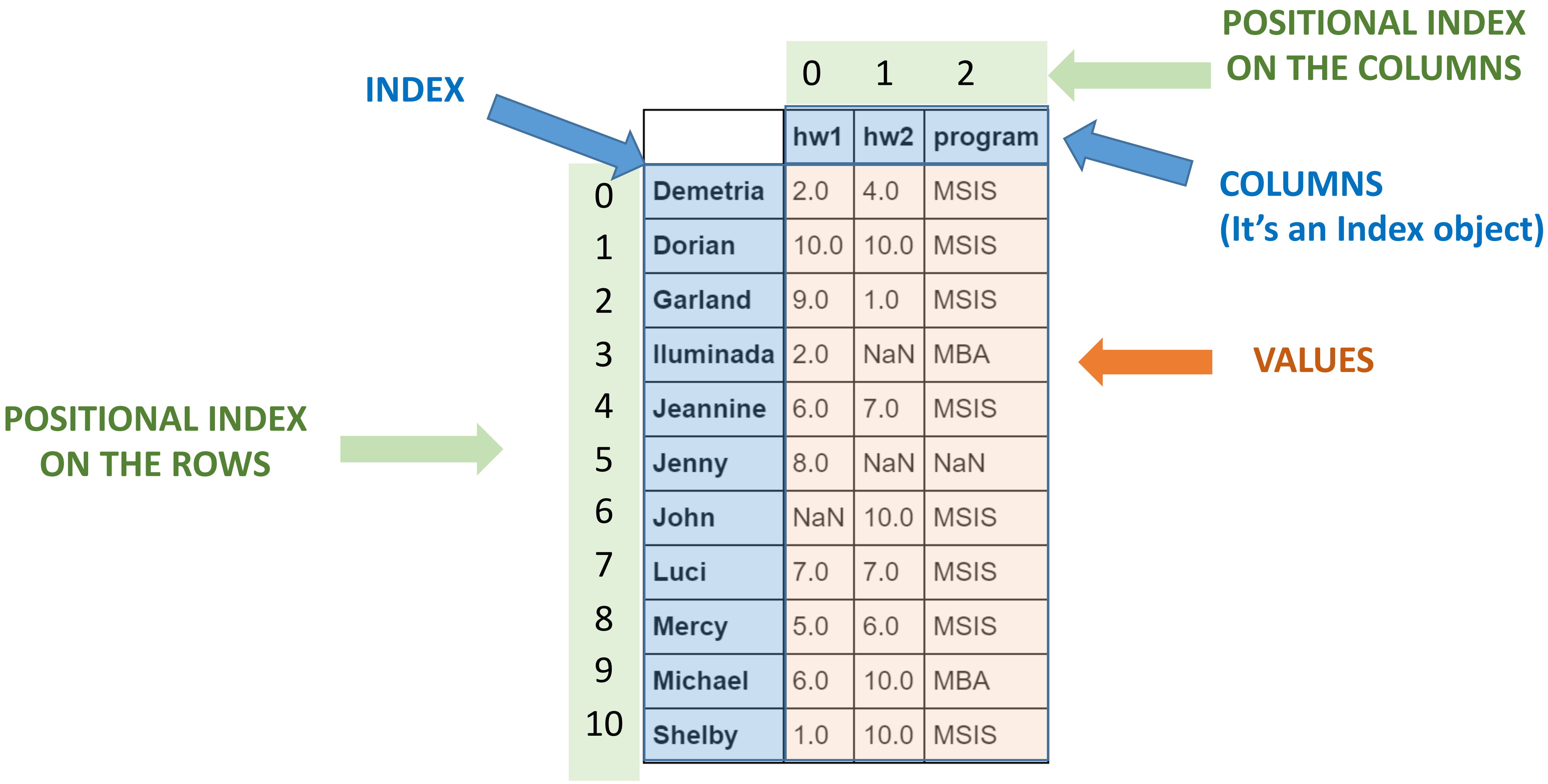
pandas.DataFrame

DataFrame

DataFrame = Table



		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

INDEX

POSITIONAL INDEX
ON THE COLUMNS

COLUMNS
(It’s an Index object)

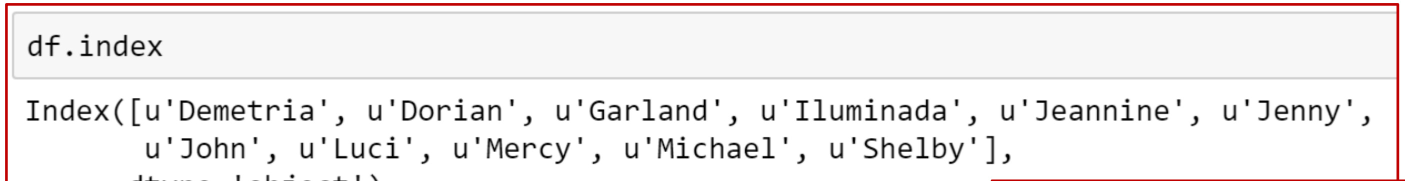
VALUES

POSITIONAL INDEX
ON THE ROWS

Index, columns, values

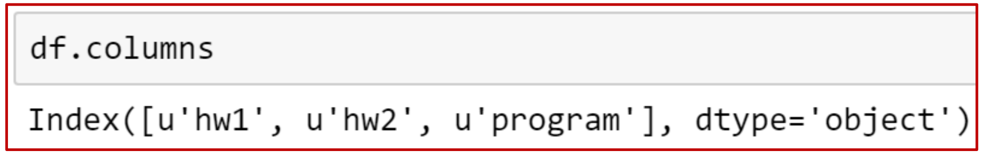
Return the index (as an index object), the columns (as index object) and the values (as 2-dimensional ndarray)

Example:



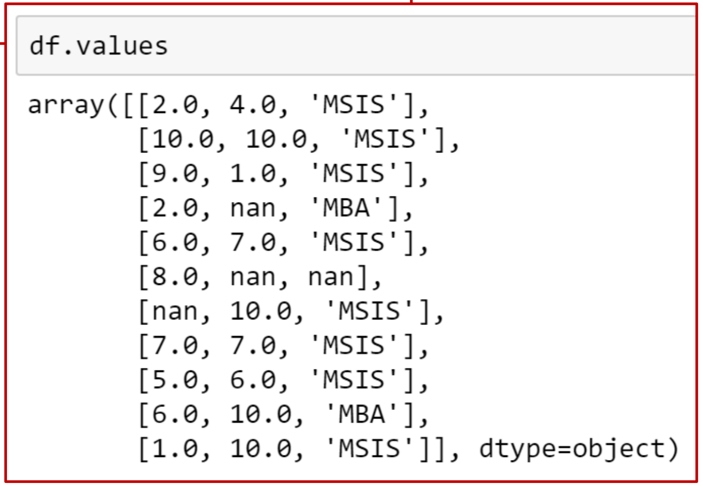
```
df.index
```

```
Index([u'Demetria', u'Dorian', u'Garland', u'Iluminada', u'Jeannine', u'Jenny',
       u'John', u'Luci', u'Mercy', u'Michael', u'Shelby'],
      dtype='object')
```



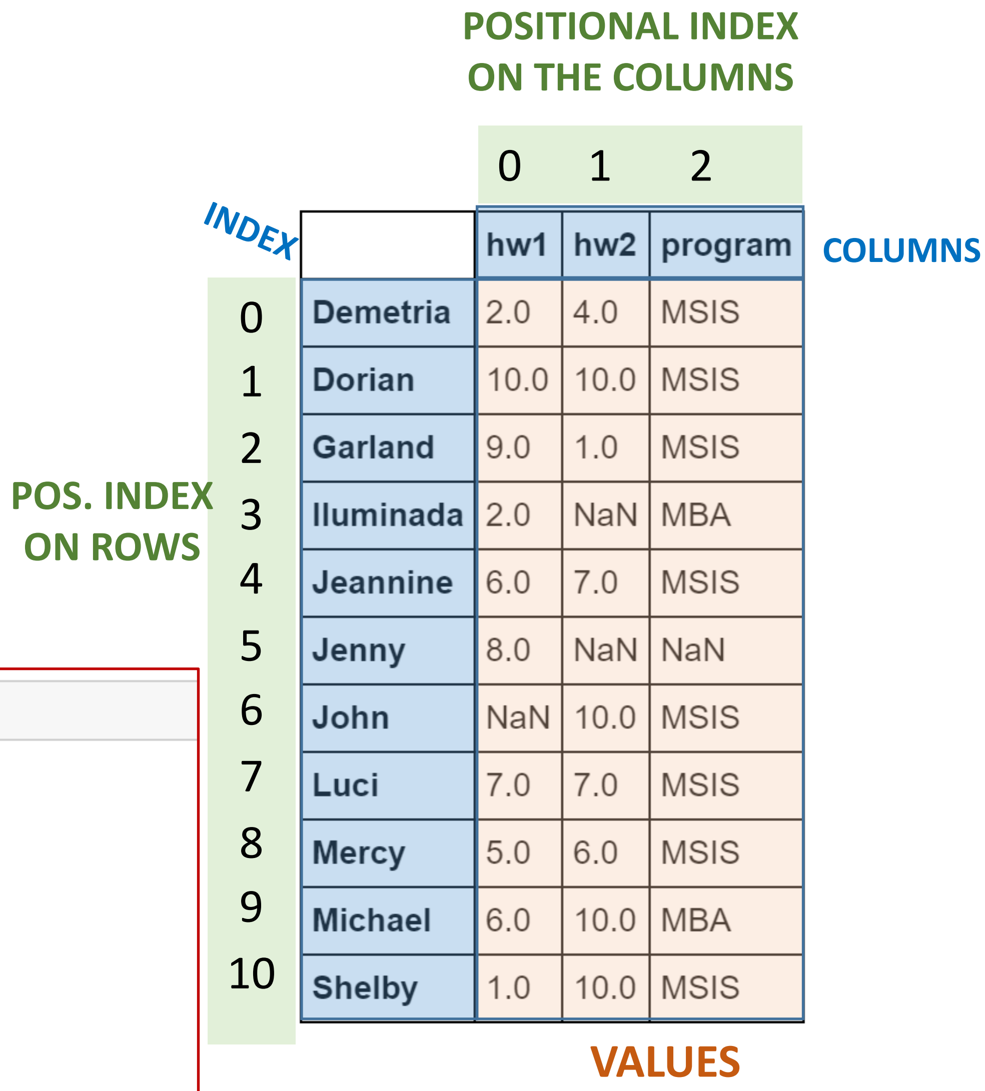
```
df.columns
```

```
Index([u'hw1', u'hw2', u'program'], dtype='object')
```



```
df.values
```

```
array([[2.0, 4.0, 'MSIS'],
       [10.0, 10.0, 'MSIS'],
       [9.0, 1.0, 'MSIS'],
       [2.0, nan, 'MBA'],
       [6.0, 7.0, 'MSIS'],
       [8.0, nan, nan],
       [nan, 10.0, 'MSIS'],
       [7.0, 7.0, 'MSIS'],
       [5.0, 6.0, 'MSIS'],
       [6.0, 10.0, 'MBA'],
       [1.0, 10.0, 'MSIS']], dtype=object)
```



POSITIONAL INDEX ON THE COLUMNS

INDEX

COLUMNS

POS. INDEX ON ROWS

		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

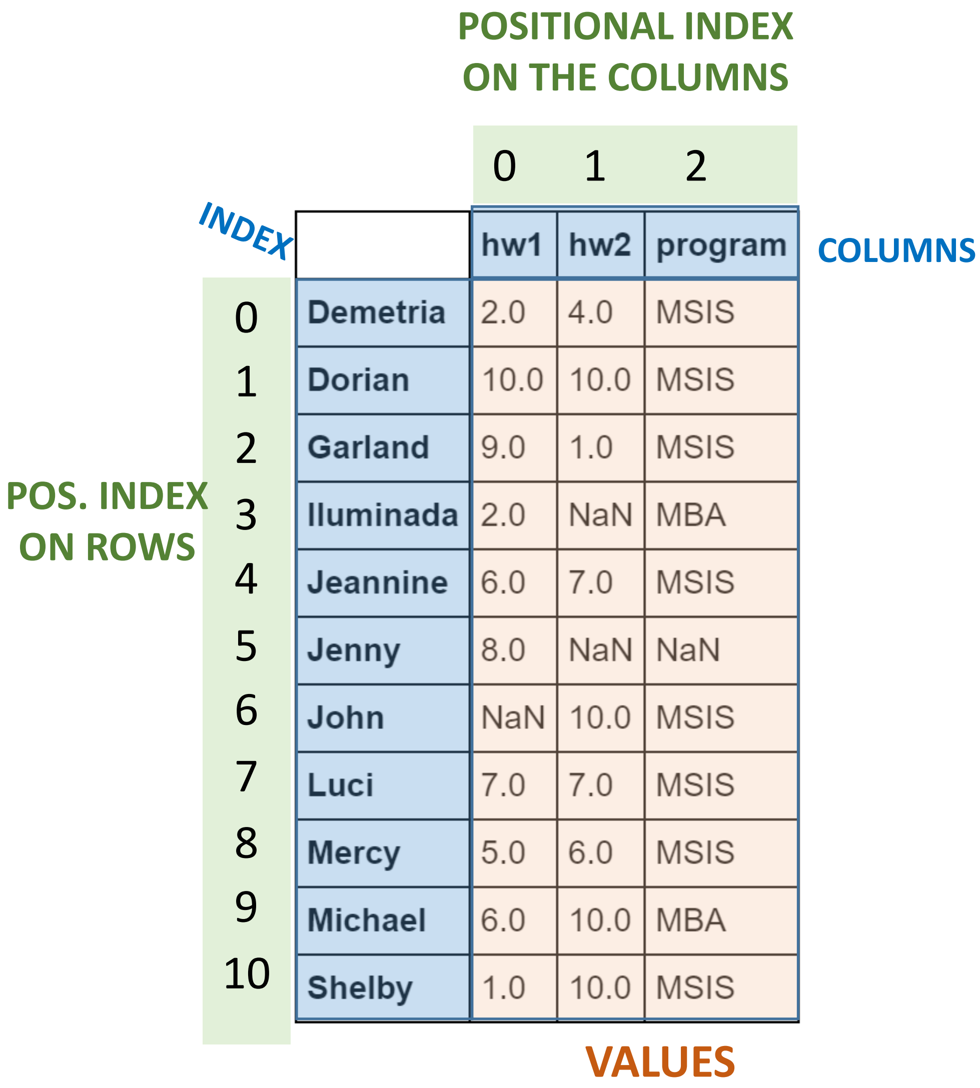
VALUES

df.iloc[x,y]

Access using the **positional index**..

