CS134 Lecture 28:
Tic Tac Toe 4

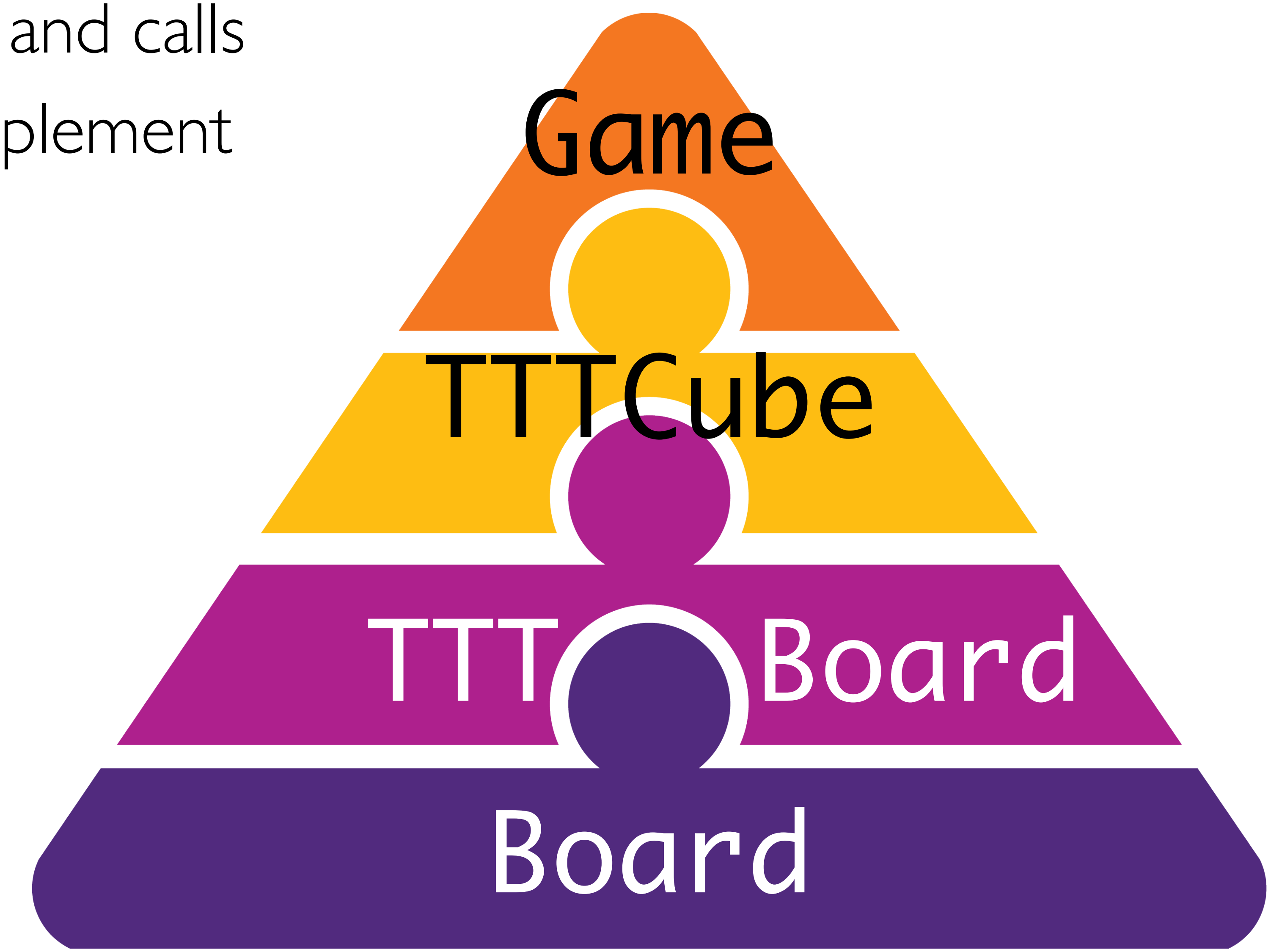
Announcements & Logistics

- **Lab 9 Boggle**: two-week lab now in progress!
  - **Part 1** due tonight/tomorrow 10 pm
  - Will return auto-tester feedback on it on Friday
  - You can fix anything broken before turning in Part 2
  - Must turn in *something* to get Part 2 grade apply to both
  - **Part 2** due May 1/2 (handout will be posted soon)
  - Part 2 also has a **prelab!**
    - Asks you to draw out the Boggle game logic (similar to TTT logic we will discuss today)

Do You Have Any Questions?

