Discussion 2

Disk, buffers and Files

Agenda

- Record Formats
- File Organisation
- Worksheet

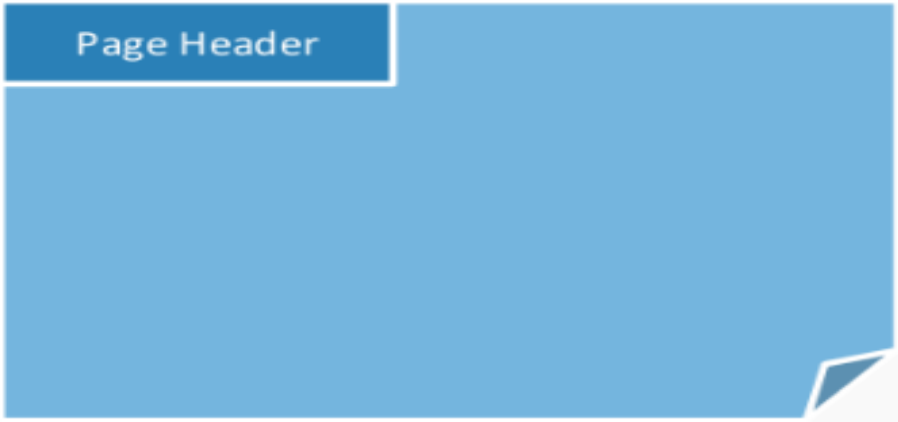
Hierarchy

- File (maps to a table)
  - Page (many pages in a table)
    - Record (many records in a page)

Record Formats

Page basics: the header

- Helps keep track of records
  - Header may contain:
    - Number of records
    - Free space location
    - Bitmap



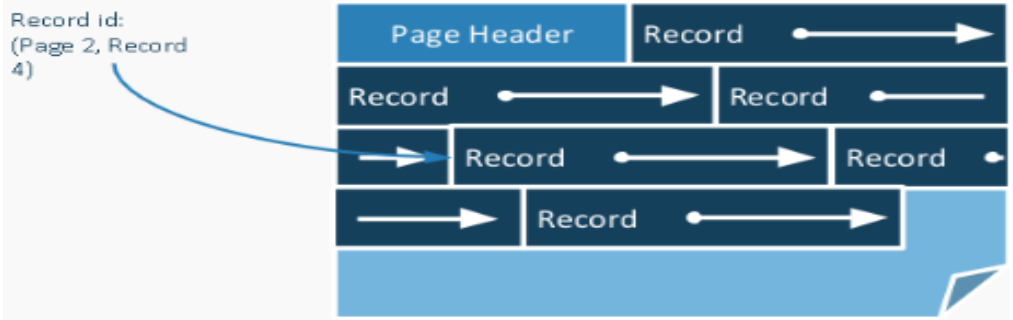
Fixed Length Records

- Fixed record length AND consistent field length
    - Multiple fields make up a record

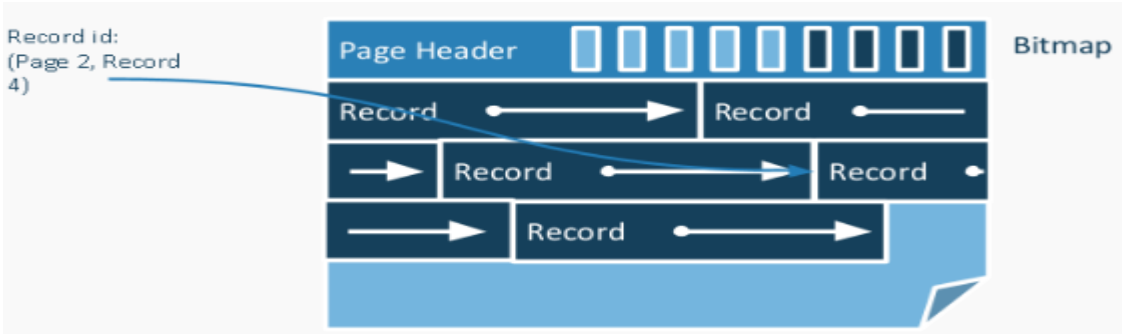
```
                |  length 5      |   2   |      3      |      4      |
Record1 =       |     Field1     |Field2|   Field3   |    Field4    |

Record2 =       |     Field1     |Field2|   Field3   |    Field4    |

Record3 =       |     Field1     |Field2|   Field3   |    Field4    |
```