•**x** is the information needed to select the rows: positional index or range of integers

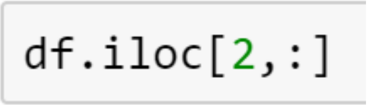
•**y (optional)** is the information needed to select the columns: positional index or range of integers



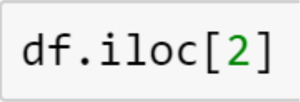
	hw1	hw2	program
Demetria	2.0	4.0	MSIS
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Iluminada	2.0	NaN	MBA
Jeannine	6.0	7.0	MSIS
Jenny	8.0	NaN	NaN
John	NaN	10.0	MSIS
Luci	7.0	7.0	MSIS
Mercy	5.0	6.0	MSIS
Michael	6.0	10.0	MBA
Shelby	1.0	10.0	MSIS

POSITIONAL INDEX ON THE COLUMNS
0
1
2
INDEX
COLUMNS
POS. INDEX ON ROWS
0
1
2
3
4
5
6
7
8
9
10
VALUES

df.iloc[x,y] – one row

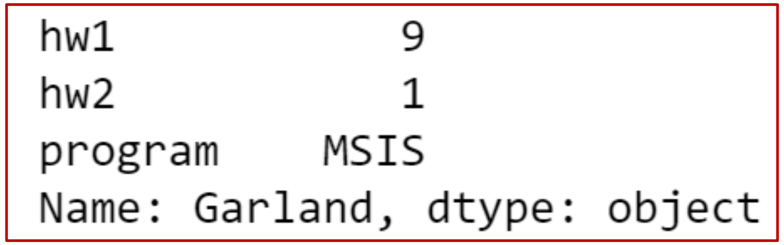


```
df.iloc[2,:]
```



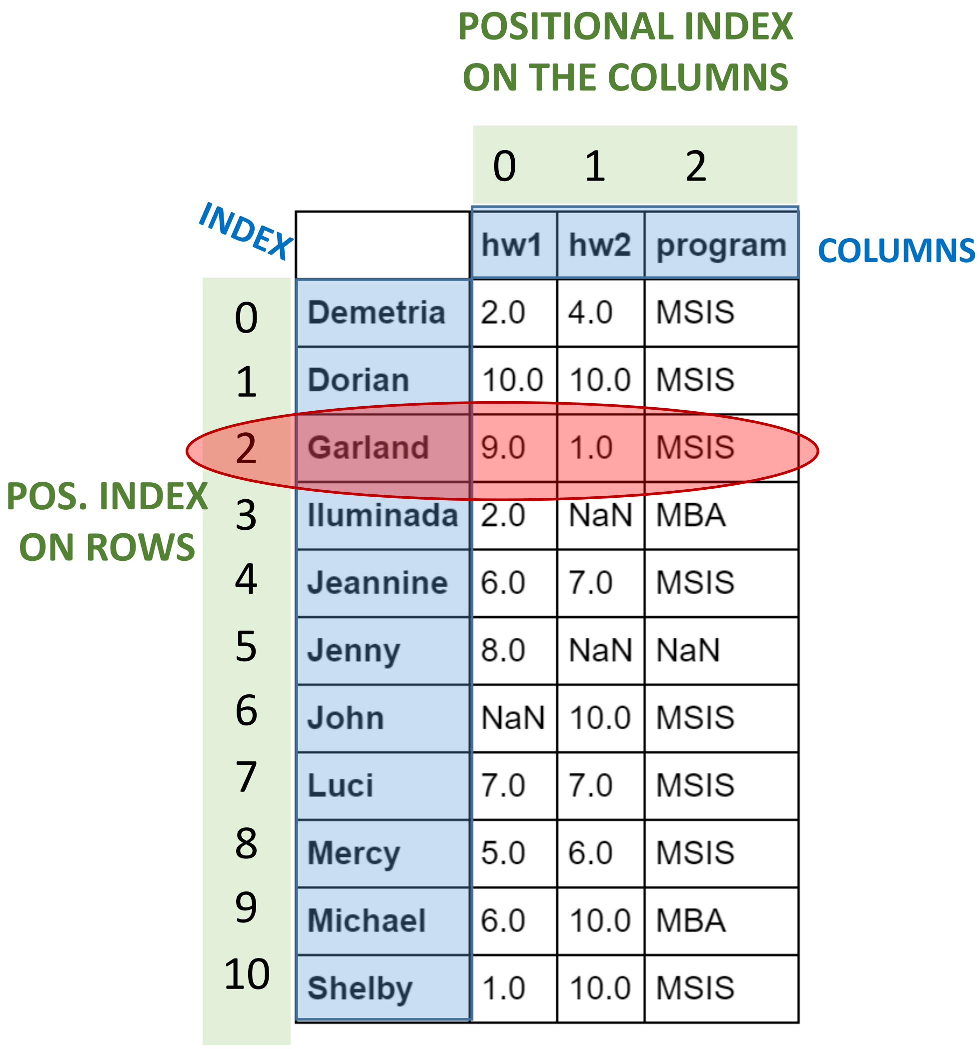
```
df.iloc[2]
```

RESULT:



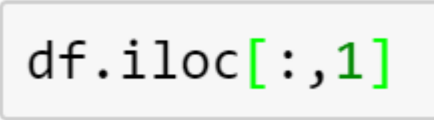
```
hw1              9
hw2              1
program       MSIS
Name: Garland, dtype: object
```

A Series!



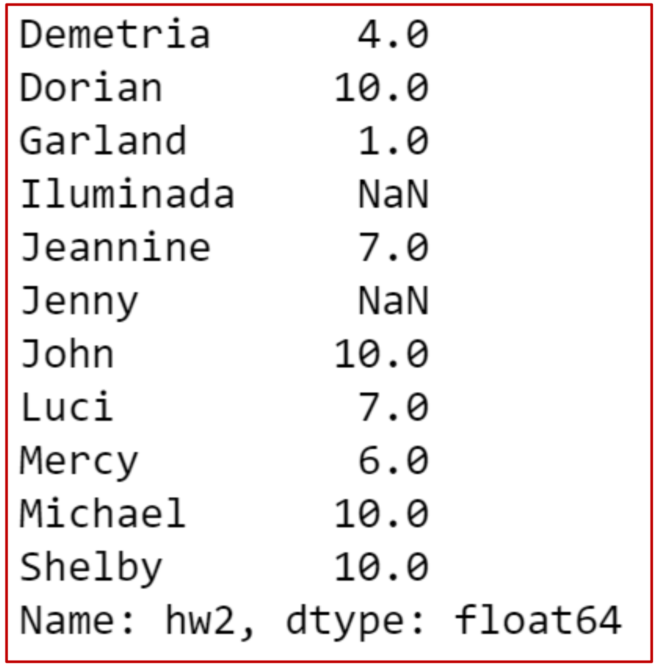
		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

df.iloc[x,y] – one column

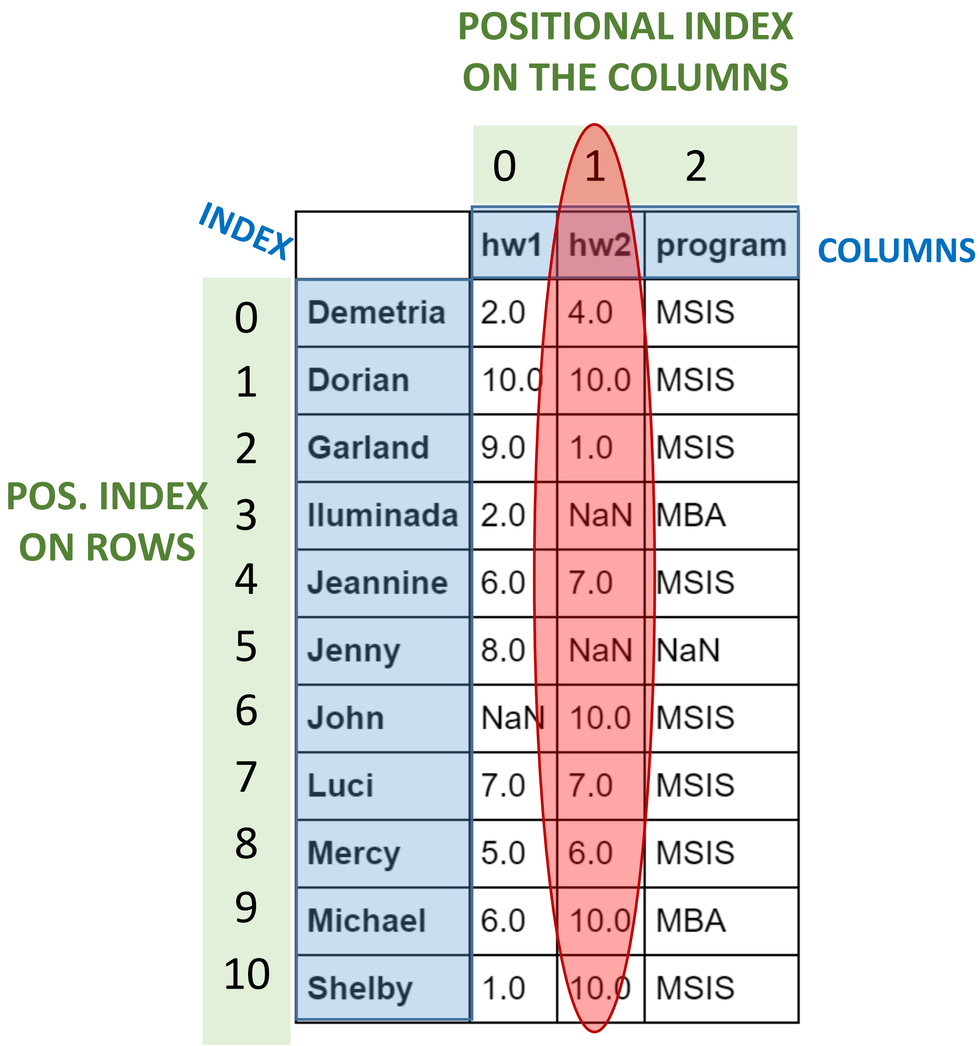


```
df.iloc[:,1]
```

RESULT:

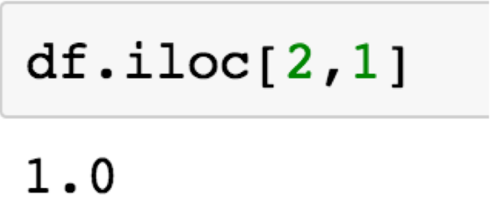


```
Demetria      4.0
Dorian       10.0
Garland       1.0
Iluminada     NaN
Jeannine      7.0
Jenny         NaN
John         10.0
Luci          7.0
Mercy         6.0
Michael      10.0
Shelby       10.0
Name: hw2, dtype: float64
```