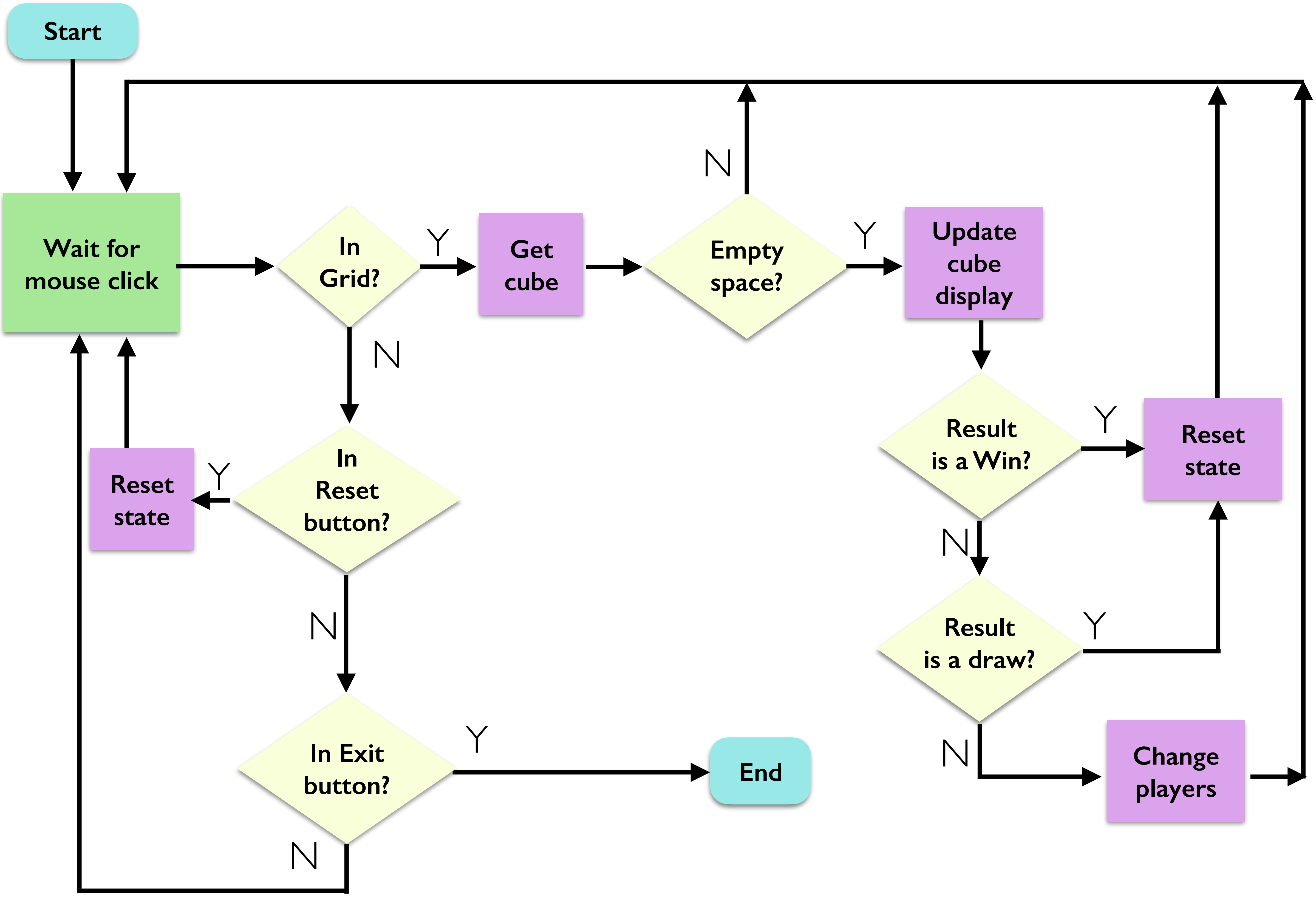
Last Time and Today

- Implemented TTTCube and TTTBoard classes
- Today: wrap up the game
  - Implement TTTGame class
  - Talks to each of the classes and calls appropriate methods to implement game logic
- TTT vs Boggle discussion