Fixed Length Records

- **Packed**: record ID is “location in page”



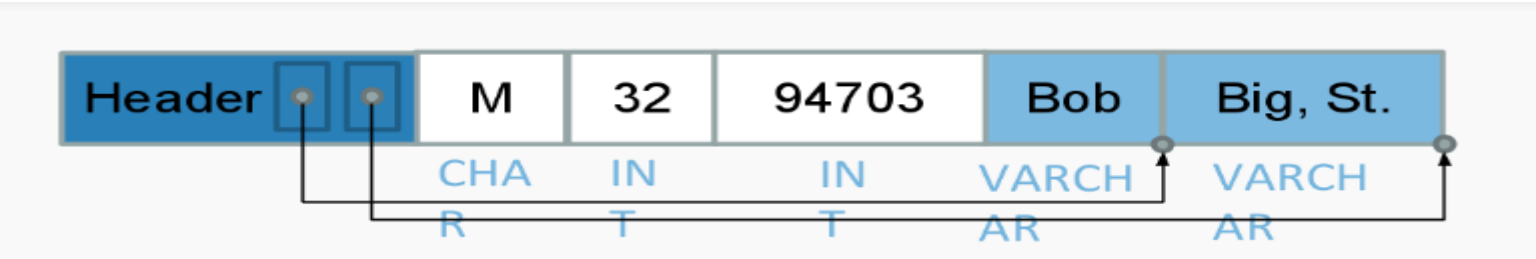
- **Unpacked**: Header includes bitmap, which denotes slots with records



Variable Length Records

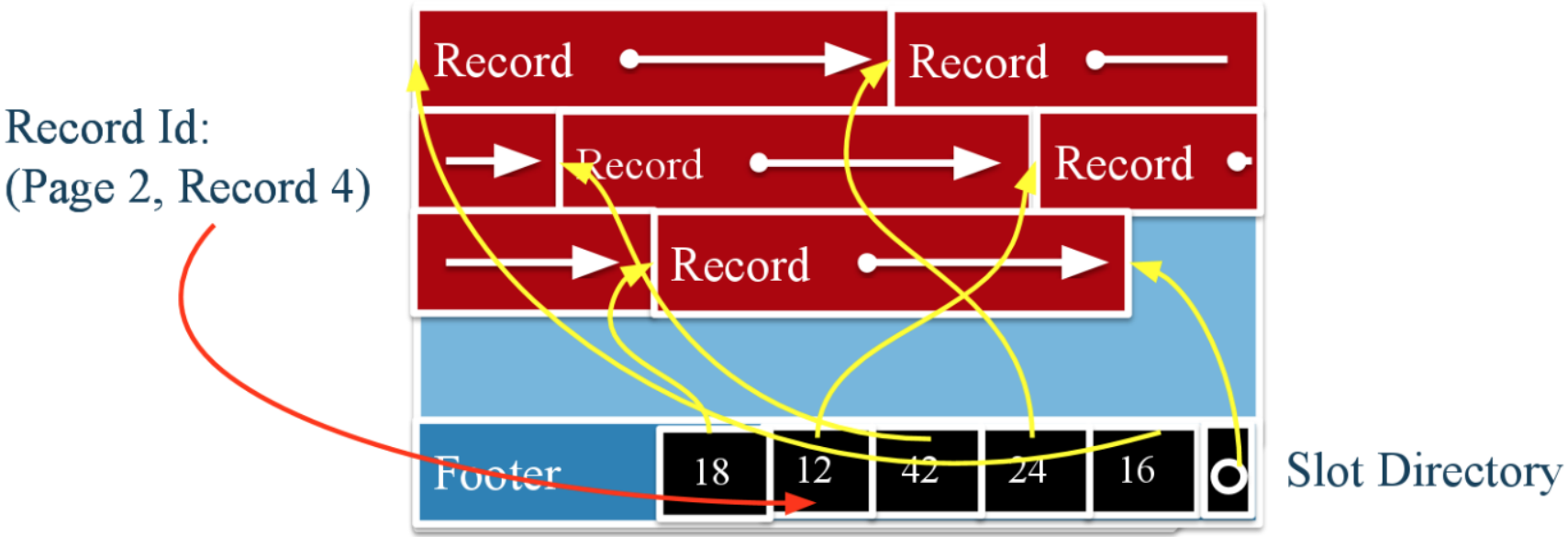
- Delimit fields with special characters