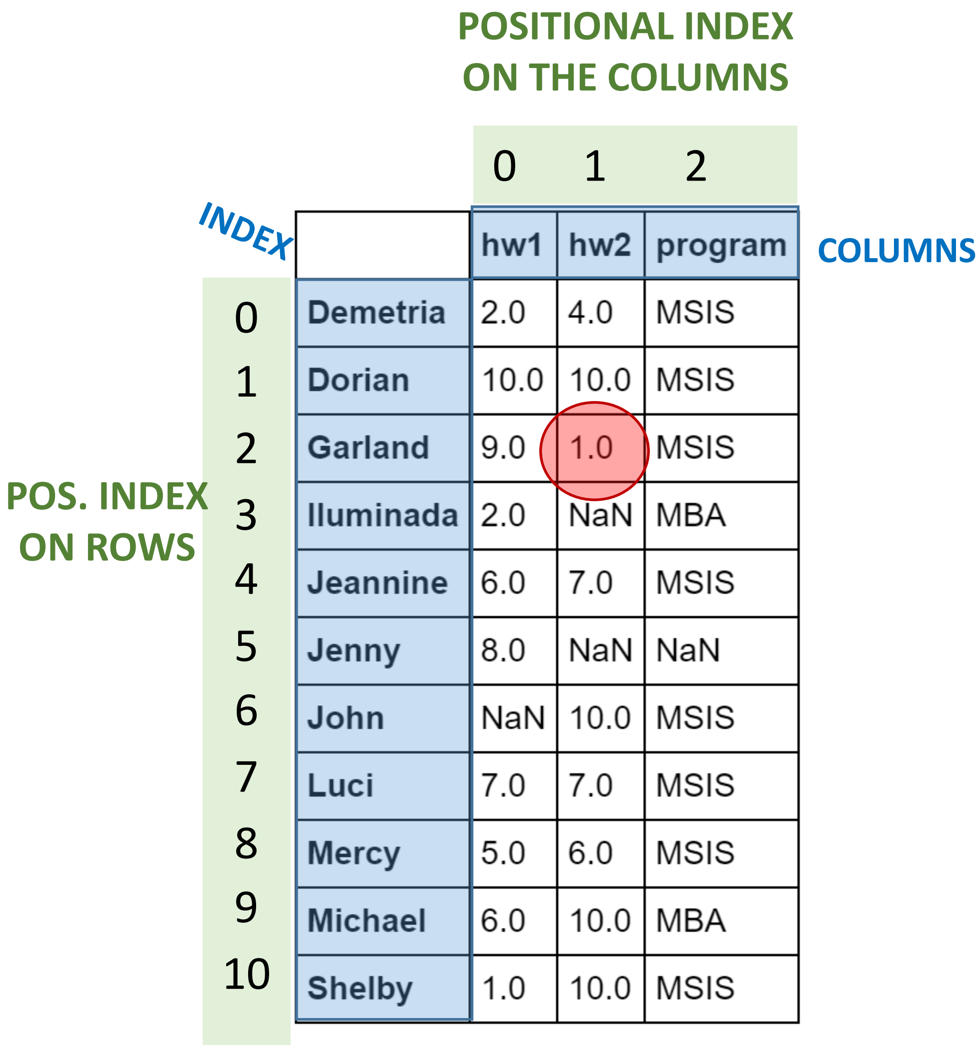
	hw1	hw2	program
Demetria	2.0	4.0	MSIS
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Iluminada	2.0	NaN	MBA
Jeannine	6.0	7.0	MSIS
Jenny	8.0	NaN	NaN
John	NaN	10.0	MSIS
Luci	7.0	7.0	MSIS
Mercy	5.0	6.0	MSIS
Michael	6.0	10.0	MBA
Shelby	1.0	10.0	MSIS

df.iloc[x,y] – one specific value



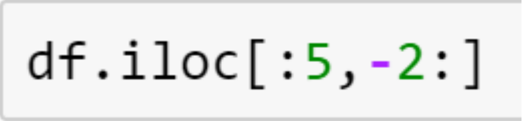
```
df.iloc[2,1]
```

```
1.0
```

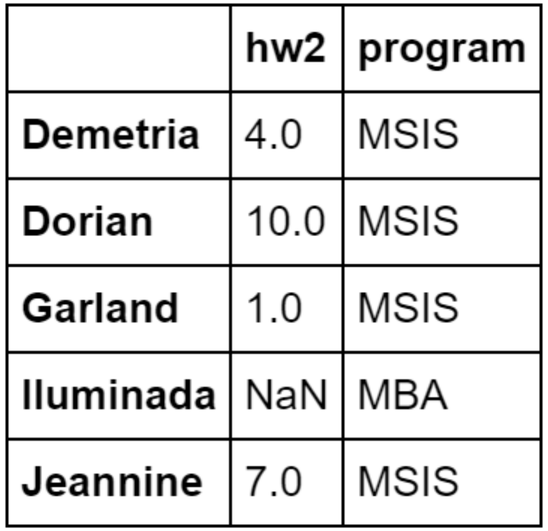


		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

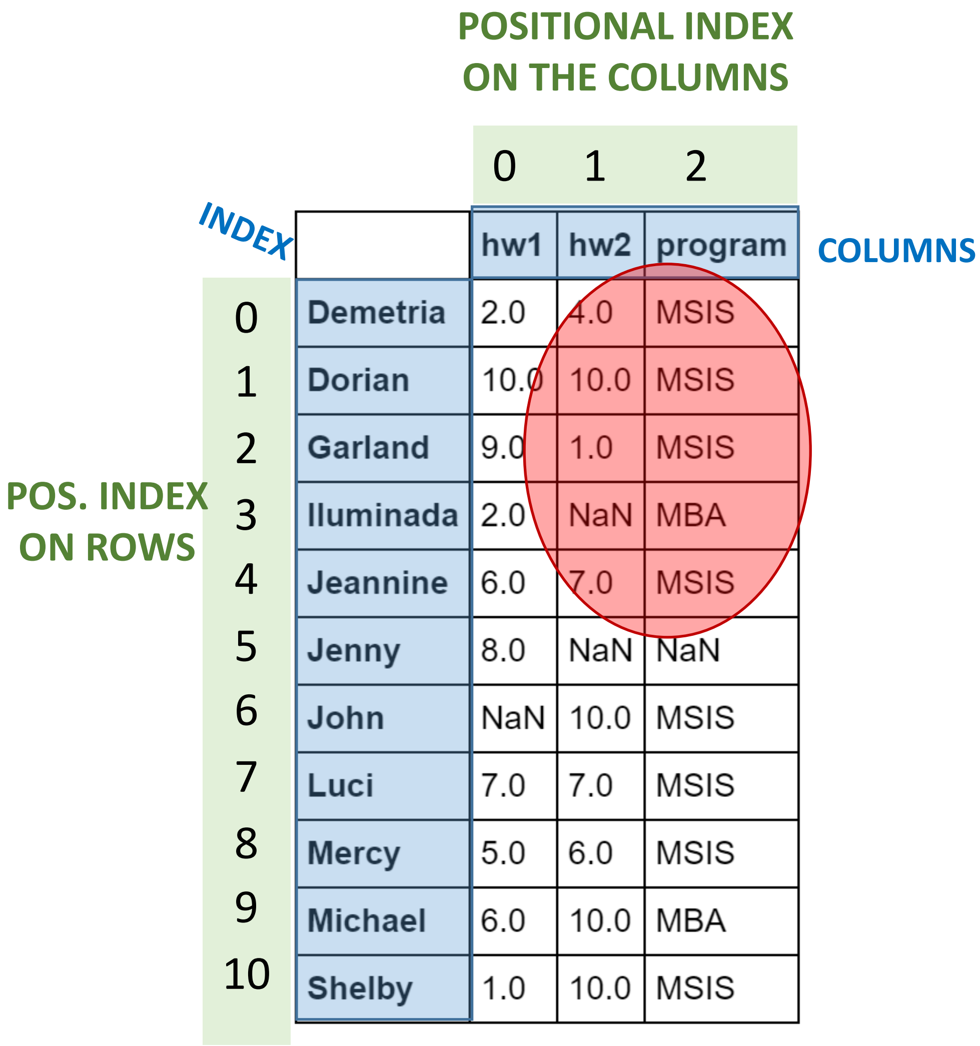
df.iloc[x,y] – a subset of rows/columns



```
df.iloc[:5,-2:]
```



	hw2	program
Demetria	4.0	MSIS
Dorian	10.0	MSIS
Garland	1.0	MSIS
Iluminada	NaN	MBA
Jeannine	7.0	MSIS



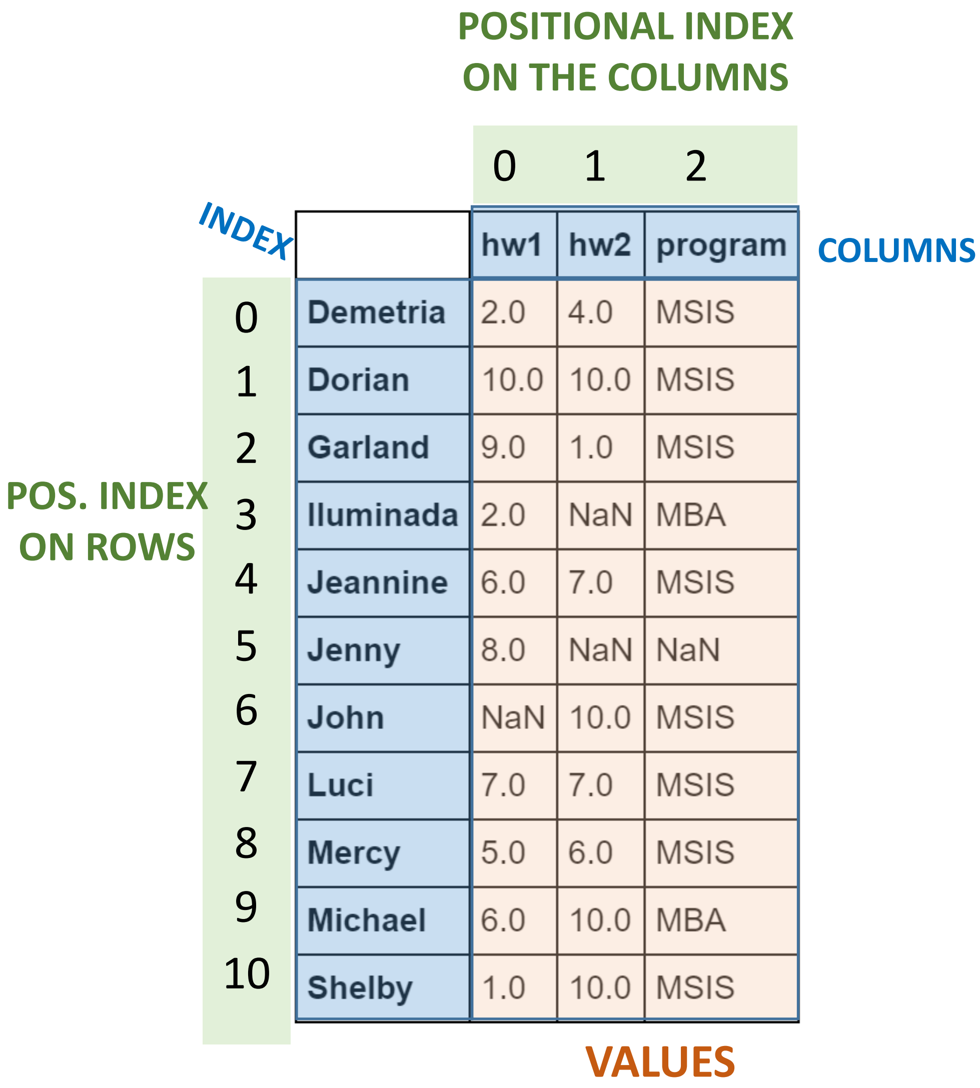
	hw1	hw2	program
Demetria	2.0	4.0	MSIS
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Iluminada	2.0	NaN	MBA
Jeannine	6.0	7.0	MSIS
Jenny	8.0	NaN	NaN
John	NaN	10.0	MSIS
Luci	7.0	7.0	MSIS
Mercy	5.0	6.0	MSIS
Michael	6.0	10.0	MBA
Shelby	1.0	10.0	MSIS

df.loc[x,y]

Access using the **index labels**.

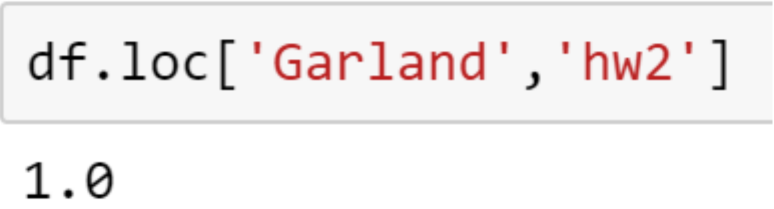
•**x** s the information needed to select the rows: label index, range of index labels, or **boolean masks**

•**y (optional)** is the information needed to select the columns: label index, range of index labels, or **boolean masks**



