Multi-dimensional arrays

How can we store a table of values?

Let's say there's a class of 8 students,
   with 10 quiz grades each:

7.5	4.5	9.5	2	7	8.5	1	8.5	7.5	6
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
4.5	2	9	9	5.5	4	7.5	6	5	9

How can we declare variables to store all this data?

Solution 1: An array per student

```
double [] student1 = new double[10];
...
double [] student8 = new double[10];
```

student1:

7.5	4.5	9.5	2	7	8.5	1	8.5	7.5	6

...

student8:

4.5	2	9	9	5.5	4	7.5	6	5	9

Tedious!

Solution 2: An array per quiz

```
double [] quiz1 = new double[8];
...
double [] quiz10 = new double[8];
```

quiz1:

7.5	...	...	...	...	...	...	4.5

...

quiz10:

6	...	...	...	...	...	...	9

Tedious!

Solution 3: 2-dimensional arrays!

```
double [][] quizScores = new double[8][10];
```

quizScores[0][6]

quizScores:

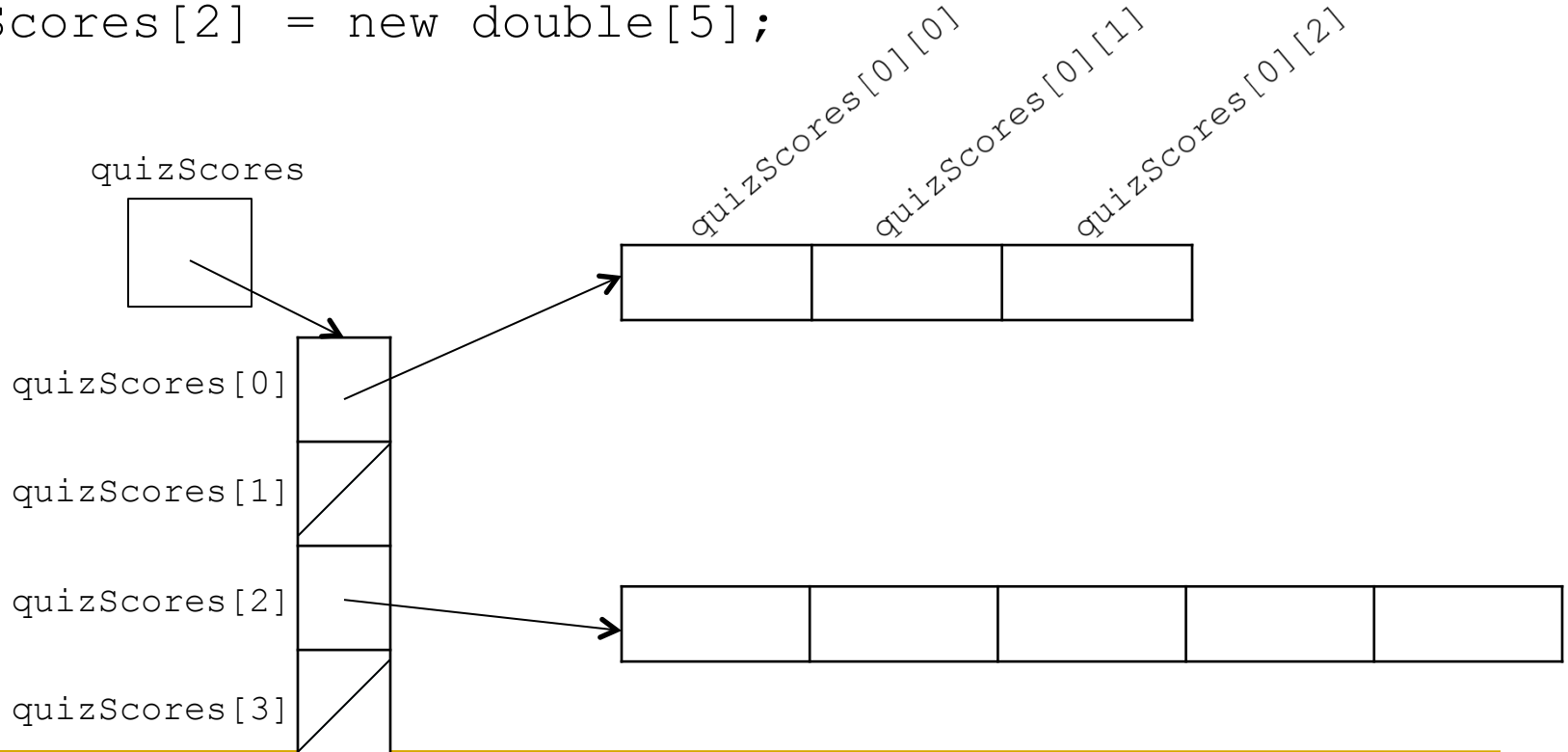| 7.5	4.5	9.5	2	7	8.5	1	8.5	7.5	6
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
4.5	2	9	9	5.5	4	7.5	6	5	9

quizScores[7][9]