- Array of field offsets (typically preferred)



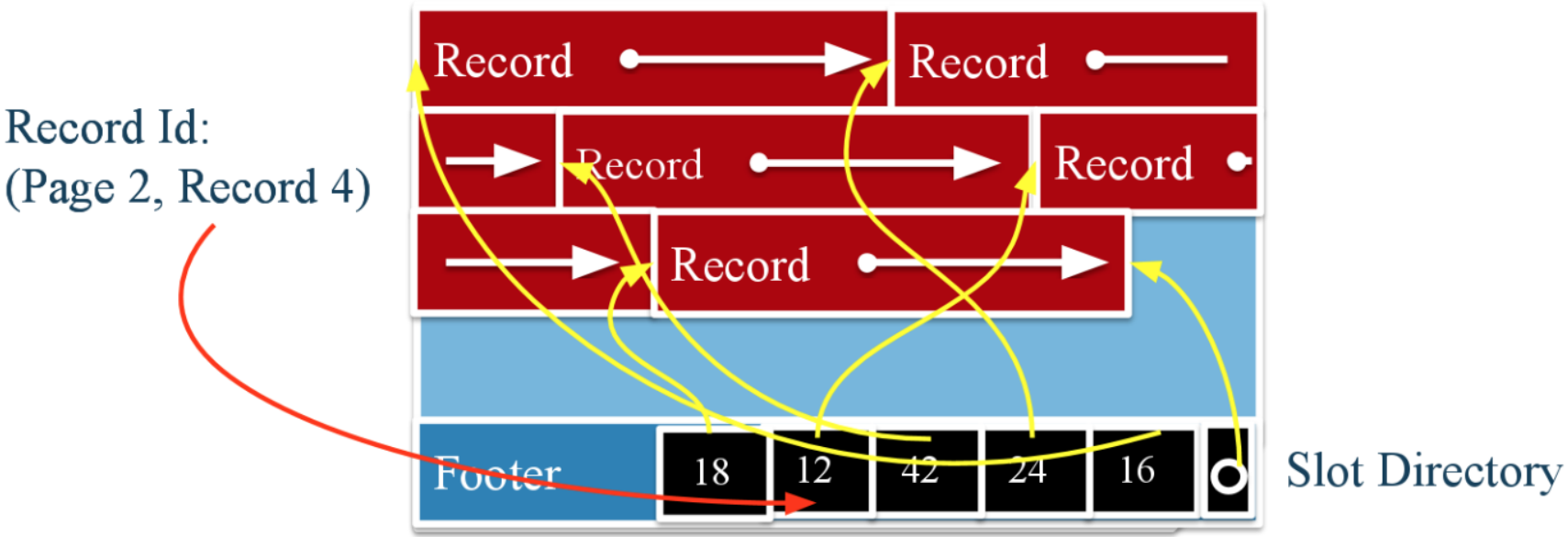
Page format w/ Variable Length Records

- How do we know where each record begins?
- What happens when we add and delete records?



Slotted Page

- Slot directory in footer:
  - Length + pointer to beginning of record (each entry is therefore 2 dimensional)
  - Pointer to free space



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F. In a page containing fixed-length records with no nullable fields, the size of the bitmap never changes. True, the size of the records is fixed, so the number we can fit on a page is fixed.