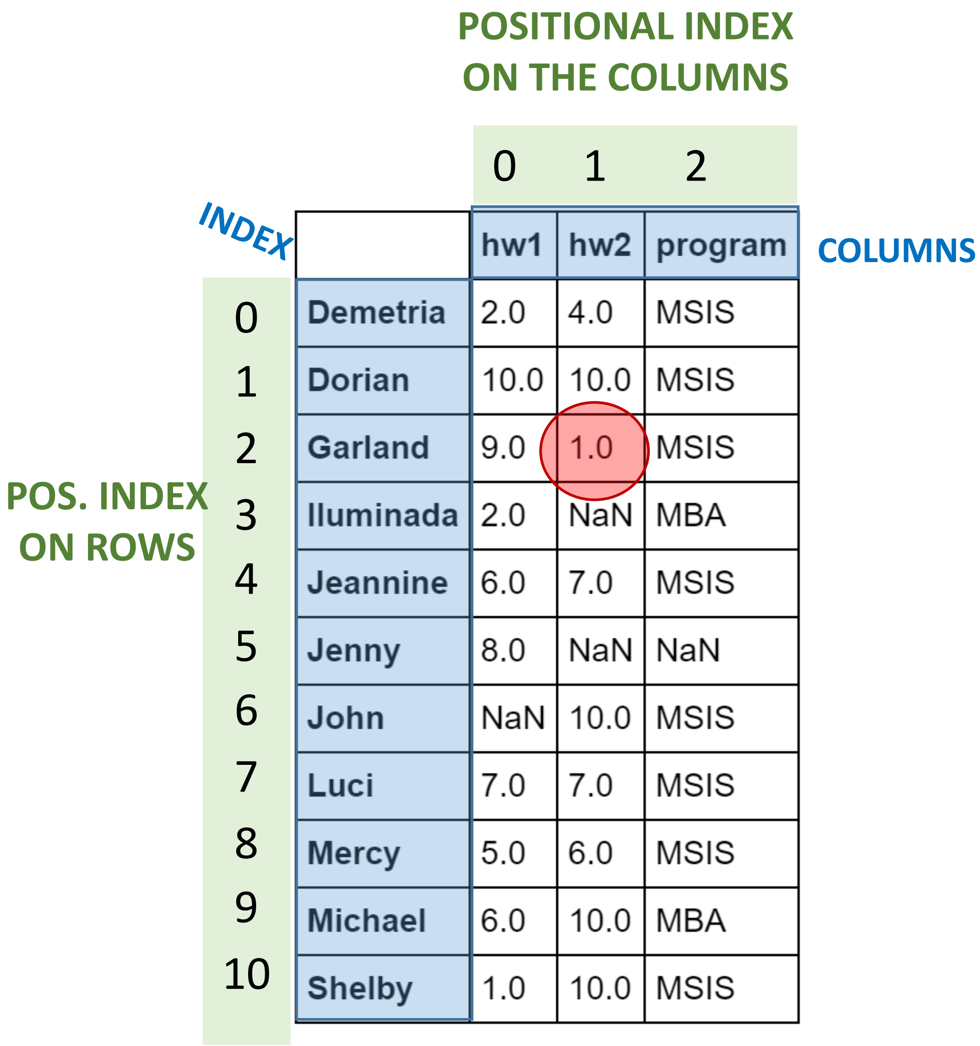
		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

df.loc[x,y] – one specific value



```
df.loc['Garland','hw2']
```

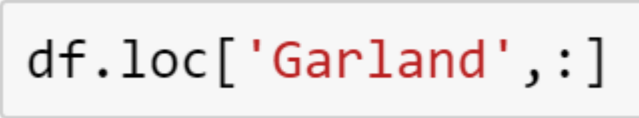
```
1.0
```



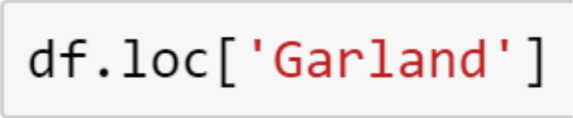
POSITIONAL INDEX
ON THE COLUMNS
0
1
2
INDEX
COLUMNS
POS. INDEX
ON ROWS

		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

df.loc[x,y] – one row

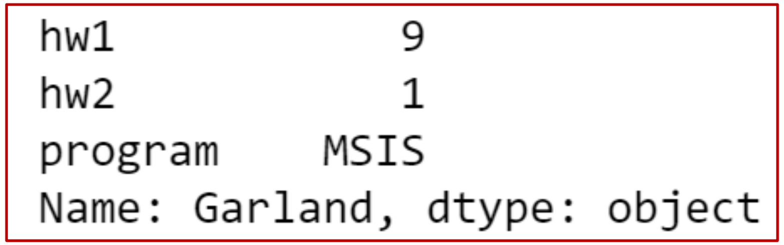


```
df.loc['Garland',:]
```



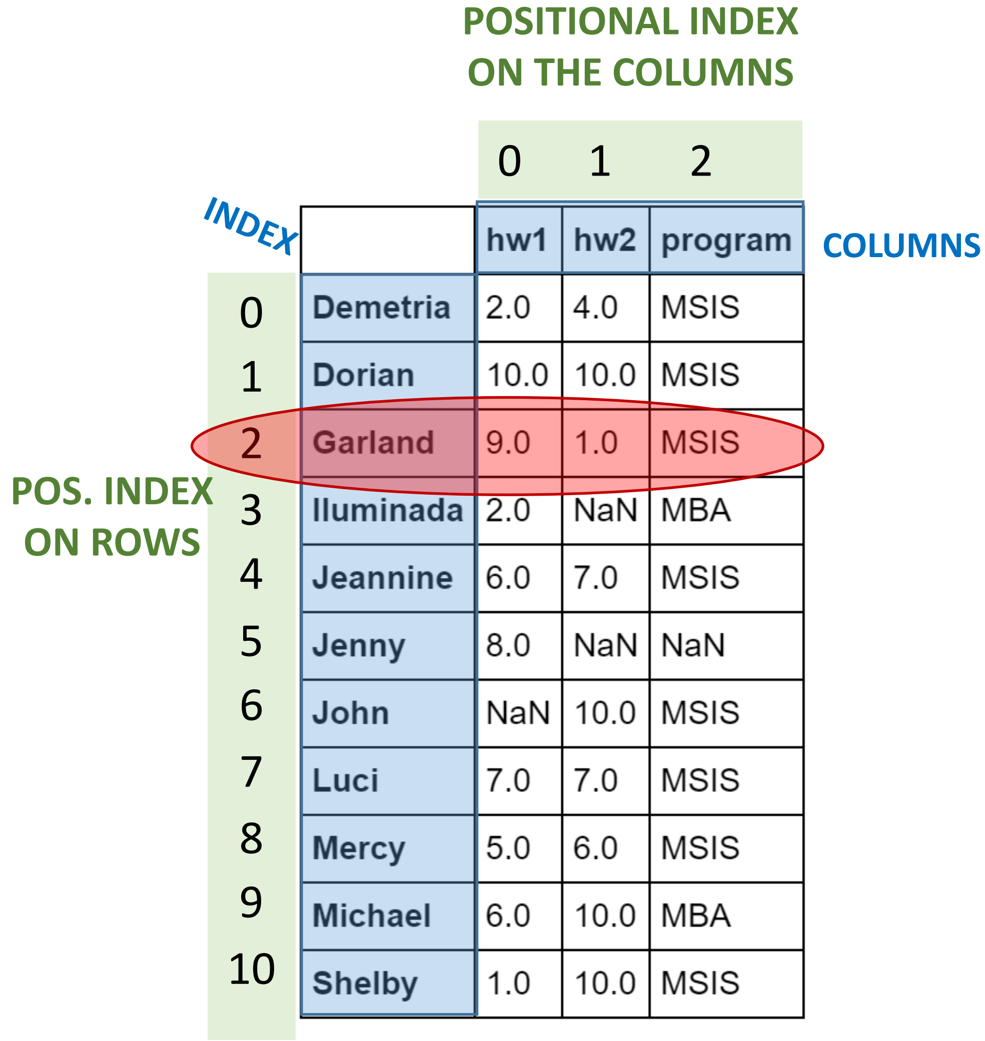
```
df.loc['Garland']
```

RESULT:



```
hw1              9
hw2              1
program       MSIS
Name: Garland, dtype: object
```

A Series!



POSITIONAL INDEX ON THE COLUMNS

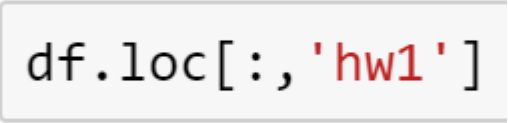
INDEX

COLUMNS

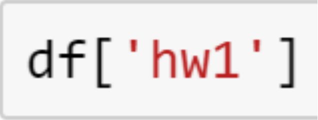
POS. INDEX ON ROWS

		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

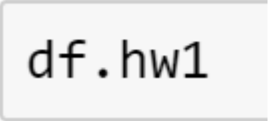
df.loc[x,y] – one column



```
df.loc[:,'hw1']
```

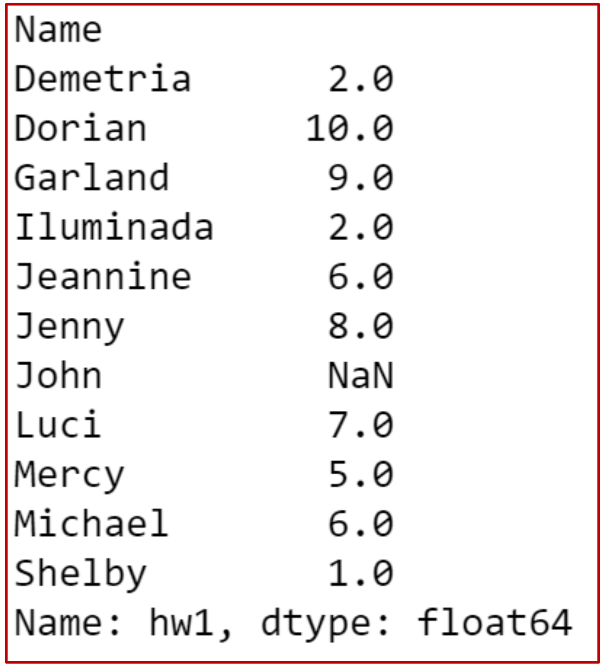


```
df['hw1']
```

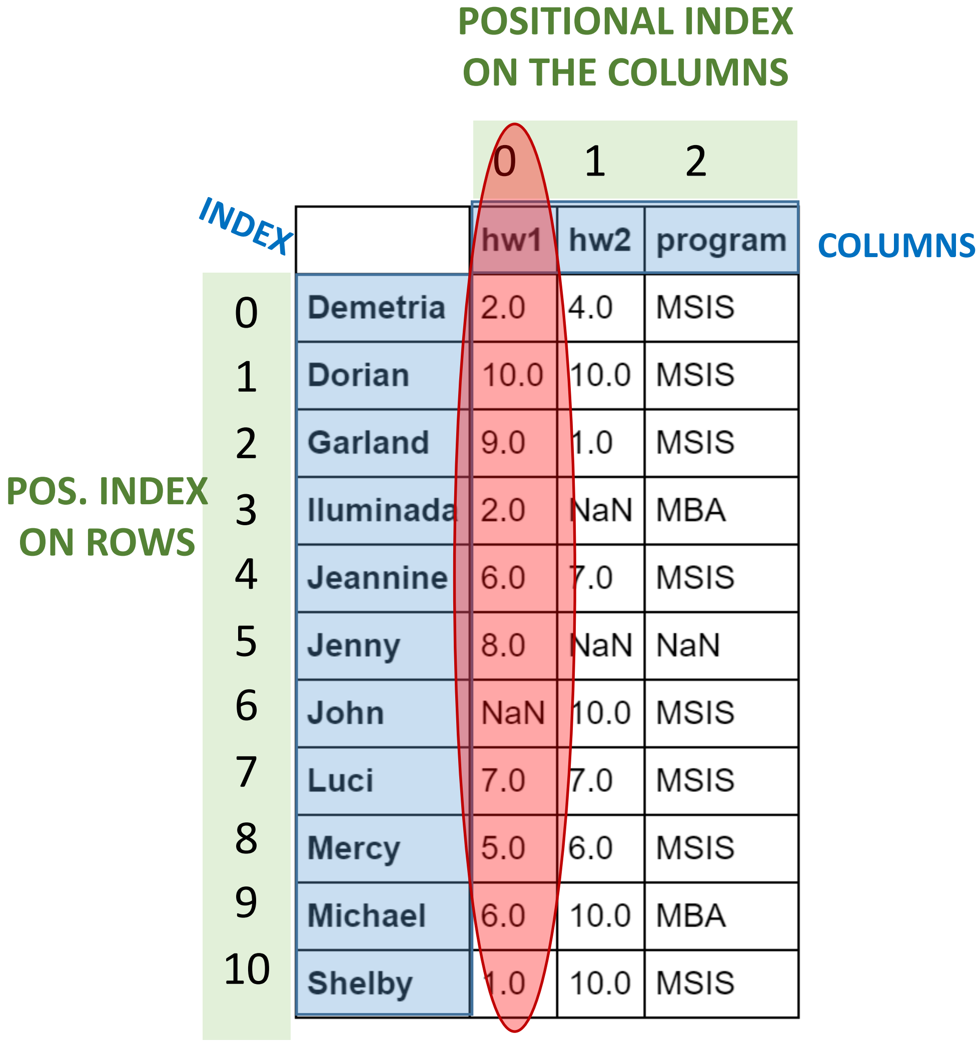


```
df.hw1
```

RESULT:



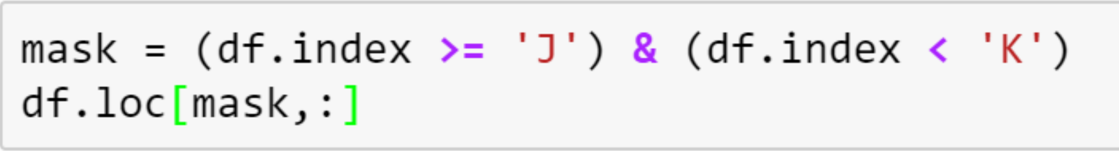
```
Name
Demetria      2.0
Dorian       10.0
Garland       9.0
Iluminada     2.0
Jeannine      6.0
Jenny         8.0
John          NaN
Luci          7.0
Mercy         5.0
Michael       6.0
Shelby        1.0
Name: hw1, dtype: float64
```