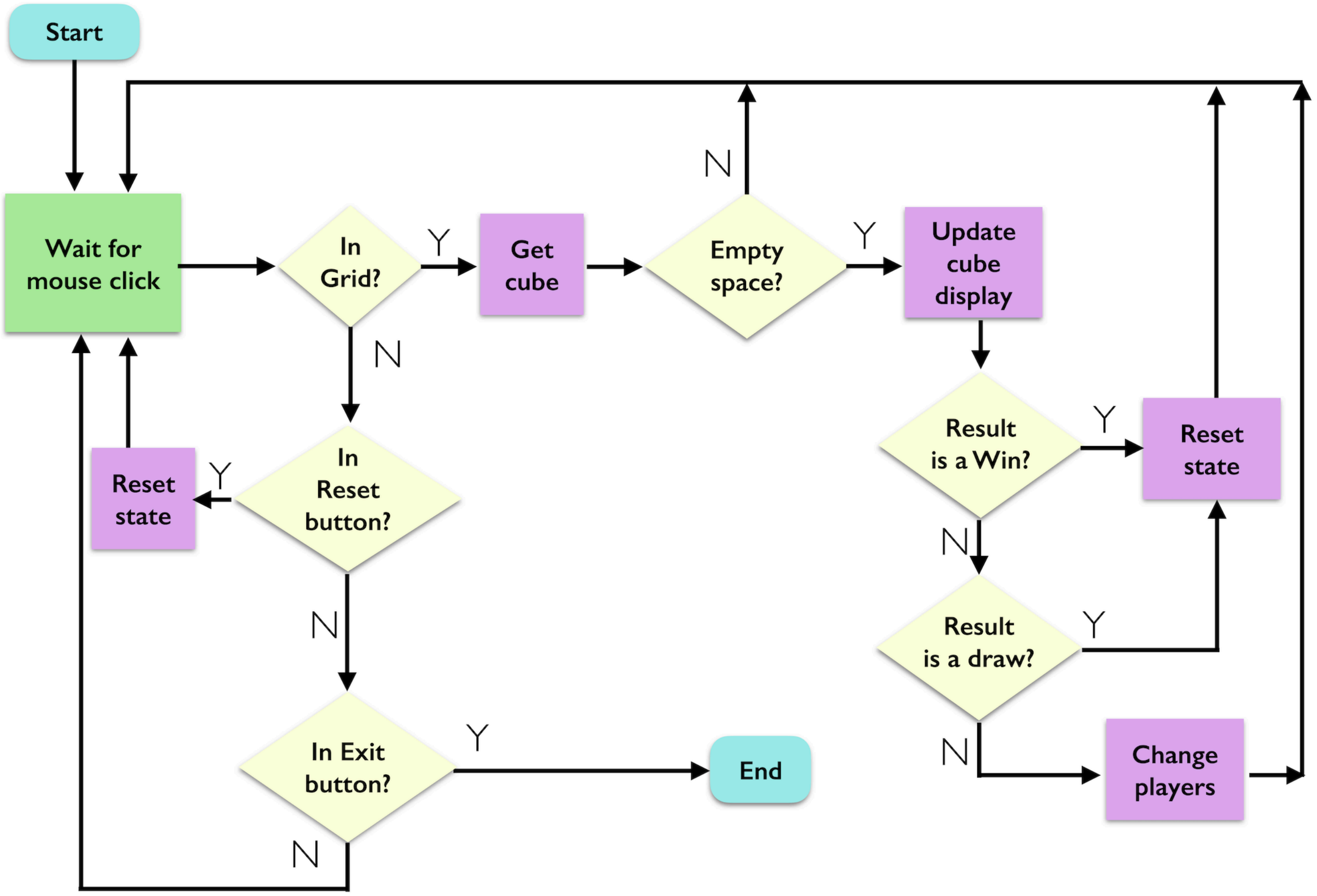
TTTGame Logic

TTT Game Logic



Translating our Logic to Code

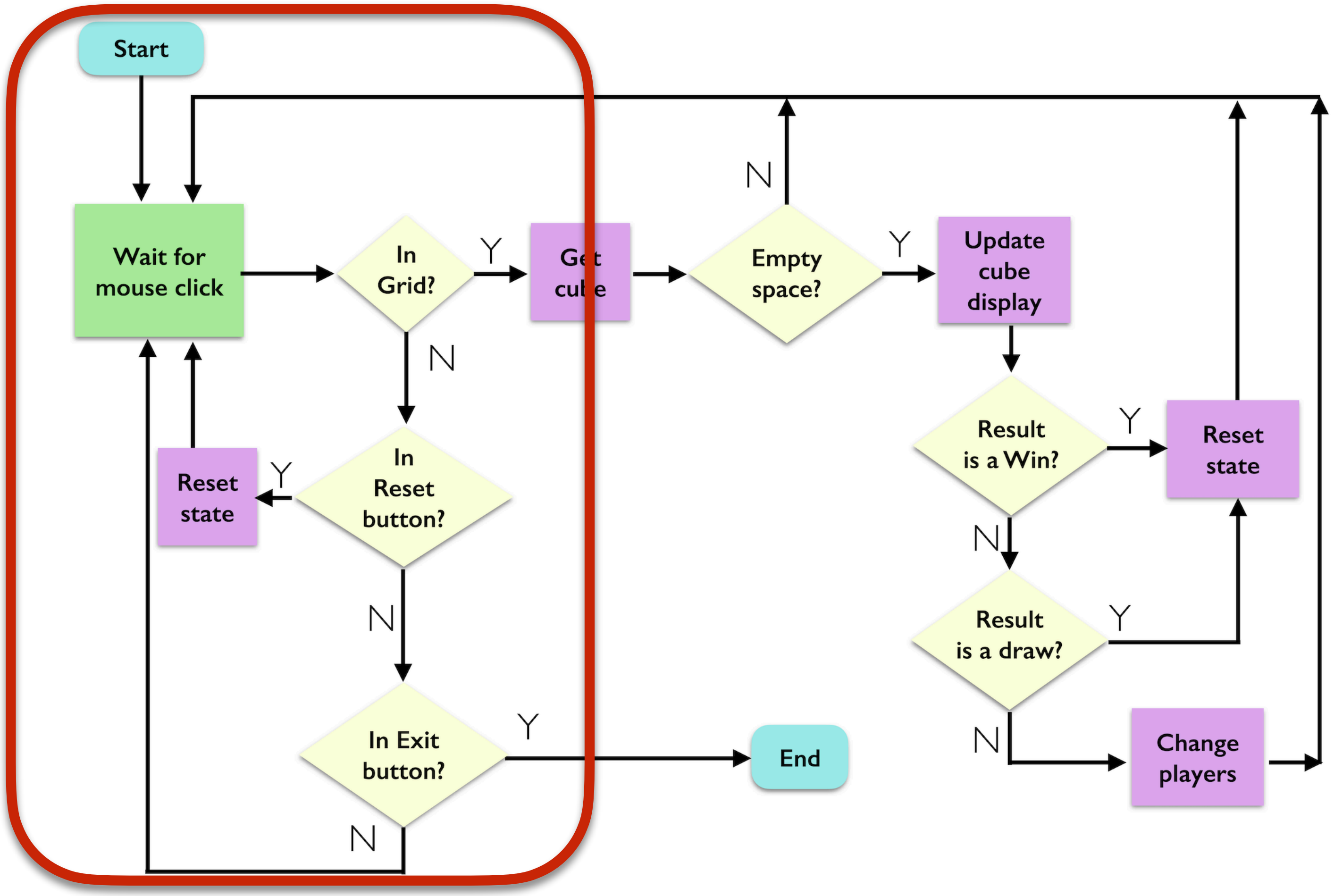
- Let's think about `__init__`:
  - What do we need?
    - a `board`, player, and maybe `num_moves` (to detect draws easily)



Translating our Logic to Code

- Now let's write a method for handling a single mouse click (point)
- The game continues (waits for more clicks) if this method returns True
- If this method returns False, game ends