2-D Arrays in memory

- A 2-D array is really an array of arrays!

```
double [][] quizScores = new double[4][3];
```
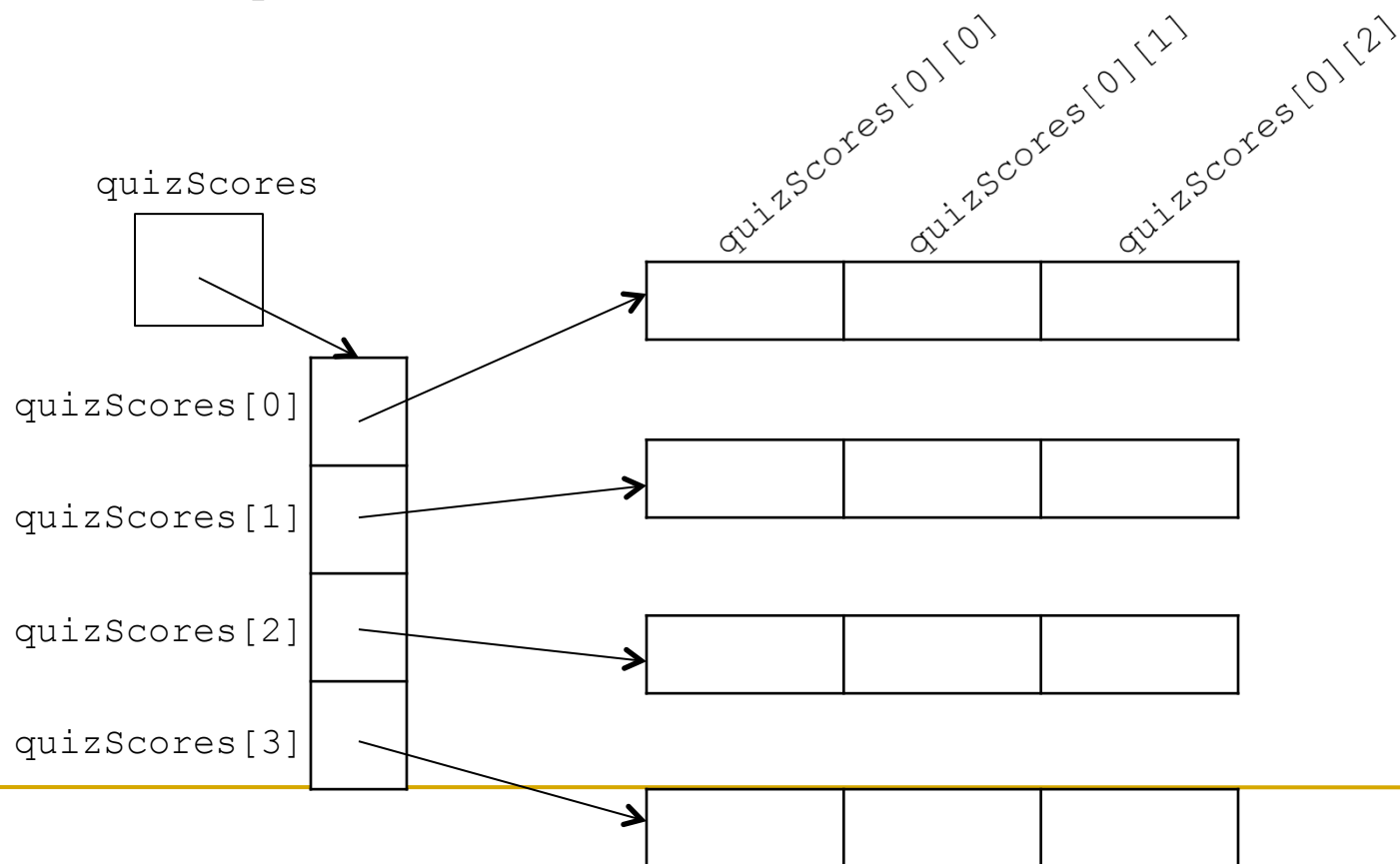
Ragged 2-D arrays

```
double [][] quizScores = new double[4][];
quizScores[0] = new double[3];
quizScores[2] = new double[5];
```

Exercises

- Compute the *trace*, or sum of the elements on the diagonal of a matrix.

- Swap each element in a square 2-D array with elements on the opposite side of the main diagonal.