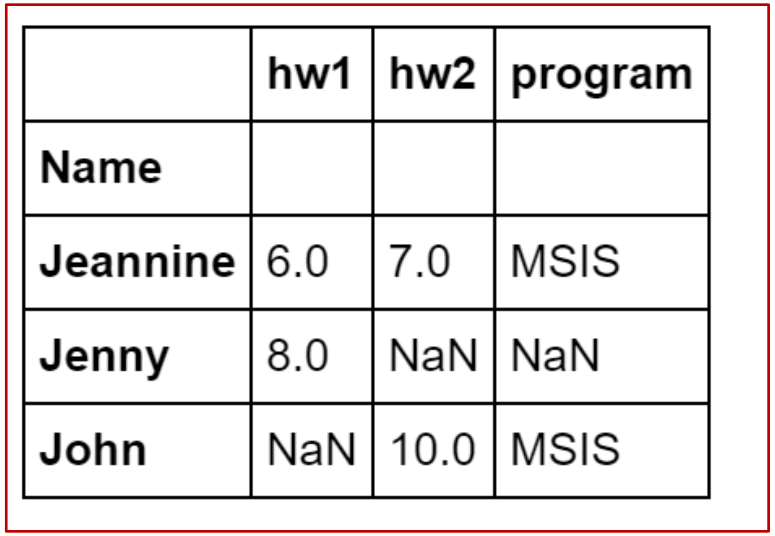
		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

df.loc[x,y] – using Boolean masks

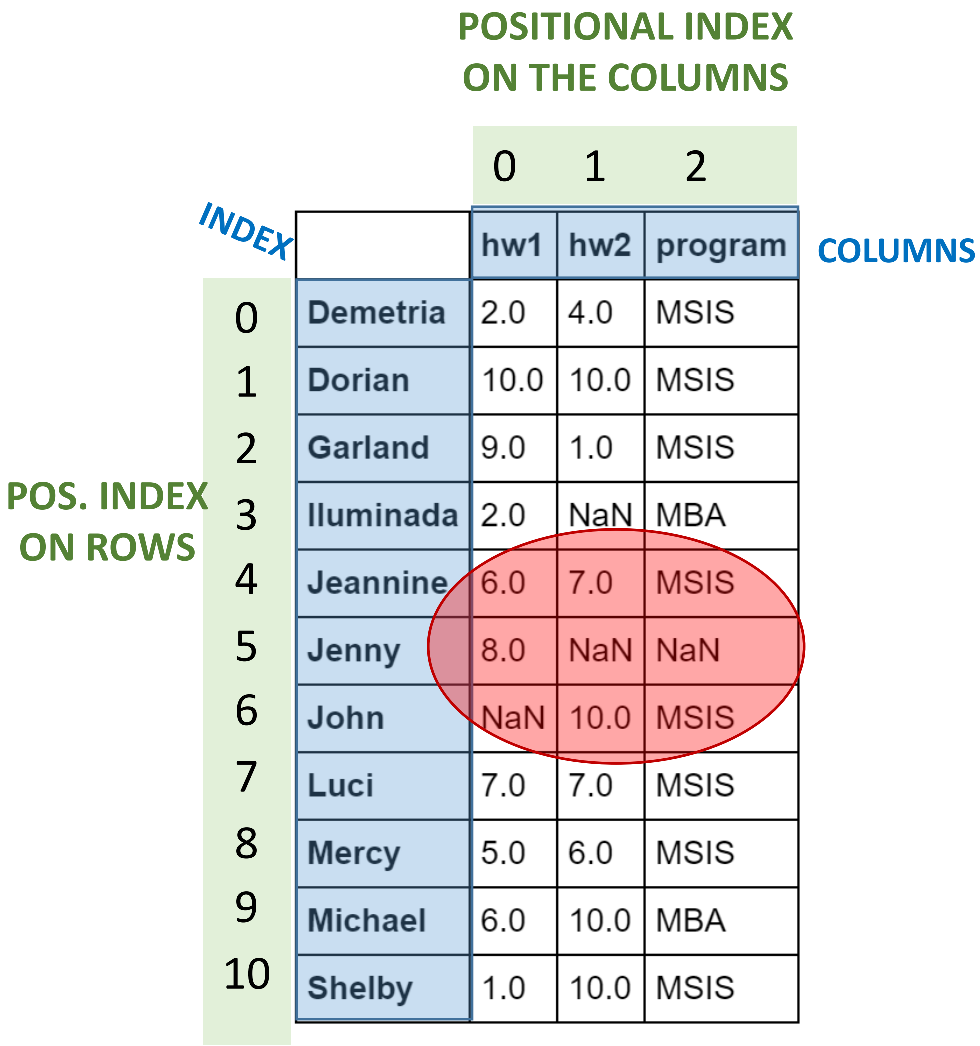
Select those students whose name starts with 'J'



```
mask = (df.index >= 'J') & (df.index < 'K')
df.loc[mask,:]
```



	hw1	hw2	program
Name			
Jeannine	6.0	7.0	MSIS
Jenny	8.0	NaN	NaN
John	NaN	10.0	MSIS



POSITIONAL INDEX ON THE COLUMNS

INDEX

COLUMNS

POS. INDEX ON ROWS

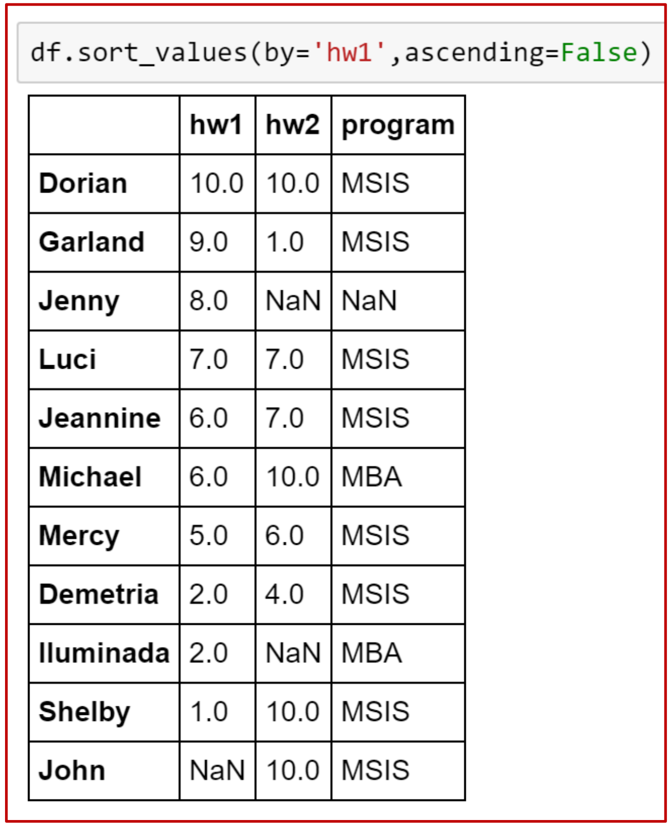
		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

Problems

1. Retrieve Shelby's hw1 grade
2. Retrieve Shelby's information
3. Who obtained the highest grade in hw2? Note that there are ties
4. Find those students who obtained the same score in hw1 and in hw2.
5. Find the average hw1 score of those students who got a hw2 score greater than 5.

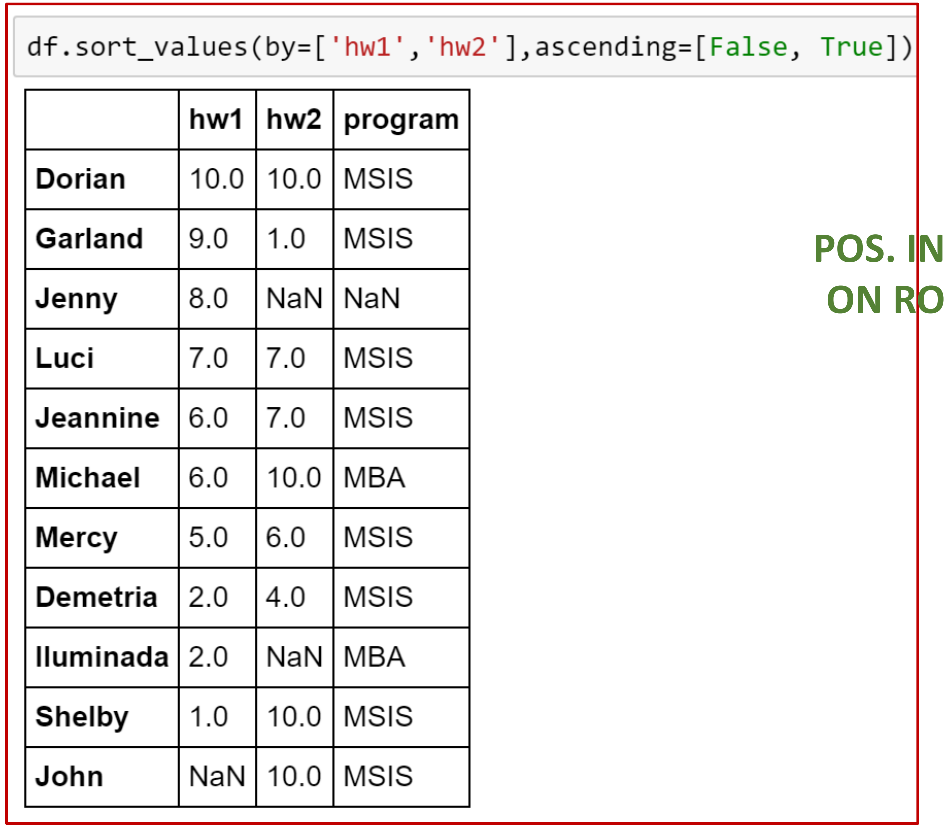
sort_values

Sort the rows based on the value of a column



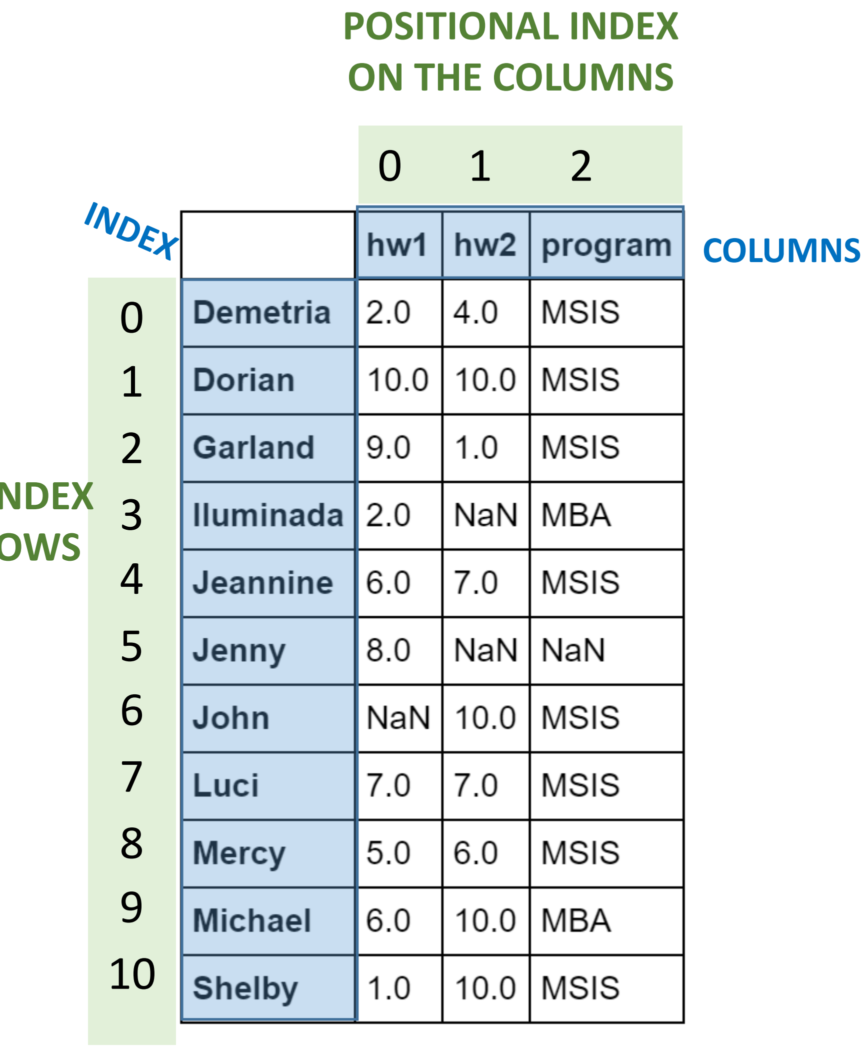
```
df.sort_values(by='hw1',ascending=False)
```

	hw1	hw2	program
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Jenny	8.0	NaN	NaN
Luci	7.0	7.0	MSIS
Jeannine	6.0	7.0	MSIS
Michael	6.0	10.0	MBA
Mercy	5.0	6.0	MSIS
Demetria	2.0	4.0	MSIS
Iluminada	2.0	NaN	MBA
Shelby	1.0	10.0	MSIS
John	NaN	10.0	MSIS



```
df.sort_values(by=['hw1','hw2'],ascending=[False, True])
```

	hw1	hw2	program
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Jenny	8.0	NaN	NaN
Luci	7.0	7.0	MSIS
Jeannine	6.0	7.0	MSIS
Michael	6.0	10.0	MBA
Mercy	5.0	6.0	MSIS
Demetria	2.0	4.0	MSIS
Iluminada	2.0	NaN	MBA
Shelby	1.0	10.0	MSIS
John	NaN	10.0	MSIS