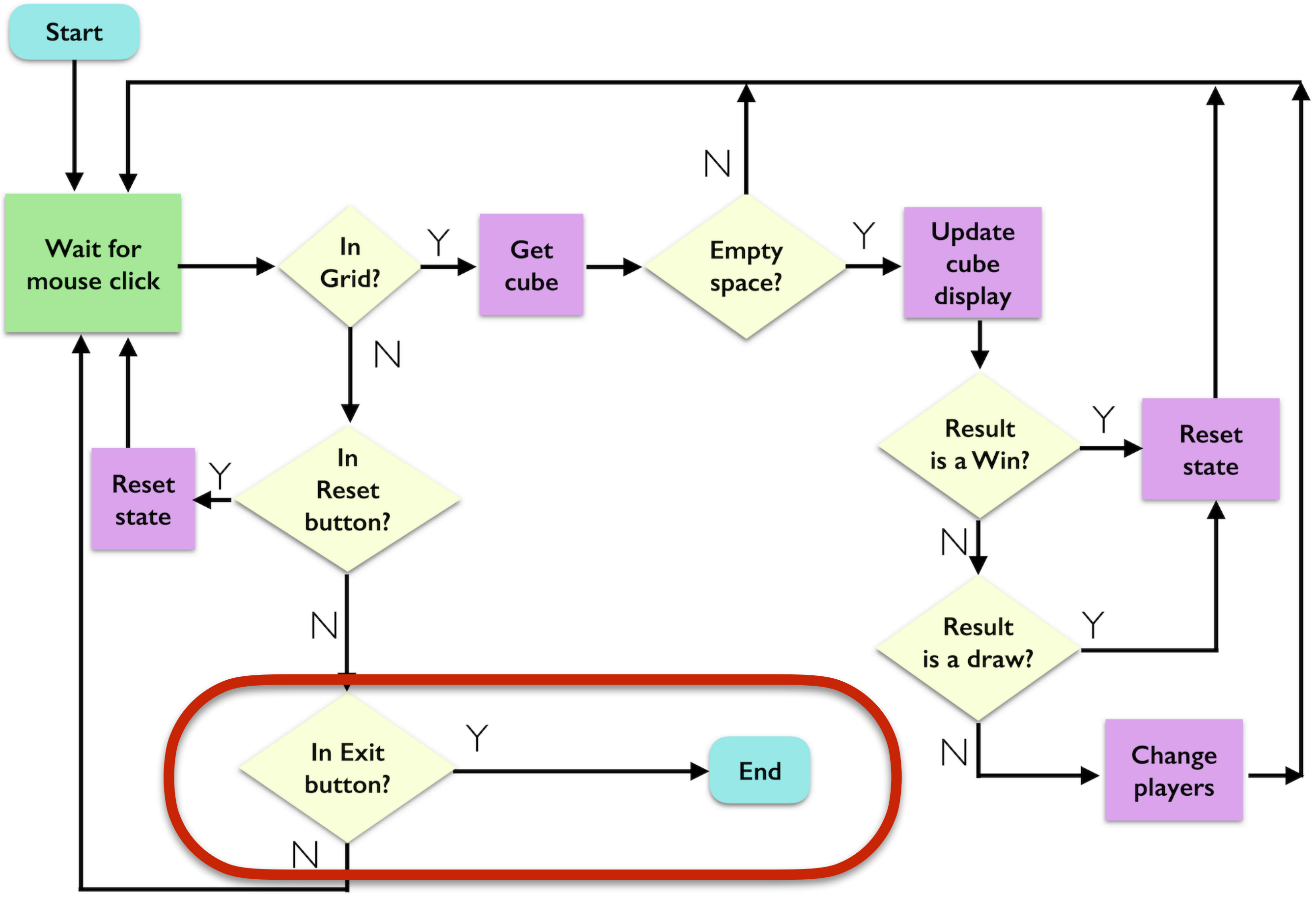
```
def do_one_click(self, point):

    # step 1: check for exit button
    if self._board.in_exit(point):
      # TODO

    # step 2: check for reset button
    elif self._board.in_reset(point):
      # TODO


    # step 3: check if click on the grid
    elif self._board.in_grid(point):
      # TODO


    # keep going!
    return True
```



Translating our Logic to Code

- Let's handle the "exit" button first (since it's the easiest)

