CSE 351 Section 6 Solutions – Arrays and Structs

Welcome back to section, we're happy that you're here ☺

We have a two-dimensional matrix of integer data of size M rows and N columns. We are considering 3 different representation schemes:

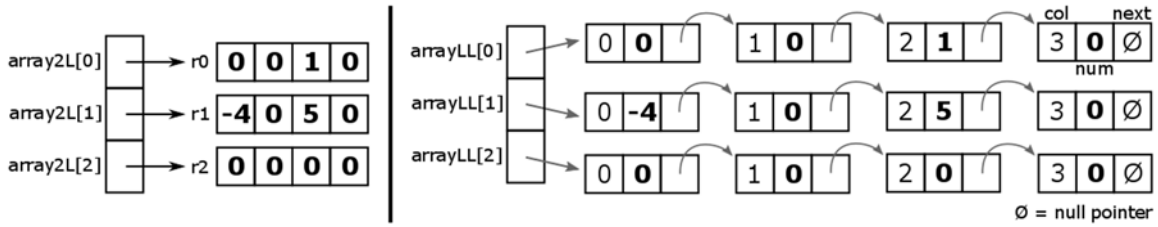
1) 2-dimensional array `int array2D[][]`, // M*N array of ints
2) 2-level array `int* array2L[]`, and // M array of int arrays
3) array of linked lists `struct node* arrayLL[]`. // M array of linked lists (struct node)

Consider the case where $M = 3$ and $N = 4$. The declarations are given below:

2-dimensional array:	**2-level array:**	**Array of linked lists:**

`int array2D[3][4];`	`int r0[4], r1[4], r2[4];`
	`int* array2L[] = {r0,r1,r2};`
		`struct node {`
		`  int col, num;`
		`  struct node* next;`
		`};`
		`struct node* arrayLL[3];`
		`// code to build out LLs`

For example, the diagrams below correspond to the matrix $\begin{bmatrix} 0 & 0 & 1 & 0 \\ -4 & 0 & 5 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ for `array2L` and `arrayLL`:



a) Fill in the following comparison chart:

	2-dim array	2-level array	Array of LLs:
Overall Memory Used	M*N*sizeof(int) = 48 B	M*N*sizeof(int) + M*sizeof(int *) = 72 B	M*sizeof(struct node *) + M*N*sizeof(struct node) = 216 B
Largest *guaranteed* continuous chunk of memory	The whole array (48 B)	The array of pointers (24 B) > row array (16 B)	The array of pointers (24 B) > struct (16 B)
Smallest *guaranteed* continuous chunk of memory	The whole array (48 B)	Each row array (16 B)	Each struct node (16 B)
Data type returned by:	`array2D[1]` `int *`	`array2L[1]` `int *`	`arrayLL[1]` `struct node *`
Number of memory accesses to get `int` in the *BEST* case	1	2	First node in LL: 2
Number of memory accesses to get `int` in the *WORST* case	1	2	Last node in LL: 5 (we have to read `next`)

b) Sam Student claims that since our arrays are relatively small ($N < 256$), we can save space by storing the `col` field as a **char** in `struct node`. Is this correct? If so, how much space do we save? If not, is this an example of internal or external fragmentation?

No. Alignment requirement of $K = 4$ for `int num` leaves 3 bytes of internal fragmentation between `col` and `num`.