POSITIONAL INDEX ON THE COLUMNS

INDEX

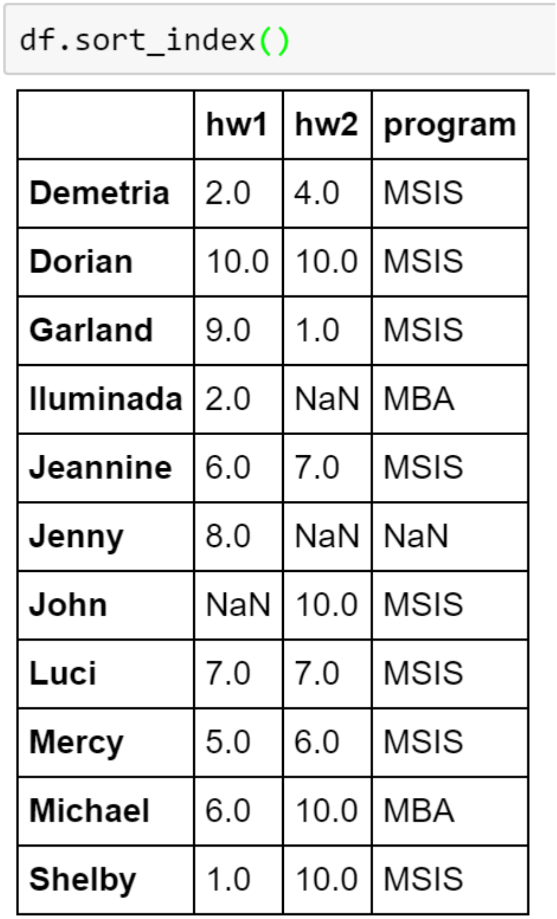
COLUMNS

POS. INDEX ON ROWS

		0	1	2
		hw1	**hw2**	**program**
0	**Demetria**	2.0	4.0	MSIS
1	**Dorian**	10.0	10.0	MSIS
2	**Garland**	9.0	1.0	MSIS
3	**Iluminada**	2.0	NaN	MBA
4	**Jeannine**	6.0	7.0	MSIS
5	**Jenny**	8.0	NaN	NaN
6	**John**	NaN	10.0	MSIS
7	**Luci**	7.0	7.0	MSIS
8	**Mercy**	5.0	6.0	MSIS
9	**Michael**	6.0	10.0	MBA
10	**Shelby**	1.0	10.0	MSIS

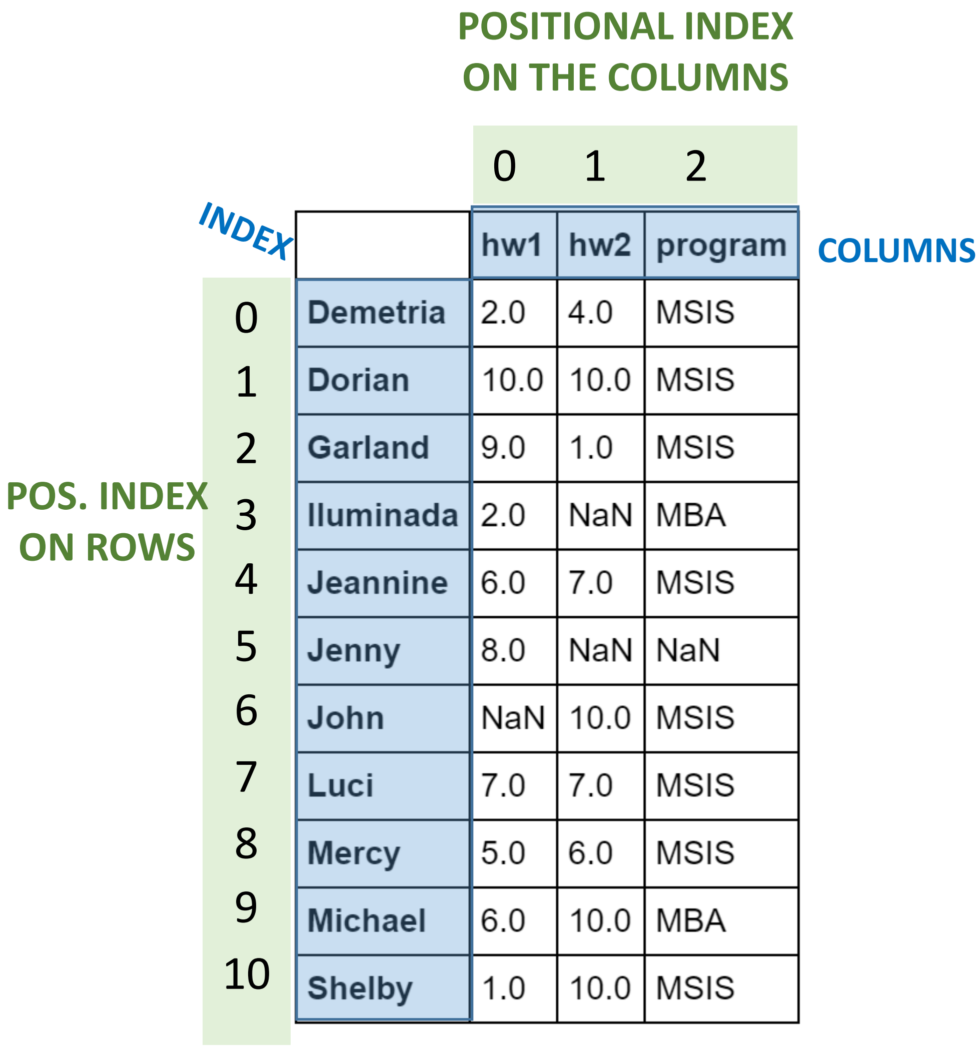
sort_index

Sort by the index labels



```
df.sort_index()
```

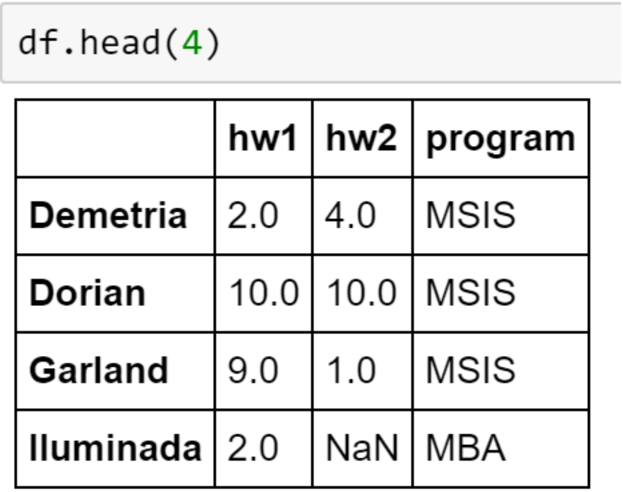
	hw1	hw2	program
Demetria	2.0	4.0	MSIS
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Iluminada	2.0	NaN	MBA
Jeannine	6.0	7.0	MSIS
Jenny	8.0	NaN	NaN
John	NaN	10.0	MSIS
Luci	7.0	7.0	MSIS
Mercy	5.0	6.0	MSIS
Michael	6.0	10.0	MBA
Shelby	1.0	10.0	MSIS



		hw1	hw2	program
		0	1	2
0	**Demetria**	2.0	4.0	MSIS
1	**Dorian**	10.0	10.0	MSIS
2	**Garland**	9.0	1.0	MSIS
3	**Iluminada**	2.0	NaN	MBA
4	**Jeannine**	6.0	7.0	MSIS
5	**Jenny**	8.0	NaN	NaN
6	**John**	NaN	10.0	MSIS
7	**Luci**	7.0	7.0	MSIS
8	**Mercy**	5.0	6.0	MSIS
9	**Michael**	6.0	10.0	MBA
10	**Shelby**	1.0	10.0	MSIS

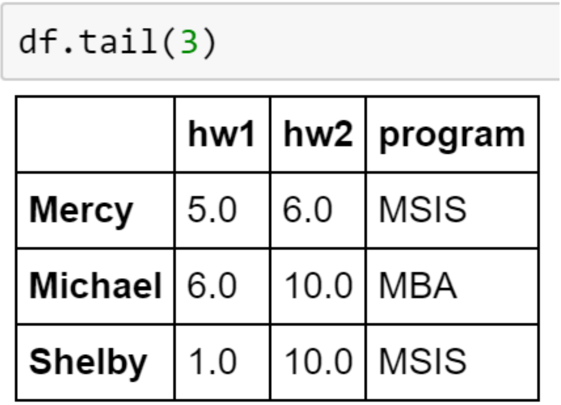
head and tail

Return the first or last rows



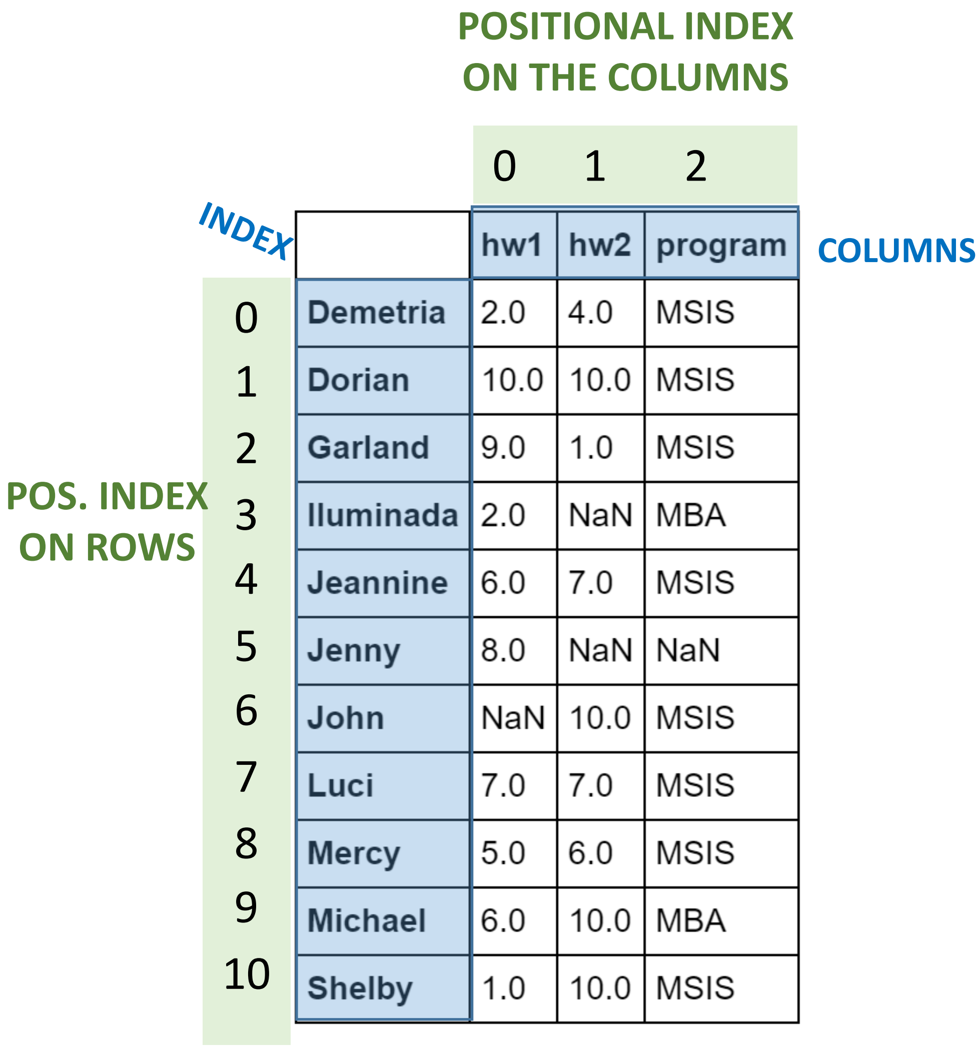
```
df.head(4)
```

	hw1	hw2	program
Demetria	2.0	4.0	MSIS
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Iluminada	2.0	NaN	MBA



```
df.tail(3)
```

	hw1	hw2	program
Mercy	5.0	6.0	MSIS
Michael	6.0	10.0	MBA
Shelby	1.0	10.0	MSIS



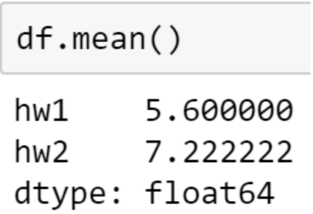
		0	1	2
		hw1	**hw2**	**program**
0	**Demetria**	2.0	4.0	MSIS
1	**Dorian**	10.0	10.0	MSIS
2	**Garland**	9.0	1.0	MSIS
3	**Iluminada**	2.0	NaN	MBA
4	**Jeannine**	6.0	7.0	MSIS
5	**Jenny**	8.0	NaN	NaN
6	**John**	NaN	10.0	MSIS
7	**Luci**	7.0	7.0	MSIS
8	**Mercy**	5.0	6.0	MSIS
9	**Michael**	6.0	10.0	MBA
10	**Shelby**	1.0	10.0	MSIS

Problems

1. Sort the MSIS students by hw2 descending.
2. Show **only** the field *hw1* of the four students with the largest hw2 grade (do not use nlargest on the dataframe... it has bugs)

