

Suppose we have blocks of size 4096 bytes that we use to store fixed-length records. Each block has a 128 byte header used to store information including the number of records in the block.

(1) Suppose we have records consisting of a 12 byte header, and 3 fields of size 16 bytes, 32 bytes and 70 bytes respectively. Within each record, fields can start at any byte. How many records can we put in a block?

(2) Suppose that we have 5 records, each with a 24 byte header and 1300 bytes of data.

(i) How many blocks will we need to store these 5 records if no spanning is allowed?

(ii) How much total free space is there in the blocks if no spanning is allowed? (Assume we are not storing anything else)

(iii) How many blocks will we need to store these 5 records if spanning is allowed? In addition to the record header, each time a record is split into fragments, each fragment needs an extra header of 12 bytes.

Answer:

(1) 对于具有 12 字节头部和分别为 16 字节、32 字节和 70 字节的 3 个字段的记录:

每条记录的总长度为: 12 字节 (头部) + 16 字节 + 32 字节 + 70 字节 = 130 字节。

块中可容纳的记录数量为: $(4096-128) \text{ 字节 (块大小)} / 130 \text{ 字节 (每条记录大小)} \approx 30.52$

因此, 我们可以在一个块中存储约 30 条记录。

(2)

(i) 对于具有 24 字节头部和 1300 字节数据的 5 条记录:

每条记录的总长度为: 24 字节 (头部) + 1300 字节 = 1324 字节。

一个块中可存储的最大记录条数 (不允许跨区块存储) 为: $\lfloor (4096-128) / 1324 \rfloor = 2$ 条。

总共需要的块数为: $\lceil 5/2 \rceil = 3$ 块。

因此, 我们总共需要 3 个块数。

(ii) 总共的空闲空间为:

$(4096-128-1324*2)*2+(4096-128-1324)=1320*2+2644=5284$ 字节

因此, 总共还有 5284 字节空闲空间。

(iii) 拆分后的记录总长度为: x_1+12 字节与 x_2+12 字节, 其中 $x_1+x_2=1324$ 字节

对于第一个块, 可以存储 $\lfloor (4096-128)/1324 \rfloor = 2$ 条 + $4096-128-1324*2-12=1308$ 字节。

则第二个块, 在存储两条记录后, 仍剩余 $4096-128-1324*2=1320$ 字节

$1320-12-(1324-1308)=1292$ 字节 >0 , 所以足够存储

因此, 总共需要两个块。

Now consider blocks of size 4096 bytes that we use to store variable-length records. Each block has a fixed 128 byte header used to store information including the number of records in the block. In addition to this fixed header, the header contains variable number of 4 byte pointers to each record in the block. Records can start at any byte offset and are packed as densely as possible. Which of these following combinations of records can be stored in a single block? Circle all that apply.

(i) 59 records of 63 bytes each

(ii) 30 records of 94 bytes each and 10 records of 100 bytes each

(iii) 50 records of 11 bytes, 10 records of 13 bytes and 20 records of 148 bytes

(iv) 2 records of size 1982

Answer:

(i) 可以存储。

59 条记录 * 63 字节/条 = 3717 字节

3717 字节 + 59 条记录 * 4 字节/条 = 3953 字节

3953 字节 + 128 字节 = 4081 字节 < 4096 字节 (块大小)

(ii) 不能存储。

30 条记录 * 94 字节/条 + 10 条记录 * 100 字节/条 = 3820 字节

3820 字节 + 40 条记录 * 4 字节/条 = 3980 字节

3980 字节 + 128 字节 = 4108 字节 > 4096 字节 (块大小)

(iii) 可以存储。

50 条记录 * 11 字节/条 + 10 条记录 * 13 字节/条 + 20 条记录 * 148 字节/条 = 3640 字节

3640 字节 + 80 条记录 * 4 字节/条 = 3960 字节

3960 字节 + 128 字节 = 4088 字节 < 4096 字节 (块大小)

(iv) 不能存储。

2 条记录 * 1982 字节/条 = 3964 字节

3964 字节 + 2 条记录 * 4 字节/条 = 3972 字节

3972 字节 + 128 字节 = 4100 字节 > 4096 字节 (块大小)