CS21: INTRODUCTION TO COMPUTER SCIENCE

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Swarthmore College

Outline Nov 14:

- Sorting algorithms
- Programming sorting algorithms
- Next time:
  - “is_sorted” function
  - Runtime of sorting algorithms

Notes

•Lab 8 due Saturday night (read BEFORE coming to lab!)
•Lab 9 due Monday after Thanksgiving
•Quiz 4 this Friday (let me know if you have conflicts)

Lab 5 extensions

Smart-tic (Larkin)

```
***********************
Welcome to Tic-Tac-Toe!
***********************

Enter your choice like the numbers below:
-------
|0|1|2|
|3|4|5|
|6|7|8|
-------

AI chooses: 4
-------
| | | |
| |O| |
| | | |
-------

Enter 0-8 for your choice: 3
-------
| | | |
|X|O| |
| | | |
-------

AI chooses: 2
-------
| | |O|
|X|O| |
| | | |
-------
```

```
Enter 0-8 for your choice: 6
-------
| | |O|
|X|O| |
|X| | |
-------

AI chooses: 0
-------
|O| |O|
|X|O| |
|X| | |
-------

Enter 0-8 for your choice: 8
-------
|O| |O|
|X|O| |
|X| |X|
-------

AI chooses: 1
-------
|O|O|O|
|X|O| |
|X| |X|
-------

AI wins!
```

Mega-tic (Mirabai)

```
How many rows/columns do you want?: 6

*** Get ready to play tic-tac-toe! ***

Please enter your choices like the numbers below:
|0|1|2|3|4|5|
|6|7|8|9|10|11|
|12|13|14|15|16|17|
|18|19|20|21|22|23|
|24|25|26|27|28|29|
|30|31|32|33|34|35|

AI moves:
| | | | | | |
| | | | | | |
| | | | | | |
| | | |O| | |
| | | | | | |
| | | | | | |

Choose an empty spot (input 0-35): 14
| | | | | | |
| | | | | | |
| | |X| | | |
| | | |O| | |
| | | | | | |
| | | | | | |

AI moves:
| | | | | | |
| | | | | | |
| | |X| | |O|
| | | |O| | |
| | | | | | |
| | | | | | |
```

```
Choose an empty spot (input 0-15): 15
|X|O| |O|
| |X|X|O|
| | | | |
| | |O|X|

AI moves:
|X|O| |O|
| |X|X|O|
| | |O| |
| | |O|X|

Choose an empty spot (input 0-15): 12
|X|O| |O|
| |X|X|O|
| | |O| |
|X| |O|X|

AI moves:
|X|O|O|O|
| |X|X|O|
| | |O| |
|X| |O|X|

Choose an empty spot (input 0-15): 8
|X|O|O|O|
| |X|X|O|
|X| |O| |
|X| |O|X|

AI moves:
|X|O|O|O|
| |X|X|O|
|X|O|O| |
|X| |O|X|

Choose an empty spot (input 0-15): 4
|X|O|O|O|
|X|X|X|O|
|X|O|O| |
|X| |O|X|
You win!
```

Sorting

Sorting with cards

1) With a partner, set up a series of ~10 cards (out of order)