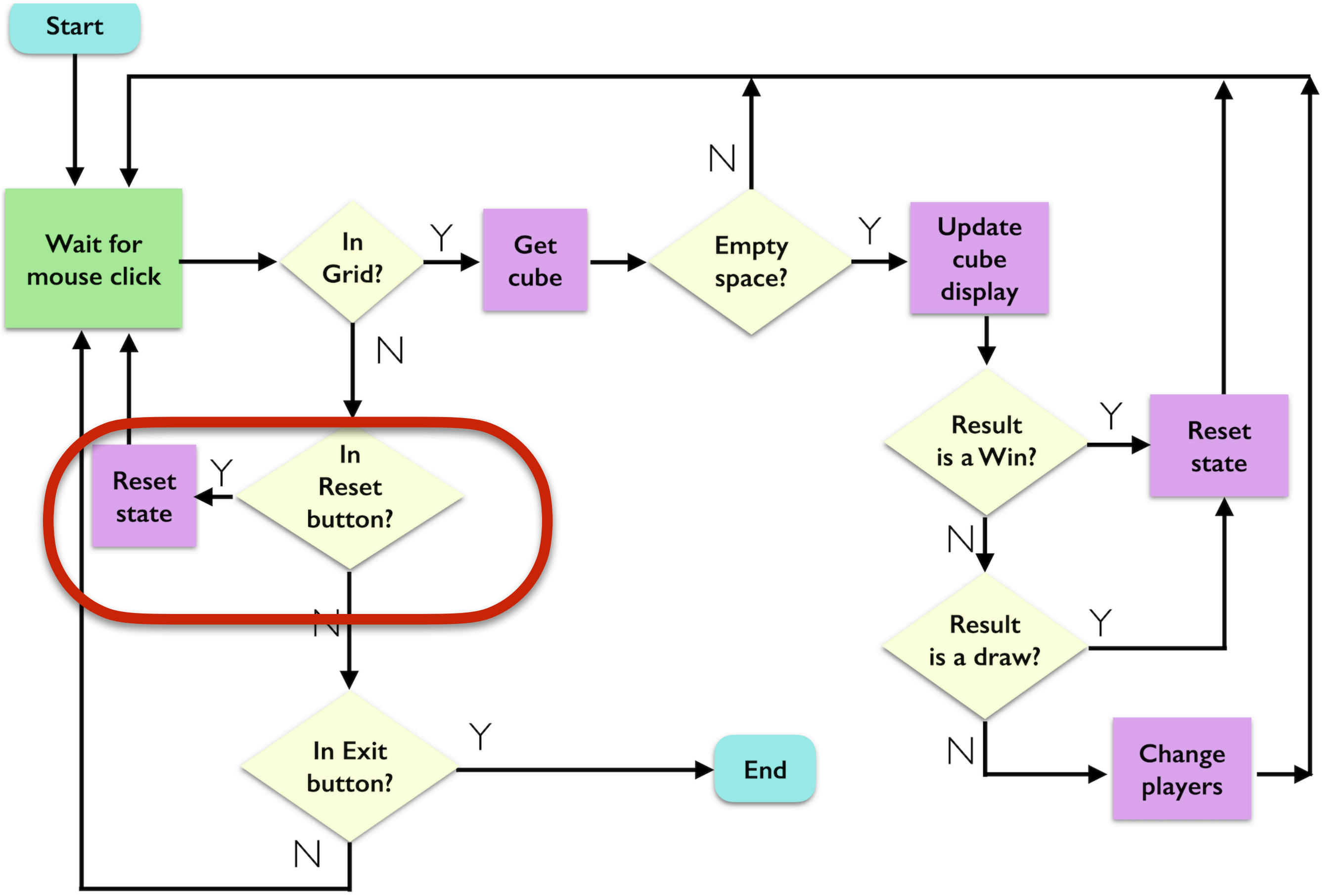
```
if self._board.in_exit(point):
    print("Exiting...")
    # game over
    return False
```