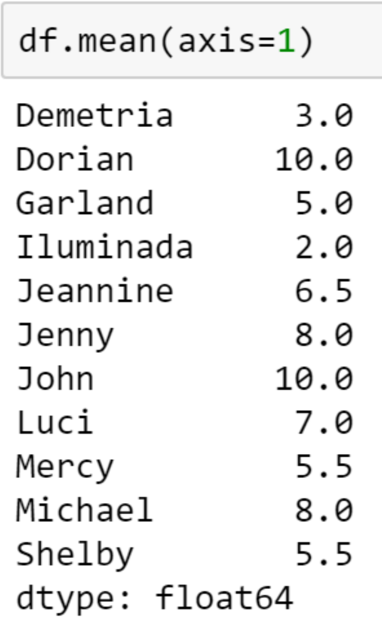
mean, max, min, etc

Aggregate functions will be broadcasted to all columns (axis = 0, default) or rows



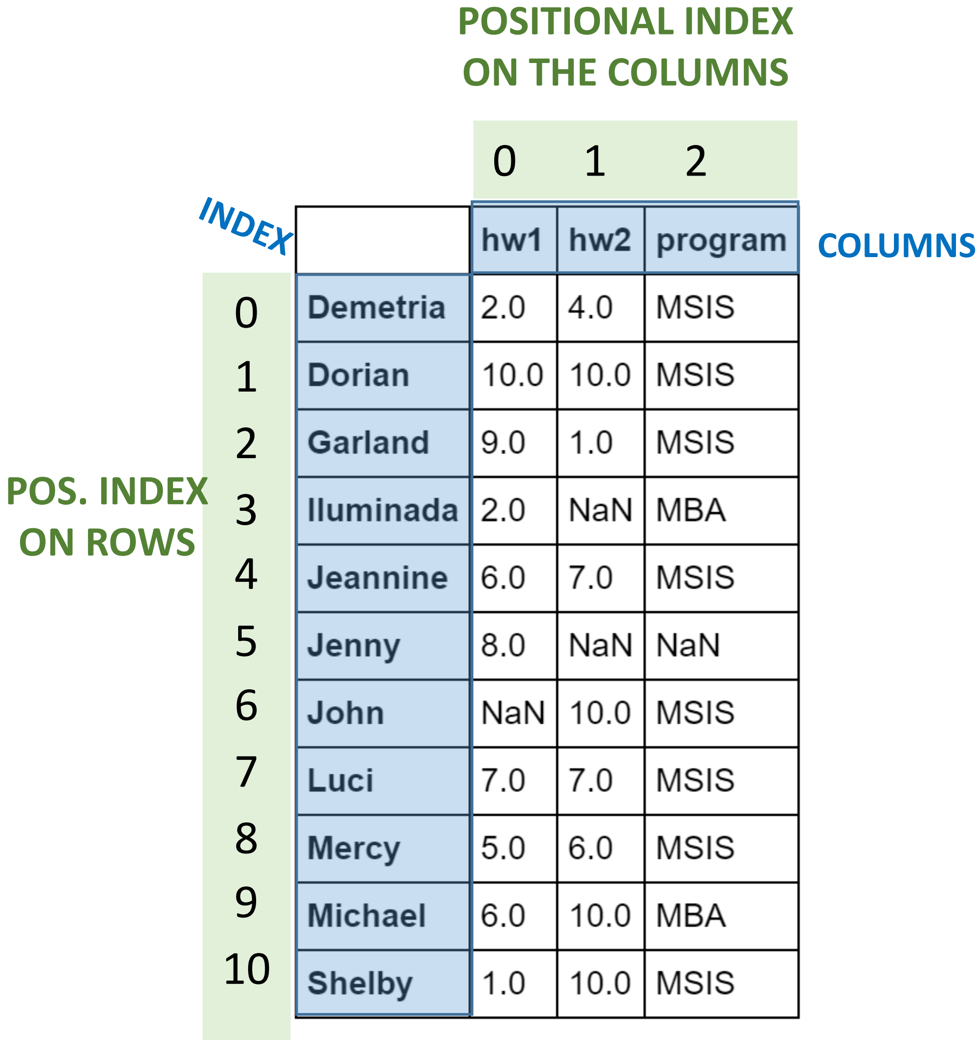
```
df.mean()
```

```
hw1     5.600000
hw2     7.222222
dtype: float64
```



```
df.mean(axis=1)
```

```
Demetria      3.0
Dorian       10.0
Garland       5.0
Iluminada     2.0
Jeannine      6.5
Jenny         8.0
John         10.0
Luci          7.0
Mercy         5.5
Michael       8.0
Shelby        5.5
dtype: float64
```



POSITIONAL INDEX ON THE COLUMNS

INDEX

COLUMNS

POS. INDEX ON ROWS

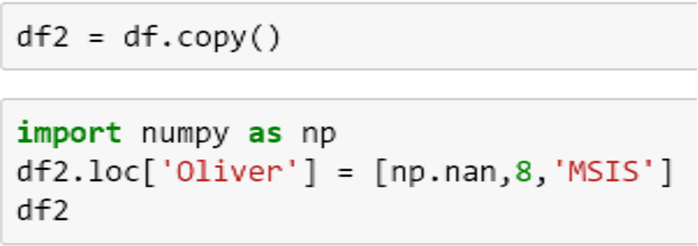
		0	1	2
		hw1	hw2	program
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS

Problems

1. Compute the spread (i.e., highest minus lowest hw grade) of each student. Consider only the students who submitted both homeworks
2. Who has the largest spread?

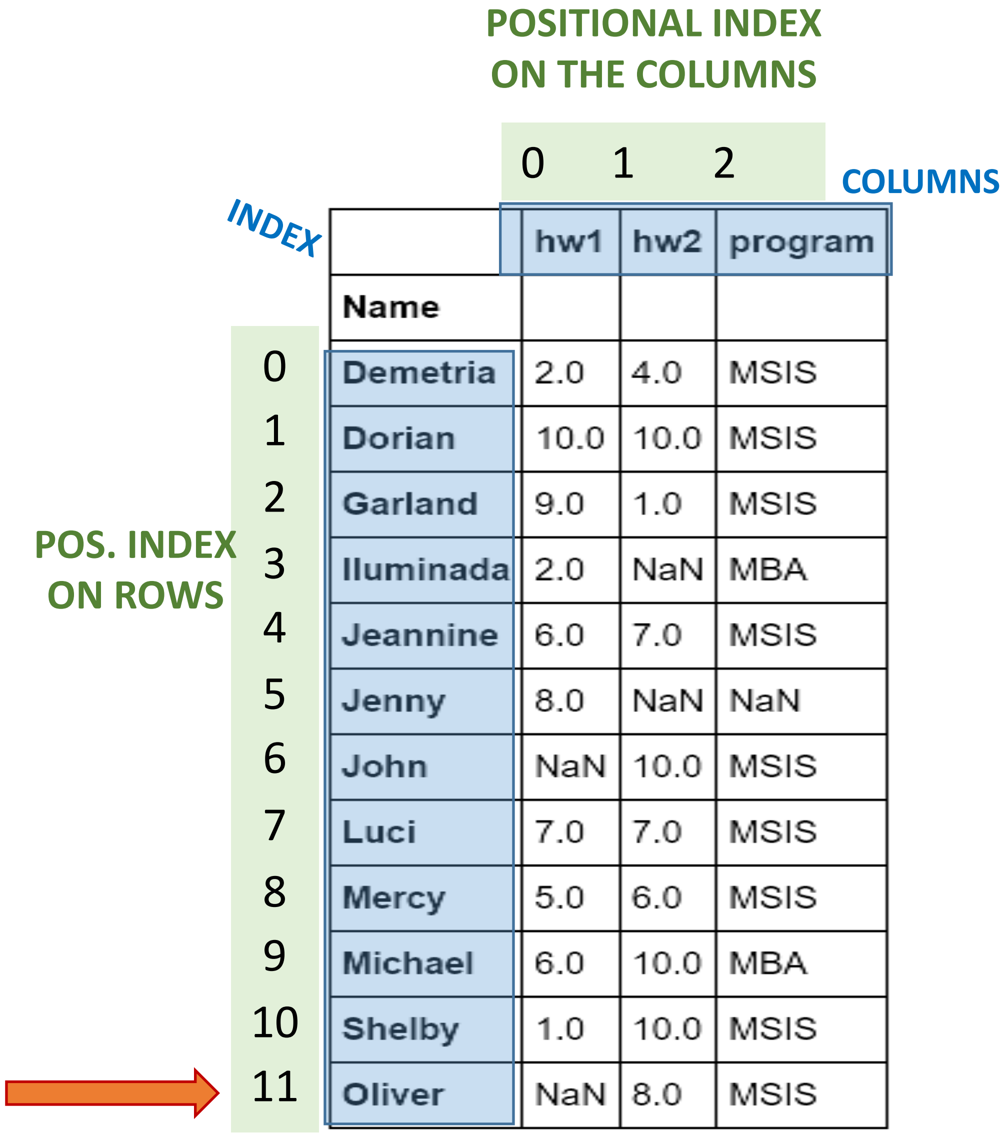
Adding rows

A new student has joined. His name is Oliver and he is the MSIS program; his hw1 is missing and his hw2 score is 8.



```
df2 = df.copy()
```

```
import numpy as np
df2.loc['Oliver'] = [np.nan,8,'MSIS']
df2
```



POSITIONAL INDEX ON THE COLUMNS

COLUMNS

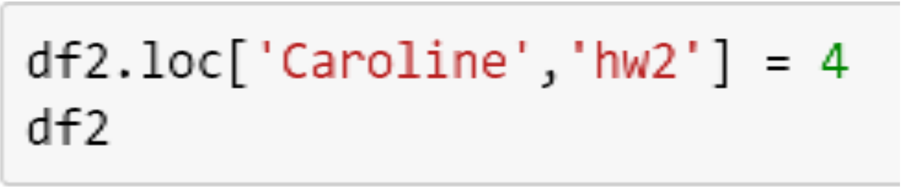
INDEX

POS. INDEX ON ROWS

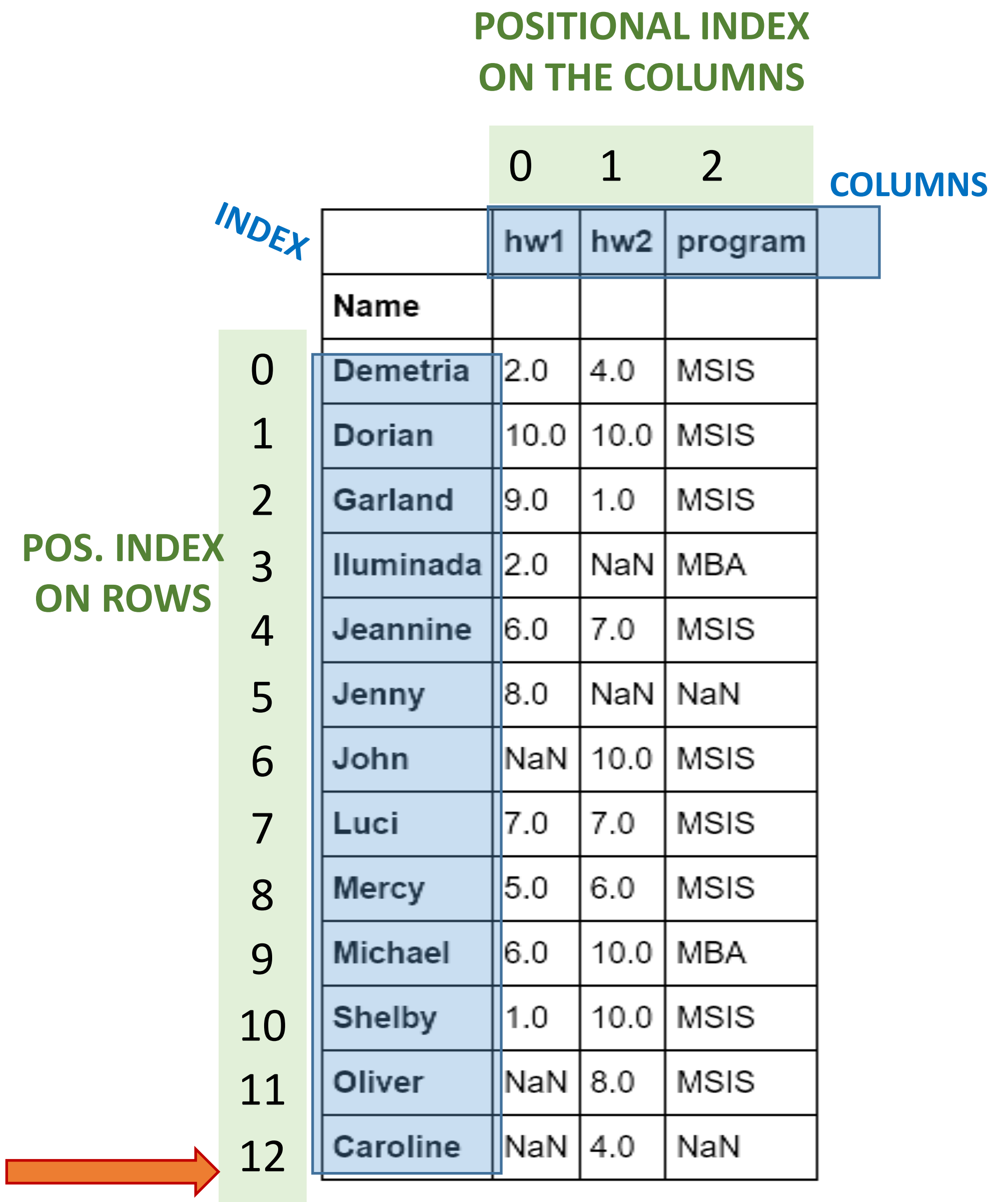
		0 hw1	1 hw2	2 program
	Name			
0	Demetria	2.0	4.0	MSIS
1	Dorian	10.0	10.0	MSIS
2	Garland	9.0	1.0	MSIS
3	Iluminada	2.0	NaN	MBA
4	Jeannine	6.0	7.0	MSIS
5	Jenny	8.0	NaN	NaN
6	John	NaN	10.0	MSIS
7	Luci	7.0	7.0	MSIS
8	Mercy	5.0	6.0	MSIS
9	Michael	6.0	10.0	MBA
10	Shelby	1.0	10.0	MSIS
11	Oliver	NaN	8.0	MSIS