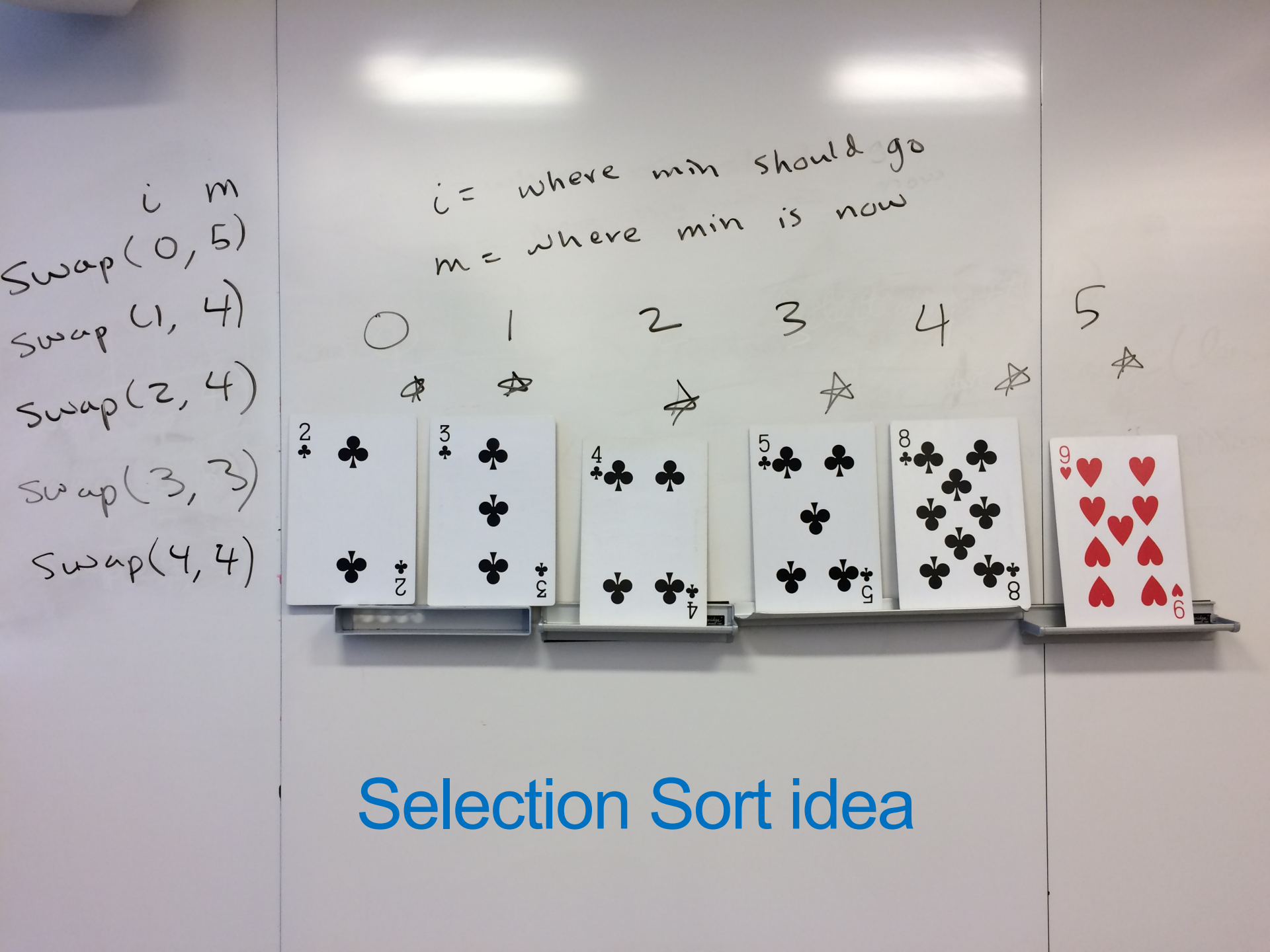
2) Try to come up with a **sorting algorithm** that only involves comparing and swapping elements

3) Check your algorithm with me or a ninja

4) Begin implementation in **sorts.py**

5) Here is our swap function from Week 6:

```
def swap(i, j, lst):
    """This function swaps the ith and jth values of the lst."""
    temp = lst[i]
    lst[i] = lst[j]
    lst[j] = temp
```


i m
Swap(0, 5)
swap (1, 4)
swap(2, 4)
swap(3, 3)
swap(4, 4)
i = where min should go
m = where min is now
0 1 2 3 4 5
Selection Sort idea

3 sorts for today

- **Selection Sort**: iteratively find the minimum element and place it in the correct position
- **Bubble Sort**: move through the list, swapping adjacent elements if they are out of place (repeat until sorted)
- **Insertion Sort (didn't get to)**: for each element of the list, move it down until it is in the correct position

Types of sorting

- **Out-of-place**: leaves the original list alone and creates a new sorted list (returns new list)
- **In-place**: modifies (mutates) the original list via swaps so that it is now sorted
- **Pros of in-place sort**: no new data structure needed (saving space)
- **Cons of in-place sort**: original order destroyed (in some cases it might be important), can be more difficult to implement