Translating our Logic to Code

- Now let's handle reset

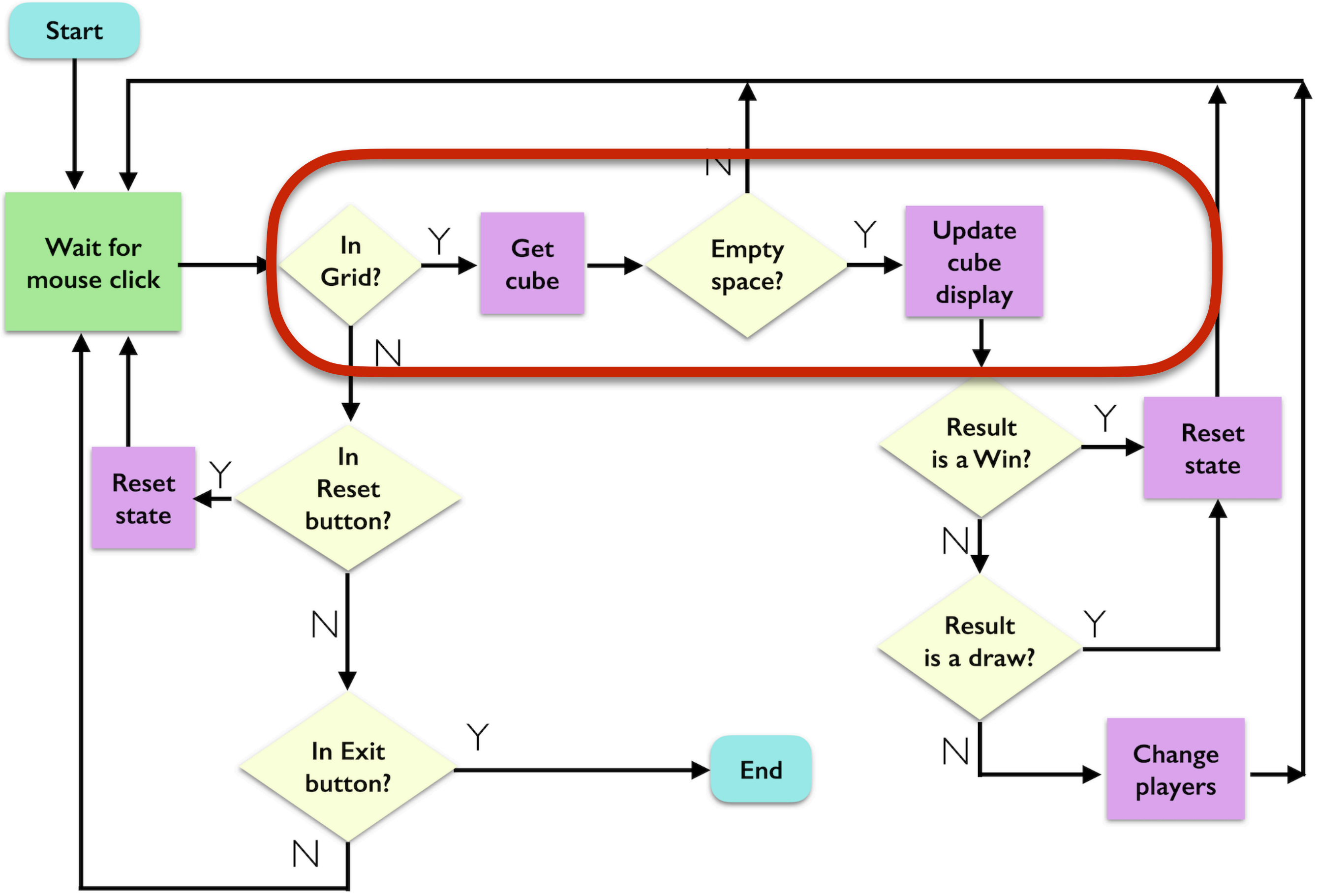
```
elif self._board.in_reset(point):
    print("Reset button clicked")
    self._board.reset()
    self._board.set_string_to_upper_text("")
    self._num_moves = 0
    self._player = "X"
```



Translating our Logic to Code

- Finally, let's handle a "normal" move. Start by getting point and TTTCube

```
elif self._board.in_grid(point):

    # get the cube at the point the user clicked
    tcube = self._board.get_ttt_cube_at_point(point)
```



Translating our Logic to Code

- The rest of our code checks for a valid move, a win, a draw, and updates state accordingly
- At the end, if the move was valid, we swap players

```
elif self._board.in_grid(point):

    # get the cube at the point the user clicked
    tcube = self._board.get_ttt_cube_at_point(point)

    # make sure this square is vacant
    if tcube.get_letter() == "":
        tcube.set_letter(self._player)
        tcube.place_cube(self._board)

        # valid move, so increment num_moves
        self._num_moves += 1

        # check for win or draw
        win_flag = self._board.check_for_win(self._player)
        if win_flag:
            self._board.set_string_to_upper_text(self._player + " WINS!")
        elif self._num_moves == self._board.get_rows()
                                         * self._board.get_cols():
            self._board.set_string_to_upper_text("DRAW!")
        # not a win or draw, swap players
        else:
            # toggle player!
            self._player = "O" if self._player == "X" else "X"

# keep going!
return True
```