File Organization

Heap Files

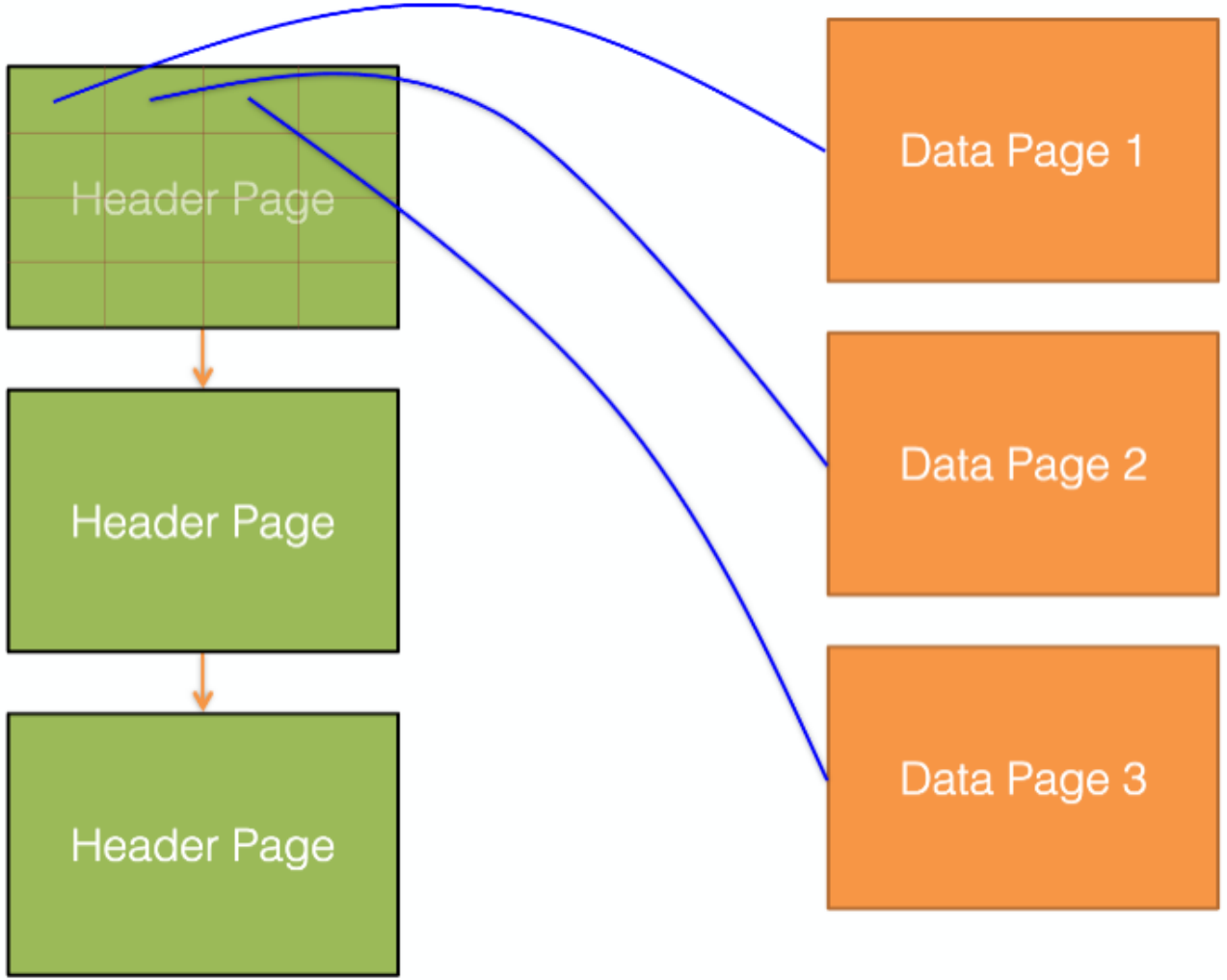
- Within a heap file, keep track of **pages**
- Within a page, keep track of **records** (and free space)
- Records placed **arbitrarily** across pages

RID (record ID) = <page id, slot #>

(Sorted files have the pages and records… sorted.)

Files: Page Directory

- We need to keep track of free space on pages
- So let's use a page directory!
- Keep track of # free bytes per page



Worksheet - File Organization

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Heap

- frequent full scans
- frequent inserts

Sorted

- selecting range of records by search key order
- frequent key lookup + update
- Frequent delete (if packed)

Worksheet - File Organization

2. Assume we have a heap file A implemented with a page directory. One page in the directory can hold 16 page entries. There are 54 data pages in file A in total.

(a) In the worst case, how many IOs are required to find a page with free space?

(b) In the worst case, how many IOs are required to write a record to a page with free space (assuming at least one free page exists)?

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4 I/Os. There will be ceil(54/16) = 4 pages in the directory. In the worst case, we will need to look through all 4 pages in the directory. (The directory contains the amount of free space for each page.)

(b) In the worst case, how many IOs are required to write a record to a page to disk with free space (assuming at least one free page exists)?

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7 I/Os. From part (a), we need 4 I/Os to find the free page. We also have to read the page with the free space (1 I/O), write a record to that free page (1 I/O), and write to the page directory (1 I/O).