Adding rows

A new student has joined. Her name is Caroline and she got 4 in hw2. She is not in any program yet.



```
df2.loc['Caroline','hw2'] = 4
df2
```



POSITIONAL INDEX ON THE COLUMNS

COLUMNS

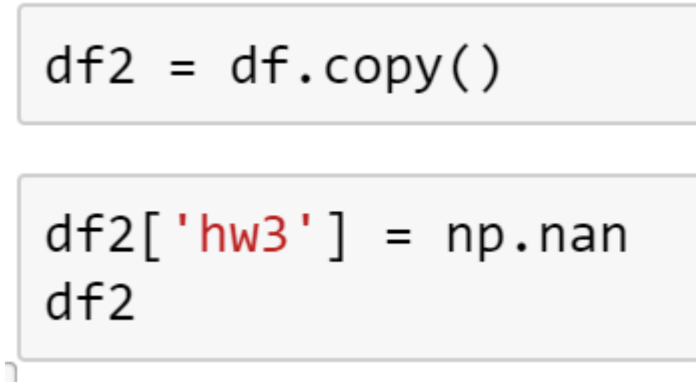
INDEX

POS. INDEX ON ROWS

	hw1	hw2	program
Name			
Demetria	2.0	4.0	MSIS
Dorian	10.0	10.0	MSIS
Garland	9.0	1.0	MSIS
Iluminada	2.0	NaN	MBA
Jeannine	6.0	7.0	MSIS
Jenny	8.0	NaN	NaN
John	NaN	10.0	MSIS
Luci	7.0	7.0	MSIS
Mercy	5.0	6.0	MSIS
Michael	6.0	10.0	MBA
Shelby	1.0	10.0	MSIS
Oliver	NaN	8.0	MSIS
Caroline	NaN	4.0	NaN

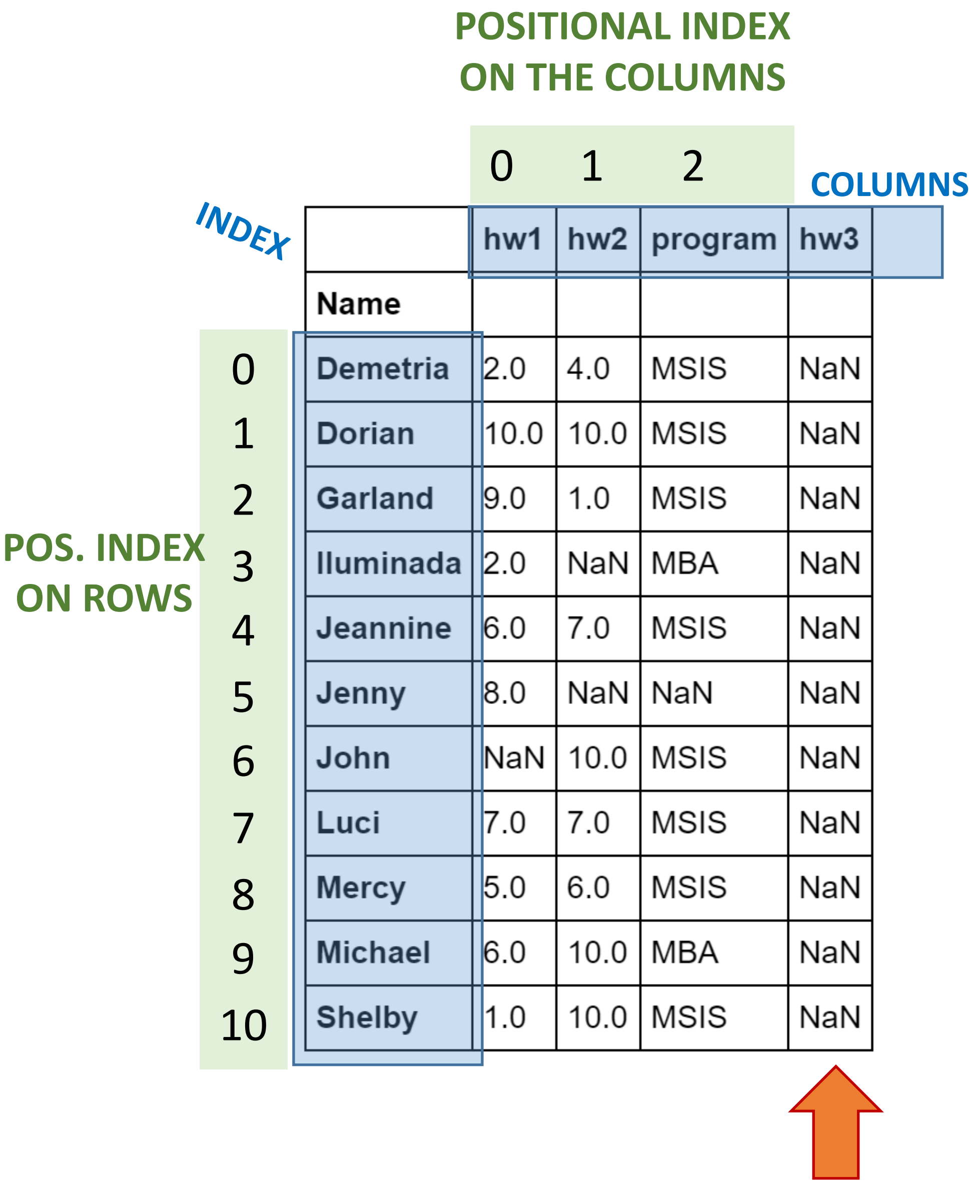
Adding columns

Add an "empty" column hw3



```
df2 = df.copy()
```

```
df2['hw3'] = np.nan
df2
```



POSITIONAL INDEX ON THE COLUMNS

0 1 2

COLUMNS

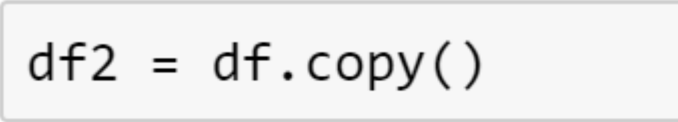
INDEX

POS. INDEX ON ROWS

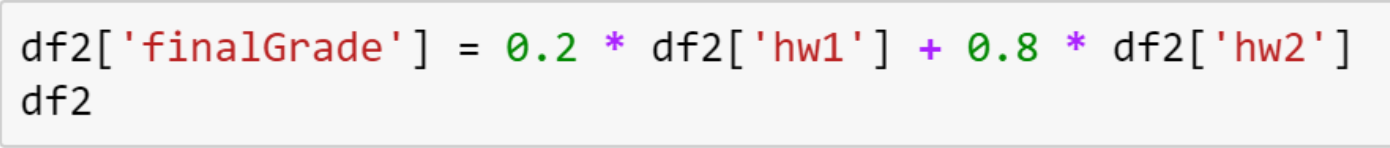
		hw1	hw2	program	hw3
	Name				
0	**Demetria**	2.0	4.0	MSIS	NaN
1	**Dorian**	10.0	10.0	MSIS	NaN
2	**Garland**	9.0	1.0	MSIS	NaN
3	**Iluminada**	2.0	NaN	MBA	NaN
4	**Jeannine**	6.0	7.0	MSIS	NaN
5	**Jenny**	8.0	NaN	NaN	NaN
6	**John**	NaN	10.0	MSIS	NaN
7	**Luci**	7.0	7.0	MSIS	NaN
8	**Mercy**	5.0	6.0	MSIS	NaN
9	**Michael**	6.0	10.0	MBA	NaN
10	**Shelby**	1.0	10.0	MSIS	NaN

Adding calculated columns

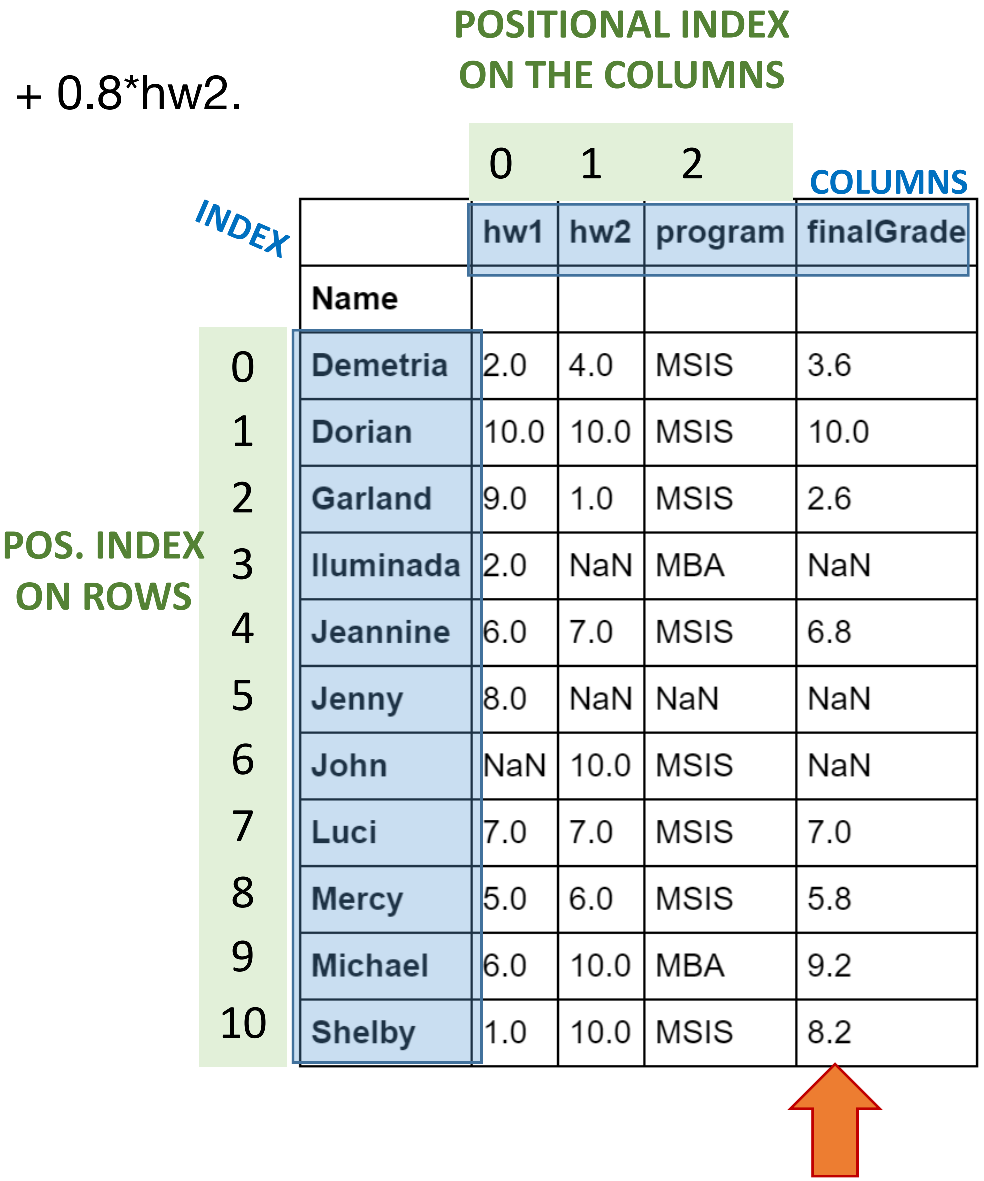
Let's add a column with the final grade. It is computed as 0.2*hw1 + 0.8*hw2.



```
df2 = df.copy()
```



```
df2['finalGrade'] = 0.2 * df2['hw1'] + 0.8 * df2['hw2']
df2
```



POSITIONAL INDEX ON THE COLUMNS

COLUMNS

INDEX

POS. INDEX ON ROWS

		hw1	hw2	program	finalGrade
		0	1	2	
	Name				
0	Demetria	2.0	4.0	MSIS	3.6
1	Dorian	10.0	10.0	MSIS	10.0
2	Garland	9.0	1.0	MSIS	2.6
3	Iluminada	2.0	NaN	MBA	NaN
4	Jeannine	6.0	7.0	MSIS	6.8
5	Jenny	8.0	NaN	NaN	NaN
6	John	NaN	10.0	MSIS	NaN
7	Luci	7.0	7.0	MSIS	7.0
8	Mercy	5.0	6.0	MSIS	5.8
9	Michael	6.0	10.0	MBA	9.2
10	Shelby	1.0	10.0	MSIS	8.2