TTT Summary

- Basic strategy
  - `Board`: start general, don't think about game specific details
  - `TTTBoard`: extend generic board with TTT specific features
    - Inherit everything, update attributes/methods as needed
  - `TTTCube` isolate functionality of a single TTT cube on board
    - Think about what features are necessary/helpful in other classes
  - `TTTGame`: think through logic conceptually before writing any code
    - Translate logic into code carefully, testing along the way

Class Discussion:
Boggle vs TTT Design Differences

Special Methods/Magic Methods

Special Methods

- Start and end with __ (double underscore)
  - Called magic methods (or informally dunder methods)
- Often not called explicitly using dot notation and called by other means
- What special methods have we already used seen/used so far?
- **`__init__(self, val)`**
  - When is it called?
    - Automatically when we ***create*** an instance (object) of the class
    - Can also be invoked as `obj.__init__(val)` (where `obj` is an instance of the class)

Special Methods

- **`__str__(self)`**
  - When is it called?
    - When we ***print*** an instance of the class using `print(obj)`
    - Also called whenever we call `str` function on it: `str(obj)`
    - Can also be invoked as `obj.__str__()`
- **`__repr__(self)`**
  - Also returns a string but its format is very specific (can be used to recreate the object of the class)
  - Useful for debugging
  - Don't worry about any more specifics for this class

Special Methods for Operators

- We can use mathematical and logical operators such as **==/+** to compare/add two objects of a class by defining the corresponding special method

- Example of polymorphism (using a single method or operator for different uses)

• `__eq__ (self, other):`	`x == y`
• `__ne__ (self, other):`	`x != y`
• `__lt__ (self, other):`	`x < y`
• `__gt__ (self, other):`	`x > y`
• `__add__(self, other) :`	`x + y`
• `__sub__(self, other):`	`x - y`
• `__mul__(self, other):`	`x * y`

__add__: why we can concatenate sequences with **+** as well as add ints with **+**

- There are many others!

Special Method: `__len__`

- `__len__(self)`
  - Called when we use the built-in function `len()` in Python on an object `obj` of the class: `len(obj)`
  - We can call `len()` function on any object whose class has the `__len__()` special method implemented
  - All built-in collection data types we saw (string, list, range, tuple, set, dictionaries) have this special method implemented
  - This is why we are able to call `len` on them
- What is an example of a built-in type that we can't call `len` on?
  - `int, float, Bool, None`

Other Special Methods for Sequences

- What other sequence operators have we used in this class?
- They each have a special method that is called whenever they are used
  - **Get** an item at an index a sequence using `[ ]:` calls `__getitem__`
    - e.g., `word_lst[2]` implicitly calls `word_lst.__getitem__(2)`
  - **Set** an item at an index to another `val` using `[ ]`: calls `__setitem__`
    - e.g., `word_lst[0] = "hello"` implicitly calls `word_lst.__setitem__(0, "hello)`

`in` Operator: `__contains__`

- **`__contains__(self, val)`**
  - When we say `if elem in seq` in Python:
    - Python calls the `__contains__` special method on `seq`
    - That is, `seq.__contains__(elem)`
- If we want the `in` operator to work for the objects of our class, we can do so by implementing the `__contains__` special method

Iteration Special Methods

- What if we want to "iterate" over an object of our class in a for loop?
- We can achieve this by implementing appropriate special methods:
  - A for loop in Python can iterate over any object whose class has the special methods `__iter__` and `__next__` defined
  - Such objects are called ***iterables***
- We can make objects of our class iterable by defining these methods appropriately

[Extra] For loop: Behind the Scenes

```
# a simple for loop to iterate over a list
for item in num_lst:
      print(item)
```

- Behind the scenes, the for loop is simply a while loop in disguise, driving iteration within a ***try-except*** statement. The above loop is really:

```
try:
   it = iter(num_lst)
   while True:
      item = next(it)
      print(item)
 except StopIteration:
    pass
```

Call the `iter` method on object

Access the `next` item if it exists, then print it

This is a way to "hide" the error

Special Methods Takeaway

- We can implement any of these functionalities **that built-in types enjoy** for objects of our own class by defining the appropriate special methods