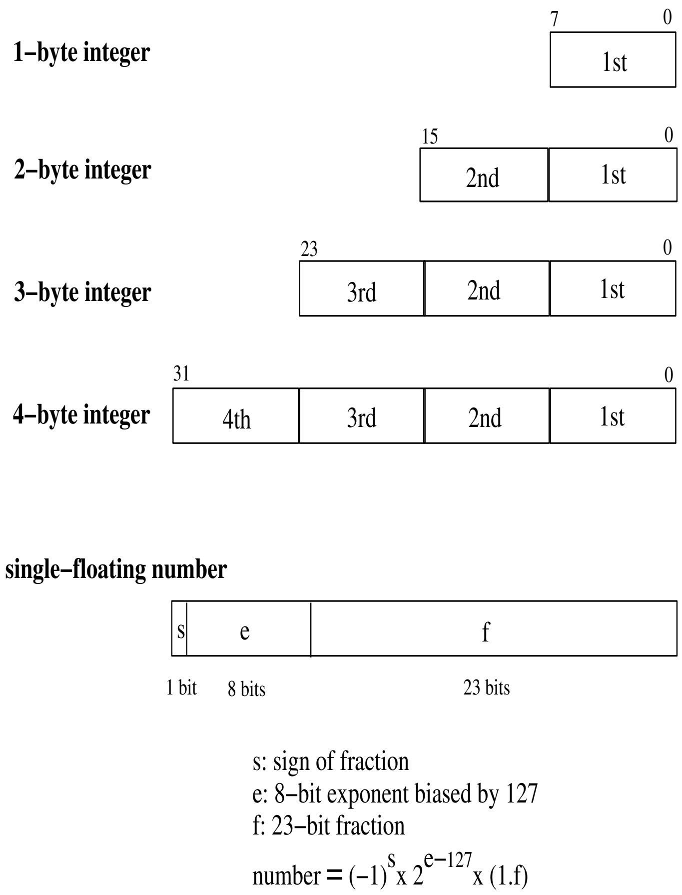

Figure 2. Format of integer and single-floating number